$\mu_o = 4\pi \times 10^{-7}$ T.m/A

Q1) A long straight wire carrying a 3.0 A current enters a room through a window 1.5 m high and 1.0 m wide.
The path integral $\oint \vec{B} \cdot d\vec{s}$ around the window frame has the value (in T.m):
A) 2.5×10^{-7} B) 3.8×10^{-6} C) 3.0×10^{-7} D) 0.20 E) 4

Q2) Resistances of 2.0 Ω, 4.0 Ω, and 6.0 Ω and a 24-V emf device are all in series.
The potential difference (in V) across the 2.0-Ω resistor is:
A) 8 B) 4 C) 12 D) 24 E) 48

Q3) A certain resistor dissipates 0.5 W when connected to a 3 V potential difference.
When connected to a 1 V potential difference, this resistor will dissipate (in W):
A) 0.50 B) 0.167 C) 15.0 D) 1.5 E) 0.056

Q4) A charged particle is moving with speed v perpendicular to a uniform magnetic field. A second identical charged particle is moving with speed $2v$ perpendicular to the same magnetic field. If the cyclotron frequency of the first particle is ω, the cyclotron frequency of the second particle is:
A) 2 ω B) ω /2 C) 4 ω D) ω E) ω /4

Q5) A certain capacitor, in series with a 720-Ω resistor, is being charged. At the end of 10 ms its charge is half the final value. The capacitance is about:
A) 9.6 μF B) 14 μF C) 10 μF D) 7.2 F E) 20 F

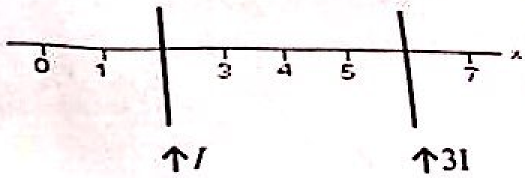
Q6) A cylindrical wire has a resistance R and resistivity ρ. If its length and diameter are both cut in half, its resistivity will be:
A) 4ρ B) 2ρ C) $\rho/4$ D) $\rho/2$ E) ρ

Q7) A charged particle (m = 5.0 g, q = −70 μC) moves horizontally at a constant speed of 30 km/s in a region where the free fall gravitational acceleration is 9.8 m/s^2 downward, the electric field is 700 N/C upward, and the magnetic field is perpendicular to the velocity of the particle. The magnitude of the magnetic field (in mT) in this region is:
A) 12 B) 0 C) 47 D) 35 E) 23

Q8) Solenoid 2 has twice the radius and six times the number of turns per unit length as solenoid 1. When equal currents are present in the two solenoids, the ratio of the magnetic field in the interior of 2 to that in the interior of 1 is:

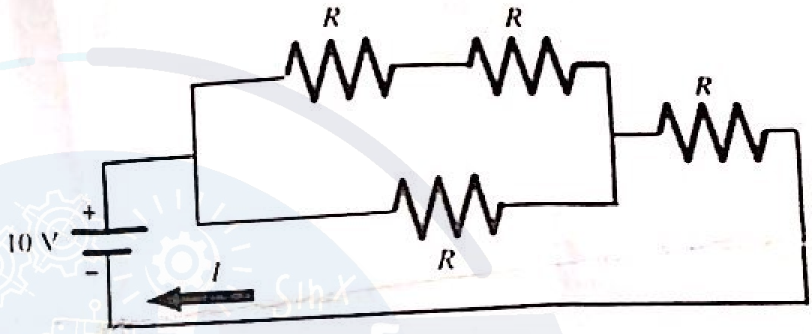
A) 1/3 B) 1 C) 6 D) 4 E) 2

Q9) Two long straight current-carrying parallel wires cross the x axis and carry currents I and $3I$ in the same direction, as shown. The value of x at which the net magnetic field is zero is:



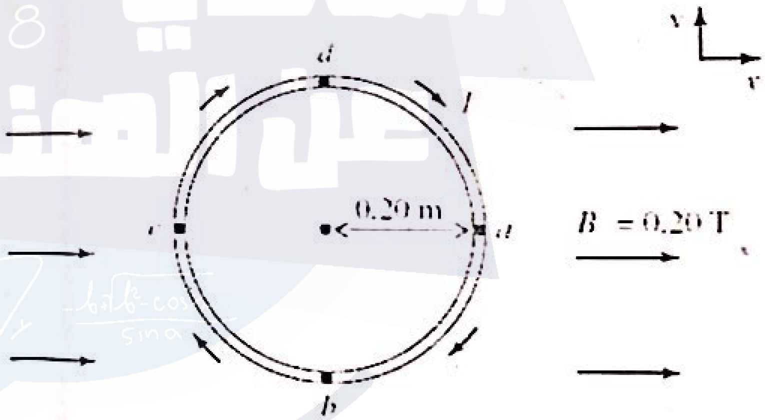
A) 3 B) 1 C) 5
D) 0 E) 7

Q10) When four identical resistors are connected to an ideal battery of voltage $V = 10$ V as shown in the figure, the current I is equal to 0.20 A. The resistance R (in Ω) is:



A) 20 B) 50 C) 40
D) 30 E) 10

Q11) A rigid circular loop has a radius of 0.20 m and is in the xy-plane. A clockwise current I is carried by the loop, as shown. The magnitude of the magnetic moment of the loop is 0.75 A · m^2. A uniform external magnetic field, $B = 0.20$ T in the positive x-direction, is present. An external torque changes the orientation of the loop from one of lowest potential energy to one of highest potential energy. The work done (in J) by this external torque is closest to:



A) 0.30 B) 0.60 C) 0.40 D) 0.20 E) 0.50

Q12) The current density in a wire of radius R is given by $J = kr$, $0 < r < R$, where k is constant. The current in the wire is:

A) $3\pi kR^3/2$ B) $2\pi kR^3/3$ C) $kR^3/3$ D) $k\pi R^2$ E) $k\pi R^2/2$

20

The University of Jordan
School of Science
Department of Physics

Date: 11/4/2018
Second Semester
Time: 4:00 – 5:00 pm

General Physics II – PHYS. 0302102
Second Exam

Name (In Arabic):
Student Number:
Instructor:
Section:

Constants: $k = 9\text{x}10^9$ N.m^2/C^2 ; $\varepsilon_o = 8.85\text{x}10^{-12}$ C^2/N.m^2; $e = 1.6\text{x}10^{-19}$ C.
$m_e = 9.11\text{x}10^{-31}$kg ; $m_p = 1.67\text{x}10^{-27}$kg ; $g = 9.8$ m/s^2

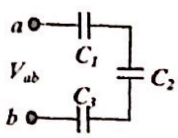
- Choose only one closest correct answer and fill the Answer Table below (with an X).

Q's	A	B	C	D	E	Q's	A	B	C	D	E	Q's	A	B	C	D	E
1			✓			5		✓				9		X		✓	
2	✓					6			✓		X	10					✓
3		✓				7			X	✓		11				✓	
4				✓		8	✓					12			✓	X	

(Q1) An air-filled capacitor consists of two parallel plates, each with an area of 3.60 cm^2, separated by a distance of 1.80 mm. A 20.0-V potential difference is applied to these plates. The charge on each plate (in pC) is:
(*A*) 41.5 ; (*B*) 74.7 ; (*C*) 35.4 ; (*D*) 22.6 ; (*E*) 93.4 ;

(Q2) The dielectric strength of Teflon insulating material equals $E_{max} = 6.0 \times 10^7$ V/m. Determine the maximum potential difference (in kV) that can be applied to a Teflon-filled parallel-plate capacitor having a plate area $A = 1.75$ cm^2 and plate separation of $d =$ 0.06 mm.
(*A*) 3.6 ; (*B*) 6.6 ; (*C*) 3.0 ; (*D*) 1.6 ; (*E*) 2.4 ;

(Q3) In the next figure given that: $C_1 = 25$ μF, $C_2 = 50$ μF, $C_3 = 25$ μF, and $V_a - V_b = 28$V, how much energy (in mJ) is stored in the 50-μF capacitor C_2?



(*A*) 0.48 ; (*B*) 0.78 ; (*C*) 0.68 ; (*D*) 0.58 ; (*E*) 0.22 ;

(Q4) A cylindrical wire has a resistance R and resistivity ρ. If its length and diameter are both cut in half, what will be its resistance?
(*A*) 4R; (*B*) R; (*C*) R/2; (*D*) 2R; (*E*) R/4;

(Q5) An aluminum wire having a cross-sectional area of 4.0×10^{-6} m^2 carries a current of 7.0 A. The free charge carrier density in aluminum is $n = 6.0 \times 10^{28}$ electron/m^3. Find the drift speed (in mm/s) of the electrons in the wire.
(*A*) 0.13 ; (*B*) 0.18 ; (*C*) 0.23 ; (*D*) 0.26 ; (*E*) 0.34 ;

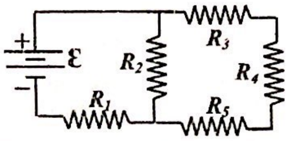
(Q6) An electric car is designed to run off a bank of 12.0-V batteries with total energy storage of 1.4 x 10^7 J. If the electric motor draws 8.0 kW as the car moves at a steady speed of 20.0 m/s, how far (in km) will the car travel before the batteries run out of energy?

(*A*) 80.0 ; (*B*) 20.0; (*C*) 60.0 ; (*D*) 50.0 ; (*E*) 35.0 ;

(Q7) A series circuit consists of a 12 V source of emf (battery), a 2.0 mF capacitor, a 500 Ω resistor, and a switch connected in series. When the switch is closed, how long (in s) does it take for the current to reach one-tenth (1/10) its maximum value?

(*A*) 8.47 ; (*B*) 4.60 ; (*C*) 2.30 ; (*D*) 1.84 ; (*E*) 9.21 ;

(Q8) In the next figure, given the emf of the battery $\mathcal{E} = 12$ V, and the resistances $R_1 = 5.0\ \Omega$, $R_2 = 20.0\ \Omega$, $R_3 = 10.0\ \Omega$, $R_4 = 10.0\ \Omega$, $R_5 = 10.0\ \Omega$. The magnitude of the potential difference (in V) across R_2 resistor is:



(*A*) 8.47 ; (*B*) 6.35; (*C*) 1.15 ; (*D*) 5.05 ; (*E*) 7.06 ;

(Q9) A current of 25 A is maintained in a square loop having sides of 50 cm length. An external magnetic field of 80 mT is directed such that the angle between the field and the plane of the loop is 35°. Determine the magnitude of the torque (in N.m) exerted on the loop by the magnetic forces acting on it.

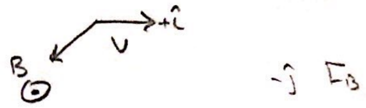
(*A*) 0.33 ; (*B*) 0.41 ; (*C*) 0.25 ; (*D*) 0.12 ; (*E*) 0.54 ;

(Q10) A straight wire of length 70 cm carries a current of 50 A and makes an angle of 60° with a uniform magnetic field. If the force on the wire is 1.7 N what is the magnitude of the magnetic field **B** (in mT)?

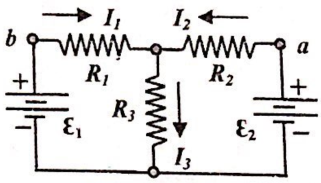
(*A*) 42.9 ; (*B*) 46.2 ; (*C*) 87.5 ; (*D*) 33.0 ; (*E*) 56.1 ;

(Q11) An electron moving with velocity v to the right enters a region of uniform magnetic field that points out of the paper. After the electron enters this region, it will be:

(*A*) deflected out of the plane of the paper;
(*B*) deflected into the plane of the paper;
(*C*) deflected downward;
(*D*) deflected upward;
(*E*) undeflected in its motion;

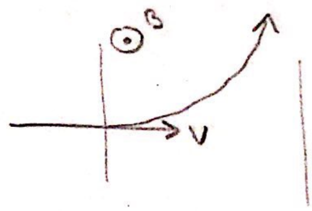


(Q12) In the next electric circuit, given the emf of the batteries $\mathcal{E}_1 = 50$ V, $\mathcal{E}_2 = 60$ V, and the resistances $R_1 = 10.0\ \Omega$, $R_2 = 10.0\ \Omega$, $R_3 = 20.0\ \Omega$, the potential difference $V_b - V_a$ (in V) is:



(*A*) – 50 ; (*B*) 50 ; (*C*) 10 ;
(*D*) – 10 ; (*E*) 20 ;

Good Luck



55+ 7 Big thumbs up 36

The University Of Jordan, Physics Department
General Physics - II (0302102) / MidTerm Exam
Summer Semester 2016/2017

[redacted]

الرقم الجامعي :

اسم المدرس :

اسم الطالب :

رقم الشعبة : 1

1	b	3	c	5	d	7	b	9	a	11	a
2	e	4	b	6	d	8	c	10	e	12	c

Constants: $e = 1.6 \times 10^{-19}$ C; $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$; $k = 9 \times 10^9$ $N \cdot m^2/C^2$

1. A charge of +80 μC is placed on the x axis at $x = 0$. A second charge of −50 μC is placed on the x axis at $x = 50$ cm. What is the magnitude of the electrostatic force (in N) on a third charge of 4.0 μC placed on the x axis at $x = 30$ cm?

a. 13 b. 77 c. 39 d. 25 e. 45

2. A +15-nC point charge is placed on the x axis at $x = 1.5$ m, and a −20-nC charge is placed on the y axis at $y = -2.0$m. What is the magnitude of the electric field (in N/C) at the origin?

a. 105 b. 15 c. 60 d. 45 e. 75

3. A charge (uniform linear density = 9.0 nC/m) is distributed along the x axis from $x = 0$ to $x = 3.0$ m. Determine the magnitude of the electric field (in N/C) at a point on the x axis with $x = 4.0$ m.

a. 81 b. 74 c. 61 d. 88 e. 20

4. A particle (mass = 5.0 g, charge = 40 mC) moves in a region of space where the electric field is uniform and is given by $E_x = -2.3$ N/C, $E_y = E_z = 0$. If the position and velocity of the particle at $t = 0$ are given by $x = y = z = 0$ and $v_z = 20$ m/s, $v_x = v_y = 0$, what is the distance (in m) from the origin to the particle at $t = 2.0$ s?

a. 60 b. 54 c. 69 d. 78 e. 3.2

5. The total electric flux through a closed cylindrical (length = 1.2 m, diameter = 0.20 m) surface is equal to -5.0 $N \cdot m^2/C$. Determine the net charge (in pC) within the cylinder.

a. −62 b. −53 c. −71 d. −44 e. −16

6. Two infinite parallel surfaces carry uniform charge densities of 0.20 nC/m^2 and -0.60 nC/m^2. What is the magnitude of the electric field (in N/C) at a point between the two surfaces?

a. 34 b. 23 c. 17 d. 45 e. 90

7. A long nonconducting cylinder (radius = 12 cm) has a charge of uniform density (5.0 nC/m^3) distributed throughout its volume. Determine the magnitude of the electric field (in N/C) 15 cm from the axis of the cylinder.

a. 20 b. 27 c. 16 d. 12 e. 54

8. A spherical conductor (radius = 1.0 cm) with a charge of 2.0 pC is within a concentric hollow spherical conductor (inner radius = 3.0 cm, outer radius = 4.0 cm) which has a total charge of −3.0 pC. What is the magnitude of the electric field (in N/C) 2.0 cm from the center of these conductors?

a. 23 b. Zero c. 45 d. 90 e. 110

9. A particle (charge = 50 μC) moves in a region where the only force on it is an electric force. As the particle moves 25 cm from point A to point B, its kinetic energy increases by 1.5 mJ. Determine the electric potential difference, $V_B - V_A$ (in V).

a. −30 b. −40 c. −50 d. −60 e. +15

10. Four identical point charges (+6.0 nC) are placed at the corners of a rectangle which measures 6.0 m × 8.0 m. If the electric potential is taken to be zero at infinity, what is the potential (in V) at the geometric center of this rectangle?

a. 58 b. 63 c. 11 d. 84 e. 43

11. A charge per unit length given by $\lambda(x) = bx$, where $b = 12\ nC/m^2$, is distributed along the x axis from $x = +9.0$ cm to $x = +16$ cm. If the electric potential at infinity is taken to be zero, what is the electric potential (in V) at the point P on the y axis at $y = 12$ cm?

a. 5.4 b. 7.2 c. 9.0 d. 9.9 e. 16

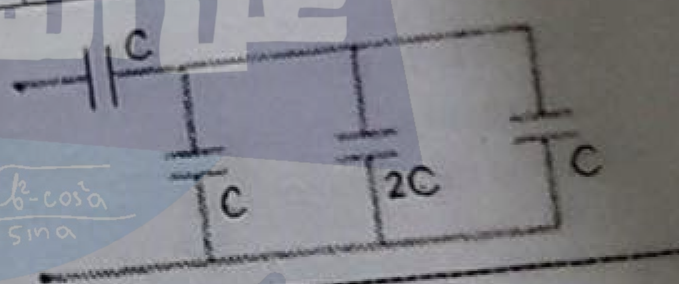
12. A charge of 4.0 nC is distributed uniformly along the x axis from $x = +4$ m to $x = +6$ m. Which of the following integrals is correct for the electric potential (relative to zero at infinity) at the origin?

a. $\int_4^6 \frac{18dx}{4-x}$ b. $\int_4^6 \frac{36dx}{x}$ c. $\int_4^6 \frac{18dx}{x}$

d. $\int_4^6 \frac{36dx}{6-x}$ e. $\int_4^6 \frac{36dx}{4+x}$

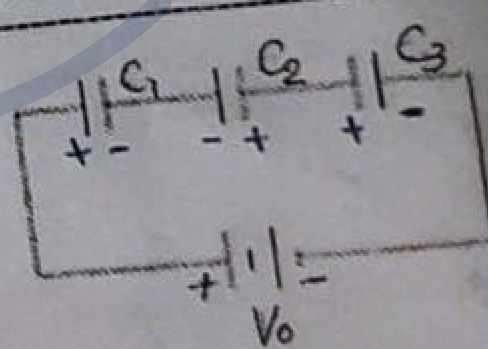
Q1	C	Q2	C	Q3	b	Q4	e

Q1. Determine the equivalent capacitance (in mF) of the combination shown when C = 15 mF.



a. 20 b. 16
c. 12 d. 24
e. 75

Q2. Determine the energy (in mJ) stored in C_1 when $C_1 = 10\ \mu F$, $C_2 = 12\ \mu F$, $C_3 = 15\ \mu F$, and $V_0 = 70$ V.



a. 6.5 b. 5.1
c. 3.9 d. 8.0
e. 9.8

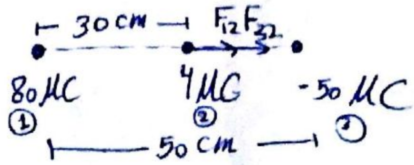
Q3. If a conducting solid sphere of radius a carries a total positive charge Q. The magnitude of the electric field at a point r inside the sphere is:

a. kQr^3/a b. Zero c. $\rho r / 3\varepsilon_0$
d. $2k\rho / r$ e. kQ/r^2

Q4. If an insulating solid sphere of radius a has a uniform volume charge density ρ and carries a total positive charge Q. The magnitude of the electric field at a point r outside the sphere is:

a. kQr^3/a b. Zero c. $\rho r / 3\varepsilon_0$
d. $2k\rho / r$ e. kQ/r^2

① $F_{12} = \dfrac{K Q_1 Q_2}{r^2}$



$= \dfrac{9\times10^9 \times 80\times10^{-6} \times 4\times10^{-6}}{(30\times10^{-2})^2} = 32$

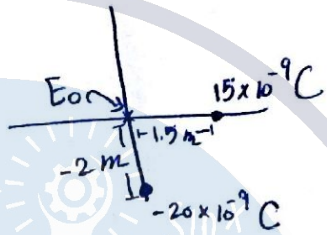
Answer: B

$F_{32} = \dfrac{K Q_2 Q_3}{r^2} = 45$ $\qquad F = F_{12} + F_{32} = 77$

---

②

$E_{10} = \dfrac{K Q_1}{R^2} = \dfrac{9\times10^9 \times 15\times10^{-9}}{(1.5)^2} = 60$



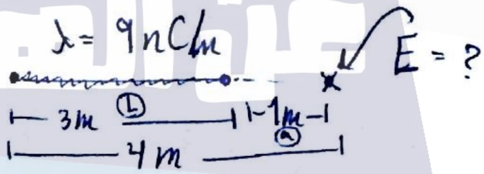
$E_{20} = \dfrac{K Q_2}{R^2} = 45$

$E_0 = \sqrt{E_{10}^2 + E_{20}^2} = 75$

Answer: e

---

③ $E = \dfrac{KQ}{a(a+L)} = \dfrac{\lambda L K}{a(a+L)}$



$= \dfrac{9\times10^9 \times 9\times10^{-9} \times 3}{1(1+3)} = 60.75 \approx 61$

Answer: C

---

④ $F = m * a$

$E * q = m * a$

$a = \dfrac{Q * E}{m} = \dfrac{40\times10^{-3}}{5*10^{-3}} * \langle -2, 3, 0, 0 \rangle$

$\vec{a} = \langle -18.4, 0, 0 \rangle$ $\qquad \dfrac{dV}{dt} = a = \langle -18.4, 0, 0 \rangle$

$V_x = V_{0x} + at$

$\boxed{V_x = -18.4t}$ $\quad V_y = 0 \quad V_z = 20 \quad \vec{V} = \langle -18.4t, 0, 20 \rangle$

$\vec{V} = \dfrac{d(\vec{d})}{dt} = \langle -9.2t^2, 0, 20t \rangle$

when $t = 2$ ↗ $\vec{d} = \langle -36.8, 0, 40 \rangle$

جذر الجذر $\sqrt{36.8^2 + 40^2} = 54.3$

Answer: B

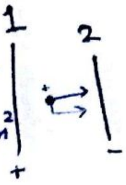
(5) $\phi = -5$ $\quad Q = ?$ $\quad L = 1.2m$ $\quad d = .2m$ $\quad r = .1m$

$$\phi = \frac{Q_{in}}{\epsilon_0} \Rightarrow Q_{in} = -5 \times 8.85 \times 10^{-12} = -44 \times 10^{-12} C = -44\ PC$$

Answer: D

---

(6) $E_1 = \frac{\sigma_1}{2\epsilon_0} = \frac{.2 \times 10^{-9}}{2 \times 8.85 \times 10^{-12}} = 11.3$ $\quad \sigma_1 = .2nC/m^2$ $\quad \sigma_2 = -.6nC/m^2$



$$E_2 = \frac{\sigma_2}{2\epsilon_0} = 33.9$$

$$E = E_1 + E_2 = 33.9 + 11.3 \approx 45$$

Answer: D

---

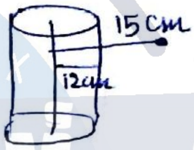
(7) nonconducting

$R = 12cm$

$\rho = 5 \times 10^{-9}$

$r = 15cm$

$E = ?$



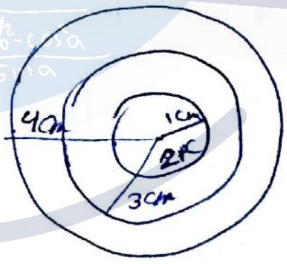
$$E = \frac{\rho R^2}{2\epsilon_0 r}$$

$$= \frac{5 \times 10^{-9} \times (12 \times 10^{-2})^2}{2 \times 8.85 \times 10^{-12} \times 15 \times 10^{-2}} = 27$$

Answer: B

---

(8) $E = \frac{KQ}{r^2}$



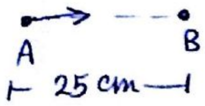
$$E = \frac{1}{4\pi\epsilon_0} \cdot \frac{2 \times 10^{-12}}{(2 \times 10^{-2})^2}$$

$$E = \frac{2 \times 10^{-12}}{4\pi\epsilon_0 \cdot (2 \times 10^{-2})^2} = 45$$

Answer: C

(9) $Q = 50\ \mu C$

$U_{A\to B} = 1.5\times10^{-3}\ J$



$U_{A\to B} = \Delta V_{A\to B}\, Q \rightsquigarrow \Delta V_{A\to B} = \dfrac{1.5\times10^{-3}}{50\times10^{-6}} = 30\ V$

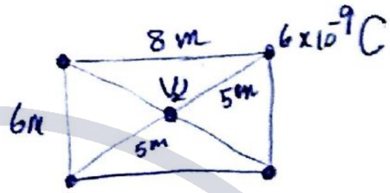
$V_{BA} = 30\,V \rightsquigarrow V_{AB} = -30\,V$

Answer: A

---

(10) $V = V_1 + V_2 + V_3 + V_4$

$V = 4\left(\dfrac{KQ}{R}\right) = \dfrac{4\times9\times10^{9}\times6\times10^{-9}}{5} = \boxed{43}$



Answer: E

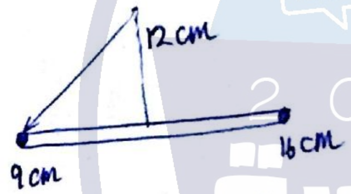
---

(11) $\lambda(x) = bx = 12\times10^{-9}\ x$

$L = 16 - 9 = 7\ cm$

$r = \sqrt{y^2 + x^2}$

$dq = \lambda dx$



$V = K\int \dfrac{dq}{r} = K\int_9^{16} \dfrac{\lambda\, dx}{\sqrt{(12)^2 + x^2}}$

على الآلة الحاسبة

$= K\int_9^{16} \dfrac{12\times10^{-9}\,(x)\,dx}{\sqrt{12^2 + x^2}} = 5.4\ V$

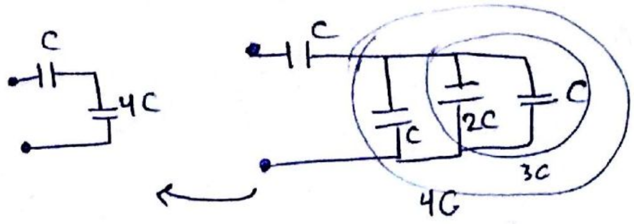
Answer: A

---

(12) $V = \int_4^6 \dfrac{K\,dq}{r} = \int_4^6 \dfrac{K\lambda\, dx}{r} = \int_4^6 \dfrac{K\, q\, dx}{2\ x} = \int_4^6 \dfrac{Kq}{2}\left(\dfrac{dx}{x}\right)$

$= \int_4^6 \dfrac{9\times10^{9}\times4\times10^{-9}}{2}\ \dfrac{dx}{x} = \int_4^6 \dfrac{18\,dx}{x}$

Answer: C



① $C_{2c,\,c} = 3C$

$C_{3c,\,c} = 4C$

$C_{eq} \Rightarrow \frac{1}{C_{eq}} = \frac{1}{4c} + \frac{1}{1c} = \frac{5}{4c}$

$C_{eq} = \frac{4}{5}C \rightsquigarrow = \frac{4}{5} \times 15 \times 10^{-3} = 12\ mF$

Answer: C

---

② $C_1 = 10\ \mu F$, $C_2 = 12\ \mu F$, $C_3 = 15\ \mu F$ $V_{eq} = 70\ V$

$C_{eq} \Rightarrow \frac{1}{C_{eq}} = \frac{1}{12} + \frac{1}{15} + \frac{1}{10} = \frac{1}{4}$

$C_{eq} = 4\ \mu F$

$q_1 = q_2 = q_3 = 280 \times 10^{-6}$

$Q_{eq} = V_{eq} \cdot C_{eq} = 4 \times 10^{-6} \times 70$

$Q_{eq} = 280 \times 10^{-6}$

$U_{C_1} = \frac{1}{2} \frac{(q_1)^2}{C} = 3.9\ mJ$

Answer: C

---

③ $E = Zero \rightarrow$ charge ← على السطح

Answer: B

---

④ $E_r = \frac{\rho R^3}{3\epsilon r^2}$ → $E = \frac{kQ}{r^2}$ بالتعويض مباشرة أو تبسيط الصيغة

$= \frac{\rho a^3}{3\epsilon_0 r^2} = \frac{q}{3 V_{olume}\, \epsilon_0 r^2} = \frac{q}{3\epsilon_0 \frac{4}{3}\pi a^3 r^2} = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$ ($\frac{1}{4\pi\epsilon_0} = k$)

$= \frac{kq}{r^2}$

Answer: ~~B~~ E

The University of Jordan
School of Science
Department of Physics

General Physics-2 (0302102)
Second Exam, 18/4/2017
4:00-5:00 pm

Name (in Arabic): سجود عمر محمد الريس ...tion: Z **Instructor:** د. حنان سعادة

30/30 Excellent

**** Solve the following questions and choose the one best answer. Fill in your answers in the Answer Table.**

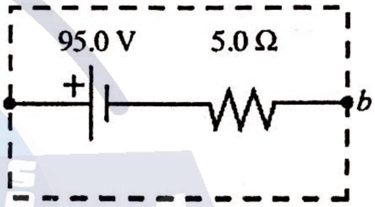
1	2	3	4	5	6	7	8	9	10	11	12
E	A	C	A	B	A	D	B	C	C	E	D

12

*** *Useful Constants:*** $k_e = 9\times10^9$ N.m^2/C^2, $m_e = 9.11\times10^{-31}$ kg, $e = 1.6\times10^{-19}$ C, $\mu_0 = 4\pi\times10^{-7}$ T.m/A, $1eV = 1.6\times10^{-19}$ J

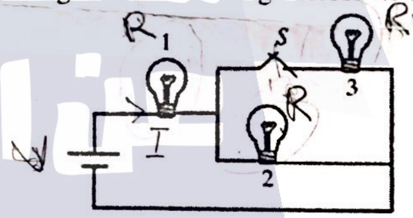
1. An electric device delivers a current of 5.0 A to a circuit. How many electrons flow through this circuit in 5 s?
A) 30 B) 50 C) 25 D) 3.1×10^{20} E) 1.6×10^{20}

2. The emf and the internal resistance of a battery are as shown in the figure. If a current of 3.8 A is drawn from the battery when a resistor R is connected across the terminals ab of the battery, what is the power dissipated by the internal resistor (i.e the 5Ω)?



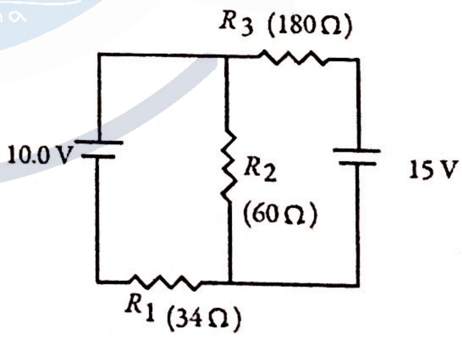
A) 72 W B) 361 W C) 62 W
D) 530 W E) 289 W

3. The figure shows three identical light bulbs connected to a battery having a constant voltage across its terminals. When the switch S is closed, the brightness of light bulb 1 will:



A) remain the same as before the switch is closed.
B) decrease.
C) increase.

4. For the circuit shown in the figure, what is the current through resistor R_3?

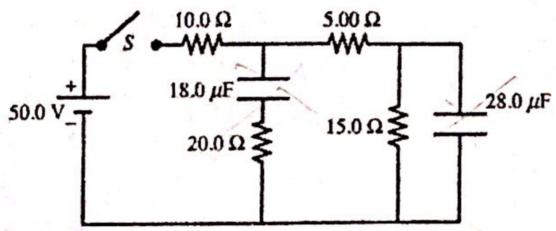


A) 0.043 A
B) 1.5 A
C) 0.028 A
D) 0.068 A
E) 0.086 A

5. What is the kinetic energy (in eV) of an electron that passes undeviated through perpendicular electric and magnetic fields if $E = 2.0$ kV/m and $B = 8.0$ mT?
A) 0.71 eV B) 0.18 eV C) 0.32 eV D) 0.54 eV E) 1.4 eV

6. For the circuit shown in the figure, the capacitors are all initially uncharged, the connecting leads have no resistance, the battery has no appreciable internal resistance, and the switch S is originally open. After the switch S has been closed for a very long time, what is the current in the 20.0-Ω resistor?

A) Zero
B) 1.67 A
C) 2.50 A
D) 3.33 A
E) 5.00 A



7. An electron moving with velocity v to the left enters a region of uniform magnetic field that points out of the paper. After the electron enters this region, it will be:

A) deflected out of the plane of the paper. B) deflected into the plane of the paper.
C) deflected upward. D) deflected downward. E) undeflected in its motion.

8. A circular coil of wire of 200 turns and diameter 2.0 cm carries a current of 4.0 A. It is placed in a magnetic field of 0.35 T, with the plane of the coil making an angle of 30° with the magnetic field. What is magnitude of the magnetic torque on the coil?

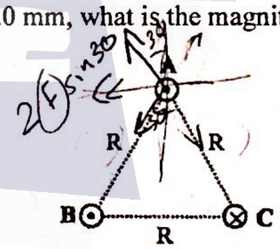
A) 0.15 N.m B) 0.076 N.m C) 0.29 N.m D) 0.044 N.m E) 0.088 N.m

9. When the number of turns in a solenoid and its length are both doubled, the ratio of the magnitude of the new magnetic field inside to the magnitude of the original magnetic field inside is:

A) 0.25 B) 0.50 C) 1 D) 2 E) 4

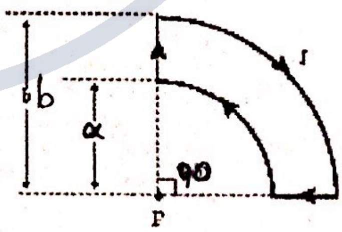
10. The figure shows a cross section of three parallel wires each carrying a current of 20 A. The currents in wires A and B are out of the paper, while that in wire C is into the paper. If the distance R = 5.0 mm, what is the magnitude of the force on a 1.0-m length of wire A?

A) 23 mN B) 32 mN C) 16 mN
D) 64 mN E) 55 mN



11. If a = 1.0 cm, b = 3.0 cm, and I = 10 A, what is the magnitude of the magnetic field at point P?

A) 0.62 mT B) 0.59 mT C) 0.35 mT
D) 0.31 mT E) 0.10 mT



12. A long cylindrical wire (radius = 2.0 cm) carries a current of 20 A that is uniformly distributed over a cross section of the wire. What is the magnitude of the magnetic field at a point which is 1.5 cm from the axis of the wire?

A) 0.53 mT B) 28 mT C) 0.30 mT D) 0.15 mT E) 1.9 mT

***** ALL THE BEST *****

The University of Jordan
Faculty of Science
Department of Physics

Summer Semester 2015
General Physics-2
Second Exam

Name (In Arabic) :
Student Number :

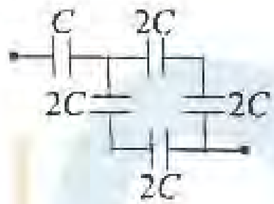
Instructor :
Section :

$k_e = 9 \times 10^9$ N.m^2/C^2; $\varepsilon_0 = 8.85\times10^{-12}$ C^2/N.m^2; $e = 1.6\times10^{-19}$ C; $g = 9.8$ m/s^2

Write the letter corresponding to the correct answer in the table

Q	1	2	3	4	5	6	7	8	9	10
Answer	c	d	b	a	e	d	[illegible]	e	a	c

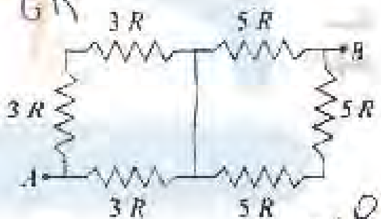
1) Determine the equivalent capacitance of the combination shown when $C = 24\ \mu$F.



a) 20 μF b) 36 μF c) 16 μF

d) 45 μF e) 27 μF

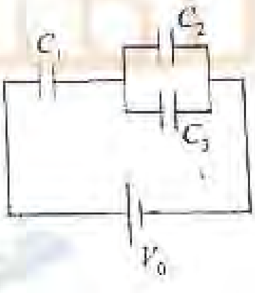
2) What is the equivalent resistance between points A and B in the figure when $R = 18\ \Omega$?



a) 48 Ω b) 64 Ω c) 80 Ω

d) 96 Ω e) 110 Ω

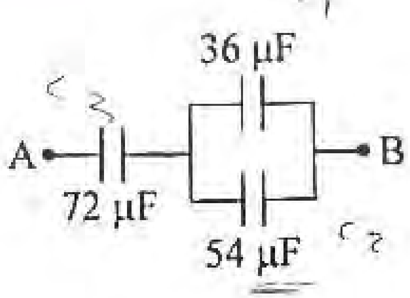
3) Determine the charge stored by C_1 (in mC) when $C_1 = 20\ \mu$F, $C_2 = 10\ \mu$F, $C_3 = 30\ \mu$F, and $V_0 = 18$ V.



a) 0.36 mC b) 0.24 mC c) 0.32 mC

d) 0.40 mC e) 0.50 mC

4) If $V_A - V_B = 50$ V, how much energy (in mJ) is stored in the 54-μF capacitor?



a) 13.3 mJ b) 17.2 mJ c) 28.1 mJ

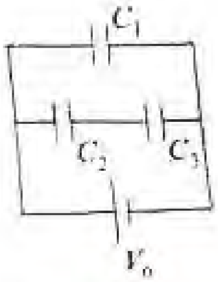
d) 8.9 mJ e) 50.3 mJ

5) A 30.0-m long wire has a cross sectional area of 5.0 mm² and a resistivity of 1.7×10^{-8} Ω.m. The resistance of the wire (in Ω) is

a) 0.50 b) 0.17 c) 0.24

d) 0.34 e) 0.10

6) What is the potential difference (in V) across C_2 when $C_1 = 5.0\ \mu F$, $C_2 = 15\ \mu F$, $C_3 = 30\ \mu F$, and $V_0 = 24$ V?



a) 21 V b) 19 V c) 24 V

d) 16 V e) 8.0 V

7) A capacitor in a single-loop RC circuit is charged to 85% of its final potential difference in 2.4 s. What is the time constant for this circuit?

a) 1.12 s b) 1.27 s c) 1.70 s d) 1.96 s e) 2.93 s

8) A 4-A current flows through a 2 Ω resister. The power (in W) delivered to the resister is

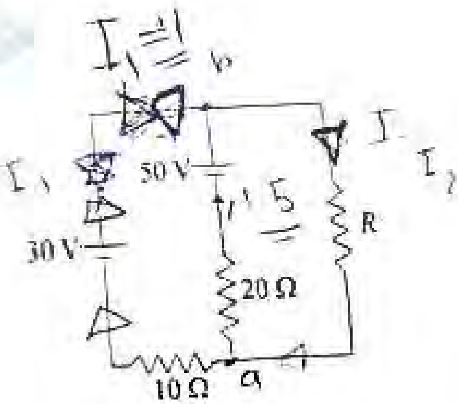
a) 96 b) 64

d) 80 e) 32

9) What is the potential difference $V_B - V_A$ when $I = 0.50$ A in the circuit segment shown?

a) +28 V b) +2.0 V c) −28 V d) −2.0 V e) +18 V

10) Determine the resistance R (in Ω) when I=1.5 A.



a) 40 Ω b) 85 Ω c) 8.0 Ω

d) 28 Ω e) 32 Ω

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THE UNIVERSITY OF JORDAN

THE UNIVERSITY OF JORDAN

PYSICS DEPARTMENT

GENERAL PHYSICS II (0302102) / SECOND EXAM / APRIL 17th 2016

SECOND SEMESTER 2015/2016

اسم الطالب :

الرقم الجامعي:

اسم المدرس:

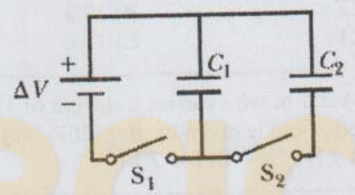
رقم الشعبة :

Q1	C	Q2	B	Q3	A	Q4	B	Q5	E
Q6	B	Q7	D	Q8	C	Q9	E	Q10	B
Q11	C	Q12	D	Q13	A	Q14	C	Q15	C

$\varepsilon_o = 8.85 \times 10^{-12}\ C^2/N.m^2$, $k_e = 9 \times 10^9\ N.m^2/C^2$, $g = 10\ m/s^2$, $\mu C = 10^{-6}\ C$, $nC = 10^{-9}\ C$, $pC = 10^{-12}\ C$, $m_e = 9.11 \times 10^{-31}$ kg, $m_p = 1.67 \times 10^{-27}$ kg, ρ (Copper) $= 1.7 \times 10^{-8}\ \Omega.m$, n_e (Copper) $= 8.456 \times 10^{28}\ e/m^3$, $1\ eV = 1.6 \times 10^{-19}$ J

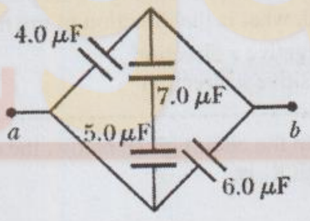
ANSWER ALL THE FOLLOWING QUESTIONS

Q1. Consider the circuit. $C_1 = 6.00\ \mu F$, $C_2 = 3.00\ \mu F$, $\Delta V = 20.0$ V. If S_1 is closed and S_2 is opened until C_1 is fully charged. Now open S_1 and close S_2 and find the final charge (in μC) on C_1.



A) 40.0
B) 120.0
C) 80.0
D) 11.5
E) 0.00

Q2. Find the equivalent capacitance, between a and b, for the combination (in μF).

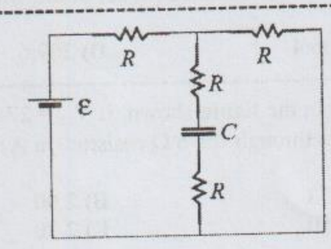


A) 10.9
B) 12.9
C) 8.90
D) 14.9
E) 22.9

Q3. Given the drift velocity of free electrons in a copper wire = 5.58×10^{-4} m/s, calculate the electric field in this wire (in V/m).

A) 0.13 B) 0.95 C) 18.6 D) 4.7 E) 0.18

Q4. In the circuit shown, all the resistors are identical. What is the charge on the capacitor after a very long time?



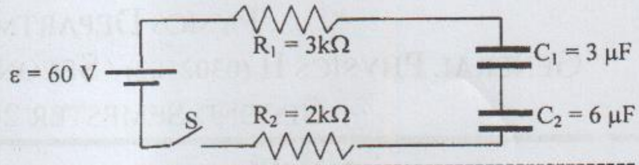
A) $Q = C\mathcal{E}$
B) $Q = C\mathcal{E}/2$
C) $Q = C\mathcal{E}/3$
D) $Q = C\mathcal{E}/4$
E) $Q = 2C\mathcal{E}$

Q5. The SI unit of the quantity $(\frac{1}{2}\varepsilon_o E^2)$ is:

A) J/F B) J/C C) J D) J/V E) J/m^3

4:00 – 5:15

Q6. In the circuit given, the capacitors are initially uncharged. The switch S is closed at time t = 0. Calculate the potential difference across capacitor C_1 at time t = 2 ms.



A) 4.83 **B)** 7.25 C) 40.0
D) 14.5 **E)** 6.66

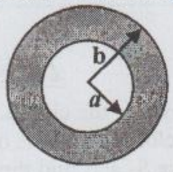
Q7. A charged particle is moving in a region of uniform steady magnetic field. Its kinetic energy:

A) Remains constant only if the path is circular. **B)** Remains constant only if it is moving parallel to the field.
C) Remains constant only if the field is uniform. **D)** Remains constant regardless of the path or the field.
E) Remains constant only if it is moving normal to the field.

Q8. A proton with a kinetic energy of 0.20 keV follows a circular path in a region where the magnetic field is uniform and has a magnitude of 60 mT. What is the radius (in cm) of this path?

A) 4.8 **B)** 1.0 C) 3.4 D) 2.7 E) 0.18

Q9. The spherical capacitor shown in the figure is filled with a dielectric material of $\kappa = 3.5$, and the radii are $a = 2$ cm and b = 4 cm. The capacitance (in pF) of this capacitor is:



A) 13.3 **B)** 17.8 C) 8.88
D) 11.1 **E)** 15.6

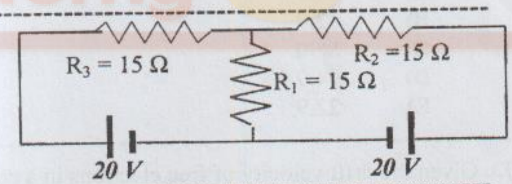
Q10. A 2.0-m wire carries a current of 15 A directed along the positive x-axis in a region where a uniform magnetic field is given by $\boldsymbol{B} = (30\mathbf{i} - 40\mathbf{j})$ mT. The resulting magnetic force (in N) on the wire is:

A) (+1.2 **i**) **B)** (−1.2 **k**) C) (−1.5 **j**) **D)** (−1.8 **k**) **E)** (+0.90 **k**+1.5 **i**)

Q11. An electron moving in the positive x direction experiences a magnetic force in the positive z direction. If $B_x = 0$, what is the direction of the magnetic field?

A) Negative z direction **B)** Positive z direction **C)** Negative y direction
D) Positive y direction E) Negative x direction

Q12. In the circuit given below, the current (in A) through R_1 is:

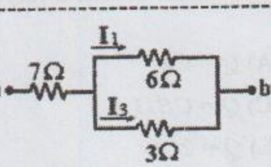


A) 5.11 **B)** *1.33* C) 0.67
D) 0.89 **E)** 0

Q13. A Nichrome wire (temperature coefficient of the Nichrome = $0.4 \times 10^{-3}(^{\circ}C)^{-1}$) has a resistance of 200 Ω at 20 °C. The resistance (in Ω) of the wire at 100 °C is:

A) 206.4 **B)** 209.6 C) 208 **D)** 212.8 **E)** 211.2

Q14. In the figure shown, if V_{ab} = 27 V, the current which passes through the 6 Ω resistor (**in A**) is:



A) 1.33 **B)** 2.00 C) 1.00
D) 0.50 **E)** 2.70

Q15. The power (in Watt) dissipated in a heating coil of 60 Ω resistance designed to operate at 220V is

A) 538 B) 605 C) 807 D) 968 (e) 691

Solution

Q.1 :- $Q_{01} = C_1 \Delta V = (6\,\mu f)(20\,V) = 120\,\mu C$ [S_1(closed), S_2(opened)]

Now → when S_1(opened) & S_2(closed) :-

(حفظ الشحنة)

* $Q_1' + Q_2' = 120\,\mu C$

→ $Q_1' = 120\,\mu f - Q_2'$

* $V_1' = V_2' \Rightarrow \frac{Q_1'}{C_1} = \frac{Q_2'}{C_2}$

$$\frac{120\,\mu C - Q_2'}{6\,\mu f} = \frac{Q_2'}{3\,\mu f} \rightarrow Q_2' = 40\,\mu C$$

→ $\therefore Q_1' = 120\,\mu f - 40\,\mu f = 80\,\mu C$

(C)

كل الشكر للطالب
صفوان العقيلي
على حل الاسئله

Q.2 :- $\frac{1}{5} + \frac{1}{7} = 0.3428$

$\Rightarrow \frac{1}{0.3428} = 2.9\,\mu f$

$\therefore C_{eq} = 4\,\mu f + 2.9\,\mu f + 6\,\mu f = 12.9\,\mu f$

(B)

Q.3 :- $J = \sigma E$

$E = \frac{J}{\sigma} = J\rho$

{ * $I = n e v_d A \rightarrow J = \frac{I}{A} = n e v_d$
* $\sigma = \frac{1}{\rho}$ }

$\therefore E = n e v_d \rho = (8.456 \times 10^{28})(1.6 \times 10^{-19})(5.58 \times 10^{-4})(1.7 \times 10^{-8})$

$\simeq 0.13\ V/m$

(A)

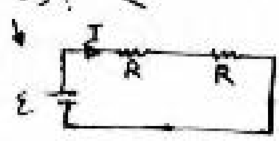
Q.4 :- after very long time ($t = \infty$) → the capacitor is fully charged

⇐ جزء الدارة يهمل (بسبب عدم مرور التيار)

$Q = CV = \frac{C\varepsilon}{2}$ (B)

$I = \frac{\varepsilon}{2R}$

$V = IR = \frac{\varepsilon}{2}$



Q.5 :- $\frac{1}{2}\epsilon_0 E^2 \equiv \frac{C^2}{N.m^2} \cdot \frac{N^2}{C^2} = \frac{N}{m^2} \cdot \frac{m}{m} = \frac{N.m}{m^3} \equiv \frac{J}{m^3}$ (E)

Q.6 : $Q(t) = C_{eq}\,\varepsilon\,(1 - e^{-t/R_{eq}C_{eq}})$, $t = 2\,ms$

$R_{eq} = 5\,k\Omega$, $C_{eq} = 2\,\mu f$ } $\tau = 10\,ms$

$\Rightarrow Q = 21.75\,\mu C = Q_1 = Q_2$

$V_1 = \frac{Q_1}{C_1} = \frac{21.75\,\mu C}{3\,\mu f} = 7.25\,V$

(B)

Q.7:- $W = \Delta K$; but the magnetic force does not do work $\rightarrow W = \text{Zero}$

$\therefore \Delta K = 0$

$K_f = K_i$

$\rightarrow$ Remains constant regardless of the path or the field

(D)

Q.8:- $r = \frac{mv}{qB}$; $K = \frac{1}{2}mv^2 = 0.2\ \text{Kev}$ $\rightarrow$ نحول الوحدة لـ J

$= 200\ \text{ev} \times \frac{1.6 \times 10^{-19}\ J}{1\ \text{ev}}$

$\frac{1}{2}mv^2 = 320 \times 10^{-19}$

$v = 19.58 \times 10^4\ m/s$

$\therefore r = \frac{(1.67 \times 10^{-27})(19.58 \times 10^4)}{(1.6 \times 10^{-19})(60 \times 10^{-3})}$

$\rightarrow r = 3.4\ \text{cm}$

(C)

Q.9:- $C = \kappa C_0$, $C_0 = \frac{1}{K_e} \frac{ab}{(b-a)}$, $b > a$ دائماً

$= \frac{1}{9 \times 10^9} \frac{8 \times 10^{-4}}{2 \times 10^{-2}} = 0.444 \times 10^{-11}\ f$

$= 4.44 \times 10^{-12}\ f = 4.44\ pf$

$\therefore C = (3.5)(4.44\ pf)$

$\approx 15.6\ pf$

(E)

Q.10:- $\vec{F}_B = I\ \vec{L} \times \vec{B}$; $\vec{L} = 2\hat{i}$, $\vec{B} = (30\hat{i} - 40\hat{j})\ mT$

$\vec{L} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 0 & 0 \\ 30 & -40 & 0 \end{vmatrix} = \hat{i}(0) - \hat{j}(0) + \hat{k}(-80) = (-80\hat{k}) \times 10^{-3}$

$\therefore \vec{F}_B = 15(-80) \times 10^{-3}\ \hat{k}$

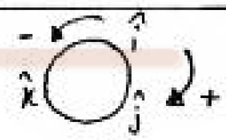
$= -1.2\hat{k}\ N$

(B)

Q.11:- $\vec{F}_B = q\vec{v} \times \vec{B}$; $\vec{F}_B \rightarrow +\hat{k}$ & $\vec{v} = +\hat{i}$

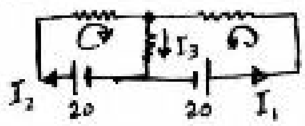
$\hat{k} = -\hat{i} \times (-\hat{j})$

* electron $\rightarrow$ (-ve)



$\therefore$ the direction is $(-\hat{j})$ (C)

Q.12:- $I_1 + I_2 = I_3$



Loop 1 $\rightarrow$ $20 - 15I_1 - 15I_3 = 0$ —①

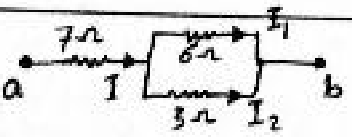
Loop 2 $\rightarrow$ $20 - 15I_2 - 15I_3 = 0$ —②

$\rightarrow$ ①+② $\Rightarrow$ $40 - 15(I_1 + I_2) - 30I_3 = 0$, where $I_1 + I_2 = I_3$

$\therefore I_3 = 0.89\ A$ ✓ (D)

Q.13:- $R = R_0(1 + \alpha(T - T_0)) = 200(1 + 0.4 \times 10^{-3}(100 - 20)) = 206.4$ ✓ (A)

Q.14:-



$\rightarrow I = I_1 + I_2$

$R_{eq} = 9\,\Omega \rightarrow I = \frac{27}{9} = 3\,A$

Wire $\rightarrow$ $V_a - 7 \times 3 - 6I_1 = V_b$

$V_{ab} - 21 = 6I_1 \rightarrow 6 = 6I_1 \rightarrow I_1 = 1A$ (C)

Q.15:- $P = \frac{V^2}{R} = (220)^2/60 \approx 807\ W$ (C)

PAST PAPERS

Physics 2

second

Jordan University / Physics department
Summer semester 2013/2014
Physics 102/ second exam

Section number : ______________ **Student name (بالعربية):** ______________

Lecturer name : ______________ **Student number :** ______________

o Some helpful information: p (pico) = 10^{-12}; n (nano) = 10^{-9}; μ (micro) = 10^{-6}; electron charge = 1.6×10^{-19} C.

Notes: Turn off your cell phone and put it out of sight. Keep your calculator on your own desk. Calculators cannot be shared. You have sixty (60) minutes to complete your exam. Be sure to fill the box below with your final answers before the end of the exam.

1	2	3	4	5	6	7	8	9	10	11	12
C	C	D	D	B	C	D	A	B	D	C	B

1. A fully charged parallel-plate capacitor remains connected to a battery while you slide a dielectric between the plates. The stored charge (Q) will:

(A) Decrease (B) Increase (C) Stay the same (D) Non of the above

2. Two capacitors give an equivalent capacitance of 10 pF when connected in parallel, and an equivalent capacitance of 1.6 pF when connected in series. The capacitance of the two capacitors (in pF) are :

(A) 9, 1 (B) 6, 4 (C) 8, 2 (D) 7, 3

3. A small rigid object carries positive and negative 4.0 nC charges. It is oriented so that the positive and negative charges have coordinates (-1.2, 1.1) mm and (1.4, -1.3) mm, respectively. The electric dipole moment of the object (in C.m) is:

(A) 12.4×10^{-12} (B) 10.6×10^{-12} (C) 11.7×10^{-12} (D) 14.2×10^{-12}

4. Two wires A and B are made of the same metal and have equal lengths, but the resistance of wire A is three times greater than that of wire B. The ratio of the cross-sectional area of B to that of A is:

(A) $\sqrt{3}$ (B) 3 (C) 1/3 (D) $1/\sqrt{3}$

5. A long wire 3 mm in diameter carries a steady current of 10 A. If the conductor is copper with a free charge density of 8.5×10^{28} electrons per cubic meter. The drift speed of the free electrons (in m/s) is:

(A) 1.0×10^{-4} (B) 1.2×10^{-4} (C) 2.3×10^{-4} (D) 9.4×10^{-4}

6. A device is rated at 1.3 kW when connected to a 120 V source. The equivalent resistance of this device (in Ω) is:

(A) 18.3 (B) 12.0 (C) 11.1 (D) 14.4

---

7. An uncharged capacitor with C = 5000 μF, and a resistor with R = 100 Ω are connected to a source of ε = 120 V. The current in the resistance 1 s after the switch is closed (in A) is:

(A) 0.24 (B) 0.20 (C) 0.10 (D) 0.16

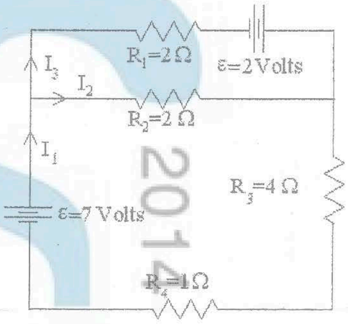
---

8. A battery has an emf of 150 V. When the switch is closed, an external load resistance of 9.9 Ω carries a current of 14 A. The internal resistance of the battery (in Ω) is:

(A) 0.8 (B) 0.9 (C) 0.2 (D) 0.7

---

9. Using the figure shown besides, if $I_3 = 1.17$A, then (I_1, I_2) A is:



(A) (3.17, 2.00) (B) (1.33, 0.17)
(C) (1.67, 0.50) (D) (1.27, 0.10)

---

10. A proton moves with a velocity of v = (i - j + 2k) m/s in a region in which the magnetic field is B = (i - j - k) T. What is the magnitude of the magnetic force this particle experiences (in N)?

(A) 8.2×10^{-19} (B) 1.0×10^{-19} (C) 9.9×10^{-19} (D) 6.8×10^{-19}

---

11. A conductor carrying a current I = 15 A is directed along the positive *x*-axis and perpendicular to a uniform magnetic field. A magnetic force per unit length of 0.12 N/m acts on the conductor in the positive *y* direction. The magnetic field in the region through which the current passes (in T) is:

(A) - 0.002 k (B) + 0.002 k (C) - 0.008 k (D) +0.008 k

---

12. A 30 turns circular coil of radius 5 cm is placed in a uniform magnetic field of 0.5 T. If the coil carries a current of 5 A, find the magnitude of the maximum possible torque exerted on the coil (in N.m).

(A) 0.59 (B) 0.98 (C) 0.20 (D) 0.42

50+ Years of Excellence

الجامعة الأردنية
THE UNIVERSITY OF JORDAN

THE UNIVERSITY OF JORDAN
PHYSICS DEPARTMENT
GENERAL PHYSICS II, 0302102 (2^{nd} EXAM)
FIRST SEMESTER 2014/2015 (DECEMBER 2^{nd}, 2014)

Student's Name (In Arabic): Time: (4:00 – 5:20) PM
Instructor's Name: Section:

Useful Information:
|q| (≡ Absolute Charge on Electron or Proton) = 1.6×10^{-19} C
m_e (≡ Mass of Electron) = 9.11×10^{-31} kg
m_p (≡ Mass of Proton) = 1.67×10^{-27} kg
k_e (≡ Coulomb's Constant) = 9×10^9 N.m²/C²
ε_0 (≡ Permittivity of free space) = 8.85×10^{-12} C² / N.m²
$\mu_o = 4\pi \times 10^{-7}$ T.m/A
Some of the results are rounded.

Q1	a	b	c	d	e	Q6	a	b	c	d	e	Q11	a	b	c	d	e
Q2	a	b	c	d	e	Q7	a	b	c	d	e	Q12	a	b	c	d	e
Q3	a	b	c	d	e	Q8	a	b	c	d	e	Q13	a	b	c	d	e
Q4	a	b	c	d	e	Q9	a	b	c	d	e	Q14	a	b	c	d	e
Q5	a	b	c	d	e	Q10	a	b	c	d	e	Q15	a	b	c	d	e

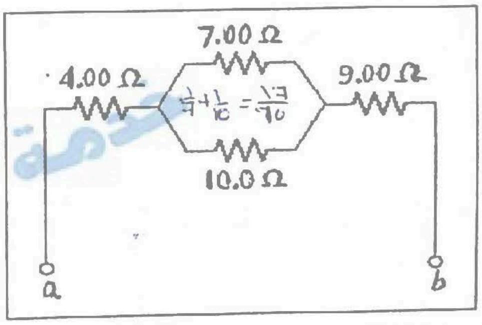
1. A resistor has a uniform cross sectional area of 5.00 mm² and resistivity = 3.5×10^{-5} Ω.m. When a potential difference of 15.0 V is applied across the ends of the rod, the rod carries a current of 4.00×10^{-3} A. The rod's length (in m) is:

a) 234 b) 356 c) 423
d) 635 e) 536

2. A conductor of radius r, length ℓ and resistivity ρ has resistance R. Its new resistance if it is stretched to 2 times its original length is (Note: No new material is added to the conductor):

a) (1/4) R b) (1/2) R c) R
d) 2 R e) 4 R

3. The equivalent resistance (in Ω) between points a and b in the Figure is:



a) 13
b) 27
c) 23
d) 17
e) 30

4. Consider a series RC circuit for which R = 1.00 MΩ, C = 5.00 μF, and ε = 30.0 V. The current (in μA) in the resistor 10.0 s after the switch is closed is:

a) 6.40 b) 4.06 c) 2.62
d) 5.23 e) 8.17

---

5. In a series RC circuit, how many time constants must elapse if an initially uncharged capacitor is to reach 80% of its final potential difference?

a) 2.2 b) 1.6 c) 5.0
d) 3.0 e) 1.9

---

6. In a parallel plate capacitor, if the plate separation is halved while the charge on each plate is kept constant, then the potential difference (V) across the plates is:

a) Does not change. b) Halved c) Tripled
d) Four times smaller e) Doubled

---

7. A proton moving at 4.00×10^{6} m/s through a magnetic field of 1.70 T experiences a magnetic force of magnitude 8.20×10^{-13} N. The angle (in Degrees) between the proton's velocity and the field is:

a) 9.9 b) 66.8 c) 48.9
d) 12.3 e) 54.7

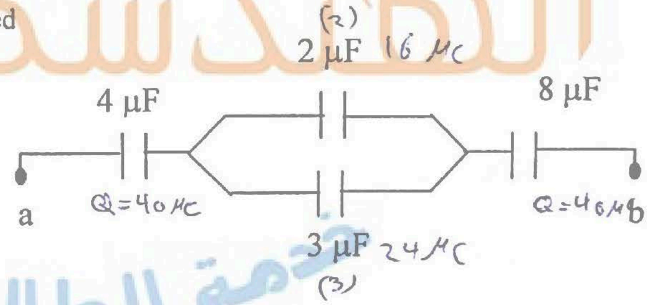
---

8. A particle (mass 2.0 mg, charge – 6.0 μC) moves in the positive direction along the *x* axis with a velocity of 3.0 km/s. It enters a magnetic field of (2.0 **i** + 3.0 **j** + 4.0 **k**) mT. The acceleration (in m/s^2) of the particle is:

a) 36 **j** – 27 **k** b) – 36 **j** + 27 **k** (c) – 24 **j** + 18 **k**
d) 24 **j** – 18 **k** e) 24 **j** – 27 **k**

---

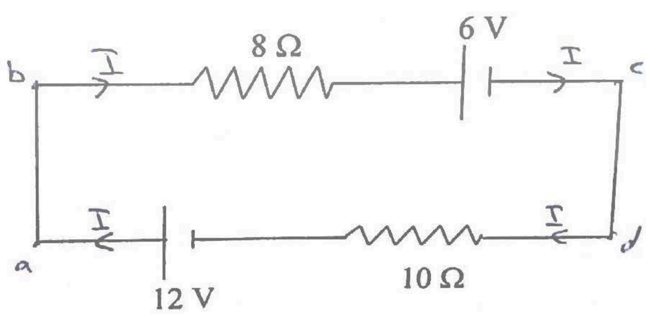
9. If a potential difference of 23.0 V is applied across points a and b, then the charge (in μC) on the 2 μF capacitor is:



a) 20.0
b) 40.0
c) 16.0
d) 24.0
e) 36.0

---

10. The power delivered to the 10 Ω resistor is:



a) 0.9
b) 1.1
c) 2.2
d) 3.3
e) 4.4

---

11. A 3μF capacitor is connected to a 10 V battery. The energy stored in the capacitor (in Joules) is:

a) 3.6×10^{-5} b) 1.1×10^{-10} c) 1.5×10^{-4}
d) 2.16×10^{-4} e) 4.32×10^{-4}

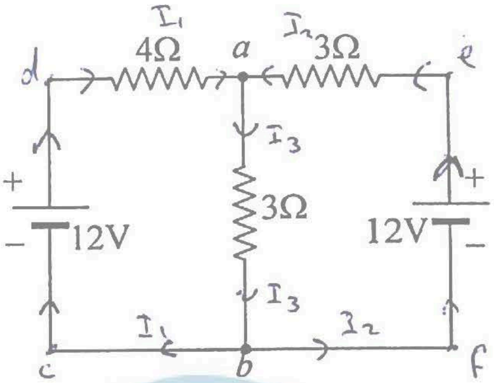
For the circuit shown, answer questions 12 and 13.

12. Assuming that the batteries have negligible internal resistance, the potential difference (in V) between points a and b is:

a) 12 b) 1.55
c) 9.33 d) 3.99
e) 7.65

13. The current passing through the 4 Ω resistor (in A) is:

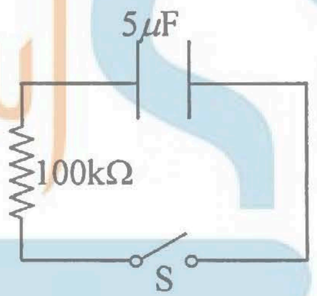
a) 1.56 b) 1.09
c) 0.66 d) 2.55
e) zero



---

14. The capacitor in the circuit shown was charged to $5\,\mu\text{C}$. After half a second of closing the switch S, the charge on the capacitor $(\text{in}\,\mu\text{C})$ will be:

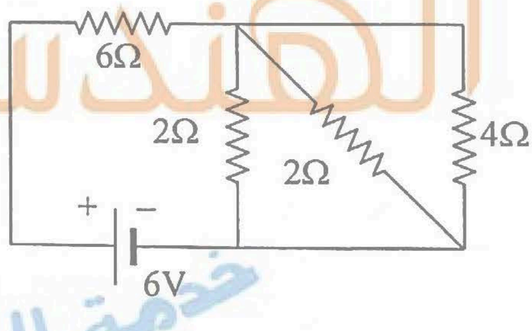
a) 3.03
b) 36.9
c) 0.68
d) 1.84
e) Zero



---

15. For the circuit shown, the current (in A) that passes through the 6 Ω resistor is:

a) 2.75
b) 0.88
c) 3.8
d) 1.58
e) 2.00



Good Luck

The University of Jordan
Faculty of Science
Department of Physics

2nd Semester 2013/2014
06/05/2014
3:00-4:00 pm

General Physics-2 (0302102) / Second Exam

Name (in Arabic): -

Registration No.: -

- Instructor:---------------------------------------

- Section: -------

-- Choose the closest correct answer and fill the Answer Table.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	e	c	b	b	e	d	a	d	c	d	e	a	c	a

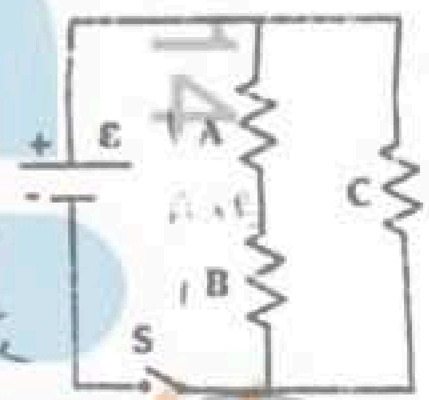
1. A 4.0 Ω resistor has a current of 4.0 A for 5.0 min. How many electrons pass through the resistor during this time interval? ($e = 1.6 \times 10^{-19}$C)

a. 7.5×10^{21} b. 3.8×10^{21} c. 8.4×10^{21} d. 2.1×10^{21} e. 5.6×10^{21}

2. A conductor of radius *r*, length *l* and resistivity *ρ* has resistance *R*. It is melted down and formed into a new conductor, also cylindrical, with one fourth the length of the original conductor. The resistance of the new conductor is

a. $\frac{1}{4}R$ b. 16*R*. c. *R* d. 4*R* e. $\frac{1}{16}R$

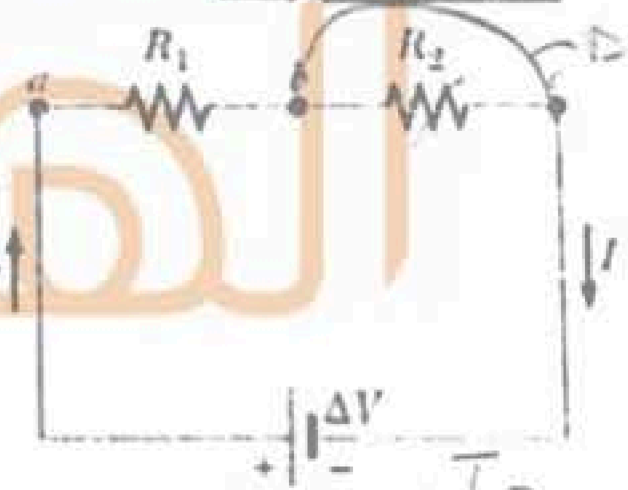
3. The circuit shown contains three resistors, A, B, and C, which all have equal resistances. The *emf* ε = 110V. Which resistor generates the most thermal energy after the switch is closed?



a. A b. B c. C d. A and B

e. All three generate equal amounts of thermal energy.

4. If a piece of conducting wire is used to connect points *b* and *c* in the circuit shown, the brightness (توهج) of the light bulb R_1 will

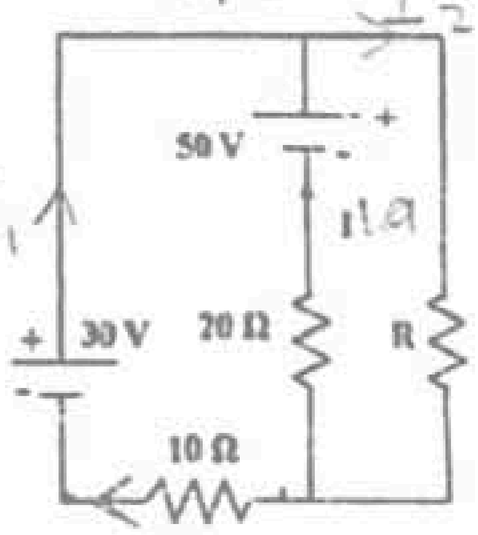


a. decrease.

b. increase.

c. remain the same.

5. Determine the magnitude and direction of the current in the 10 Ω resistor when *I* = 1.9 A.



a. 1.6 A, left to right. b. 1.8 A, right to left. c. 1.2 A, right to left.

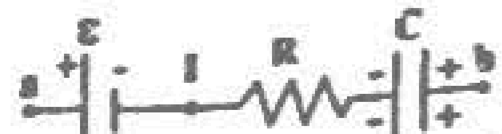
d. 1.2 A, left to right. e. 1.8 A, left to right.

6. An electron moves in a circular path in a region of space filled with a uniform magnetic field B = 0.2 T. To double the radius of the electron's path, the magnitude of the magnetic field must become:

a. 0.8 T. b. 0.2 T. c. zero. d. 0.3 T e. 0.1 T.

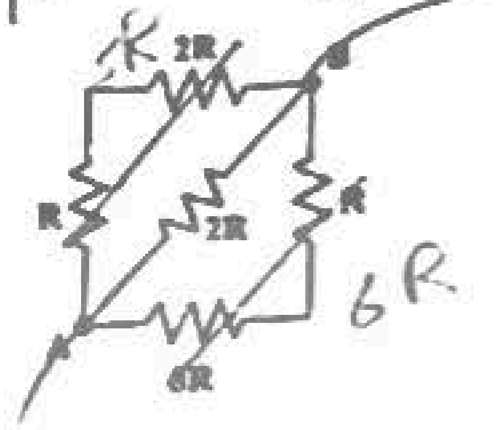
$V_b - 4 - 2 + 9 - V_a = 0$

7. If $R = 4.0$ kΩ, $C = 3.0$ mF, $\varepsilon = 9$ V, $Q = 12$ mC, and $I = 2.0$ mA, what is the potential difference V_b-V_a in the circuit segment shown?



a. +8 V b. -19 V c. -3.0 V d. +3 V e. -8 V

8. What is the equivalent resistance between points A and B in the figure when $R = 25$ Ω?

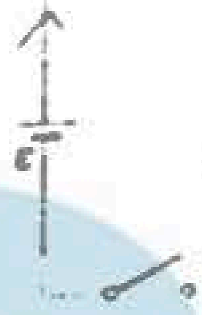


a. 25 Ω b. 10 Ω c. 20 Ω d. 15 Ω e. 3.2 Ω

9. Two resistors (R_1 and R_2) are connected in series across a potential difference. R_1 has twice the resistance of R_2. If the current carried by R_1 is I, then the current carried by R_2 is:

a. I/2. b. 4I. c. 2I. d. I. e. I/4.

10. Consider the circuit in the figure shown and assume that the battery has no internal resistance. If the switch is closed for a very long time, the current in the battery is



a. zero b. $\varepsilon/2R$ c. ε/R d. $2\varepsilon/R$ e. impossible to determine

11. Which of the following statements is a characteristic of both electric and magnetic forces?

a. The force exerted on a stationary charged object is nonzero.
b. The force exerted on a stationary charged object is zero.
c. The force exerted on a charged object is proportional to its speed.
d. Positive and negative charges feel forces in opposite directions.
e. None of the above.

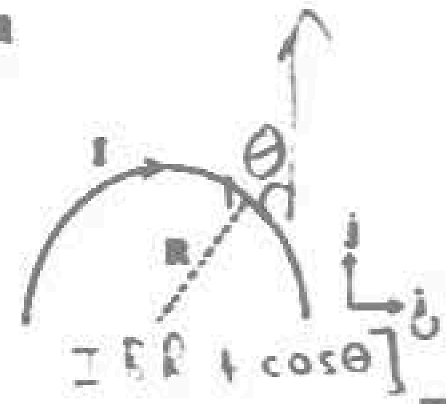
12. An electron moves in the plane of this paper toward the top of the page. A magnetic field is also in the plane of the page and directed to the right. The direction of the magnetic force on the electron is

a. toward the top of the page. b. toward the bottom of the page.
c. toward the left edge of the page. d. into the page. e. out of the page.

13. A velocity selector consists of electric and magnetic fields described by the expressions $\vec{E} = E\hat{k}$ and $\vec{B} = B\hat{j}$, with $B = 20$ mT. Find the value of E such that a 1.6×10^7 m/s electron moving in the negative x direction is undeflected.

a. 320 kV/m b. 160 kV/m c. 420 kV/m d. 120 kV/m e. 240 kV/m

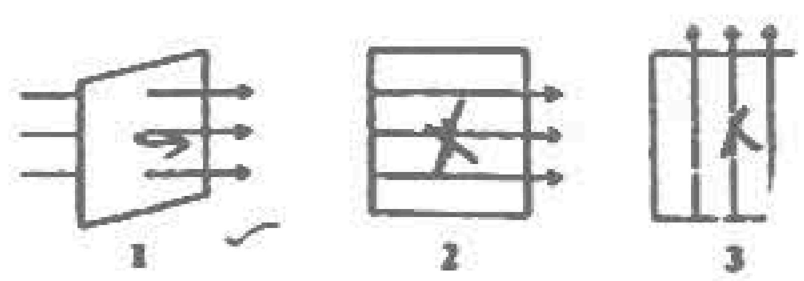
14. A wire is bent into a semicircle of radius R as shown. The wire carries a current (I) and lies in the xy-plane in a region of uniform magnetic field $\vec{B} = B\hat{j}$. Find the magnetic force acting on the wire.



a. $\pi RIB\hat{k}$ b. $-\pi RIB\hat{k}$ c. $2RIB\hat{k}$ d. $-2RIB\hat{k}$ e. zero.

15. A current loop and a uniform magnetic field are oriented in three different positions. In position 1 the plane of the loop is perpendicular to the field lines. In positions 2 and 3 the plane of the loop is parallel to the field as shown. The torque on the loop is zero in

a. position 1. b. position 2. c. position 3.
d. positions 2 and 3. e. all three positions.



– ALL THE BEST –

Physics Department/The University of Jordan

Second Exam/20April/2015 (3:30 – 4:30)

Student's Name: **KEY** **Student's Number:**

Section Number: **Lecturer's Name:**

$e = -1.6 \times 10^{-19}$ C, $m_e = 9.11 \times 10^{-31}$ kg, $g = 9.8$ m/s^2

Q1) The quantity of charge (in Coulombs) that has passed through a surface area of 2.0 cm^2 varies with time as $q = 4t^3 + 5t + 6$ where t is in seconds. The instantaneous current (in A) through the surface at $t = 1.0$ s is

a) 15 b) 23 c) 0 d) 17 e) 10

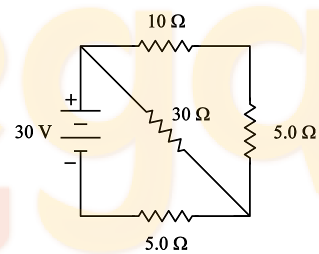
Q2) A light bulb is rated at 30 W when operated at 120 V. How much charge (in Coulombs) passes through this bulb in 1.0 min?

a) 17 b) 15 c) 14 d) 13 e) 60

Q3) A conductor of radius *r*, length *L* and resistivity ρ has resistance *R*. What is the new resistance if it is stretched to 4 times its original length **keeping its volume constant**?

a) *R/4* b) *R* /16 c) *R* d) 4*R* e) 16*R*

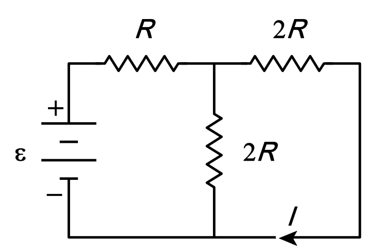
Q4) What is the rate at which thermal energy is generated in the 30 Ω resistor shown?



a) 20 W b) 27 W c) 60

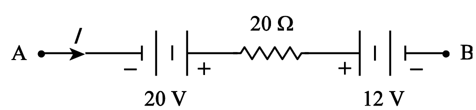
d) 13 W e) 30 W

Q5) In the figure shown, if *I* = 0.50 A and 2Ω ,
determine (in Volt).



a) 12 b) 24 c) 30
d) 15 V e) 6.0

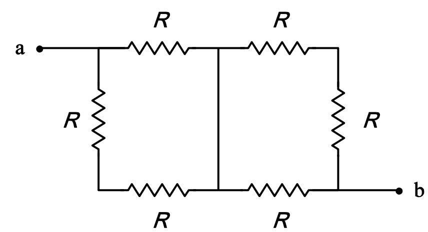
Q6) In the figure, if *I* = 1.5 A in the circuit segment shown, what is the potential difference $V_B - V_A$ (in volt)?



a) +22 b) -38 c) -22

d) +38 e) +2.0

Q7) In the figure, if $R = 12\ \Omega$, what is the equivalent resistance between points a and b



a) 16 b) 20 c) 24
d) 28 e) 6.0

8) An *RC* circuit consists of uncharged capacitor, 30 V battery and a 5 Ω resistor. When the switch is closed the initial current (in A) in the circuit is

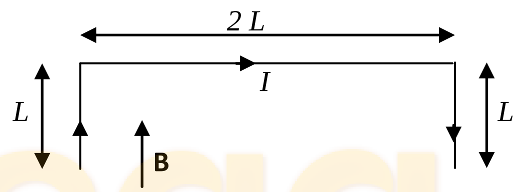
a) 0.6 b) 15 c) 6.0 d) 3.0 e) 5.0

Q9) An electron has a velocity of $)^6$ m/s in the positive *x* direction at a point where the magnetic field has the components, 3 T, $B_z = 0$. What is the magnitude of the magnetic force acting on the electron (in N)?

a) b) c) 3 d) e)

Q10) A straight wire is bent into the shape shown. Determine the net magnetic force on the wire.

a) 2*IBL* into the page b) 2*IBL* out of the page
c) 4*IBL* out of the page d) 4*IBL* into the page
e) zero

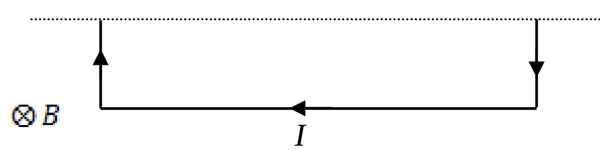


Q11) A circular loop (radius = 0.50 m) carries a current of 3.0 A and has unit normal vector of (2**i** – **j** + 2**k**)/3. What is the *x* component of the torque (in N.m) on this loop when it is placed in a uniform magnetic field of (2**i** – 6**j**) T ?

a) 4.7 b) 3.1 c) 19 d) 9.4 e) 12 N

Q12) A horizontal wire (mass = 50 g, length = 40 cm) is suspended by two massless vertical wires which conduct a current *I* = 8.0 A, as shown in the figure. The horizontal wire is subjected to a magnetic field of magnitude 60 mT into the paper. What is the value of the tension (in N) in each of the vertical wires?

a) 0.34 b) 0.68 c) 0.30
d) 0.15 e) 0.10



Answers

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
D	B	E	D	B	C	A	C	A	B	D	A

اسئلة سنوات
Past Papers

إعداد :

zenon

مجموعة من طلبة الهندسة - الجامعة الأردنية

بالتعاون.. نمضي..

Physics2
Second

30/30

PHYSICS DEPARTMENT

PHYSICS 102 (2^{nd} EXAM)

SPRING 2010/2011 (APRIL 23^{rd}, 2011)

Student's Name (In Arabic): Registration #:

Instructor's Name: Section:

Useful Information:

|q| (≡ Absolute Charge on Electron or Proton) = 1.6×10^{-19} C

m_e (≡ Mass of Electron) = 9.11×10^{-31} kg

m_p (≡ Mass of Proton) = 1.67×10^{-27} kg

k_e (≡ Coulomb's Constant) = 9×10^9 N.m²/C²

ε_0 (≡ Permittivity of free space) = 8.85×10^{-12} C² / N.m²

Some of the results are rounded.

Q1	a	b	c	d	e	**Q7**	a	b	c	d	e
Q2	a	b	c	d	e	**Q8**	a	b	c	d	e
Q3	a	b	c	d	e	**Q9**	a	b	c	d	e
Q4	a	b	c	d	e	**Q10**	a	b	c	d	e
Q5	a	b	c	d	e	**Q11**	a	b	c	d	e
Q6	a	b	c	d	e	**Q12**	a	b	c	d	e

1. Points A [at (2, 3) m] and B [at (5, 7) m] are in a region where the electric field is uniform and given by **E** = (4**i** + 3**j**) N/C. The potential difference $V_A - V_B$ (volts) is:

a) 33
b) 27
c) 30
d) 24
e) 11

2. A non-uniform linear charge distribution given by $\lambda(x) = b\,x$, where b is a constant, is distributed along the x axis from $x = 0$ to $x = +L$. If $b = 40$ nC / m² and $L = 0.20$ m, the electric potential (in volts) (relative to a potential of zero at infinity) at the point $y = 2L$ on the y axis is:

a) 19
b) 17
c) 21
d) 23
e) 14

3. A non-conducting sphere of radius 10 cm is charged uniformly with a density of 100 nC / m³. The magnitude of the potential difference (in volts) between the center and a point 4.0 cm away is:

a) 12
b) 6.8
c) 3.0
d) 4.7
e) 2.2

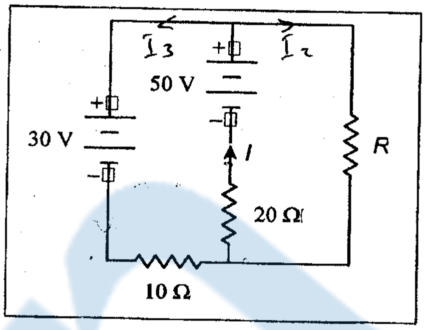
4. The number of electrons that pass through a 20 Ω resistor in 10 min if there is a potential drop of 30 volts across it is:

a) 5.6×10^{21}
b) 7.5×10^{21}
c) 9.4×10^{21}
d) 1.1×10^{21}
e) 3.8×10^{21}

5. A conductor of radius r, length ℓ and resistivity ρ has resistance R. Its new resistance if it is stretched to 4 times its original length is:

a) (1/16) R
b) (¼) R
c) R
d) 4 R
e) 16 R

6. The resistance R (in Ω) when $I = 1.5$ A is:



a) 40
b) 8.0
c) 85
d) 28
e) 32

---

7. The following is not a capacitance: (Hint: κ is a dielectric constant)

a) $a\,b/\,k_e(b - a)$ b) $\kappa\,\varepsilon_0 A / d$ c) $\varepsilon_0 A / d$
d) $\ell\,/2\ k_e \ln(b/a)$ e) $k_e\,\varepsilon_0 A / d$

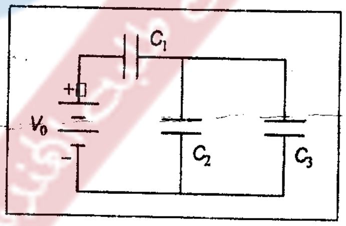
---

8. A small bulb is rated at 7.5 W when operated at 125 V. The tungsten filament has a temperature coefficient of resistivity $\alpha = 4.5 \times 10^{-3}$ /°C. When the filament is hot and glowing, its temperature is seven times room temperature (20 °C). What is the resistance of the filament (in Ω) at room temperature?

a) 1280 b) 1352 c) 1532
d) 4530 e) 5630

---

9. The energy stored (in mJ) in C_2 when $C_1 = 15\ \mu F$, $C_2 = 10\ \mu F$, $C_3 = 20\ \mu F$, and $V_0 = 18$ V is:



a) 0.72
b) 0.36
c) 0.50
d) 0.18

---

10. A capacitor in a single loop RC circuit is charged to 85% of its final potential difference in 2.4 s. The time constant (in s) for this circuit is:

a) 1.5 b) 1.3 c) 1.7
d) 2.3 e) 2.9

---

11. The time (in ms) it will take a charged 80 μF capacitor to lose 20% of its initial energy when it is allowed to discharge through a 45 Ω resistor is:

a) 0.92 b) 0.64 c) 0.40
d) 0.19 e) 0.80

---

12. A typical toaster oven can generate 1200 watts in its heating element, when driven by 120 volts. The heating element is a thin Nichrome wire of length 4 meters and cross sectional area 0.33 mm². The resistivity ρ of the Nichrome wire (in Ω . m) is:

a) 9.9×10^{-7} b) 6.6×10^{-7} c) 0.99
d) 12 e) 1.46×10^{8}

مكتبة العماره والفنون

Archi Arts

اسئلة سنوات سابقة

لمادة

فيزياء 102

الامتحان الثاني

1,200

فيزياء 102 2013/2000

4. A 4.0-mF capacitor initially charged to 50 V and a 6.0-mF capacitor charged to 30 V are connected to each other with the positive plate of each connected to the negative plate of the other. What is the final charge on the 6.0-mF capacitor?

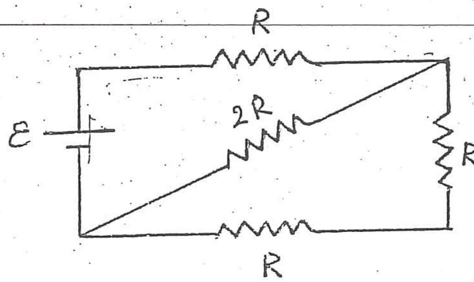
a. 230 mC
b. 12 mC
c. 10 mC
d. 8.0 mC
e. 20 mC

5. A 50-V potential difference is maintained across a 2.0-m length wire that has a diameter of 0.50 mm. If the wire is made of material that has a resistivity of $7.0 \times 10^{-8}\ \Omega \cdot m$, what is the current in the wire?

a. 280 A
b. 65 A
c. 58 A
d. 61 A
e. 70 A

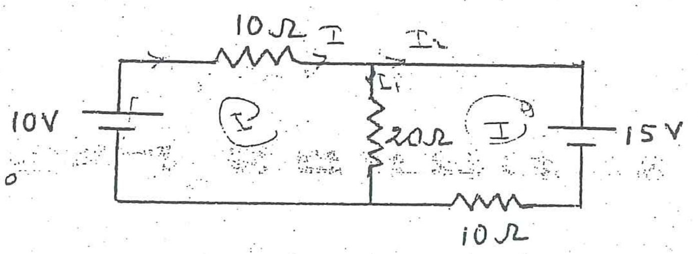
6. If ε = 12 V and R = 3.0 Ω, at what rate is thermal energy being generated in the 2R-resistor shown?

a. 12 W
b. 6.0 W
c. 24 W
d. 3.0 W
e. 1.5 W



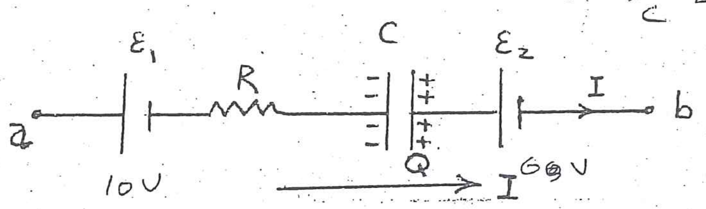
7. What is the magnitude of the current in the 20-Ω resistor shown?

a. 0.50 A
b. 1.00 A
c. 0.25 A
d. 0.75 A
e. 0.00 A



8. In the figure, if $R = 3.0\ k\Omega$, $C = 6.0\ nF$, $\varepsilon_1 = 10.0\ V$, $Q = 18\ nC$, $\varepsilon_2 = 6.0\ V$, and $I = 5.0\ mA$, what is the potential difference $V_b - V_a$?

a. −13 V
b. −28 V
c. 13 V
d. 28 V
e. +2.0 V



9. In an RC circuit, how many time-constants must elapse if an initially uncharged capacitor is to reach 80% of its final potential difference?

a. 1.6
b. 3.0
c. 2.2
d. 1.9
e. 5.0

10. The square plates of a 6 nF capacitor measure 30mm by 30mm and are separated by a dielectric which is 0.1mm thick. The dielectric constant of the dielectric is closest to:

a. 65
b. 55
c. 45
d. 85
e. 75

11. The current in a wire varies with time according to the relation $I=20+3t^2$, where I is in Amperes and t is in seconds. How many Coulombs are transported by the wire between t=0 and t=10 s?

a. 1000
b. 1200
c. 1100
d. 1300
e. zero

12. A toaster with a Nichrome heating element has a resistance of 80 Ω at 20 °C and an initial current of 1.5 A. When the heating element reaches its final temperature, the current is 1.3A. What is the final temperature of the heating element in °C? (α=0.0004 $°C^{-1}$).

a. 420
b. 405
c. 400
d. 600
e. 1000

GOOD LUCK

FACULTY OF SCIENCE
PHYSICS DEPARTMENT

UNIVERSITY OF JORDAN
Wednesday 7 – 5 - 2003

General Physics 102

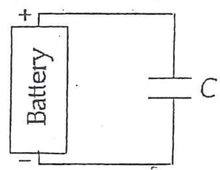
Second Exam

الأسم بالعربية:............ الرقم الجامعي: .... المدرس: ....

Note: $k = \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 N \cdot m^2 / C^2$; $\varepsilon_o = 8.85 \times 10^{-12} C^2 / N \cdot m^2$

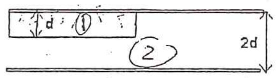
The mass of a proton is, $m_p = 1.67 \times 10^{-27}$ kg, 1eV=1.6×10^{-19}J.

1. A capacitor is connected to a battery as shown. When a dielectric is inserted between its plates,
   A) only the capacitance changes;
   B) only the voltage across the capacitor changes;
   C) only the charge on the capacitor changes;
   D) both the capacitance and the charge change.
   E) both the capacitance and the voltage change;



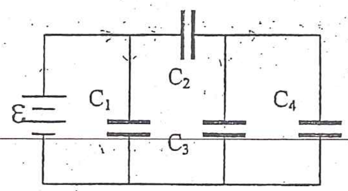
2. By what percentage does the resistance of a copper wire ($\alpha = 3.9 \times 10^{-3}$/K) increase when its temperature increases from 40°C to 100°C?
   A) 11% ; B) 14% ; C) 23% ; D) 31% ; E) 57%.

3. A conducting plate of thickness d is inserted into a large area parallel plate capacitor of area A and separation 2d as shown in figure (consider the field to be uniform all over the area). If the conductor fills half the capacitor, the effective capacitance of the combination is:



   A) (5/4)(ε_0A/d) B) (1/4)(ε_0A/d) C) (1/2)(ε_0A/d) D) (ε_0A/d) E) (3/4)(ε_0A/d)

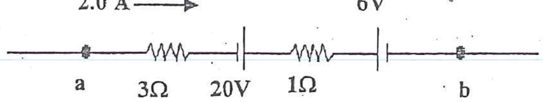
4. Four parallel plate capacitors are connected to a battery as shown below. The charge on the capacitor C_1 is:
   A) Smaller than the charge on C_2
   B) Smaller than the charge on C_4
   C) Larger than the charge on C_3
   D) Equal to the charge on C_2 and C_4
   E) Equal to the charge on C_3 and C_4



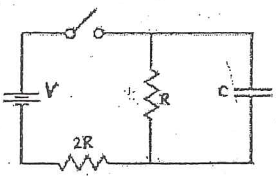
C_1=20μF
C_2=20μF
C_3=30μF
C_4=40μF
ε = 3volts.

5. A typical toaster oven can generate 1200 watts in its heating element, when driven by 120 volts. The heating element is a thin Nichrome wire of length 4 meters and cross sectional area 0.33 mm². The resistivity ρ of the Nichrome wire (in Ohm.m) is:
   A) 9.9×10^{-4} B) 9.9×10^{-7} C) 0.99 D) 12 E) 1.46×10^{8}

6. If a current of 2.0 A is flowing from point a to point b, the potential difference between $V_b - V_a$ (in V) is:
   A) 6 B) 8 C) -6 D) -8 E) 22

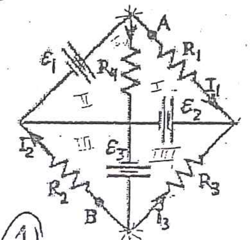


7. In the circuit shown, the switch has been opened for a long time so that the capacitor is uncharged. the charge on the capacitor after the switch has been closed for a long time is
   A) VC B) 2CV/3 C) CV/3 D) 2CV E) 3CV



8. When two identical resistors are connected in parallel across the terminals of a battery, the power delivered by the battery is 10 watts. If these resistors are instead connected in series across the terminals of the same battery, then the power delivered by the battery (in W) is:
   A) 40 B) 5 C) 20 D) 10 E) 2.5

<ins>The following text is for question 9 and 10:</ins> Four wires and three batteries are connected as shown here.



R_1 = 10 Ω
R_2 = 20 Ω
R_3 = 30 Ω
R_4 = 40 Ω
ε_1 = 10 Volt
ε_2 = 20 V
ε_3 = 30

9. The potential difference between the points marked A and B, $V_{AB} = V_B - V_A$ (in V) is:
   A) 20 B) -20 C) 10 D) -10 E) can not be found

10. The current passing through R_2 (in A) is:
   A) 0.25 B) 0.5 C) 0.75 D) 1.5 E) 1.25

10. The square plates of a 6 nF capacitor measure 30mm by 30mm and are separated by a dielectric which is 0.1mm thick. The dielectric constant of the dielectric is closest to:

a. 65
b. 55
c. 45
d. 85
e. 75

11. The current in a wire varies with time according to the relation $I=20+3t^2$, where I is in Amperes and t is in seconds. How many Coulombs are transported by the wire between t=0 and t=10 s?

a. 1000
b. 1200
c. 1100
d. 1300
e. zero

12. A toaster with a Nichrome heating element has a resistance of 80 Ω at 20 °C and an initial current of 1.5 A. When the heating element reaches its final temperature, the current is 1.3 A. What is the final temperature of the heating element in °C? ($\alpha=0.0004$ °C^{-1}).

a. 420
b. 405
c. 400
d. 600
e. 1000

GOOD LUCK

University of Jordan
Physics Department

Date: 9/5/2002
Time: 5:00-6:0

General Physics (102)
Second Exam

الاسم باللغة العربية:..................الرقم الجامعي:.............الشعبة:.....

1. An air filled parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. It is then disconnected from the battery and the plate separation is decreased to ½ d. After the plates are ½ d apart, the magnitude of the charge on the plates and the potential difference between them are:
a) Q_0, ½V_0 b) ½Q_0, V_0 c) Q_0, V_0 d) Q_0, $2V_0$ e) $2Q_0$, $2V_0$

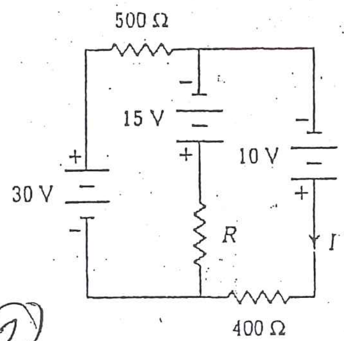
2. An air filled parallel plate capacitor of capacitance C_0 stores energy U_0 when it is connected to a battery of voltage V_0. While it is connected to the battery the space between the plates is filled with a material of dielectric constant 3/2. After the dielectric is added, the energy stored in the capacitor is :
a) 1/3 U_0 b) U_0 c) $3U_0$ d) 3/2 U_0 e) 2/3 U_0

3. Light bulb A is rated at 60 W and light bulb B is rated at 100 W. Both are designed to operate at 110 V. Which statement is correct?
a) The 60 W bulb has a greater resistance and greater current than the 100 W bulb.
b) The 60 W bulb has a smaller resistance and smaller current than the 100 W bulb.
c) The 60 W bulb has a greater resistance and smaller current than the 100 W bulb.
d) The 60 W bulb has a smaller resistance and greater current than the 100 W bulb.
e) We need to know the resistivities of the filaments to answer this question.

4. The current density through a copper wire of length 1.80 m is 6.00×10^{8} $A.m^{-2}$. If the resistivity of copper at 20 °C is 1.5×10^{-8} Ω.m, the voltage (V) across the wire is:-
a) 7.5 b) 5.0 c) 16.2 d) 10.8 e) 21.6

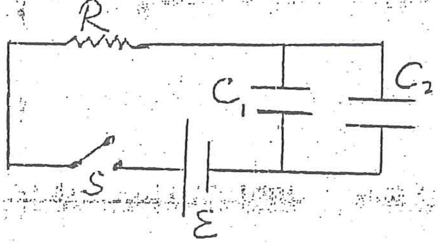
5. A resistor of unknown resistance and a 30-Ω resistor are connected across a 20-V emf in such a way that a 2.0 A current is observed in the emf. The value of the unknown resistance (Ω) is:
a) 75 b) 12 c) 7.5 d) 30 e) 15

6. In the figure shown, if I = 30 mA, the magnitude and sense (direction) of the current in the 500-Ω resistor is:
a) 56 mA right to left b) 56 mA left to right
c) 48 mA left to right d) 48 mA right to left.
e) 26 mA left to right



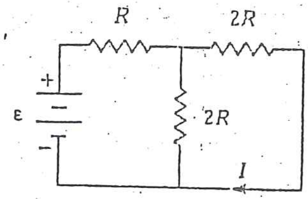
2

7. In the circuit shown in this figure, let $R = 4.0\ k\Omega$, $C_1 = 10\ \mu F$, $C_2 = 5.0\ \mu F$ and $\varepsilon = 10\ V$. When the switch S is closed, the charge (μC) on the capacitor C_2 after 5 ms, is:



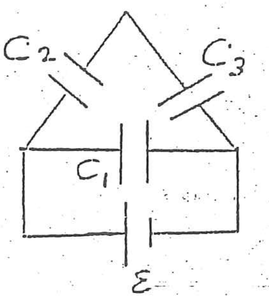
a) 150 b) 11 c) 12
d) 8.0 e) 4.0

8. In the figure shown, if $I = 1.0$ A and $R = 12\ \Omega$, then the emf. ε(V) is:.



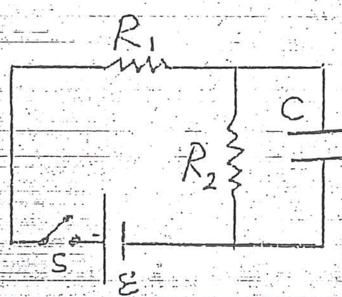
a) 12 V b) 24 V c) 30 V
d) 48 V e) 19 V

9. In the circuit shown in this figure, $\varepsilon = 12.0$ V, $C_1 = 3.00\ \mu F$, $C_2 = C_3 = 4.00\ \mu F$. The energy (μJ) stored in each of the 4.00 μ F capacitor is:



a) 72.0 b) 144 c) 36.0
d) 180 e) 24.0

10. In the circuit shown in this figure, let $\varepsilon = 50$ V, $R_1 = 30\ k\Omega$, $R_2 = 20\ k\Omega$ and $C = 5.0\ \mu F$. If the switch S is closed for a long time and is then opened, the current (mA) through the 20 k Ω resistance after 80 ms is:



a) 1.5 b) 0.61 c) 2.5
d) 1.1 e) 0.45

Answer Table

No.	a	b	c	d	e	No.	a	b	c	d	e
1						6					
2						7					
3						8					
4						9					
5						10					

3

2nd exam 102, 9.5.2002. (answers)

Q.1 $C_o, V_o, Q_o, d' = \frac{d}{2}$

عند فصل المكثف عن البطارية فإن ما يبقى محتفظاً به هو الشحنة، أما ما سواها فهو قابل للتغيير. لذا فالجهد هنا سيتغير تبعاً لتغير السعة باعتبار $Q = CV$، وهنا

$$C_o = \frac{\epsilon_o A}{d} \Rightarrow C' = \frac{\epsilon_o A}{d'} = \frac{\epsilon_o A}{d'} = \frac{\epsilon_o A}{\frac{1}{2} d} = 2\frac{\epsilon_o A}{d} = 2C_o$$

and as

$$V_o = \frac{Q}{C_o} \Rightarrow V' = \frac{Q}{C'} = \frac{Q}{2C_o} = \frac{1}{2}\frac{Q}{C_o} = \frac{1}{2}V_o \Rightarrow Q_o, V_o \rightarrow \boxed{Q_o, \frac{1}{2}V_o}$$

answer is (a)

Q.2 $C_o, U_o, V_o, K = 1.5$

بما أن المكثف موصول بالبطارية، فسيبقى الجهد ثابتاً على لوحيه مهما تغيرت العوامل الأخرى. أما السعة فسوف تتغير بتغير العازل داخل المكثف

$U_o = \frac{1}{2} C_o V^2$ and with $C = KC_o = 1.5 C_o$

$$\Rightarrow U = \frac{1}{2} K C_o V^2 = K\left(\frac{1}{2} C_o V^2\right) = K U_o = \boxed{1.5\, U_o}$$

answer is (d)

* وبشكل عام: $\left(\frac{q}{q_o}\right)$ إذا كان مشحوناً ببطارية $= \frac{\epsilon}{\epsilon_o} = \frac{U}{U_o} = \frac{C}{C_o} = K = \frac{E_o}{E} = \frac{V_o}{V}$ (إذا لم يكن موصولاً ببطارية)

Q.3 $P_A = 60W$, $P_B = 100W$, $V = 110V$

بما أن فرق الجهد ثابت على كل من المصباحين، فهذا يعني أن المقاومة وبالتالي شدة التيار هما اللذان يحددان القدرة في كل من المصباحين. وحيث أن $P = I^2R = \frac{V^2}{R}$

فهذا يعني أن قدرة أكبر تتطلب مقاومة أقل وبالتالي تياراً أكبر.

أي ان المصباح الأصغر لديه مقاومة كبيرة وتياراً قليلاً مقارنة بالمصباح الأكبر.

answer is (c)

Q.4 $j = 6 * 10^8\ A/m^2$, $l = 1.8\,m$, $\rho = 1.5 * 10^{-8}\ \Omega m$

$$E = \rho j \Rightarrow V = E * l = \rho j l = 1.5 * 10^{-8} * 6 * 10^8 * 1.8 = \boxed{16.2\ V}$$

or $j = \frac{i}{A} \Rightarrow i = jA$ and $R = \frac{\rho l}{A} \Rightarrow V = iR = jA * \frac{\rho l}{A} = j\rho l = \boxed{16.2V}$

answer is (c)

Q.5 $R_1 = R$, $R_2 = 30\Omega$, $V = 20V$, $i = 2A$

لقد تم التوصيل إما على التوالي (حيث المحصلة أكبر من أكبر مقاومة موصولة) أو على التوازي (حيث المحصلة أقل من أصغر مقاومة موصولة)، نبحث في المقاومة المكافئة حيث

$R_{eq} = \frac{V}{i} = \frac{20}{2} = 10\Omega$

Parallel connection $\Rightarrow \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R_{eq} = \frac{R_1 R_2}{R_1 + R_2} \Rightarrow \frac{30R}{30+R} = 10 \Rightarrow \boxed{R = 15\Omega}$

(4)

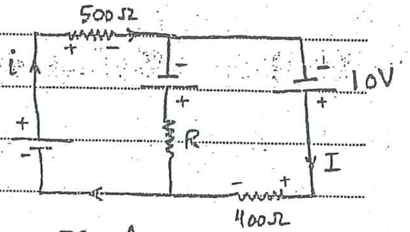
answer is (e)

2nd exam 102, 9.5.2002 (answers)

Q.6 $I = 30\ mA$

حسب قانون كيرشوف الأول، فإن مجموع تغيرات الجهد عبر حلقة مغلقة = صفراً.

لذا يمكننا الاكتفاء بأخذ تغيرات الجهد عبر الحلقة الخارجية التي تتضمن المقاومة المطلوبة لنجد التيار فيها،



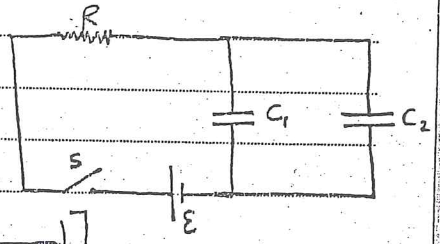
$10 - 400I + 30 - 500i = 0 \Rightarrow$

$500i = 40 - 400(30 * 10^{-3}) \Rightarrow i = \frac{40-12}{500} = 56\ mA$ (left to right)

(answer is (b))

Q.7 $R = 4\ k\Omega,\ C_1 = 10\ \mu F,\ C_2 = 5\ \mu F,\ \varepsilon = 10V,\ t = 5\ ms.$

$C_{eq} = C_1 + C_2 = C = 15\ \mu F$



عند الشحن تعطى الشحنة الكلية على السعة الكائنة بأعلاه:

$q(t) = \varepsilon C(1 - e^{-t/RC}).$

وبعد مرور زمن 5ms تكون:

$$q(5\ ms) = 10 * 15 * 10^{-6}\left[1 - \exp\left(-\frac{5*10^{-3}}{4*10^{3} * 15*10^{-6}}\right)\right]$$

$= 1.2 * 10^{-5} = 12\ \mu C$

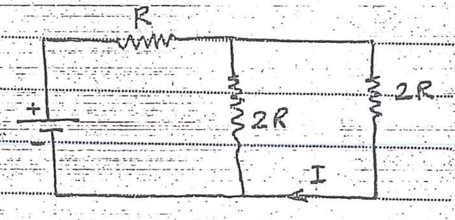
وحيث أن الجهد على المكثفين متساوٍ، نظراً لتوصيلهما على التوازي فإن:

$\frac{q_1}{C_1} = \frac{q_2}{C_2} \Rightarrow q_1 = \frac{C_1}{C_2} q_2$ —① and $q_1 + q_2 = q = 12\ \mu C$ ---②

$\Rightarrow \frac{C_1}{C_2} q_2 + q_2 = 12\ \mu C \Rightarrow 2q_2 + q_2 = 12\ \mu C \Rightarrow \boxed{q_2 = 4\ \mu C}$

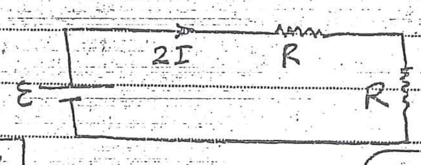
(answer is (e))

Q.8 $R = 12\ \Omega,\ I = 1A$



نظراً للتماثل في الدائرة يمكننا التأكيد أن كلاً من مقاومات 2R يمر بها تيار مقداره I، وهذا يعني أن تيار R هو 2I.

وبأخذ المقاومة المكافئة لمقاومتي 2R تبسط الدائرة إلى الشكل التالي وتكون

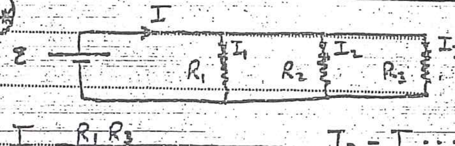


$\varepsilon = (2I)(2R) = 4 * 12 * 1 = \boxed{48\ V}$

(answer is (d))

مجزئ التيار

$I = \frac{\varepsilon}{R},\quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$



$\Rightarrow I = \left(\frac{R_1R_2 + R_1R_3 + R_2R_3}{R_1R_2R_3}\right)\varepsilon$

5

$I_1 = \frac{\varepsilon}{R_1} \Rightarrow I_1 = I\frac{R_2R_3}{R_1R_2 + R_1R_3 + R_2R_3},\quad I_2 = I\frac{R_1R_3}{R_1R_2 + R_1R_3 + R_2R_3},\quad I_3 = I \ldots$

University of Jordan General Physics (0302102) Second Sem.2000/2001
Physics of Dept. Second Exam Date: 12/5/2001 Time: 70 minutes

الاسم باللغة العربية: ____________________

الرقم الجامعي: ____________ الشعبة: ____________ اسم المدرس: ____________

Use $k = 9*10^9\ N\ m^2/C^2$; $1\ \mu F = 10^{-6}\ F$; $1\ nC = 10^{-9}\ C$

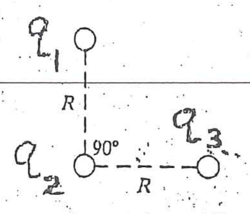
1- Two spherical conductors of radii $r_1 = 0.30$ m and $r_2 = 0.60$ m are very far apart. Initially the larger sphere is uncharged and the electric field at the surface of smaller sphere is 1.8×10^3 N/C. If the spheres are then connected by a very long thin conducting wire, the final charge (in nC) on the larger sphere is:

a) 54 b) 12 c) 6.0 d) 36 e) 15

2- The electric field in a region of space is given by $\vec{E}\,(V/m) = -6.0*10^2.x\,(m).\hat{i}$. If points A and B have locations $\vec{r}_A\,(m) = 2.0\hat{i}$ and $\vec{r}_B\,(m) = 3.0\hat{i} + 2.0\hat{j}$, the potential difference $V_B - V_A$ (in V) is:

a) 6.0×10^2 V b) 6.3×10^3 c) zero d) 1.5×10^3 e) 3.0×10^3

3- If $q_1 = q_2 = Q$ and $q_3 = -Q$ in the charge configuration shown in the figure, the electrostatic potential energy of this system is:



a) $-(k\,Q^2)/\sqrt{2}\,R$ b) $-(4k\,Q^2)/\sqrt{2}\,R$
c) $(k\,Q^2/R).(2-1/\sqrt{2})$ d) zero
e) $(k\,Q^2/R).(2+1/\sqrt{2})$

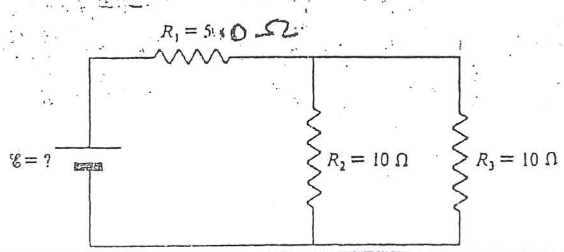
4- The capacitance of a parallel–plate capacitor is 24 μF with the space between its plates is filled with a material of dielectric constant κ = 2.0. If this dielectric material is being replaced by air and then the separation between the plates is tripled, the final capacitance (in μ F) is:

a) 15 b) 5.0 c) 4.0 d) 12 e) 16

5- When a 15-μF capacitor is combined with a capacitor of unknown capacitance C, the equivalent capacitance of the combination is 5.0 μ F. The value of C (in μF) is:

a) 2.5 b) 5.0 c) 8.6
d) 30 e) 7.5

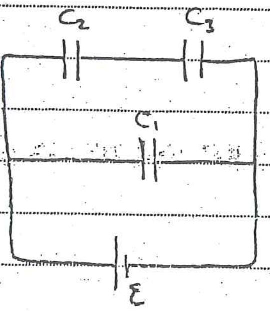
6- If the 5.0- Ω resistor in the circuit shown in the figure shown is dissipating energy at a rate of 20 W, the e.m.f ε (in V) of the battery is:



a) 20 b) 10 c) 30
d) 40 e) 50

2nd exam, 102, 9.5.2002, (answers)

Q.9 $\mathcal{E} = 12V$, $C_1 = 3\mu F$, $C_2 = C_3 = 4\mu F$



البطارية موصولة على التوازي مع كل من C_1 والفرع (C_2 ، C_3).

لذا فرق الجهد عليهما واحد

for $C_2, C_3 \Rightarrow C_{eq} = \frac{C_2 C_3}{C_2 + C_3} = \frac{4*4}{4+4} = 2\mu F$.

$\Rightarrow q_2 = q_3 = q =$

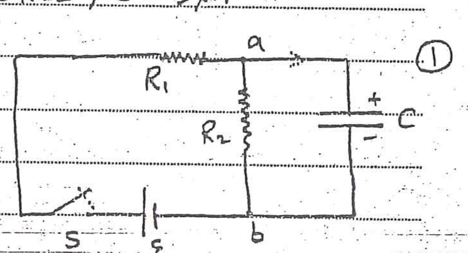
$= \mathcal{E}C = 12 * 2\mu F = 24\,\mu C$.

* لاحظ أنه في المكثفات الموصولة على التوالي تكون الشحنات متساوية على جميع المكثفات بغض النظر عن سعتها، كما أنه في التوصيل على التوازي يكون الجهد متساوياً على جميع المكثفات

$\Rightarrow U_2 = U_3 = \frac{1}{2}\frac{q^2}{C} = \frac{1}{2} * \frac{(24*10^{-6})^2}{4*10^{-6}} = 72*10^{-6}\,J = \boxed{72\,\mu J}$

answer is (a)

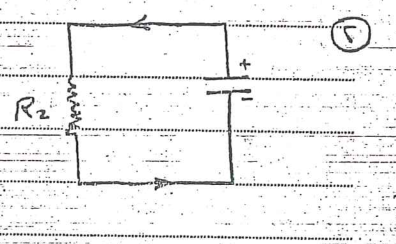
Q.10 $\mathcal{E} = 50V$, $R_1 = 30\,k\Omega$, $R_2 = 20\,k\Omega$, $C = 5\mu F$



بعد زمن طويل من التوصيل يكون المكثف مشحون تماماً، وعند فتح المفتاح S يبدأ التفريغ ولكن عبر المقاومة R_2 فقط. لذا لدينا مرحلتان:

المرحلة الأولى: شحن المكثف:

بعد اكتمال الشحن يتوقف التيار عبر فرع المكثف ويمكننا حساب فرق الجهد V_{ab} وحساب الشحنة على المكثف.



$\mathcal{E} = I(R_1 + R_2) \Rightarrow I = \frac{50}{50\,k\Omega} = 1\,mA$

$\Rightarrow V_{ab} = IR^2 = 1*20 = 20$ Volts

$q = CV_{ab} = 5*10^{-6}*20 = 100\,\mu C$ (ابتدائية).

المرحلة الثانية: تفريغ المكثف:

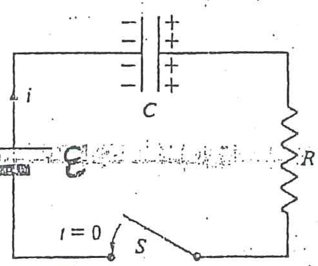
يبدأ المكثف بالتفريغ عبر R_2 بعد فتح المفتاح S. لاحظ أن التيار سيتحرك بعكس اتجاهه في المرحلة الأولى، ويعطى التيار عند زمن 80 ms من فتح المفتاح:

$i(t) = i_o e^{-t/RC} \Rightarrow i_o = \frac{V_{ab}}{R_2}$

$i(80\,ms) = \frac{20}{20\,k\Omega} * \exp\left(\frac{-80*10^{-3}}{20*10^{3}*5*10^{-6}}\right) = \boxed{0.45\,mA}$

answer is (e)

7- A resistor R, a battery of e.m.f ε , and a charged capacitor are connected in series so that the polarity of the capacitor is as shown in the figure. If the magnitude of the potential different across C is 2ε immediately after the switch S is closed, the current i (t ≥ 0) is given by:

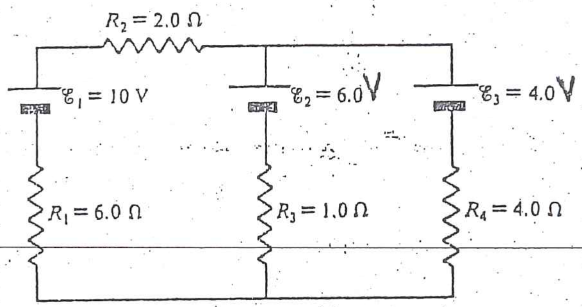


a) $(4\varepsilon / R)\, e^{-t/RC}$ b) $(\varepsilon / R)\, e^{-t/RC}$
c) $\varepsilon\, e^{-t/RC}$ d) Zero
e) $(3\varepsilon / R)\, e^{-t/RC}$

8- Two capacitors having capacitances in air C_1 (20μF) and C_2 (40μF) are connected in series. The space region between the plates of C_2 is then filled with a dielectric material (κ = 1.5) while the potential difference across the combination is held constant at 80 V. The final energy (in mJ) stored in C_2 is:

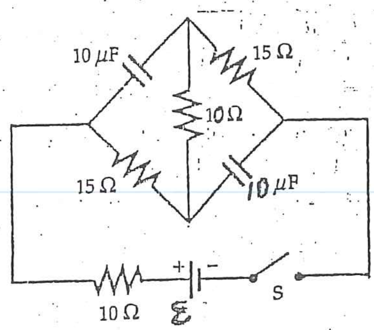
a) 48 b) 10 c) 12
d) 51 e) 36

9- In the circuit shown in the figure, the current (in A) through the resistor R_3 is:



a) 0.50 b) 1.5
c) 0.13 d) zero
e) 1.2

10. The capacitors in the circuit shown are initially uncharged. If ε = 30 V, the final charge (in μ C) on each capacitor after the switch S is closed is:



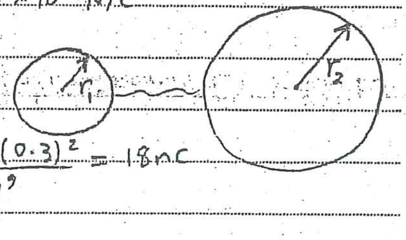
a) 530 b) 150 c) 880
d) 250 e) 360

Answer Table

No.	A	b	c	d	e	No.	a	b	c	d	e
1						6					
2						7					
3						8					
4						9					
5						10					

Q.1 $r_1 = 0.3\,m$, $r_2 = 0.6\,m$, $E_1 = 1.8 \times 10^3\, N/C$

بما أن الكرتين متباعدتان فلا تأثير لإحداهما على الأخرى:



$$E_1 = \frac{KQ_1}{r_1^2} \Rightarrow Q_1 = \frac{E_1 r_1^2}{K} = \frac{1.8 \times 10^3 (0.3)^2}{9 \times 10^9} = 18\,nc$$

وعند التوصيل تتوزع الشحنات على سطحي كل من الكرتين بحيث يكون جهداهما متساويان بما يعني أن:

$$V_1 = V_2 \Rightarrow \frac{KQ_1}{r_1} = \frac{KQ_2}{r_2} \Rightarrow \frac{Q_1}{Q_2} = \frac{r_1}{r_2} \quad ---- (1)$$

but

$$Q_1 + Q_2 = 18\,nc \quad —— (2)$$

$$\Rightarrow \text{from } (1) \quad Q_2 = \frac{r_2}{r_1} Q_1 = 2Q_1$$

put in (2) $\Rightarrow Q_1 + 2Q_1 = 18\,nC \Rightarrow Q_1 = 6\,nC$, $\boxed{Q_2 = 12\,nc}$

answer is (b)

Q.2 $\vec{E} = -6 \times 10^2 x\,(\hat{i}) \Rightarrow E_x = -600x$, $\vec{r}_A = 2\hat{i}$, $\vec{r}_B = 3\hat{i} + 2\hat{j}$.

$$V_B - V_A = -\int_{r_A}^{r_B} \vec{E} \cdot d\vec{r} = -\int_{x_A}^{x_B} E_x\, dx$$

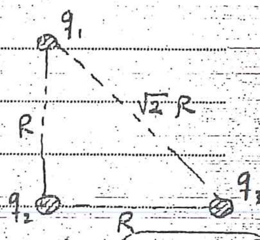
لأن E_y = صفر أسقطنا جزء y ،

$$= +\int_2^3 600x\, dx = 600 \left.\frac{x^2}{2}\right]_2^3 = 300\,(9-4) = \boxed{1500\,V}$$

answer is (d)

Q.3 $q_1 = q_2 = Q$. $q_3 = -Q$

$$U = U_{12} + U_{13} + U_{23} = k\left[\frac{q_1 q_2}{R} + \frac{q_1 q_3}{\sqrt{2}R} + \frac{q_2 q_3}{R}\right]$$



$$= k\left[\frac{Q^2}{R} - \frac{Q^2}{\sqrt{2}R} - \frac{Q^2}{R}\right] = \boxed{\frac{-KQ^2}{\sqrt{2}\,R}}$$

answer is (a)

Q.4 $C = KC_0 \Rightarrow C_0 = \frac{C}{K} = \frac{24}{2} = 12\,\mu F$

$$C_0 = \frac{\epsilon_0 A}{d} \Rightarrow \text{as } d' \to 3d \Rightarrow C' = \frac{\epsilon_0 A}{d'} = \frac{\epsilon_0 A}{3d}$$

$$\Rightarrow C' = \frac{C_0}{3} = \boxed{4\,\mu F}$$

answer is (c)

Q.5 $C_1 = 15\mu F$, $C_2 = C$, $C_{eq} = 5\mu F$

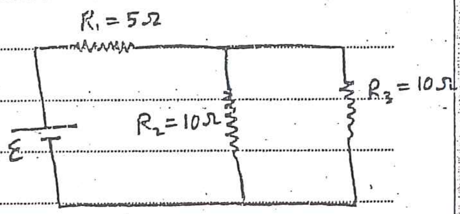
أولاً وبما أن القيمة النهائية للسعة أقل من C_1 فهذا يعني أن التوصيل تم على التوالي، لأن توصيل المكثفات على التوالي يقلل السعات وعلى التوازي يزيدها وهذا يعني أن:

$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2} \Rightarrow 5 = \frac{15\,C}{15 + C} \Rightarrow 5(15 + C) = 15\,C$$

$$\Rightarrow 15 + C = 3C \Rightarrow \boxed{C = 7.5\ \mu F}$$

answer is (e)

Q.6 $P_1 = 20W$ but $P_1 = I_1^2 R_1$



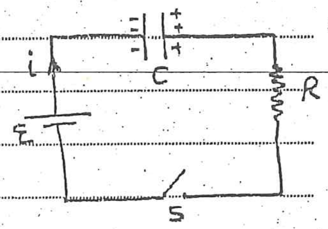
$$\Rightarrow I_1 = \frac{\varepsilon}{R_{eq}} \Rightarrow R_{eq} = 5 + \frac{10*10}{10+10} = 10\Omega$$

$$I_1 = \frac{\varepsilon}{10} \Rightarrow P_1 = \left(\frac{\varepsilon}{10}\right)^2 * 5 = 20$$

$$\Rightarrow \left(\frac{\varepsilon}{10}\right)^2 = 4 \Rightarrow \varepsilon^2 = 400 \Rightarrow \boxed{\varepsilon = 20\ \text{Volts}}$$

answer is (a)

Q.7 $V_c = 2\varepsilon$



لاحظ أن قطبية المكثف والبطارية هما في نفس الاتجاه.

لذا فعند اغلاق الدائرة سيكون التيار

$$i(0) = \frac{\varepsilon + V_c}{R} = \frac{\varepsilon + 2\varepsilon}{R} = \frac{3\varepsilon}{R}$$

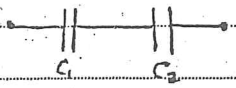
وبعد زمن قصير من فتح الدائرة يتوقع أن يسلك التيار سلوك الاضمحلال بحيث:

$$i = i_0\, e^{-t/RC} = \boxed{\frac{3\varepsilon}{R}\, e^{-t/RC}}$$

answer is (e)

> لكن المسألة ليست بهذه البساطة فبعد مرور وقت كاف لن تكون الشحنة على المكثف كما ε ابتداء. وتتغير صيغة اضمحلال التيار.

Q.8 $C_1 = 20\mu F$, $C_2 = 40\mu F$, $k_2 = 1.5V$, $V = 80V$



$$C_2' = k_2 C_2 = 1.5 * 40 = 60\mu F.$$

$$C_{eq}' = \frac{C_1 C_2'}{C_1 + C_2} = \frac{20*60}{20+60} = 15\mu F. \Rightarrow$$ (وعلى التوالي يكون $q = q_2 = q_1$)

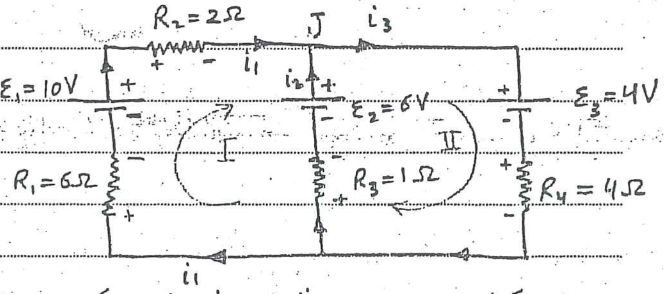
$$\Rightarrow q = C'V = 15 * 80 = 1200\,\mu C$$

in C_2', the energy stored is $U_2' = \frac{1}{2}\frac{q^2}{C'_2} = \frac{1}{2}\frac{(1200*10^{-6})^2}{60*10^{-6}} = \boxed{12\ mJ}$

answer is (c)

Q.9

حل مسألة تتضمن أكثر من حلقة متصلة معاً (كيرشوف) نتبع التسلسل التالي:



١. نحدد قطبيات البطارية ونختار بناء عليها اتجاهات للتيارات، فيكون هنالك تيار مختلف لكل فرع، ولنا الحرية في أخذ الاتجاه الذي نريد للتيار، لكن الأفضل مراعاة أن يكون تيار البطارية الأقوى خارجاً من القطب الموجب لها.

٢. من خلال مداخل ومخارج التيار في المقاومات نحدد الطرف الأعلى جهداً والأقل جهداً حيث يكون مدخل التيار أعلى جهداً من مخرجه بسبب هبوط الجهد عبر المقاومة، ونضع اشارة + عند الجهد الاعلى واشارة – عند الجهد الأدنى (وهذا لا يعني ان للمقاومة أقطاب لكنه اسلوب لتتبع تغيرات الجهد عبر الدائرة).

٣. نحدد اتجاهات للسير عبرها في تتبع تغيرات الجهد عبر كل حلقة ونعطي رقماً لكل حلقة تسهيلاً لترتيب الأفكار والعودة عند المراجعة:

٤. نبدأ من نقطة في الحلقة ونسجل جميع تغيرات الجهد التي تصادفنا وذلك من خلال الانتقال من اشارة + الى اشارة – (هبوط) أو من – الى + (صعود) كما يلي:

(I) $-6i_1 + 10 - 2i_1 - 6 + i_2 = 0$ ⟹ $8i - i_2 = 4$ —— ①

(II) $-4 - 4i_3 - i_2 + 6 = 0$ ⟹ $i_2 + 4i_3 = 2$ —— ②

(J) $i_1 + i_2 - i_3 = 0$ ⟹ $i_3 = i_1 + i_2$ —— ③

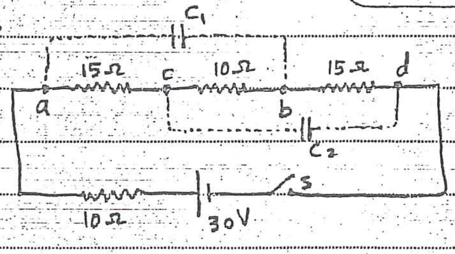
put ③ in ① and ② : ⟹ $8i_1 - i_2 = 4$, $i_2 + 4i_1 + 4i_2 = 2$ ⟹ $8i_1 - i_2 = 4$, $(4i_1 + 5i_2 = 2) \times -2$

⟹ $8i - i_2 = 4$
$-8i - 10i_2 = -4$
⟹ $-11i_2 = 0$ ⟹ $\boxed{i_2 = 0}$

⟹ $8i_1 - 0 = 4 \Rightarrow i_1 = \frac{1}{2}A \Rightarrow i_3 = 0 + \frac{1}{2} = \frac{1}{2}A$

answer is (d)

Q.10 طالب الشحنات النهائية نحتاج معرفة فرق الجهد النهائي على كل مكثف. بعد زمن طويل يتوقف التيار عبر المكثفات فتصبح كأنها دوائر مفتوحة ويمكن إهمال المكثفات:



$i = \frac{30}{50} = 0.6A \Rightarrow V_{ab} = 25 \times 0.6 = 15V$

$V_{cd} = 25 \times 0.6 = 15V$

$\Rightarrow q_1 = C_1 V_{ab} = 10 \times 15 = 150\mu C$ and $q_2 = C_2 V_{cd} = 10 \times 15 = 150\mu C$ answer is (b)

Department of Physics
Faculty of Science
University of Jordan

General Physics (0302102)
First Semester: 99/2000
Date: 23/12/2000

(21)

Second Exam

Student Name: ----------, Registration No.: --------------------, Lecturer Name: ------------

Q1: A charge - Q is uniformly distributed on a circular arc of radius R and a subtended central angle of 120°. With V=0 at infinity, the electric potential (in V) at point P, the center of curvature of the rod is:
A) $-3Q/2\pi\varepsilon_oR$ B) $3Q/2\pi\varepsilon_oR^2$ C) $-Q/4\pi\varepsilon_oR$ D) $-Q/\pi\varepsilon_oR$ E) zero

Q2: The electrical potential energy (in J) of the charge configuration shown in Figure below with d=1.4 cm and q = 1.6×10^{-7} C is:
A) - 0.12 B) 0.37 C) zero
D) 0.044 E) - 0.044

2d d
O------------------------O-------------O
4q 5q -2q

Q3: A conducting sphere of radius R=15 cm carries a charge Q. If V=0 at infinity and the potential of the sphere is 1500 V, the value of Q (in nC) is:
A) can not be determined B) 3.8 C) 2500 D) zero E) 25

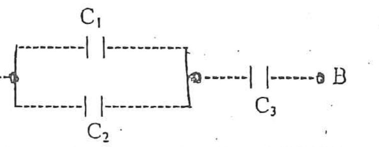
Q4: A capacitor of capacitance C is connected with a battery of constant e. m. f. If a dielectric slab is slipped completely between the plates of the capacitor while the battery remains connected. Which of the following is correct:
A) Both the capacitance C and the charge Q_C of the capacitor will increase
B) Both the charge Q_C and potential across capacitor V_C will change
C) Only the charge Q_C on the capacitor will increase
D) The capacitance C will increase but the charge on the capacitor Q_C will decrease by the same amount
E) The capacitance C, potential V_C and charge Q_C of the capacitor all remain unchanged

Q5: A spherical drop of mercury (assumed to be conducting) of radius R has a capacitance given by $C=4\pi\varepsilon_0 R$. If two such drops combine to form a single large drop, the capacitance of this large drop is:
A) Zero B) 8.0 πεo R C) 5.66 πεo R D) 4 πεo R E) 5.04 πεo R

Q6: One capacitor is charged until its stored energy is 4.0 J. A second uncharged capacitor is then connected to it. If the charge distributes equally between the two capacitors, the total energy (in J) stored in the capacitors is:
A) 4.0 B) 1.0 C) 2.0 D) zero E) can not be determined

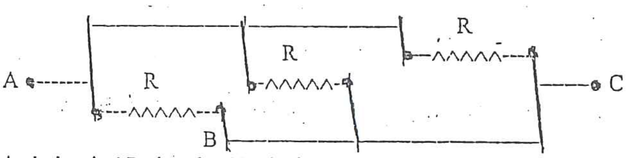
Q7: Find the equivalent capacitance (in μF) between A and B for the combination shown in Figure below. Take C_1=10.0 μF, C_2=5.00 μF, and C_3=4.00 μF.

A) 19 B) 1.82
C) 7.33 D) 3.16
E) 14.00



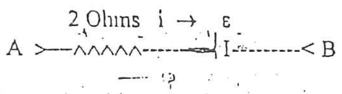
Q8: An unknown resistor of resistance R is connected between the terminals of a 3.00-V battery and the power dissipated in the resistor is P_1= 0.540 W. If the same resistor is then connected between the terminals of a 1.50-V battery, the power P_2 (in W) dissipated in the resistor is:
A) 0.270 B) 0.135 C) zero D) 0.068 E) R must be given to find P_2.

Q9: With R=20.0 Ohms, R_{eq} (in Ohms) between A and B in the resistors-configuration shown in Figure below is:
A) 6.67
B) zero
C) 60.0
D) 20.0
E) 13.3



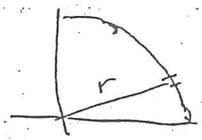
Q10: In Figure below, the section of an electrical circuit AB absorbs 50 W of power when a current i=1.0 A passes through it in the indicated direction. The potential difference $V_A - V_B$ (in V)

A) - 50 B) 48 C) 50
D) - 48 E) 52



(Q.2)

Q.1 $dV = \frac{k\,dq}{r} = \frac{k\,\lambda r\,d\theta}{r}$



$\lambda = \frac{-Q}{\frac{2}{3}\pi R}$

$dq = \lambda ds = \lambda r\,d\theta$

$V = \int k\lambda\,d\theta =$

$V = \frac{-Qk}{\frac{2}{3}\pi R}\left(\frac{2}{3}\pi - 0\right) = \frac{-Qk}{R} = \frac{-Q}{4\pi\epsilon_0 R}$

$\theta_i = 0$, $\theta_f = \frac{120*\pi}{180} =$

$\theta_f = \frac{2}{3}\pi$

(C)

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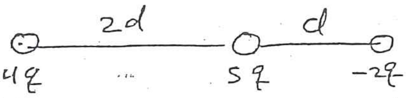
Q.2



$U = k\left[\frac{4q*5q}{2d} + \frac{4q*-2q}{3d} + \frac{5q*-2q}{d}\right] = \frac{kq^2}{d}\left[\frac{20}{2} - \frac{8}{3} - 10\right]$

$U = -\frac{8}{3}\frac{kq^2}{d} = -0.0111$ (E)

Q.3 $V = \frac{kQ}{R} \Rightarrow Q = \frac{VR}{k} = \frac{1500*0.15}{9*10^9} = 25\,nC$ (E)

Q.4 (a)

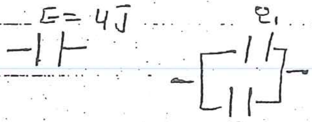
دروس تقوية في الفيزياء لطلبة
الهندسة والطب (101.102,105)
077-424590

Q.5 $C = 4\pi\epsilon_0 R$ (b) (R)

$\rho = \rho \Rightarrow \frac{m}{V} = \frac{m'}{V'} \Rightarrow \frac{m}{\frac{4}{3}\pi r^3} = \frac{2m}{\frac{4}{3}\pi R^3} \Rightarrow R^3 = 2r^3 \Rightarrow R = \sqrt[3]{2}\,r$

$C = 4\pi\epsilon_0 \sqrt[3]{2}\,r = 5.04\,\pi\epsilon_0 r$

Q.6



$\Rightarrow E = \frac{1}{2}\frac{Q_1^2}{C_1} + \frac{1}{2}\frac{Q_2^2}{C_2} = \frac{1}{2}\frac{(Q/2)^2}{C}*2 = \frac{1}{4}\frac{Q^2}{C}$

$E = \frac{1}{4}\frac{Q^2}{C} = \frac{1}{2}\left(\frac{1}{2}\frac{Q^2}{C}\right) = \frac{1}{2}E_0 = \frac{1}{2}*4 = 2\,J$

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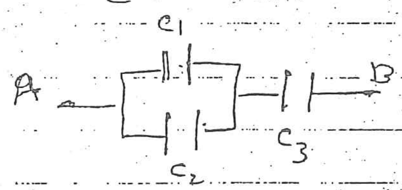
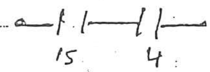
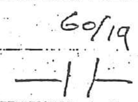
Q.7 $C_{12} = C_1 + C_2 = 15\,\mu f$







$\frac{1}{15} + \frac{1}{4} = \frac{4+15}{60} = \frac{19}{60} \Rightarrow C_{eq} = \frac{60}{19} = 3.16\,\mu f$

Q.8

$P_1 = 0.54\ W \quad , \quad V_1 = 3\ V$

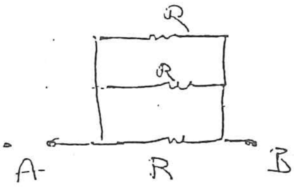
$P = I^2 R \Rightarrow R = \frac{V^2}{R}$

$P_1 = \frac{V_1^2}{R} \quad , \quad P_2 = \frac{V_2^2}{R}$

$\frac{P_1}{P_2} = \frac{V_1^2}{V_2^2} \Rightarrow \frac{0.54}{P_2} = \frac{(3)^2}{(1.5)^2} \Rightarrow P_2 = 0.135$

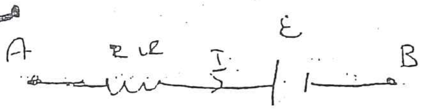
Q.9

$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$



$R_{eq} = R/3 = 20/3 = 6.67$

Q.10



$P = I V_{AB}$

$50 = 1\ V_{AB}$

$V_{AB} = 50\ Volt$

$V_{AB} =$

$V_A - 2I - \varepsilon = V_B$

$V_A - V_B = 2I + \varepsilon$

positive

(24)

UNIVERSITY OF JORDAN
PHYSICS DEPT.
2ND. EXAM.

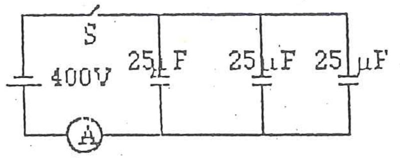
GENERAL PHYS.
32102

1ST. SEMESTER
1994 -1995
TIME : 1 hr

Student Name : Student Number :
Section : Lecturer Name:

CONSIDER : $e = 1.6*10^{-19}$ C & $1eV = 1.6\times10^{-19}$ J $\epsilon_0 = 8.85\times10$

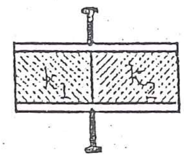
Q1. For the circuit shown in figure, the amount of charge (in C) passes through the ammeter after the switch S is closed is: (consider the capacitors initially uncharged)



a) 0.006 b) 0.012 c) 0.030
d) 0.036 e) 0.046

Q2. A 100 μF capacitor is charged to 100 V. It is then connected to 400 μF uncharged capacitor. The energy (in J) dissipated in the connecting wires between the capacitors is:
a) 0.8 b) 0.6 c) 0.4 d) 1.2 e) 1.6

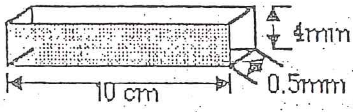
Q3. A parallel plate capacitor has a 3.6 cm^2 area and 2.4 mm separation. Two different dielectric materials of equal size filled the space between the plates as shown in the figure. If the dielectric constants $k_1 = 5.4$ and $k_2 = 4.2$, the equivalent capacitance (in pF) of the system is:



a) 12.74 b) 6.37 c) 25.50 d) 16.74 e) 16.37

Q4. ~~Suppose~~ you want to store exactly ~~1 J/ m³ of electric~~ energy in a parallel plate ~~capacitor,~~ the magnitude of the electric field (in N/ m) is:
a) 4.75×10^5 b) 9.50×10^5 c) 4.75×10^4 d) 9.50×10^4 e) 4.75×10^3

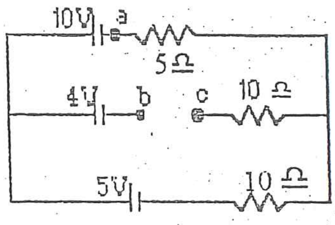
Q5. A wire of conducting material has a rectangular cross section (0.5 × 4 mm) and length 10 cm as shown in figure. If the density of free electrons is 6×10^{20} electrons/m³ and the current passing through it is 4.8 mA, the time (in ms) required for a free electron



a) 1 b) 2 c) 4 d) 8 e) 16

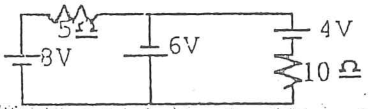
Q6. The power output of a power station is 500 MW at a potential difference 132 kV. If the resistance of the complete power lines (the cables used to connect the station to houses) is 4 Ohm, the percentage loss of power in the connecting cables is:
a) 23.00% b) 17.20% c) 11.47% d) 4.54% e) 1.08%

Q7. For the circuit shown in figure, the potential difference between point a and point b ($V_{ab} = V_a - V_b$) in Volts is:



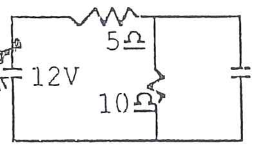
a) -10 b) 4 c) 6 d) -6 e) -4

Q8. For the circuit shown, the power (in W) delivered (consumed) by the 6 V battery is:



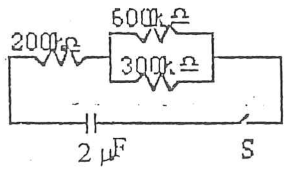
a) 6.1 b) 2.4 c) 7.3
d) 3.6 e) 22.8

Q9. for the circuit shown in figure, the amount of charge (in μC) on C = 3 μF when it is completely charged is:



a) 48 b) 24 c) 32
d) 16 e) 12

Q10. For the circuit shown below, if the capacitance is initially charged by a 10 V source, then the switch "S" is closed at t = 0, the time (in S) required to discharge the capacitance to 3.66 V is:



a) 1.6 b) 1.2 c) 0.4 d) 0.8
e) 0.6

TABLE OF ANSWERS

Q/A	a	b	c	d	e	Q/A	a	b	c	d	e
1						6					
2						7					
3						8					
4						9					
5						10					

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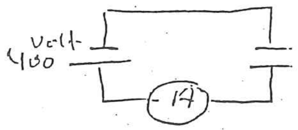
Q.1



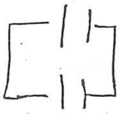
$Q = CV$

$= 400 * 75 * 10^{-6}$

$= 0.03$ Coulombs.

Q.2

$\Rightarrow$ $Q = CV = 10^{-2}\,C$



$\Rightarrow E_f = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}\frac{(10^{-2})^2}{(500)*10^{-6}} = 0.1\ J$

$E_i = \frac{1}{2}C_1V^2 = \frac{1}{2} * 100*10^{-6} * (100)^2$

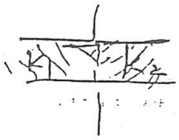
$= 0.5\ J$

energy loss $= 0.5 - 0.1 = 0.4$

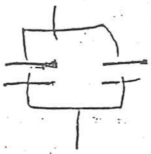
Q.3

$A = 3.6\ cm^2 \quad d = 2.4\ mm, \quad k_1 = 5.4$

$k_2 = 4.2$



$\Rightarrow$



$C_{eq} = C_1 + C_2$

$C_{eq} = \frac{k_1\epsilon_0(A/2)}{d} + \frac{k_2\epsilon_0(A/2)}{d}$

$C_{eq} = \frac{\epsilon_0 A}{2d}(k_1 + k_2) = 6.37\ pf$

Q.4

~~Ener~~ $\frac{U}{Volume} = \frac{\frac{1}{2}CV^2}{dA} = \frac{\frac{1}{2}\frac{\epsilon_0 A}{d}(E\cdot d)^2}{dA} = \frac{1}{2}\frac{\epsilon_0 A E^2 d^2}{Ad^2}$

$\frac{U}{Vol} = \frac{1}{2}\epsilon_0 E^2 = 1 \Rightarrow E = \sqrt{\frac{2}{\epsilon_0}} = 475*10^3\ \frac{N}{C}$

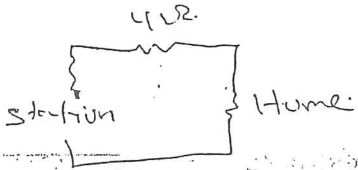
$= 4.75*10^5\ N/C$

Q.5

no. of electron $= n = 6*10^{20} *$ Volume $= 6*10^{20} * 0.5 * 4 * 10^{-6} * 0.1 = 1.2*10^{14}$

$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta t = \frac{\Delta Q}{I} = \frac{1.2*10^{14} * 1.6*10^{-19}}{4.8*10^{-3}} = 0.4*10^{-2} = 4*10^{-3} = 4\ ms$

6. $P = 500 * 10^{6}\ W \quad V = 132 * 10^{3}\ V \quad R = 4\Omega$



$$I = \frac{P}{V} = \frac{500*10^{6}}{132*10^{3}} = 3.79*10^{3}\ Amp$$

$$P = I^{2}R = (3.79*10^{3})^{2} * 4 = 57.4 * 10^{6}\ W$$

$$Percent = \frac{57}{500} * 100\% = 11.5\%$$

Q.7 $V_a + 10 - 4 = V_b \Rightarrow V_a - V_b = -6\ Volt$

Q.8 22.8 W

Q.9 $Q = 24\ \mu C$

Q.10 $t = 0.8\ s$

(12)

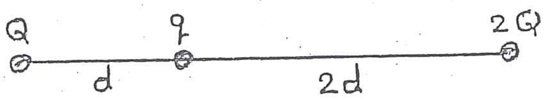
University of Jordan	General Physics-2	Second Sem.99/2000
Faculty of Science	(0302102)	Time: 4:00-5:15
Physics Department	First Exam	Date: 20 /3/ 2000

الاسم باللغة العربية:------------------------ الرقم الجامعي: ----------------------

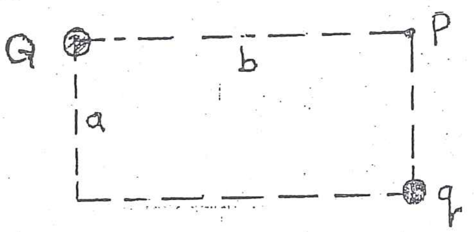
اسم المدرس: ------------------------ رقم الشعبة: ----------------------

محمد عوض الله
هاتف ٤٣٩٦٦٩٣٧

Constants:
Coulomb constant $k = 9.0\times10^{9}\ N.m^2/C^2$, $\varepsilon_o = 8.85\times10^{-12}\ C^2/N.m^2$
Mass of electron = 9.1×10^{-31} kg , $e = 1.6\times10^{-19}$ C



1- In the figure shown the point charges
$Q = 30\ \mu C$, $q = 5.0\ \mu C$; and d = 30 cm.
The magnitude of the electrostatic force on q in (N) is:
a) 15 b) 23 c) zero d) 7.5 e) 38

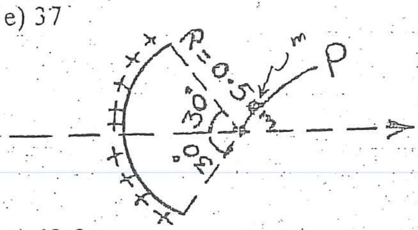


2- In the rectangular figure shown
a = 60 cm , b = 80 cm; and the point charges Q = -4.0 nC, and q = +1.5 nC.
The magnitude of the electric field at point P in (N/C) is:
a) 68 b) 72 c) 77 d) 82 e) 120

3- A charge of 80 nC is uniformly distributed along the x-axis from x=0 to x= 2.0 m. The magnitude of the electric field in (N/C) at the point x = 8.0 m is:
a) 30 b) 15 c) 48 d) 90 e) 60

4- Two point charges q_1 = + 1.6 nC and q_2 = -1.6 nC are placed at x=0, and x=60 cm respectively. The magnitude of the electric field in (N/C) on the y – axis at y = 80 cm is:
a) 14 b) 35 c) 27 d) 12 e) 37

5- A charge of uniform density of 3.5 nC/m is distributed along a circular arc as shown.
The magnitude of the electric field in (N/C) at point P is :
a) 76.5 b) zero c) 126.0 d) 31.5 e) 63.0



6- A solid spherical conductor has a radius of 15 cm. The electric field 30 cm from the center of this sphere has a magnitude of 800 N/C. The surface charge density in (C/m^2) on the sphere is:
a) 7.1×10^{-9} b) 1.0×10^{-8} c) 1.4×10^{-8} d) 2.8×10^{-8} e) 1.1×10^{-7}

7- An electron enters a region of uniform electric field of magnitude 50 N/C with an initial velocity of 40 km/s in a direction parallel to that of the electric field. The speed in (km/s) of the electron 1.5 ns after entering this region is:
a) 18 b) 53 c) 27 d) 62 e) 42

8- A uniform electric field $E = i\,5.0$ (kN/c). The flux in ($kN.m^2/C$) of this field through a square of side 20 cm, when the normal to the plane of the square makes an angle of 45° with the x-axis, is:
a) 71 b) 0.19 c) 0.28 d) 0.35 e) 0.14

9- An infinitely long cylinder of radius 4.0cm carries a uniform volume charge density $\rho = 2000$ nC/m^3. The electric field at $r = 2.0$ cm in (kN/C) is:
a) 2.26 b) 0.11 c) 0.057 d) 0.44 e) 0.23

10- Point A at (2m, 3m) and B at (5m, 7m) are in a region of uniform electric field $E = (4i+3j)$ N/C. The potential difference $V_A - V_B$ in (volts) is:
a) 33 b) 27 c) 24 d) 30 3) 11

محمد عوض الله
هاتف : ٠٧٩٦٦١٣٧

Answer Table

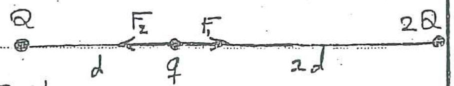
No.	a	b	c	d	e	No.	a	b	c	d	e
1						6					
2						7					
3						8					
4						9					
5						10					

مركز الرائد للخدمات الطلابية
الجامعة الأردنية . جسر كلية الزراعة
تلفون ٥٣٥٦٨٤٩

مركز الرائد للخدمات الطلابية
الجامعة الأردنية . جسر كلية الزراعة
تلفون ٥٣٥٦٨٤٩

ملاحظة ١: في تطبيق قانون كولوم $F=\frac{kq_1q_2}{r^2}$ أو شدة المجال $E=\frac{kq}{r^2}$ يفضل تعويض مقدار الشحنة دون إشارتها لحساب مقدار القوة أو المجال، والاستدلال على الاتجاه من الرسم بملاحظة أن الشحنات المتماثلة تتنافر والمختلفة تتجاذب.

Q.1 $Q = 30\mu c \quad q = 5\mu c \quad d = 30cm$



$$F_1 = \frac{kQq}{d^2} = \frac{9\times10^9 \times 30 \times 5 \times 10^{-12}}{(0.3)^2} = 1.5\ N$$

$$\Rightarrow \vec{F_1} = 1.5\,\hat{i}$$

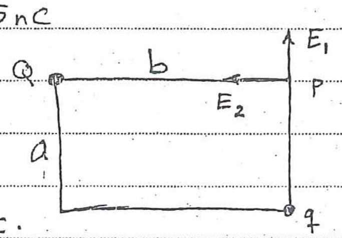
$$F_2 = \frac{k2Qq}{(2d)^2} = \frac{2}{4}\frac{kQq}{d^2} = \frac{1}{2}F_1 = 0.75N \Rightarrow \vec{F_2} = -0.75\,\hat{i}\ N$$

so

$$\vec{F} = \vec{F_1} + \vec{F_2} = 1.5\hat{i} - 0.75\hat{i} = 0.75\hat{i}\ N$$

ans is (d)

Q.2 $a = 60\ cm \quad b = 80cm \quad Q = -4nC \quad q = 1.5nC$



$$E_1 = \frac{kq}{a^2} = \frac{9\times10^9 \times 1.5\times10^{-9}}{(0.6)^2} = 37.5\ N/C$$

$$\Rightarrow \vec{E_1} = 37.5\,\hat{j}\ N/C$$

$$E_2 = \frac{kQ}{b^2} = \frac{9\times10^9 \times 4\times10^{-9}}{(0.8)^2} = 56.25\ N/C$$

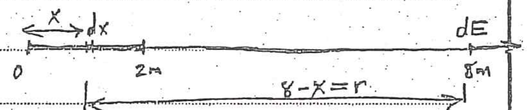
$$\Rightarrow \vec{E_2} = 56.25(-\hat{i})\ N/C.$$

$$\Rightarrow |\vec{E}| = |\vec{E_1}+\vec{E_2}| = |-56.25\hat{i} + 37.5\hat{j}| = \sqrt{(56.25)^2+(37.5)^2} = 67.6\ N/C$$

ans is (a)

Q.3 $q = 80\ nc \quad l = 2m \quad , \lambda = \frac{dq}{dx} = \frac{q}{l} = \frac{80}{2} = 40\ nc/m.$

$$dE = \frac{kdq}{r^2} = \frac{k\lambda dx}{r^2} = k\lambda\frac{dx}{(8-x)^2}$$



so

$$E = k\lambda\int_0^2 \frac{dx}{(8-x)^2}$$

let $u = 8-x$
$du = -dx$
$x=0 \to u=8 \ , \ x=2 \to u=6$

$$E = k\lambda\int_8^6 \frac{-du}{u^2}$$

$$= -k\lambda\left[\frac{-1}{u}\right]_8^6 = k\lambda\left(\frac{1}{6}-\frac{1}{8}\right) = \frac{k\lambda}{24} = \frac{9\times10^9 \times 40\times10^{-9}}{24} = 15\ N/C$$

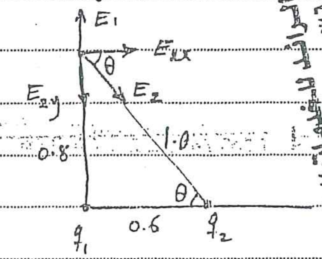
ans is (b)

ملاحظة ٢: لاحظ أننا عند تحديد حدود التكامل نهتم بتوزيع الشحنة (هنا من 0←2) ومن المهم عدم الخلط بين توزيع الشحنات وبين النقطة التي نحسب عندها المجال في حدود التكامل

محمد عوض الله
هاتف ٤٢٦٦٩٣٧

Q.4 $q_1 = 1.6\,nC$, $q_2 = -1.6\,nC$

$E_1 = \dfrac{9\times10^9 * 1.6\times10^{-9}}{(0.8)^2} = 22.5\ N/C \Rightarrow \vec{E}_1 = 22.5\ N/C\ \hat{j}$



$\vec{E}_2 = (E_2 \cos\theta)\,\hat{i} + (E_2 \sin\theta)(-\hat{j})$.

with $\cos\theta = \dfrac{0.6}{1.0} = 0.6$

but $\sin\theta = \dfrac{0.8}{1.0} = 0.8$

$E_2 = \dfrac{9\times10^9 * 1.6\times10^{-9}}{(1.0)^2} = 14.4\ N/C$

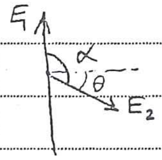
so

$\vec{E}_2 = (14.4 * 0.6)\,\hat{i} - (14.4 * 0.8)\,\hat{j} = 8.64\,\hat{i} - 11.5\,\hat{j}$

$\Rightarrow \vec{E} = \vec{E}_1 + \vec{E}_2 = 8.64\,\hat{i} + 10.98\,\hat{j} \Rightarrow |E| = \sqrt{195.2} \simeq 14\ N/C$

ans is (a)

حل بديل ⇒



$|\vec{E}_1| = 22.5\ N/C$, $|\vec{E}_2| = 14.4\ N/C$

using cosines' law:

$|\vec{E}| = \sqrt{|\vec{E}_1|^2 + |\vec{E}_2|^2 + 2|\vec{E}_1||\vec{E}_2|\cos\alpha}$

with the identity:

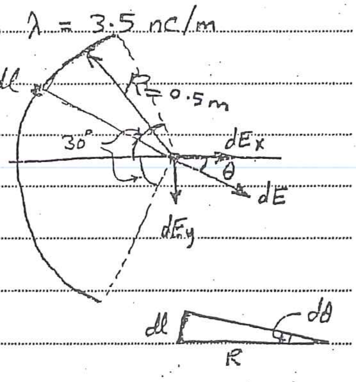
$\cos\alpha = \cos(90+\theta) = -\sin\theta = -0.8$

$|\vec{E}| = \sqrt{(22.5)^2 + (14.4)^2 + 2(22.5)(14.4)(-0.8)} = \sqrt{195.2} \simeq 14\ N/C$.

Q.5 correction on the question sheet $R = 0.5\,m$. , $\lambda = 3.5\ nc/m$

$\lambda = \dfrac{dq}{dl} = \dfrac{q}{l} = 3.5\ nc/m$.

due to symmetry E_y component vanishes, so



$dE_x = dE\cos\theta = \dfrac{k\,dq}{R^2}\cos\theta = \dfrac{k\lambda\,dl}{R^2}\cos\theta$

Recall that

$dl = R\,d\theta$ so

$dE_x = \dfrac{k\lambda R}{R^2}\,d\theta\cos\theta$.

or

$E_x = \dfrac{k\lambda}{R}\displaystyle\int_{-\pi/6}^{\pi/6}\cos\theta\,d\theta = \dfrac{k\lambda}{R}\sin\theta\Big]_{-\pi/6}^{\pi/6} = \dfrac{9\times10^9 * 3.5\times10^{-9}}{0.5}\left[\dfrac{1}{2} - \dfrac{-1}{2}\right]$

so $E = E_x = 63\ N/C$

ans is (e)

محمد عوض الله
هاتف ٥٣٦٦١٣٧

Q.6 $R = 15\,cm$, $E(r = 30\,cm) = 800\,N/C$

total charge is Q, where $E = \frac{kQ}{r^2} \Rightarrow Q = \frac{E r^2}{k} = \frac{800 * (0.3)^2}{9 * 10^9}$

$\Rightarrow Q = 8\,nC$.

this Q is distributed on the surface of the sphere because it is a conductor, so

$$\sigma = \frac{Q}{A} = \frac{Q}{4\pi R^2} = \frac{8 * 10^{-9}}{4\pi * (0.15)^2} = 2.83 * 10^{-8}\ C/m^2$$

ans is (d)

Q.7 $E = 50\,N/C$, $v_0 = 40\,km/s$, $v_0 \parallel E$, $t = 1.5 * 10^{-9}\,s$

the force on the electron is: $\vec{F} = q\vec{E} = -e\vec{E} = m\vec{a}$ so

$\vec{a} = -\frac{e}{m}\vec{E}$ which means that the electron should decelerate.

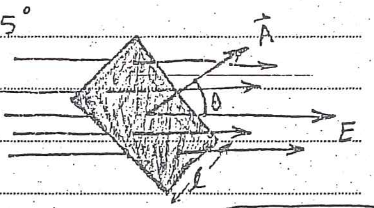
now

$$\vec{v} = \vec{v}_0 + \vec{a}t \Rightarrow v = 40 * 10^3 + \left(-\frac{1.6 * 10^{-19}}{9.1 * 10^{-31}} * 50\right) * 1.5 * 10^{-9}$$

$\Rightarrow v = 26.8 * 10^3\ m/s = 26.8\ km/s$

ans is (c)

Q.8 $\vec{E} = 5\,kN/C\ \hat{i}$ $\quad \phi = ?$ $\quad l = 20\,cm$, $\theta = 45°$



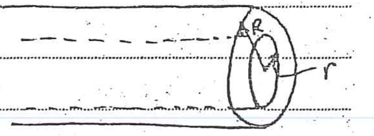
$\phi = \vec{E}\cdot\vec{A} = EA\cos\theta = E l^2 \cos\theta$

$= 5 * 10^3 * (0.2)^2 * \cos 45 = 141.4\ N/C$

$\phi = 0.141\ kN/c$

ans is (e)

Q.9 $R = 4\,cm$, $\rho = 2000\ nC/m^3$ $\quad r = 2\,cm$



using Gauss' law, the enclosed charge q' is that within the internal volume of gaussian surface:

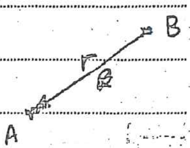
$q' = \rho V' = \rho \pi r^2 l$ so,

$$\oint E \cdot dA = \frac{q_{in}}{\epsilon_0} \Rightarrow E \cdot 2\pi r l = \frac{\rho}{\epsilon_0}\pi r^2 l \Rightarrow E = \frac{\rho r}{2\epsilon_0} = \frac{2000 * 10^{-9} * 0.02}{2 * 8.85 * 10^{-12}}$$

$\Rightarrow \vec{E} = 2.26 * 10^3\ N/C\ \hat{r}$

ans is (a)

Q.10 $\vec{r}_{B\to A} = (x_A - x_B)\hat{i} + (y_A - y_B)\hat{j} = -3\hat{i} - 4\hat{j}$, $\vec{E} = 4\hat{i} + 3\hat{j}$



$\Rightarrow \Delta V = V_A - V_B = -\vec{E}\cdot\vec{r} = 12 + 12 = 24\ Volts$.

ملاحظة ٣: لاحظ أننا نحدد الاتجاه مع مراعاة (النهائي - الابتدائي) لذا فإن قولنا $V_A - V_B$ يعني أن r تتجه من B إلى A

ans is (c)

Jordan University
Department of Physics

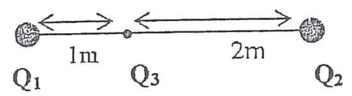
Physics 102
First Exam

Date: 9/4/2005
Time: 11-12

Student's Name: [redacted] **Instructor's Name:**

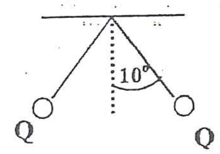
Note: $k_e = 9\times10^9\ N.m^2/C^2$

Question1: In the figure shown, if the force acting on a charge Q_3 due to the other two charges Q_1 and Q_2 is zero, then the ratio (Q_1/Q_2) is:



(a) 1/2 (b) 2 (c) 1/4 (d) 4 (e) 1/8

Question 2 and 3:
Two small spheres of equal charges Q, 3 gram each, are suspended by a 10 cm long string as shown, if the spheres are in equilibrium when the string makes a 10° angle with the vertical. (consider $g = 10 m/s^2$).

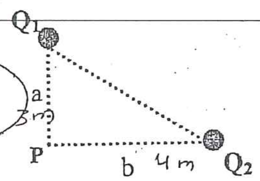


2. The tension in the string (in 10^{-3} N) is:

(a) 30 (b) 25 (c) 17
(d) 45 (e) 56

3. The charge on each sphere (in nC) is:
(a) 26 (b) 31 (c) 63 (d) 125 (e) 150

Question 4 and 5:
If $Q_1 = Q_2 = 16\ \mu C$, a = 3.0 m and b = 4.0 m, then



4. Total electric potential at point P (in kV) is:

(a) 12 (b) 29 (c) 47 (d) 69 (e) 84

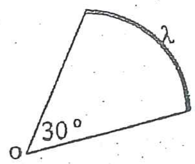
5. The change in potential energy of a 3 μC charge as it moves from infinity to point P (in mJ) is:

(a) 252 (b) 87 (c) 126 (d) 207 (e) 870

Question 6: A proton (mass = 1.67×10^{-27} kg, charge = 1.60×10^{-19} C) enters a region of uniform electric field (E = 250 N/C) with an initial velocity of 40 km/s in the same direction as the electric field. The final velocity of the proton after t = 2μs in the same direction (in km/s) is:

(a) 40 (b) 88 (c) 64 (d) 48 (e) 96

Question 7: The electric potential (الجهد الكهربائي) at the center of an arc of radius R having uniform charge distribution λ is:

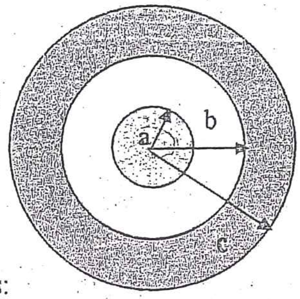


(a) $2k\lambda\pi$ (b) $k\lambda\pi/3R$ (c) $k\lambda\pi/6$ (d) $k\lambda\pi/3$ (e) $k\lambda\pi/6R$

Question 8: A uniform electric field $2\mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$ N/C intersects a surface of area $5m^2$. Then the electric flux through this area if the surface lies in the xy plane (Nm^2/C) is:

(a) 10 (b) 15 (c) 30 (d) 25 (e) 20

Question 9 and 10: A solid, insulating sphere of radius (a) has a uniform charge density (ρ) and a total charge Q. Concentric with this sphere is an uncharged, conducting spherical shell whose inner and outer radii are b and c as shown.



9. The magnitude of the electric field in the region r < a is:

(a) k_eQ/r^2 (b) k_eQ/a^2 (c) k_eQr/a^2

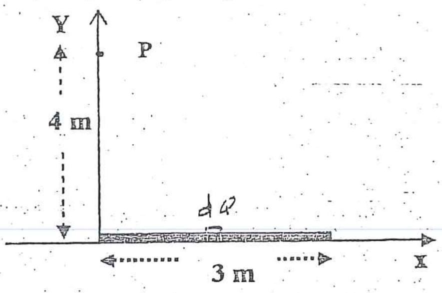
(d) k_eQr/a^3 (e) zero

10. The magnitude of the electric field in the region r > c is:

(a) k_eQ/r^2 (b) k_eQ/a^2 (c) k_eQr/a^2

(d) k_eQr/a^3 (e) zero

Question 11: A uniform linear charge of 2.0 nC/m is distributed along the x axis from $x = 0$ to $x = 3$ m. Which of the following integrals is correct for the y component of the electric field at $y = 4$ m on the y axis?



(a) $\int_0^3 \frac{72dx}{(16+x^2)^{3/2}}$ (b) $\int_0^4 \frac{54dx}{(9+x^2)^{3/2}}$

(c) $\int_0^3 \frac{572dy}{16+y^2}$ (d) $\int_0^5 \frac{54dy}{16+y^2}$

(e) $\int_0^7 \frac{54dy}{9+y^2}$

Question 12: The potential in a region is $V(x,y,z) = 2x + 3x^2y + 4z$, then the magnitude of the electric field at the point that has coordinates (4,2,1) is:

(a) 108 (b) zero (c) 18 (d) 59 (e) 69

GOOD LUCK

(17)

University of Jordan — General Physics (0302102) — Second Sem.2000/2001
Physics of Dept. — Second Exam — Date: 12/5/2001 — Time: 70 minutes

الاسم باللغة العربية: ____________________

الرقم الجامعي: ____________ الشعبة: ____________ اسم المدرس: ____________

Use $k = 9*10^9$ N m^2/C^2; 1 μF=10^{-6} F; 1 nC = 10^{-9} C

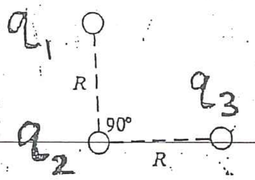
1- Two spherical conductors of radii $r_1 = 0.30$ m and $r_2 = 1.5$ m are very far apart. Initially the larger sphere is uncharged and the electric field at the surface of smaller sphere is 1.8×10^3 N/C. If the spheres are then connected by a very long thin conducting wire, the final charge (in nC) on the larger sphere is:

a) 54 b) 12 c) 6.0 d) 36 e) 15

2- The electric field in a region of space is given by $\vec{E}(V/m) = -6.0*10^2.x(m).\hat{i}$. If points A and B have locations $\vec{r}_A(m) = 2.0\hat{i}$ and $\vec{r}_B(m) = 5.0\hat{i} + 4.0\hat{j}$, the potential difference $V_B - V_A$ (in V) is:

a) 6.0×10^2 V b) 6.3×10^3 c) zero d) 1.5×10^3 e) 3.0×10^3

3- If $q_1 = 2q_2 = 2Q$ and $q_3 = -2Q$ in the charge configuration shown in the figure, the electrostatic potential energy of this system is:



a) $-(kQ^2)/\sqrt{2}R$ b) Zero
c) $(kQ^2/R).(2-1/\sqrt{2})$ d) $-(4kQ^2)/\sqrt{2}R$
e) $(kQ^2/R).(2+1/\sqrt{2})$

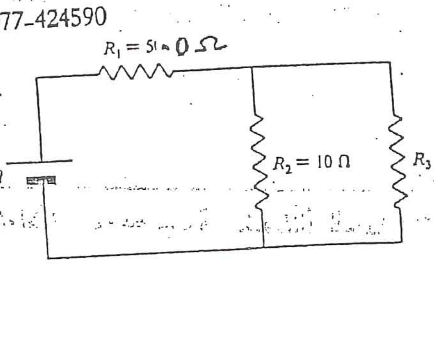
4- The capacitance of a parallel-plate capacitor is 24 μF with the space between its plates is filled with a material of dielectric constant κ = 1.6. If this dielectric material is being replaced by air and then the separation between the plates is tripled, the final capacitance (in μ F) is:

a) 5.0 b) 15 c) 4.0 d) 12 e) 16

5- When a 15-μF capacitor is combined with a capacitor of unknown capacitance C, the equivalent capacitance of the combination is 10 μ F. The value of C (in μF) is:

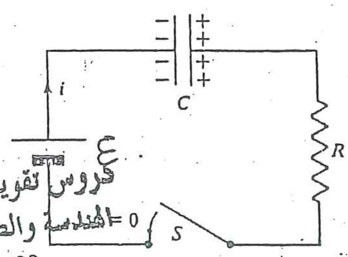
a) 2.5 b) 5.0 c) 30
d) 8.6 e) 7.5

6- If the 5.0- Ω resistor in the circuit shown in the figure shown is dissipating energy at a rate of 45 W, the e.m.f ε (in V) of the battery is:



a) 20 b) 30 c) 10
d) 40 e) 50

7- A resistor R, a battery of e.m.f ε , and a charged capacitor are connected in series so that the polarity of the capacitor is as shown in the figure. If the magnitude of the potential different across C is 3ε immediately after the switch S is closed, the current i (t ≥ 0) is given by :

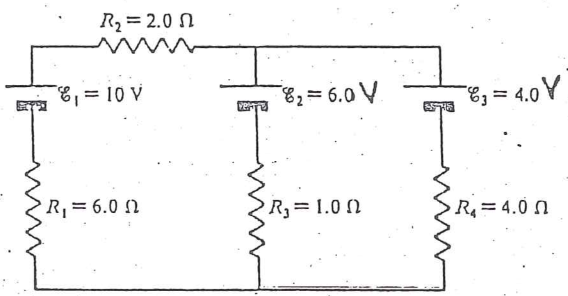


a) Zero
b) $(\varepsilon / R)\, e^{-t/RC}$
c) $\varepsilon\, e^{-t/RC}$
d) $(4\varepsilon / R)\, e^{-t/RC}$
e) $(3\varepsilon / R)\, e^{-t/RC}$

8- Two capacitors having capacitances in air C_1 (20μF) and C_2 (40μF) are connected in series. The space region between the plates of C_2 is then filled with a dielectric material (κ =2.0) while the potential difference across the combination is held constant at 80 V. The final energy (in mJ) stored in C_2 is:

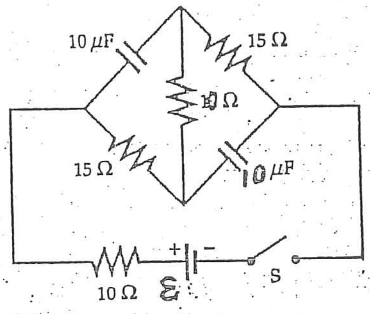
a) 10
b) 48
c) 12
d) 51
e) 36

9- In the circuit shown in the figure, the current (in A) through the resistor R_3 is:



a) 0.50
b) 1.5
c) Zero
d) 0.13
e) 1.2

10. The capacitors in the circuit shown are initially uncharged. If ε = 50 V, the final charge (in μ C) on each capacitor after the switch S is closed is:



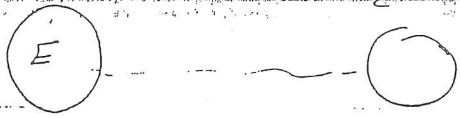
a) 530
b) 150
c) 880
d) 360
e) 250

Answer Table

No.	A	b	c	d	e	No.	a	b	c	d	e
1					X	6		X			
2		X				7				X	
3				X		8	X				
4	X					9			X		
5			X			10					X

Q.1

$r_1 = 0.3$ $\quad r_2 = 1.5$ $\quad E = 1.8 * 10^3$



$E = \frac{kq}{r_1^2} \Rightarrow q = \frac{E r_1^2}{k}$

$V_1 = V_2 \Rightarrow \frac{kq_1}{r_1} = \frac{kq_2}{r_2} \Rightarrow q_1 = \frac{r_1 q_2}{r_2}$ $\qquad q = q_1 + q_2$

$\frac{E r_1^2}{k} = \frac{r_1 q_2}{r_2} + q_2 = \left(\frac{r_1}{r_2} + 1\right) q_2$

$q_2 = \frac{\frac{E r_1^2}{k}}{\left(1 + \frac{r_1}{r_2}\right)} = 15\ nC$

Q.2

$E = -600x\hat{i}$

$r_A = 2\hat{i}$

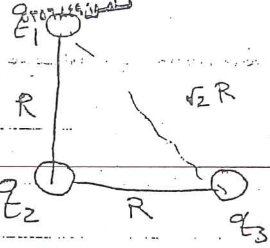
$r_B = 5\hat{i} + 4\hat{j}$

$\int_A^B dv = \int -E \cdot dr = -\int_2^5 \vec{E} \cdot (dx\hat{i} + dy\hat{j})$

$V_B - V_A = -\left[-600\int_2^5 x\,dx + 0\right] = 600 \frac{x^2}{2}\Big]_2^5$

$V_B - V_A = 300[5^2 - 2^2] = 6.3 * 10^3$ Volt

Q.3



$q_1 = 2q_2 = 2Q$

$q_3 = -2Q$

$U = \frac{kq_1q_2}{r_{12}} + \frac{kq_1q_3}{r_{13}} + \frac{kq_2q_3}{r_{23}}$

$U = \frac{kQ^2}{R}\left[\frac{1*2}{1} + \frac{2*-2}{\sqrt{2}} + \frac{1*-2}{1}\right]$

$U = \frac{kQ^2}{R}\left[2 - 2 + \frac{-4}{\sqrt{2}}\right] = \frac{-4kQ^2}{\sqrt{2}R}$

Q.4

[$C = 24\ \mu f$, $k = 1.6$] → [air C_0] → [Separation is tripled]

$C = kC_0 \Rightarrow C_0 = \frac{24}{1.6} = 15\ \mu f$ و $C_0 = \frac{\epsilon_0 A}{d}$, $C_f = \frac{\epsilon_0 A}{3d} = \frac{1}{3}\left(\frac{\epsilon_0 A}{d}\right)$

$C_f = \frac{1}{3} C_0 = 5\ \mu f$

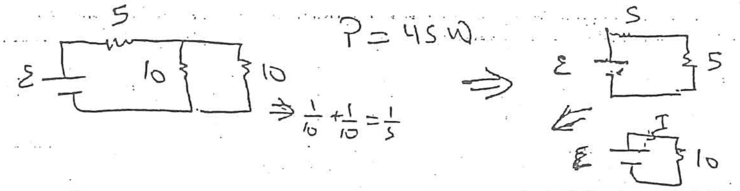
Q.5

$C_1 = 15\ \mu f$ $\qquad C_2 = ??$ $\qquad \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{C_f} \Rightarrow \frac{1}{C_2} = \frac{1}{C_f} - \frac{1}{C_1}$

$C_f = 10\ \mu f$

$\frac{1}{C_2} = \frac{1}{10} - \frac{1}{15} \Rightarrow C_2 = 30\ \mu f$

Q.6



$P = 45\,W$

$\Rightarrow \frac{1}{10} + \frac{1}{10} = \frac{1}{5}$

$P = I^2 R$

$45 = I^2 * 5 \Rightarrow I = 3A$

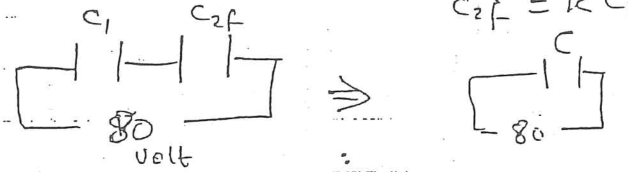
$\varepsilon = I R_{tot} = 3 * 10 = 30$ Volt

Q.7

$I = \frac{V_0}{R} e^{-t/RC}$ $\quad \varepsilon + 3\varepsilon = 4\varepsilon$

$I = \frac{4\varepsilon}{R} e^{-t/RC}$

Q.8



$C_{2f} = k C_2 = 2 * 40 = 80\,\mu f$

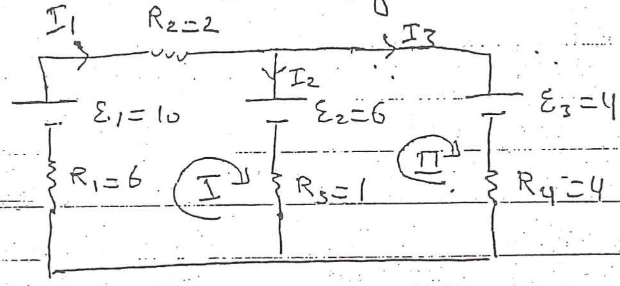
$C = 16\,\mu f$

$q = 1280\,\mu C$

$q_1 = q_2 = q = 1280\,\mu c \Rightarrow E = \frac{1}{2} \frac{q^2}{c} = 0.01\,J$

$= 10\,mJ$

Q.9



$I_1 = I_2 + I_3$ -- (1)

$10 - 6 - 6I_1 - 2I_1 - I_2 = 0$

$4 - 8I_1 - I_2 = 0$ -- (2)

$-4 + 6 - 4I_3 + I_2 = 0$ -- (3)

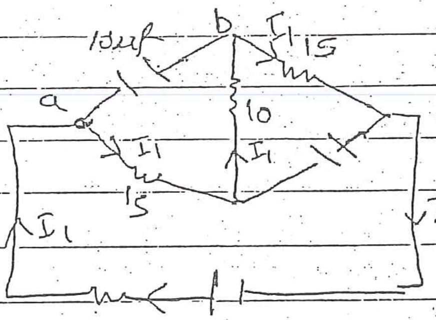
sub (1) in (2) $\Rightarrow -9I_2 - 8I_3 + 4 = 0$ --- (1)

$I_2 - 4I_3 + 2 = 0$ (3) $* -2$

$-11 I_2 + 0 = 0 \Rightarrow I_2 = 0$

Q.10

for long time there is no current in the capacitors



$50 = (10 + 15 + 10 + 15) I_1$

$50 = 50 I_1 \Rightarrow I_1 = 1$ Amp

$V_{ab} = (10 + 15) I_1 = 25$ Volt $\Rightarrow V_C = 25$ Volt $\Rightarrow Q = CV$

$Q = 25 * 10 = 250\,C$

PHYSICS DEPARTMENT UNIVERSITY OF JORDAN	PHYSICS 102 SECOND EXAM	DATE : 2-8-98 TIME: ONE HOUR

الرقم

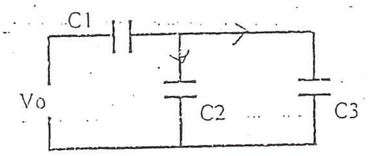
الاسم

Note :Permitivity constant $\varepsilon = 8.85\times10^{-12}$ F/m , Electron charge $e = -1.6 \times 10^{-19}$ C, Electron mass $m_E = 9.11 \times 10^{-31}$ kg

Q1:- . If the resistivity of copper $\rho = 1.69\times10^{-8}\ \Omega$m. What is the current density in a copper wire of 8m length when a voltage of 100 V is applied across it.

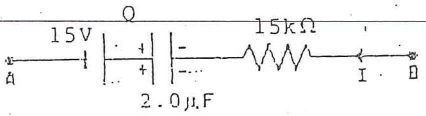
a) 7.4×10^{8} b) 3.7×10^{8} c) 14.8×10^{8} d) 1.7×10^{8}

Q2:- If C1=15μF ,C2 = 10 μF , C3 = 20μF and Vo=18V, determine the energy stored by C2 (in mJ).



a) 0.72
b) 0.32
c) 0.50
d) 0.18

Q3:- In the circuit segment shown if I = 2mA and Q = 50μC ,determine the potential difference , $V_A - V_B$?



a) –40V b) + 40 V c) + 20 V d) –20 V

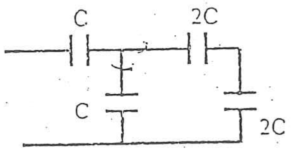
Q4:- -How long it will take an electron to pass through a copper wire of length 20 cm and cross sectional area 0.4 cm^2 if it caries a current of 80 A . The density of electrons in copper $n=8\times10^{28}$ $/m^3$

a) 2.31 min b) 21.3 min c) 4.62 min d) 42 .6 min

Q5:-How many electrons pass through a 20Ω resistor in 10 min if there is a potential drop of 30V across it

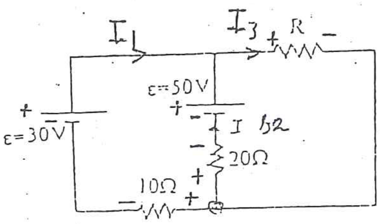
a) 5.6×10^{21} b) 7.5×10^{21} c) 9.4×10^{21} d) 1.1×10^{21}

Q6- If $C = 45\ \mu F$, determine the equivalent capacitance (in μF) for the combination shown in the figure.



a) 36
b) 32
c)34
d)30

Q7:-In the circuit shown , if the current I = 1.2 A ,What is the magnitude of the current in the resistor R?



a) 5.6 A
b) 3.6 A
c) 2.6 A
d)1.6 A

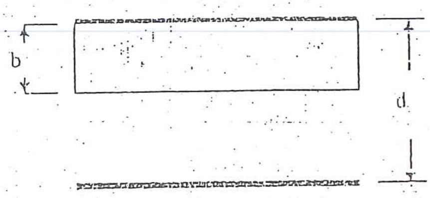
Q8:- If a $3\mu F$ capacitor is charged to 40 V and a $5\mu F$ capacitor charged to 18V are connected to each other ,with the positive plate of each connected to the negative plate to the other .What is the final charge (in μC) on the $3\mu F$ capacitor.

a) 11 b) 15 c) 19 d) 26

Q9:-A capacitor in a single –loop RC circuit is charged to 85% of its final potential difference in 2.5s .What is the time constant for this circuit?

a) 1.5 s b)1.3 s c)1.7 s d)1.9 s

Q10:The figure below shows a parallel-plate capacitor of plate area $A=100\ cm^2$ and plate separation d=1cm. A battery with voltage $V_0 = 75V$ is connected to the plates .The battery is then disconnected ,and a dielectric slab of thickness b=0.5 cm and dielectric constant k=3 is inserted between the plates as shown .What is the potential difference (in V)between the plates after the slab has been introduced .



a) 25 b) 50 c)100 d)75

Q.1 $\rho = 1.69 \times 10^{-8}\ \Omega \cdot m$, $l = 8m$, $V = 100V$

$E = \frac{V}{l} = \frac{100}{8} = 12.5\ V/m$, using microscopic ohm's law: $E = \rho J$

$\Rightarrow$

$J = \frac{E}{\rho} = \frac{12.5}{1.69 \times 10^{-8}} = 7.39 \times 10^{8}\ A/m^2$. (ans. is ⓐ)

Q.2 $C_1 = 15\mu F$, $C_2 = 10\mu F$, $C_3 = 20\mu F$, $V_0 = 18V$

$U = \frac{1}{2} CV^2$, $C_{eq} = 10 + 20 = 30\mu F$

$V_0 = \frac{q}{C_1} + \frac{q}{C_{eq}} \Rightarrow 18 = q\left(\frac{1}{15} + \frac{1}{30}\right) \Rightarrow q = 180\mu C$.

هذه الشحنة هي شحنة C_1 وكذلك شحنة المكثفة المكافئة أي

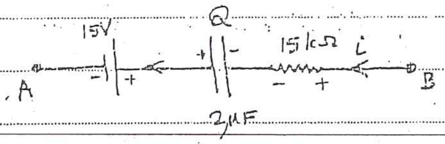
$q_2 + q_3 = 180\mu C$. but $V_2 = V_3 \Rightarrow \frac{q_2}{C_2} = \frac{q_3}{C_3} \Rightarrow q_3 = \frac{C_3}{C_2} q_2$

substitute in $q_2 + q_3 = 180\mu C \Rightarrow$

$q_2 + \frac{C_3}{C_2} q_2 = 180 \times 10^{-6} \Rightarrow q_2\left(1 + \frac{20}{10}\right) = 180 \times 10^{-6} \Rightarrow q_2 = 6 \times 10^{-5} C$

$\Rightarrow U = \frac{1}{2} CV^2 = \frac{1}{2}\frac{q^2}{C} = \frac{1}{2}\frac{(6 \times 10^{-5})^2}{10^{-5}} = 1.8 \times 10^{-4} J = 0.18 mJ$. (ans. is ⓓ)

Q.3 $i = 2mA$, $Q = 50\mu C$



$V_A + 15 - \frac{Q}{C} + 15 \times 10^3 i = V_B$

so

$V_B - V_A = \frac{50 \times 10^{-6}}{2 \times 10^{-6}} - 15 - 15 \times 10^3 \times 2 \times 10^{-3} = 25 - 15 - 30 = -20V$ (ans. is ⓓ)

Q.4 $l = 0.2\ m$, $A = 0.4 \times 10^{-4} m^2$, $i = 80A$, $n = 8 \times 10^{28}/m^3$

$i = nevA = ne\frac{l}{t}A \Rightarrow t = \frac{nelA}{i} = \frac{8 \times 10^{28} \times 1.6 \times 10^{-19} \times 0.2 \times 0.4 \times 10^{-4}}{80}$

$\Rightarrow$

$t = 1280\ sec = 21.3\ min$. (ans. is ⓑ)

Q.5 $R = 20\Omega$, $\Delta t = 10 min = 60\ sec$, $V = 30V$, $e = 1.6 \times 10^{-19} C$

$i = \frac{\Delta q}{\Delta t} = \frac{V}{R} \Rightarrow \Delta q = \frac{V\Delta t}{R} = \frac{30 \times 600}{20} = 900C$

$n = \frac{\Delta q}{e} = \frac{900}{1.6 \times 10^{-19}} = 5.6 \times 10^{21}$ electrons. (ans. is ⓐ)

محمد عوض الله
هاتف ٤٣٦٦٩٣٧

Q.6 $C = 45\mu F$, equivalent Capacitance (series - parallel - series):

1. Series (right branch $2C$ & $2C$):

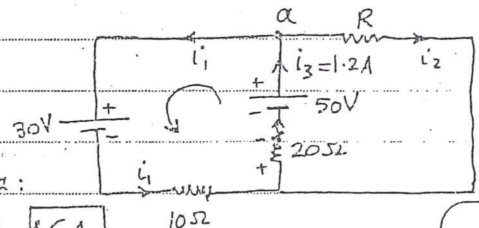
$$C_{eq} = \frac{2C \ast 2C}{2C+2C} = \frac{4C^2}{4C} = C$$

2. Parallel (right branch & C): $C_{eq} = C + C = 2C$

3. Series (Parallel & last C):

$$C_{eq} = \frac{2C \ast C}{2C + C} = \frac{2C^2}{3C} = \frac{2}{3} C = \frac{2}{3} \ast 45 = 30\,\mu F$$ (ans is (d))

Q.7 بأخذ مسار مغلق عبر الحلقة اليسرى:



$$-30 - 10 i_1 - 20 i_3 + 50 = 0$$

$$\Rightarrow 10 i_1 = 50 - 30 - 20 \ast 1.2 = -4$$

$\Rightarrow i_1 = -0.4A$ ⇒ from junction a:

$$i_1 + i_2 = i_3 \Rightarrow i_2 = 1.2 - (-0.4) = \boxed{1.6A}$$ (ans is (d))

Q.8 لو كان توصيل القطب الموجب الى الموجب والسالب الى السالب يبقى كل من المكثفين محتفظ باشارة شحنته قبل التوصيل كما في التوازي، أي يكون الجهد مشتركا لكليهما $V_1 = V_2$ بعد فترة كافية من التوصيل. وتتوزع الشحنة الكلية عليهما حسب سعة كل منهما أما قبل التوصيل كانت:

$C_1 = 3\mu F$, $V_1 = 40V \Rightarrow q_1 = C_1 V_1 = 120\mu C$.

$C_2 = 5\mu F$, $V_2 = 18V \Rightarrow q_2 = C_2 V_2 = 90\mu C$

وأما وقد تم توصيل القطب الموجب الى السالب والسالب الى الموجب فان الشحنات تعادل بعضها بعضا وتبقى الشحنة الزائدة على أحد المكثفين لتتوزع على كليهما وبحيث يصبح بعد ذلك كل قطبين متقابلين لهما نفس الاشارة أي موجب مع موجب وسالب مع سالب وهنا ايضا يصبح الجهد مشتركا بينما تتوزع الشحنة حسب السعة. فمن تعادل $120\mu C$ مع $90\mu C$ يبقى منها 30μ علينا أن تتوزع على المكثفين:

$$q_1 + q_2 = 30\mu C \quad (1), \quad V_1 = V_2 \Rightarrow \frac{q_1}{C_1} = \frac{q_2}{C_2} \Rightarrow q_2 = \frac{C_2}{C_1} q \quad (2)$$

substituting in (1):

$$q_1 + \frac{C_2}{C_1} q_1 = 30\mu C \Rightarrow q_1 \left(1 + \frac{5}{3}\right) = 30 \Rightarrow \boxed{q_1 = 11.25\,\mu C}$$

Plus: so $q_2 = 30 - 11.25 = 18.75\,\mu C$ and

$$V_1 = \frac{q_1}{C_1} = \frac{11.25}{3} = 3.75V \quad \text{and} \quad V_2 = \frac{q_2}{C_2} = \frac{18.75}{5} = 3.75V$$

(ans is (a))

محمد عوض الله
هاتف ٤٣٦٦١٣٧

Q.9 $V = 0.85 V_0$, $t = 2.5$ sec

but: $V = V_0(1 - e^{-t/RC})$ $\Rightarrow$ $\frac{V}{V_0} = 1 - e^{-t/RC}$

$\Rightarrow$

$$\frac{0.85 V_0}{V_0} = 1 - e^{-t/RC} \Rightarrow e^{-t/RC} = 1 - 0.85 = 0.15$$

take ln of both sides to extract RC:

$$-\frac{t}{RC} = \ln(0.15) \Rightarrow RC = \frac{-t}{\ln(0.15)} = \frac{-2.5}{\ln(0.15)} = 1.32 \text{ sec}$$

ans. (b)

Q.10 $A = 100\ cm^2 = 10^{-2}\ m^2$, $d = 10^{-2}\ m$, $V_0 = 75\ V$, $b = 5 * 10^{-3}\ m$, $K = 3$.

the initial charge is $q_0 = C_0 V_0 = \frac{\epsilon_0 A}{d} V_0 = \frac{8.85 * 10^{-12} * 10^{-2} * 75}{10^{-2}}$

$\Rightarrow q_0 = 6.64 * 10^{-10}\ C$

وبما ان المكثف غير موصول بمصدر شحنات فسوف تبقى شحنته كما هي رغم ادخال عازل فيه. لذا:

$q = CV \Rightarrow C_0 V_0 = C' V' \Rightarrow V' = \frac{C_0}{C'} V_0$, with $C_0 = \frac{\epsilon_0 A}{d}$.

but these can be considered two capacitors in series connection so:

$$C' = \frac{C_1 * C_2}{C_1 + C_2} \text{ with: } C_1 = \frac{K \epsilon_0 A}{d}, \ C_2 = \frac{\epsilon_0 A}{(d-b)} \Rightarrow C' = \frac{\left[\frac{K\epsilon_0 A}{b} \cdot \frac{\epsilon_0 A}{(d-b)}\right]}{\left[K\frac{\epsilon_0 A}{b} + \frac{\epsilon_0 A}{(d-b)}\right]}$$

$$\Rightarrow C' = \frac{K \epsilon_0 A}{b(d-b)\left(\frac{k(d-b)+b}{b(d-b)}\right)} = \frac{K \epsilon_0 A}{k(d-b)+b} \Rightarrow$$

$$V = \frac{C_0}{C'} V_0 = \frac{\epsilon_0 A}{d}\left(\frac{k(d-b)+b}{K\epsilon_0 A}\right) V_0 = \frac{K(d-b)+b}{Kd} V_0 = \frac{3(1-\frac{1}{2})+\frac{1}{2}}{3 * 1} * 75$$

$\Rightarrow V_0 = \boxed{50V}$

Another numerical soln:

$$C_0 V_0 = C' V' \Rightarrow C_0 = \frac{\epsilon_0 A}{d} = \frac{8.85 * 10^{-12} * 10^{-2}}{10^{-2}} = 8.85 * 10^{-12}\ F.$$

$$C_1 = \frac{K \epsilon_0 A}{b} = \dots = 5.31 * 10^{-11}\ F, \quad C_2 = \frac{\epsilon_0 A}{d-b} = \dots = 1.77 * 10^{-11}\ F$$

$$\text{so, } C' = \frac{C_1 C_2}{C_1 + C_2} = \frac{5.31 * 10^{-11} * 1.77 * 10^{-11}}{(5.31 + 1.77) * 10^{-11}} = 1.32 * 10^{-11}\ F$$

hence $V' = \frac{8.85 * 10^{-12}}{1.32 * 10^{-11}} * 75 = \boxed{50V}$

ans. is (b)

محمد عوض الله
هاتف ٤٢٦٦١٣٧

Physics Department | Second Semester 1994/9

Date: 27/4/1995 | Time: 9,00 - 10:15

GENERAL PHYSICS -2 (0302-102)

SECOND EXAM

(33)

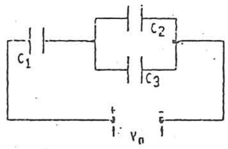
NOTE: *The permittivity of free space*, $\varepsilon_o = 8.85 \times 10^{-12}$ *C/(N.m²).*

الاسم باللغة العربية: حسام صبري ابراهيم عادي

الرقم الجامعي: ٩٤٢٦٤٠ الشعبة: ١٠-١١

اسم المدرّس: ________

1. If C_1 = 20 μF, C_2 =10 μF, C_3 = 30 μF, and V_o = 18 V, then the charge (in mC) stored by C_1 is:
a. 0.37; b. 0.24; c. 0.32;
d. 0.40; e. 0.50 .



2. A 15 μF capacitor is charged to 40 V and then connected across an initially uncharged 25 μF capacitor. The final potential differenc (in V) across the 25 μF capacitor is:
a. 12; b. 18; c 15; d. 21; e. 24 .

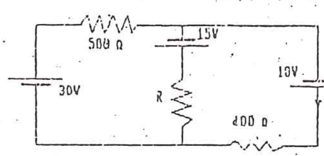
3. A light bulb is rated at 30 W when operated at 120 V. The amount of charge (in C) that passes through this bulb in 1.0 min is:
a. 17; b. 15; c. 14; d. 13; e. 60 .

4. The maximum power (in W) that can be generated from an 18 V emf usi any combination of a 6.0 Ω resistor and a 9.0 Ω resistor is:
a. 54; b. 71; c. 90; d. 80; e. 22 .

5. A 50 V potential difference is maintained across a 2.0 m length wi that has a diameter of 0.50 mm. If the wire is made of material tha has a resistivity of 7.0 x 10^{-8} Ω·m, then the current (in A) in the wire is:
a. 70; b. 65; c. 61; d. 58; e. 280 .

6. A resistor of unknown resistance and a 15 Ω resistor are connected across a 20 V emf in such a way that a 2.0 A is observed in the emf. The value of the unknown resistance (in Ω) is:
a. 75; b. 12; c. 7.5; d. 30; e. 5.0 .

7. If I = 30 mA, then the magnitude and sense (direction) of the current in the 500 Ω resistor are:
a. 56 mA left to right;
b. 56 mA right to left;
c. 48 mA left to right;
d. 48 mA right to left;
e. 26 mA left to right.



Q.1 $C_1 = 20\mu F$, $C_2 = 10\mu F$, $C_3 = 30\mu F$, $V_0 = 18V$

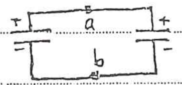
$C_{parallel} = C_2 + C_3 = 10 + 30 = 40\mu F \Rightarrow C_{eq} = \frac{40 * 20}{40 + 20} = 13.3\mu F$.

$q = V_0 C_{eq} = 18 * 13.3 * 10^{-6} = 24\mu C$, this charge is on C_1 and is distributed on both C_2 and C_3.

ans is (b)

Q.2 $C_1 = 15\mu F$ $V = 40V$ $C_2 = 25\mu F \Rightarrow q_0 = C_1 V = 15 * 40 = 600\mu C$

هذه الشحنة تتوزع على المكثفين حيث توصيلها كلا على التوازي لذا فرق كل منها يساوي فرق الجهد بين a و b.



$V_{ab} = \frac{q_1}{C_1} = \frac{q_2}{C_2}$ with $q_1 + q_2 = q_0$ so $\frac{q_1}{C_1} = \frac{q_0 - q_1}{C_2} \Rightarrow$

$C_2 q_1 = C_1 (q_0 - q_1) \Rightarrow q_1 = \frac{C_1 q_0}{C_1 + C_2} \Rightarrow q_1 = \frac{15 * 600}{15 + 25} = 225\mu C \Rightarrow V_1 = \frac{q_1}{C_1} = 15V$

ans is (c)

Q.3 $P = 30W$ $V = 120V$ $\Delta t = 1 min = 60 sec \Rightarrow i = \frac{P}{V} = \frac{30}{120} = \frac{1}{4} A$

so $\Delta q = i \Delta t = 0.25 * 60 = 15 C$.

ans is (b)

Q.4 $\mathcal{E} = 18V$, $R_1 = 6\Omega$, $R_2 = 9\Omega$, $P = \frac{V^2}{R}$ as R is less, P is larger.

Now, with $R_{par.} = \frac{R_1 R_2}{R_1 + R_2} = \frac{6 * 9}{6 + 9} = 3.6\Omega \Rightarrow P = \frac{(18)^2}{3.6} = 90$ Watt

ans is (c)

Q.5 $V = 50V$, $l = 2m$, $d = 0.5 mm$, $\rho = 7 * 10^{-8}\Omega \cdot m$, $R = \frac{\rho l}{A} = \frac{7 * 10^{-8} * 2}{\pi (0.25 * 10^{-3})^2}$

so $R = 0.71\Omega$ and $i = \frac{V}{R} = \frac{50}{0.71} = 70.1 A$

ans. is (a)

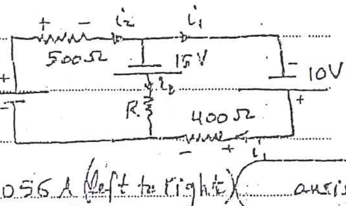
Q.6 $R_1 = ?$, $R_2 = 15\Omega$ $\mathcal{E} = 20V$ $i = 2A$, $R_{eq} = \frac{V}{i} = \frac{20}{2} = 10\Omega$

this is less than R_2 which means connection is in parallel since:

في التوصيل على التوازي تكون المحصلة اصغر من اصغر مقاومة في المجموعة وفي التوالي اكبر من اكبر مقاومة موصولة لذا

$\frac{1}{R_1} + \frac{1}{15} = \frac{1}{10} \Rightarrow \frac{1}{R_1} = \frac{1}{10} - \frac{1}{15} = \frac{3 - 2}{30} = \frac{1}{30} \Rightarrow R_1 = 30\Omega$

ans is (d)



Q.7 $i_1 = 30 mA$, take the external loop:

$10 - 400 i_1 + 30 - 500 i_2 = 0$

$\Rightarrow 500 i_2 = 30 + 10 - 400 * 30 * 10^{-3} \Rightarrow i_2 = \frac{28}{500} = 0.056 A$ (left to right)

ans is (a)

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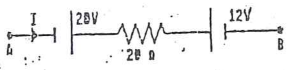
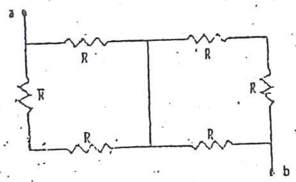
(34)

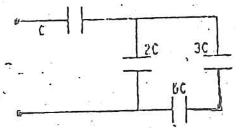
8. If I = 1.5 A in the circuit segment shown, then the potential difference $V_B - V_A$ (in V) is:
a. +22; b. -22; c. -38; d. +38; e. +2.V .



9. How many time-constants must elapse if an initially uncharged capacitor is to reach 80% of its final potential difference?
a. 2.2; b. 1.9; c. 1.6; d. 3.0; e. 5.0 .



0. If R = 12 Ω, then the equivalent resistance (in Ω) between points a and b is:
a. 20; b. 16; c. 24; d. 28;
e. 6.0 .



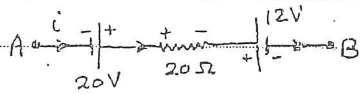
1. If C = 45 μF, then the equivalent ca0pacitance (in μF) for the combination shown is:
a. 28; b. 36; c. 52; d. 44; e. 23 .

2. A parallel plate capacitor of separation 5.0 mm is initially charged to a potential of 600 V, then isolated. The region between the plates is then filled with a dielectric of K = 5 . The induced surface charge density (in C/m^2) is:
a. 1.7×10^{-7}; b. 1.7×10^{-10}; c. 3.4×10^{-7};
d. 3.4×10^{-8}; e. 8.5×10^{-7} .

END OF QUESTIONS

ANSWER TABLE

Q.No.	a	b	c	d	e	Q.No.	a	b	c	d	e
1		X				7	X				
2			X			8		X			
3		X				9			X		
4			X			10		X			
5	X					11		X			
6				X		12					X

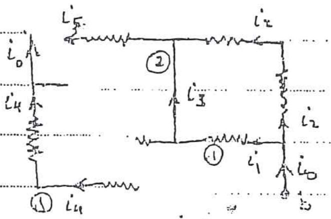


Q.8 $i = 1.5A \Rightarrow V_A + 20 - 20i - 12 = V_B \Rightarrow$

$V_B - V_A = 20 - (20 \times 1.5) - 12 = 20 - 30 - 12 = -22V$ (ans. is ⓑ)

Q.9 $V = 0.80\, V_0 \Rightarrow 0.8V_0 = V_0(1 - e^{-t/T}) \Rightarrow 1 - 0.8 = e^{-t/T}$ (ans. is ⓒ)

$\Rightarrow \ln 0.2 = -\frac{t}{T} \Rightarrow t = 1.61T$



Q.10 $R = 12\Omega$

لاحظ أنه لا يمكننا حساب المقاومة المكافئة كتوالي أو توازي لذا نلجأ لافتراض مرور تيار ما ينقسم الى فروع ثم تلتقي لتكون i عند a . ونحتاج لمعرفة هذه التيارات الفرعية من أجل حساب تغيرات الجهد التي تمكننا من معرفة R المكافئة :

take $V_{ab} = i_1R + i_4(2R)$ ① and $V_{ab} = i_1R + i_3(0) + i_5R$ ②

so $i_1R + 2i_4R = i_1R + i_5R \Rightarrow i_1 = i_5 = 2i_4$, similarly $i_1 = 2i_2 = 2i_4$

$\Rightarrow i = 3i_2 \Rightarrow V_{ab} = i_0R_{eq} = 3i_2R_{eq} = i_2R + i_2R + 2i_2R$

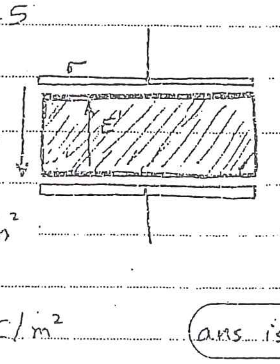
$\Rightarrow R_{eq} = \frac{4}{3}R = \frac{4}{3} \times 12 = 16\,\Omega$ (ans. is ⓑ)

Q.11 $C = 45\mu F$

1. series $\Rightarrow C_s = \frac{3C \times 5C}{3C + 5C} = \frac{15}{8}C = 1.87C$
2. parallel $\Rightarrow 2C + 1.87C = 3.87C$
3. series $\Rightarrow C_{eq} = \frac{1C \times 3.87C}{1C + 3.87C} = 0.79C = 0.79 \times 45 = 36\mu F$

(ans. is ⓑ)

Q.12 $d = 5\,mm = 5 \times 10^{-3}$ $V = 600V$, $K = 5$



$E = E_0 - E' \Rightarrow E' = E_0 - E \Rightarrow \left(E = \frac{E_0}{K}\right)$

$\Rightarrow E' = E_0 - \frac{E_0}{K}$ but $E = \frac{\sigma}{\epsilon_0}$ so

$\sigma' = \sigma_0\left(1 - \frac{1}{K}\right)$ and with $E = \frac{V}{d} = \frac{\sigma}{\epsilon_0}$

$\Rightarrow \sigma = \frac{\epsilon_0 V}{d} = \frac{8.85 \times 10^{-12} \times 600}{5 \times 10^{-3}} = 1.06 \times 10^{-6}\, C/m^2$

so

$\sigma' = \sigma\left(1 - \frac{1}{K}\right) = 1.06 \times 10^{-6}\left(1 - \frac{1}{5}\right) = 8.5 \times 10^{-7}\, C/m^2$ (ans. is ⓔ)

Q.23 $\vec{B} = 2\hat{i} - 3\hat{j}$ T , $\vec{U} = (\hat{i} + \hat{j} + 3\hat{k})$ m/s

مركز الرائد

$$\vec{F} = -e\,\vec{U}\times\vec{B} = -e\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 3 \\ 2 & -3 & 0 \end{vmatrix}$$

مركز الرائد

$$= -e\left[\hat{i}(-(-9)) - \hat{j}(-6) + \hat{k}(-3-2)\right] = -1.6\times10^{-19}(9\hat{i} + 6\hat{j} - 5\hat{k})$$

$$= (-14.4\,\hat{i} - 9.6\,\hat{j} + 8\,\hat{k})\times10^{-19}\ N$$

ans is (a)

Q.24 Particle is not deflected (ينحرف) when $F_{tot} = 0$

here $F = qE + qUB = 0 \Rightarrow E + UB = 0 \Rightarrow$

$$U = \frac{-E}{|B|} \Rightarrow |U| = \frac{|E|}{|B|}$$

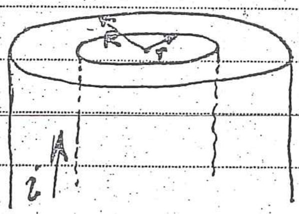
ans is (a)

Q.25 $i = 6A$, $B = 0.5\,T$, $F = ilB\sin 90$ ($\sin 90 = 1$) $\Rightarrow$

$$\frac{F}{l} = iB = 6\times\frac{1}{2} = 3\ N/m = \frac{3\ N}{100\ cm} = 0.03\ N/cm$$

ans is (a)

Q.26 $R = 2.5$ cm , $i = 2.5A$ $r = R/2$



التيار المار في القطاع الذي نريده (نصف قطره r) هو الذي
يولد المجال المغناطيسي عند النقطة المطلوبة على بعد r .
لذا علينا حساب هذا التيار 'i وهو بالطبع جزء من التيار الكلي :

$$i' = \frac{i}{A}\times A' = \frac{2.5}{\pi R^2}\times\pi r^2 = \frac{2.5}{\pi R^2}\,\pi\left(\frac{R}{2}\right)^2$$

$$= \frac{2.5 R^2}{4R^2} = 0.625\ A.$$

مركز الرائد

so

$$\oint B\cdot dl = \mu_0 i \Rightarrow B\cdot 2\pi r = \mu_0 i \Rightarrow B = \frac{\mu_0 i}{2\pi r} = \frac{4\pi\times10^{-7}\times2.5}{2\pi\times1.25}$$

$$B = 1\times10^{-7} = 0.1\times10^{-6} = 0.1\ \mu T$$

ans is (c)

مركز الرائد

Q.27 $i = 20A$, $a = 3cm$, $b = 5cm$

this is $\frac{60}{360} = \frac{1}{6}$ circle, but for full circle $\Rightarrow B = \frac{\mu_0 i}{2R}$ so

for the external arc $B_1 = \frac{1}{6}\frac{\mu_0 i}{2b} = \frac{1}{6}\left(\frac{4\pi\times10^{-7}\times20}{2\times0.05}\right) = 4.19\times10^{-5}$ ⊗ (in)

and for the internal arc $B_2 = \frac{1}{6}\frac{\mu_0 i}{2a} = \ldots\ldots = 6.98\times10^{-5}$ ⊙ (out)

$\Rightarrow B = B_2 - B_1 = (6.98 - 4.19)\times10^{-5} = 27.9\times10^{-6}\ T$ ⊙ (out)

ans is (b)

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Q.28 $l = 30\,cm$, $B = 5\times10^{-4}\,T$, $i = 1A$

for Salinoid: $B = \mu_0 n i = \mu_0 \frac{N}{l} i \Rightarrow N = \frac{Bl}{\mu_0 i} = \frac{5\times10^{-4}\times0.3}{4\pi\times10^{-7}\times1} = 119$ turns

(ans is ©)

Q.29 $N = 50$ turns, $A = 5\times10 = 50\,cm^2 = 50\times10^{-4}\,m^2$, $B_1 = 0$, $B_2 = 0.5T$

$\theta = 0$, $\Delta t = 0.25\,sec.$ Now;

$$\mathcal{E} = -N\frac{\Delta\phi}{\Delta t} = -N\frac{\Delta(B\cdot A)}{\Delta t} = -NA\cos 0\frac{\Delta B}{\Delta t} \Rightarrow$$

$$|\mathcal{E}| = 50\times50\times10^{-4}\times\frac{0.5}{0.25} = 0.5\,V$$

(ans is ⓐ)

Q.30 $d = 5\,cm \Rightarrow r = 2.5\,cm$, $\frac{\Delta B}{\Delta t} = 0.4\,T/s$, $\theta = 0$

$$\mathcal{E} = \frac{\Delta\phi}{\Delta t} = \frac{\Delta(BA\cos0)}{\Delta t} = A\frac{\Delta B}{\Delta t} = \pi(0.025)^2\times0.4 = 0.785\times10^{-3}\,V$$

(ans is ©)

Q.31 $N = 60$ turns, $R = 0.2\,\Omega$, $v = 6\,m/s$, $i = 0.2\,A$, $l = 8\,cm$

$$\mathcal{E} = iR = 0.2\times0.2 = 0.04\,V$$

but $\mathcal{E} = N\frac{\Delta\phi}{\Delta t} = N\frac{\Delta(BA\cos0)}{\Delta t} = NB\frac{\Delta A}{\Delta t} = NBl\frac{\Delta v}{\Delta t}$

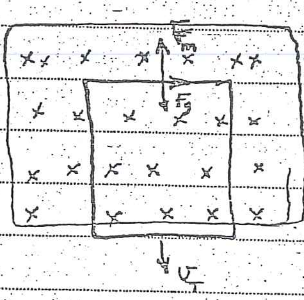
$$\Rightarrow \mathcal{E} = NBlv$$

so $B = \frac{\mathcal{E}}{Nlv} = \frac{0.04}{60\times0.08\times6} = 1.39\times10^{-3}\,T = 1.39\,mT$

(ans is ©)

Q.32 $A = 50\times6 = 300\,cm^2 = 300\times10^{-4}\,m^2$, $m = 5g$, $B = 2T$,

$v_T = 0.3\,m/s$.



بعد أن يخرج الطرف السفلي للحلقة من نطاق المجال المغناطيسي
تصبح القوة المغناطيسية F_m مؤثرة فقط على الطرف العلوي
(حيث أن بقية الأطراف تلغي بعضها لتعاكس الاتجاه)، وهذا
يجعل الحلقة تصل إلى سرعة حدية terminal vel. ، v_T نتيجة
تعادل F_m مع الوزن F_g وتنزل الحلقة لجهة بسرعة ثابتة
ويحدث ذلك لأن الحلقة حسب قاعدة لنز تحاول أن تمنع تناقص الفيض المغناطيسي عبرها
وذلك بأن تولد تياراً حثياً عكسه النظر اليه على انه يحاول ايقاف الحلقة بواسطة القوة F_m
أو أنه يولد مجالاً معززاً لذلك الذي يتناقص أي مجال داخل الصفحة (قاعدة اليد اليمنى) لذلك...

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Q8:-A parallel plate air filled capacitor is charged until a potential difference V appears across it. Another capacitor, having hard rubber (dielectric constant k=3) between its plates but otherwise identical, is also charged to the same potential difference. If the energy of the first capacitor is W, that of the second is

a) W/3 b) W c) 3W d) 9W

Q9:-A charge of 10^{-10} C between two parallel metal plates 1cm apart experience a force of 10^{-5} N. The potential difference between the plates is

a) 10^{-5}V b) 10V c) 10^{3} V d) 10^{5}V

Q10:-An electron whose KE is 150 eV has a speed of

a) 7.3×10^{6} m/s b) 5.1×10^{7} m/s c) 2.3×10^{8} m/s d) 7.3×10^{13} m/s

Q11:-Which of the following combination of length and cross sectional area will give a certain volume of copper the least resistance

a) L and A b) 2L and A/2
c) (1/2)L and 2A d) does not matter because the volume remains

Q12:-A battery of emf ε and internal resistance r is connected to an external resistance R. If R = r

a) the current in the circuit will be minimum
b) the current in the circuit will be maximum
c) the power dissipated in the circuit will be maximum
d) the power dissipated in the circuit will be minimum

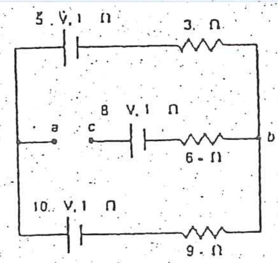
Q13:-When a 100-W, 240-V light bulb is operated at 200 V, the current that flows in it is

a) 0.35A b) 0.42 A c) 0.50 A d) 0.58 A

Q14:- A resistor of unknown resistance is in parallel with a 12-Ω resistor. A battery of emf 24 V and negligible internal resistance is connected across the combination. The battery provides a current of 3A. The unknown resistance is

a) 8 Ω b) 12Ω c) 24Ω d) 36Ω

Q15:-In the circuit shown, the potential difference between points *a* and *c* is:

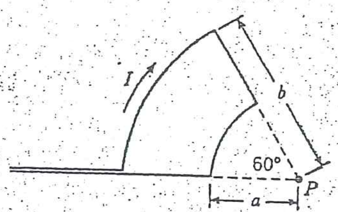


a) 3.2 V b) 1.6 V c) 1.2V d) 5.4V

Q16:-The magnetic field do not interact with

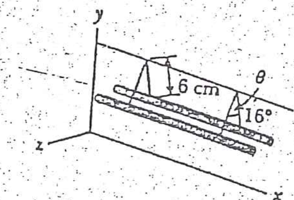
a) stationary electric charge
b) stationary permanent magnet
b) moving electric charge
d) moving permanent magnet

Q23:-Consider the current carrying loop shown ,the magnitude of the magnetic field B at the point *P* is



a) $\mu_o I(b-a)/12ab$ b) $\mu_o I(b^2-a^2)/12ab$ c) $\mu_o ab /12I(b-a)$ d) $12\mu_o (b-a)/Iab$

Q24:-Two long parallel wires ,each having a mass per unit length of 40 g/m ,are supported in a horizontal plane by strings as shown in the figure below. Each wire carries the same current ,I, causing the wires to repel each other so the angle , θ , between the supporting strings is16°. The magnitude and direction for both currents is



a) 7..82 A antiparallel
b) 67.8 A antiparallel
c) 12.3 A parallel
d) 40 A antiparallel

Q25:-A wire carries a steady current 2.4 A. A straight section of the wire with a length 0.75 m along the x axis ,lies in a uniform magnetic field B = 1.2 i+2j+1.6 k If the current flows in the +x direction ,what is the magnetic force on the section of the wire
a)-2.88 j + 3.6 k b) 3.6j –2.88 k c) 1.5 j +1.2 k +2i d) –1.5i

Q.1 deficiency ≡ lack = نقص ans is (b)

Q.2 $k = \frac{1}{4\pi\epsilon}$ where ϵ is the electric permittivity of the medium and for vacuum or air it is ϵ_0, $k = 9*10^9 \frac{Nm^2}{c}$ ans is (b)

Q.3 $E = \frac{F}{q}$ so it is 'force per unit charge' ans is (c)

Q.4 $r_2 = 3r_1 \Rightarrow F_2 = \frac{kQ_1Q_2}{(3r_1)^2} = \frac{F_1}{9}$ ans is (c)

Q.5 Electric field is a vector, while others are scalars ans is (b)

Q.6 since −ve charges repel each other also, then they have +ve potential energy, where −ve pot. energy refers to attraction and $U = k\frac{q_1q_2}{r}$. ans is (c)

Q.7 $E_0 = KE$ so it is less since $K>1$. ans is (a)

Q.8 $K=3$, $U_1 = \frac{1}{2}C_1V_1^2$, $C_2 = 3C_1 \Rightarrow U_2 = \frac{1}{2}(3C_1V_1^2) = 3U_1$
since also $U_2 = KU_1$ ans is (c)

Q.9 $q = 10^{-10}c$ $d = 1cm$ $F = 10^{-5}N$
$F = qE \Rightarrow E = \frac{10^{-5}}{10^{-10}} = 10^{+5}$ N/C ans is (c)
$V = Ed = 10^5 * 10^{-2} = 10^3$ Volts

Q.10 $K.E = 150$ eV $= 150 * 1.6*10^{-19} = 2.4*10^{-17}$ J $= \frac{1}{2}mv^2$,
so
$v = \sqrt{\frac{2*2.4*10^{-7}}{9.11*10^{-31}}} = 7.26*10^6$ m/s ans is (a)

Q.11 (a) $R = \frac{\rho L}{A}$ (b) $\frac{\rho 2L}{A/2} = \frac{2\rho 2L}{A} = 2R$ (c) $\frac{\rho(\frac{L}{2})}{2A} = \frac{R}{4}$
(d) it doesn't depend on the volume as a whole so,.. ans is (c)

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Q.12 س تحرج - نذكر أن القدرة العظمى يمكن الحصول عليها اذا Power transfer
كانت مقاومة الحمل تساوي المقاومة الداخلية ، حيث القدرة تعطى :

$P = I^2 R$ which is max with current.

ans is (c)

Q.13 $P = 100W$, $V_{max} = 240V$, $V = 200V$

هنا تكون مقاومة اللمبة ثابتة بغض النظر عن فرق الجهد على طرفيها وعليها :

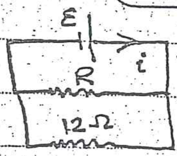
$$P = \frac{V_{max}^2}{R} \Rightarrow R = \frac{(240)^2}{100} = 576 \Omega .$$

وعند التأثير بفرق جهد اقل يكون التيار كما يلي :

$$i = \frac{V}{R} = \frac{200}{576} = 0.347 A$$

ans is (a)

Q.14 $R_1 = ?$, $R_2 = 12 \Omega$, $\varepsilon = 24V$, $i = 3A$



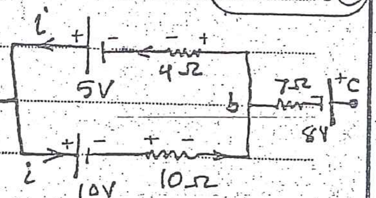
$$R_{eq} = \frac{\varepsilon}{i} = \frac{24}{3} = 8 \Omega , \quad so \quad \frac{R_1 R_2}{R_1 + R_2} = 8 \Omega$$

$\Rightarrow$

$$\frac{12 R_1}{12 + R_1} = 8 \Rightarrow 12 R_1 = 12 * 8 + 8 R_1 \Rightarrow 4R_1 = 96 \Rightarrow R_1 = 24 \Omega$$

ans is (c)

Q.15 لاحظ ان الفرع bc لا تيار فيه لانه غير مغلق
فيكون هناك تيار واحد فقط داخل الحلقة اذا حسبناه
يمكننا اخذ اي مسار من a الى c لحساب فرق الجهد Vac :
من الحلقة الداخلية لدينا المعادلة :



$$-4i + 5 - 10 - 10i = 0 \Rightarrow i = \frac{-5}{14} A .$$

وباخذ مسار عبر الفرع العلوي من الحلقة يكون (لاحظ لا تيار في المقاومة 7Ω) :

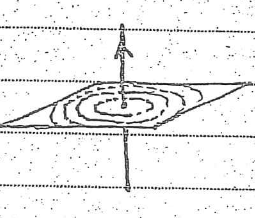
$$V_c - 8 - 4i + 5 = V_a \Rightarrow V_c - V_a = +8 + 4 * \left(\frac{-5}{14}\right) - 5 = 1.57V$$

ans is (b)

Q.16 it interacts with all except stationary electric charge

ans is (a)

Q.17 تظهر برادة الحديد المنثورة على ورق مقوى
تجربة تيار كما في الشكل أن خطوط المجال المغناطيسي
للسلك هي دوائر متمركزة حوله عمودياً عليه .



ans is (c)

Q.18 $F = q v \times B = q v B \sin 0 = 0$ so, no force acts on the electron.

ans is (a)

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Q.19 $qvB = \frac{mv^2}{R} \Rightarrow R_1 = \frac{mv}{qB} \Rightarrow R_2 = \frac{m(2v)}{qB} = 2R_1$

(ans is ⓒ)

Q.20 $N = 10$ turns , $r = 10\,cm$, $i = 5A$, $\vec{B} = 2.55\,T$, $\theta = 90°$

تختزن الطاقة في الملف عند تدويره من $\theta=0$ الى $\theta=90°$ وتكون :

$\mu = NiA = 10 * 5 * \pi (0.1)^2 = 1.57\ A\,m^2$

$\Delta U = -\Delta W = \int_0^{\pi/2} \tau\, d\theta = -\int_0^{\pi/2} B\mu \sin\theta\, d\theta = \mu B \cos\theta \Big]_0^{\pi/2}$

$= \mu B [0 - 1] = -1.57 * 2.55 = 4\,J$

(ans is ⓑ)

Q.21 $d_1 + d_2 = (a-b) \Rightarrow$ in series for capacitors:

$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{d_1}{\epsilon_0 A} + \frac{d_2}{\epsilon_0 A} = \frac{a-b}{\epsilon_0 A} \Rightarrow C = \frac{\epsilon_0 A}{a-b}$

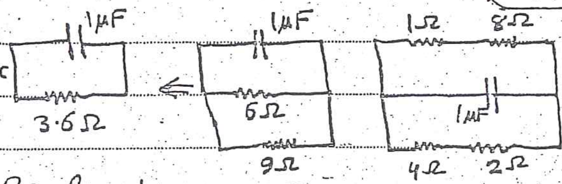
(ans is ⓑ)

Q.22 in discharging:

$V = V_0 e^{-t/RC} \Rightarrow 0.1 V_0 = V_0 e^{-t/RC}$

$0.1 = e^{-t/RC} \Rightarrow$

$-\frac{t}{RC} = \ln 0.1 \Rightarrow t = -RC \ln 0.1 = 8.29\,\mu s$



(ans is ⓐ)

Q.23 from Biot-Savart law:

$B = \int \frac{\mu_0 i}{4\pi} \frac{dl}{R^2} = \frac{\mu_0 i}{4\pi R^2} \int_0^{\pi/3} R\, d\theta = \frac{\mu_0}{4\pi R} \frac{\pi}{3} = \frac{\mu_0 i}{12 R}$

OR for full circle, $B = \frac{\mu_0 i}{2R}$ so for $\frac{1}{6}$ circle $B = \frac{\mu_0 i}{12 R}$

NOW: for arc a $\Rightarrow B_1 = \frac{\mu_0 i}{12 a}$ ⊙ while

for arc b $\Rightarrow B_2 = \frac{\mu_0 i}{12 b}$ ⊗ $\Rightarrow$

$B = B_1 + (-B_2) = \frac{\mu_0 i}{12}\left(\frac{1}{a} - \frac{1}{b}\right) = \frac{\mu_0 i}{12} \frac{b-a}{ab}$ ⊙

(ans is ⓐ)

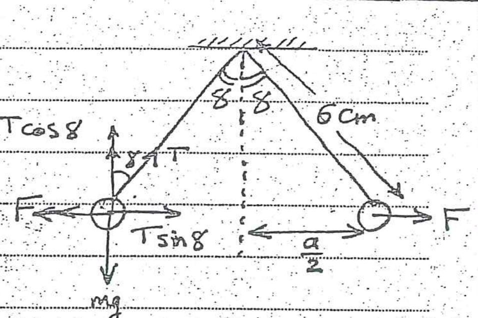
مركز الوافد

مركز الوافد

محمد عوض الله
هاتف ٤٣٩٦٩٣٧

Q.24 $\frac{m}{l} = 40\ g/m$, $\theta = 16°$

بما ان القوة هي تنافر فهذا يعني ان التيارين
مختلفين في الاتجاه : antiparallel :



$T\cos 8 = mg$ and $T \sin 8 = F$

$\Rightarrow$

$\frac{F}{mg} = \tan 8 \Rightarrow F = mg \tan 8 = 40 * 10^{-3} * 10 * \tan 8 = 0.055\ N/m$

but

$\frac{F}{l} = \frac{\mu_o i_1 i_2}{2\pi a} = \frac{\mu_o i^2}{2\pi a} \Rightarrow$ ولإيجاد a من مثلث القائم الزاوية :

$\frac{\frac{a}{2}}{0.06} = \sin 8 \Rightarrow \frac{a}{2} = 0.06 \sin 8 \Rightarrow a = 0.0167 \Rightarrow$

$\frac{F}{l} = \frac{4\pi * 10^{-7} * i^2}{2\pi * 0.0167} = 0.055 \Rightarrow i^2 = 4584.15\ A^2$

$\Rightarrow i = 67.7\ A$ (ans is (b))

Q.25 $i = 2.4\ A$, $\vec{l} = (0.75\ \hat{i})\ m$, $\vec{B} = (1.2\hat{i} + 2\hat{j} + 1.6\hat{k})\ T.$

$\vec{F} = i l B \sin\theta\ \hat{n}$ OR

$$\vec{F} = i \vec{l} \times \vec{B} = 2.4 * \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.75 & 0 & 0 \\ 1.2 & 2 & 1.6 \end{vmatrix}$$

$= 2.4 [\hat{i}(0) - \hat{j}(0.75 * 1.6) + \hat{k}(0.75 * 2)]$

$= 2.4[-1.2\hat{j} + 1.5\hat{k}] = -2.88\hat{j} + 3.6\hat{k}\ N$

(ans is (a))

محمد عوض الله
هاتف ٤٣٩٦٩٣٧

Physics Department
Date: 22/5/1995

Second Semester 1994/95
Time: 3.00 - 5.00 PM

GENERAL PHYSICS 2:(0302-102)
FINAL EXAM

NOTE: $\varepsilon_o = 8.85\times 10^{-12}\ C^2/(N.m^2)$, $m_e = 9.11\times 10^{-31}$ kg, $\mu_o = 4\pi\times 10^{-7}$ Tm/A,
$e = 1.6 \times 10^{-19}$ C, $g = 9.8\ m/s^2$

الاسم باللغة العربية: ____________________

الرقم الجامعي: ________ الشعبة: ________

اسم المدرس: ________

1. Charge of uniform density 8.0 nC/m is distributed along the x axis from x = -2.0 m to x = +3.0 m. The magnitude of the electric field (in N/C) at the point x = +5.0 m on the x axis is:
a. 16; b. 13; c. 19; d. 26; e. 5.0 .

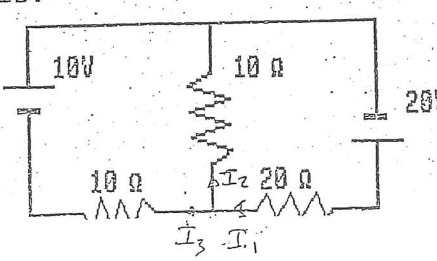
2. Two infinite, uniformly charged, flat surfaces are mutually perpendicular. One of the sheets has a charge density of +30 pC/m^2, and the other carries a charge density of -40 pC/m^2. The magnitude of the electric field (in N/C) at any point not on either surface is:
a. 2.8; b. 5.6; c. 7.9; d. 3.8; e. 4.0 .

3. A particle (charge = 40 μC) moves directly toward a second particle (charge = 80 μC) which is held in a fixed position. At an instant when the distance between the two particles is 2.0 m, the kinetic energy of the moving particle is 24 J. The distance (in m) separating the two particles when the moving particle is momentarily stopped is:
a. 0.75; b. 0.84; c. 0.95; d. 0.68; e. 0.56 .

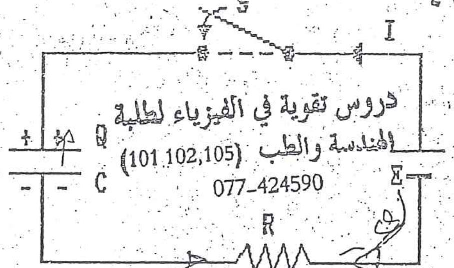
4. A linear charge of nonuniform density $\lambda = bx$, where b = 3.2 nC/m^2, is distributed along the x-axis from x = 2.0 m to x = 3.0 m. The electric potential (in V), relative to zero at infinity, of the point y = 4.0 m on the y-axis is:
a. 36; b. 95; c. 10, d. 17; e. 15 .

5. An electric device, which heats water by immersing a resistance wire in the water, generates 50 cal of heat per second when an electric potential difference of 13 V is placed across its leads. The resistance (in Ω) of the heater wire is: (Note: 1 cal = 4.186 J)
a. 0.94; b. 0.81; c. 0.58; d. 0.69; e. 1.5 .

6. The power (in W) supplied by the 20 V emf is:
a. -10;
b. +10;
c. zero;
d. +20;
e. -20 .



7. At t = 0 the switch S is closed with the capacitor uncharged. If C = 30 μF, Σ = 50 V, and R = 10 kΩ, then the potential difference (in V) across the capacitor when I = 3.0 mA is:
a. 20; b. 15; c. 25;
d. 30; e. 45 .

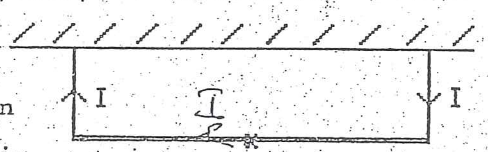


دروس تقوية في الفيزياء لطلبة
الهندسة والطب (101 102,105)
077-424590

8. A 2.0 C charge moves with a velocity of $(2\hat{i} + 4\hat{j} + 6\hat{k})$ m/s and experiences a magnetic force of $(4\hat{i} - 20\hat{j} + 12\hat{k})$ N. The x component of the magnetic field is equal to zero. The z component of the magnetic field (in T) is:
a. -3.0; b. +3.0; c. +5.0; d. -5.0; e. +6.0 .

9. A current of 4.0 A is maintained in a single circular loop having a circumference of 80 cm. An external magnetic field of 2.0 T is directed such that the angle between the field and the plane of the loop is 70°. The magnitude of the torque (in N.m) exerted on the loop by the magnetic forces acting upon it is:
a. 0.41; b. 0.14; c. 0.38; d. 0.27; e. 0.77 .

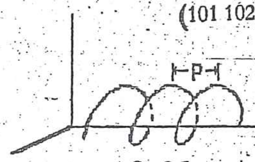
10. A wire (mass = 50 g, length = 90 cm) is suspended horizontally by two vertical wires which conduct a current I = 12.0 A, as shown. The magnetic field in the region is into the paper and has a magnitude of 80 mT. The tension (in N) in either wire is:
a. 0.15; b. 0.68; c. 0.30; d. 0.34; e. 0.10 .



11. An electron which moves through a velocity selector (E = 4.0 kV/m, B = 2.0 mT) subsequently follows a circular path (radius = 6.3 mm) in a uniform magnetic field. The magnitude of this magnetic field (in mT) is:
a. 1.8; b. 2.4; c. 3.2; d. 2.8; e. 4.6 .

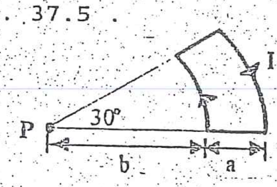
دروس تقوية في الفيزياء لطلبة
الهندسة والطب (101 102,105)
077-424590

12. A charged particle moves in a region of uniform magnetic field along a helical path (radius = 2.7 cm, pitch, P = 20 cm, period = 2.0 ms). The speed (in km/s) of the particle as it moves along this path is:
a. 0.13; b. 0.10; c. 0.16; d. 0.23; e. 0.06 .



13. Two long parallel wires, separated by 16 cm carry equal currents in opposite directions. If the magnitude of the magnetic field is 50 μT at a point between the wires that is 10 cm from one of them, then the current (in A) in each wire is:
a. zero; b. 9.4; c. 15; d. 25; e. 37.5 .

14. In the figure shown beside, if a = 2.0 cm, b = 5.0 cm, and I = 25 A, then the magnitude of the magnetic field (in μT) at the point P is:
a. 4.5; b. 7.5; c. 9.0;
d. 6.0; e. 3.6 .



15. A straight wire (length = 8.0 m) is bent to form a square. If the wire carries a current of 30 A, then the magnitude of the magnetic field (in μT) at the center of the square is:
a. 17; b. 14; c. 11; d. 20; e. 36 .

16. A solenoid 4.0 cm in radius and 4.0 m in length has 5000 uniformly spaced turns and carries a current of 5.0 A. Consider a plane circular surface (radius = 2.0 cm) located at the center of the solenoid with its axis coincident with the axis of the solenoid. The magnetic flux (in μWb) through this surface is:
a. 63; b. 16; c. 250; d. 10; e. 5.0 .

University of Jordan
Department of Physics
Faculty of Science

Final Exam (102)

Date: 22/5/93
Time: 2 hour

Student Name: ____________________ Student No.:------------
Instructor: ____________________ Section Number:----------

$g = 9.8\ m.s^{-2}$ $\mu_o = 4 X 10^{-7}$ wb/A.m

$e = 1.6 X 10^{-19}$ C

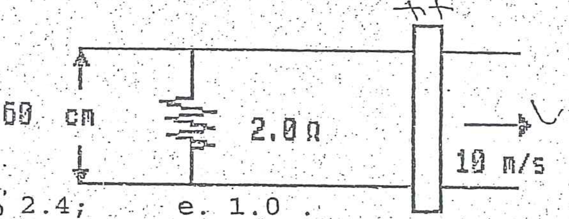
Q.No.	A	B	C	D	E
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

Total Mark ٥١ 20

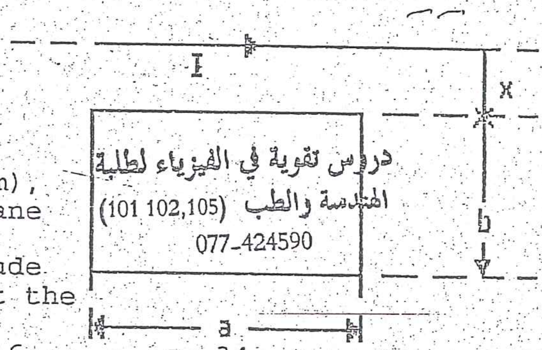
. A 20-turn circular coil (radius = 4.0 cm, total resistance = 0.20 Ω) is placed in a uniform magnetic field directed perpendicular to the plane of the coil. The magnitude of the magnetic field varies with time as given by $B = 50 \sin(10 \pi t)$ mT where t is measured in seconds. The magnitude of the induced current (in mA) in the coil at 0.10 s is:
a. 50; b. 1579; c. 320; d. zero; ⓔ 790 .

. A conducting rod (length = 80 cm) rotates at a constant angular rate of 15 revolutions per s about a pivot at one end. A uniform field (B = 90 mT) is directed perpendicularly to the plane of rotation. The magnitude of the emf induced (in V) between the ends of the rod is:
ⓐ 2.7; b. 2.1; c. 2.4; d. 1.8; e. 3.3 .

. A conducting bar moves along parallel frictionless conducting rails connected on one end by a 2.0 Ω resistor as shown. A uniform 1.60 T magnetic field makes an angle of 60° with the normal to the paper. The current (in A) in the resistor is:
a. 2.1; b. 1.6; c. 1.2; ⓓ 2.4; e. 1.0 .



). A long straight wire carrying current (I = 100 A) is parallel to one edge and is in the plane of a single-turn rectangular loop (a = 50 cm and b = 6.0 cm), as shown. If the loop is moving in the plane shown so that the distance x changes at a constant rate of 20 cm/s, then the magnitude of the emf induced (in μV) in the loop at the instant x = 5.0 cm is:
ⓐ 11; b. 22; c. 27; d. 16; e. 34 .



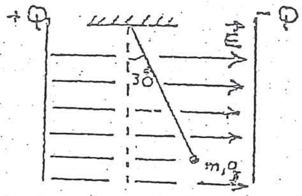
END OF QUESTIONS

ANSWER TABLE Key

Q.No.	a	b	c	d	e	Q.No.	a	b	c	d	e
1				X		11	X				
2	X					12	X				
3	X					13		X			
4					X	14		X			
5		X				15	X				
6				X		16				X	
7	X					17					X
8			X			18	X				
9		X				19				X	
10		X				20		X			

Q.1 A small sphere of mass 0.1 gm is suspended by a light string between two charged parallel plates 5cm apart. The electric field between the plates is uniform and the charge on the sphere is 6×10^{-9} C. If the string makes an angle of 30° with the vertical (at equilibrium), then the potential difference (in volt) between the two plates is :

a) 9430
b) 8166
c) 4715
d) 4083
e) 5200



Q.2 Eight charged spherical raindrops each of radius r and each at a potential 6 V combine to form a single raindrop of radius R. The potential of the large drop is :

a) 16 V b) 12 V c) 32 V d) 24 V
e) 48 V

Q.3 A solid insulating sphere of radius R has a uniform charge density ρ. The sphere is located at the center of a cube of side 2R. The electric flux through each face of the cube is :

a) $\frac{4}{3}\frac{\pi R^3\rho}{\epsilon_0}$ b) $\frac{3}{4}\frac{\pi R^3\rho}{\epsilon_0}$ c) zero

d) $\frac{9}{2}\frac{\pi R^3\rho}{\epsilon_0}$ e) $\frac{2}{9}\frac{\pi R^3\rho}{\epsilon_0}$

Q.4 An air filled parallel-plate capacitor is charged and insulated (disconnected from the source). The plates are brought closer togather, using insulated handles to move them . Which of the following statements is correct?

a) The potential difference between the plates increases,
b) The potential difference between the plates decreases,
c) The charge on each plate increases,
d) The charge on each plate decreases,
e) The capacitance decreases.

Q.5 A resistance wire has a cross sectional area of 0.02 cm^2, a resistance of 0.6 Ω and a length of 3 m . Its conductivity $(\text{ohm-m})^{-1}$ is:

a) 6×10^{6} b) 3.76×10^{6} c) 5×10^{6}
d) 1.25×10^{6} e) 2.5×10^{6}

Q.6 An electron is moving with a velocity $\vec{v}=(5\hat{i}+3\hat{j})\times10^{14}\,m.s^{-1}$ in a magnetic field $\vec{B}=0.003\,\hat{i}$ T. The magnetic force (in N) on the electron is:

a) $1.44\times10^{-7}\,\hat{k}$ b) $-2.88\times10^{-7}\,\hat{k}$ c) $+2.88\times10^{-7}\,\hat{k}$
d) $-1.44\times10^{-7}\,\hat{k}$ e) Zero

(1) $A = 3.6\,cm^2$, $\Delta V = 20V$, $d = 1.8\,mm$

$q = ??$

$q = C\Delta V$, $C = \frac{A\varepsilon_0}{d} \rightarrow C = 1.77\times10^{-12}\,pF$

$\rightarrow q = C\Delta V = 3.54\times10^{-11}\,C = 35.4\,pC$

(2) $E_{max} = 6\times10^{7}\,V/m$, $A = 1.75\,cm^2$, $d = 0.06\,mm$

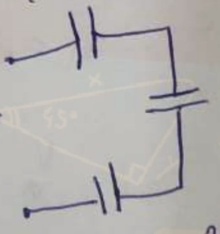
$\Delta V_{max} = ??$

$\Rightarrow \Delta V_{max} = E_{max}\, d = 3600\,V = 3.6\,kV$

(3) $U = 0.78\,mJ$

$V_2 = ??$, V

$C_1 = 25\,\mu F$



$C_2 = 50\,\mu F$

$V_{ab} = 28V$

$C_3 = 25\,\mu F$

$U = \frac{q^2}{2C} = \frac{CV^2}{2} = \frac{1}{2}qV$

$\hookrightarrow U = 7.84\times10^{-4}\,J = 0.78\,mJ$

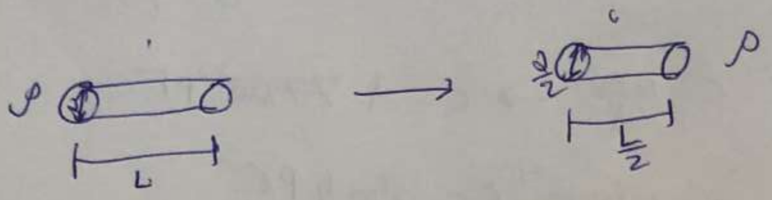
$\rightarrow q = q_2 = q_3 \rightarrow$, $V_2 = \frac{q}{C_2}$, $q = C_{eq}V_{ab}$

$\rightarrow \frac{1}{C_{eq}} = \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right) \rightarrow C_{eq} = 10\,\mu F$

$\rightarrow q = 2.8\times10^{-4}\,C \rightarrow V_2 = \frac{q}{C_2} = \frac{2.8\times10^{-4}}{50\times10^{-6}} = 5.6V$

(4)

$R_1 = \rho \frac{L}{A}$, $R_2 = ??$



$R_2 = ??$

$A_1 = \frac{\pi}{4} d^2$

$A_1 = \frac{\pi}{4} d^2$

$L_1 = L$

$A_2 = \frac{\pi}{4} \left(\frac{d}{2}\right)^2 = \frac{\pi}{4} d^2 \times \left(\frac{1}{4}\right)$

$A_2 = \frac{1}{4} A_1$

$L_2 = \frac{1}{2} L_1 = \frac{1}{2} L$

$R_2 = \rho \frac{\frac{1}{2} L}{\frac{1}{4} A} = 2 \frac{\rho L}{A} = 2R$

$\rightarrow \boxed{R_2 = 2R_1}$

---

(5)

$A = 4 \times 10^{-6}\ m^2$ $\quad n = 6.0 \times 10^{+28}\ e/m^3$

$I = 7A$ $\quad v_d \rightarrow ??$

$J = n(q) v_d$

$I = nqA\, v_d \rightarrow v_d = \frac{I}{nqA} = 1.8 \times 10^{-4}\ m/s = 0.18\ mm/s$

(6) $d = ??$. $E = 1.4\times10^{7}\,J$, $P = 8\times10^{3}\,W$

$\Delta V_{battery} = 12\,V$ $V = 20\,m/s$

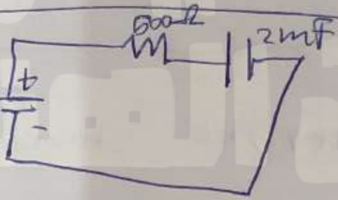
$E = Pt \rightarrow 1.4\times10^{7} = 8\times10^{3}\,t \rightarrow t = 1750\,s$

$\rightarrow d = vt = 35000\,m = 35\,km$

$d = 35\,km$ answer : E

---

(7) $t = 2.3\,s$



$t = ??$ when $I = \frac{1}{10} I_{max}$

$I = I_{max}\, e^{-t/RC}$

$I_{max} = \frac{\varepsilon}{R} = 0.024\,A$

$I = 0.0024\,A = 2.4\times10^{-3}\,A$

$\rightarrow 2.4\times10^{-3} = 2.4\times10^{-2}\, e^{-t/2}$

$2.4\times10^{-3} = 2.4\, e^{-t} \rightarrow$

$\rightarrow 0.1 = e^{-t} \rightarrow t = 2.3\,s$

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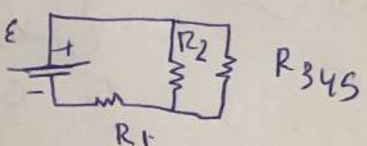
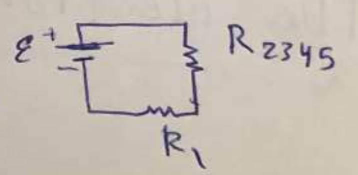
(8) $V_2 = 8.47\,V$ $V_2 = ??$, $V_2 = I_2 R_2$

$\varepsilon = 12\,V$



$R_{345} = R_3 + R_4 + R_5 = 30\,\Omega$

$R_{2345} = \left(\frac{1}{R_{345}} + \frac{1}{R_2}\right)^{-1} = 12\,\Omega$



$R_{eq} = R_{2345} + R_1$

$R_{eq} = 17\,\Omega$, $I_1 = I_{total} = I_{2345} = \frac{\varepsilon}{R_{eq}} = 0.705\,A$

$V_1 = 3.53\,V$ $V_{2345} = 8.47\,V$ = $V_2 = V_{345}$

(9) $\boxed{\tau = 0.41\,Nm}$ $I = 25\,A$ ~~L = 50 cm~~ ~~$A = L^2 (50 \times 10^{-2})^2$~~

$L = 50\,cm$

$B = 80\,mT$ $\tau = ??$

$\theta = 90 - 35 = 55^0$

$\tau = IAB \sin\theta = 0.41\,N.m$

---

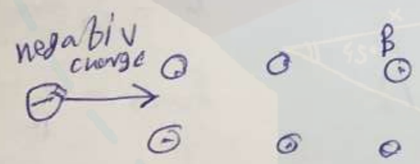
(10) $L = 70\,Cm$ $I = 50\,A$ $\theta = 60^0$

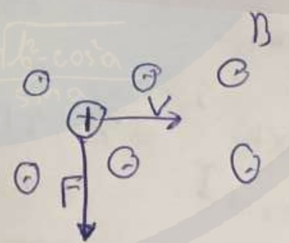
$F = 1.7\,N$

$B = \frac{F}{IL\sin\theta} = 56.1 \times 10^{-3}\,T = \boxed{56.1\,mT}$

---

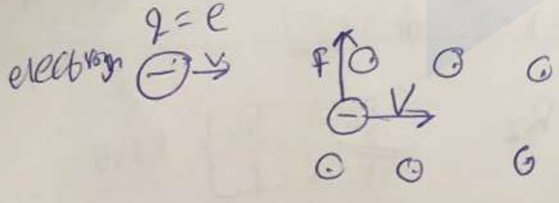
(11) using the right hand rule





if postive

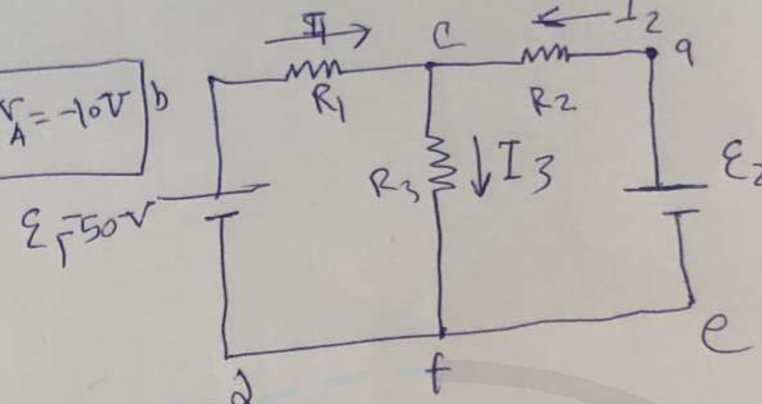
$q = e$



since negtiv its $(\vec{F})$ the opposite direction of the postive charge

$\Rightarrow$ **the electron will be deflected upward** answer

(12) $V_b - V_A = -10V$

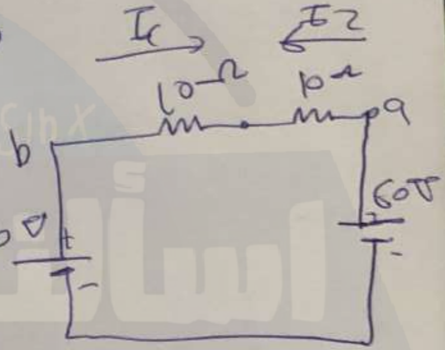


$R_1 = R_2 = 10\Omega$

$R_3 = 20\Omega$

$V_b - V_a = ??$

⟹ Kirchoff's law $\sum V = 0$



Take path of abcda

→ Assume direction

$$+V_A - 10I_2 + 10I_1 - V_b = 0$$

$$\rightarrow (V_A - V_b) = 10I_2 + 10I_1$$

$V_A = +60 \quad V_b = +50 \rightarrow 60 - 50 = 10I_2 + 10I_1$

$10 = 10I_2 + 10I_1 \Rightarrow V_A - V_b = 10 \rightarrow$ $V_b - V_A = -10V$

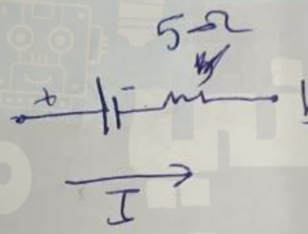
(1) $I = 5A \quad t = 5s \quad n = ??$

$q = ne \rightarrow n = \frac{q}{e} \quad , \quad q = It = 25C$

$\rightarrow \boxed{n = 1.6 \times 10^{20}}$

$\boxed{p = 72W}$

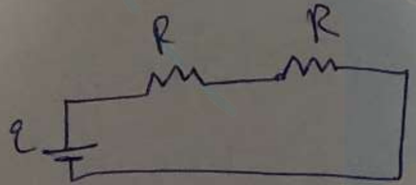
(2) $I = 3.8\,A \rightarrow$



$\boxed{p = I^2 R = 72W}$

---

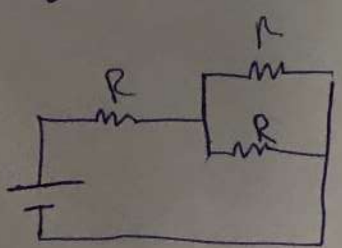
(3)



$R_{eq} = 2R$

$\rightarrow I_1 = \frac{\varepsilon}{2R} = \frac{1}{2}\frac{\varepsilon}{R}$

↓

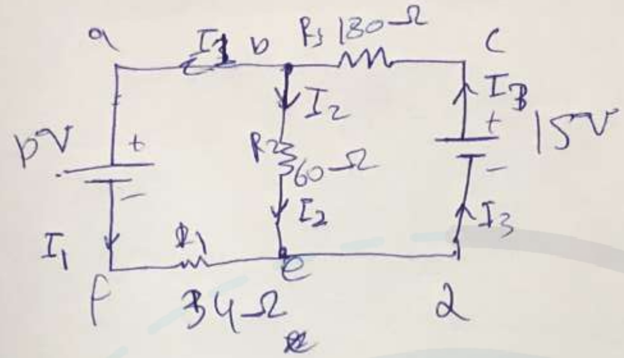


$R_{eq} = \frac{3}{2}R \rightarrow I_2 = \frac{\varepsilon}{\frac{3}{2}R} = \frac{2}{3}\frac{\varepsilon}{R}$

$\Rightarrow I_2 > I_1 \rightarrow p = I^2 R \rightarrow \boxed{P_2 > P_1}$

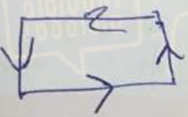
$\Rightarrow$ power will increase dissipitation

(4)

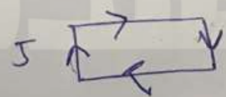


$$I_3 = I_1 + I_2$$

→ $\Sigma V = \Sigma IR$ ~~acd~~ path bcdeb

Assume 

→ $+15 = 180 I_3 + 60 I_2 \rightarrow 15 = 180 I_1 + 240 I_2$

Take path abefa 

$\Sigma V = \Sigma IR \rightarrow 10 = 60 I_2 - 34 I_1$

→ solve (1) $15 = 180 I_1 + 240 I_2$

$10 = -34 I_1 + 60 I_2$

→ $I_1 = -0.0791 A$

$I_2 = 0.1218 A$

$$I_3 = I_1 + I_2 = 0.043 \text{ A}$$

(5)

$E = 2\,kV/m \; , \; B = 8\,mT \qquad K = ??$

$$V = \frac{E}{B} = 250 \times 10^{3}\ m/s$$

$$K = \tfrac{1}{2} m V^2 = 2.846 \times 10^{-20}\ J$$

$$\Rightarrow K = 2.846 \times 10^{-20}\ J \ast \frac{1\ eV}{1.6 \times 10^{-19}\ J}$$

$$\boxed{K = 0.177\ eV = 0.18\ eV}$$

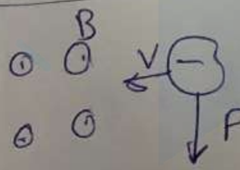
---

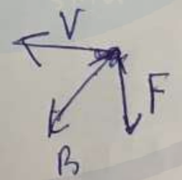
(6) $I = 0$ RC circuits when the switch is closed for a very long time $Q = Q_{max}$, $I = 0$

$$\Rightarrow I(t) = 0$$

---

(7)





deflected downward

---

(8)

$N = 200 \qquad I = 4A \qquad r = \frac{d}{2} = 1\,cm$

$B = 0.35\,T \qquad \theta = 90 - 30 = 60^{\circ} \qquad \boxed{A = \pi r^2}$

$$\tau = NIAB \sin\theta = 0.076\ N.m$$

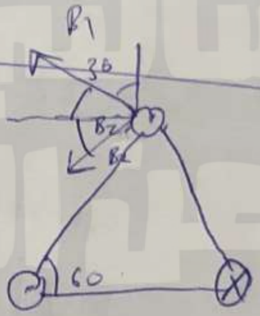
(9)

$$B = \mu_0 n I = \frac{\mu_0 N I}{L}$$

$$B_1 = \frac{\mu_0 N I}{L} \qquad B_2 = \frac{\mu_0 (2N) I}{2L} = \frac{\mu_0 N I}{L}$$

$\Rightarrow B_1 = B_2 = \text{constant}$

$\Rightarrow$ $\boxed{B_1 = \boxed{1}\, B_2}$



(10)

$$B_x = B_1 \cos 60 + B_2 \cos 60$$

or $B_x = B_1 \sin 30 + B_2 \sin 30$

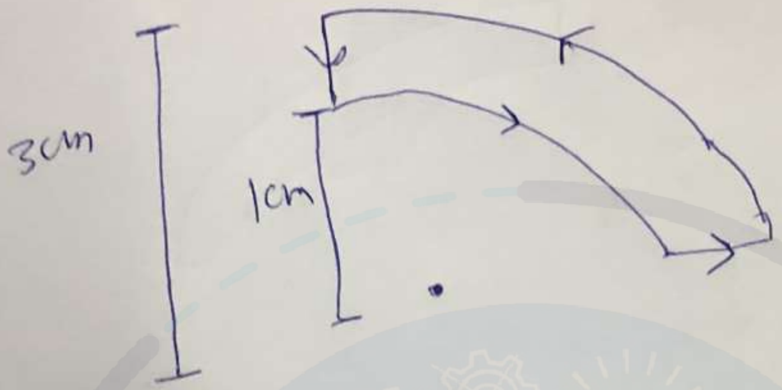
$B_y = 0$ $\qquad \Rightarrow B_x = 2B_1 \cos 60$

$$B_1 = B_2 = \frac{\mu_0 I}{2\pi r_1} * \cos 60 = \frac{2\times10^{-7} * I}{r_1} * \cos 60 \quad \rightarrow \boxed{F = \frac{2 I_1 I_2 L}{2\pi d} \times \mu_0}$$

$$F = 2 * \frac{2\times10^{-7} I^2 L}{r_1} \cos 60 = \frac{2\times10^{-7} \times 20^2 \times 1}{5\times10^{-3}} \times \cos 60$$

$$F_1 = 8\times10^{-3}\,N \rightarrow F_{net} = 2F_1 = 16\times10^{-3} = 16\ mN$$

(11)



$$B = \frac{\mu_0 I}{4\pi R_1} \odot - \frac{\mu_0 I}{4\pi R_2} \odot$$

$$= \frac{\mu_0 I}{4\pi} \odot \left[\frac{1}{R_1} - \frac{1}{R_2}\right] = 1.047\times10^{-4}\ T$$

$$B = 0.104\ mT$$

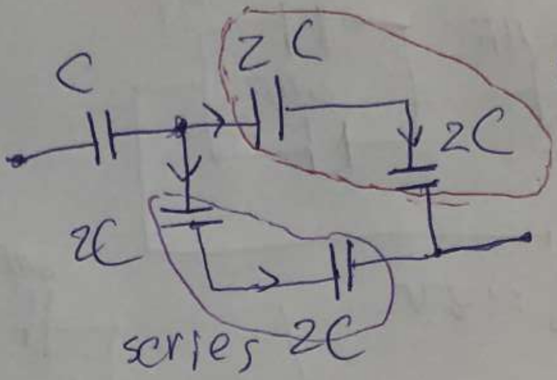
---

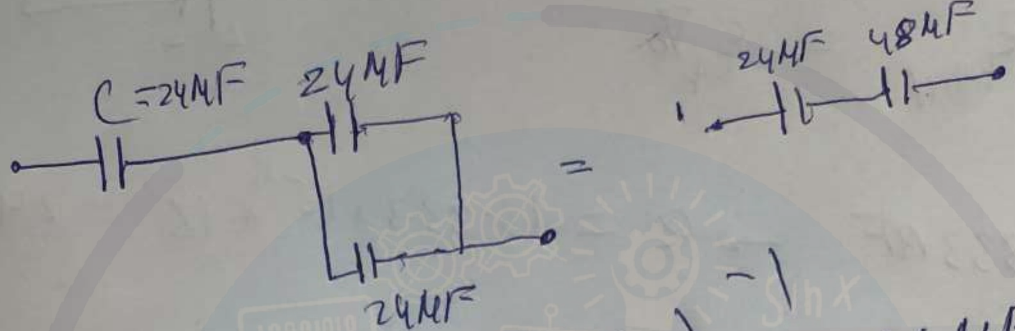
(12) $R = 2cm$ $I = 20A$ $r = 1.5cm$

$$B = \frac{\mu_0 I}{2\pi} \frac{r}{R^2} \quad (r < R)$$

$$= 1.5\times10^{-4}\ T = 0.15\ mT$$

(1)

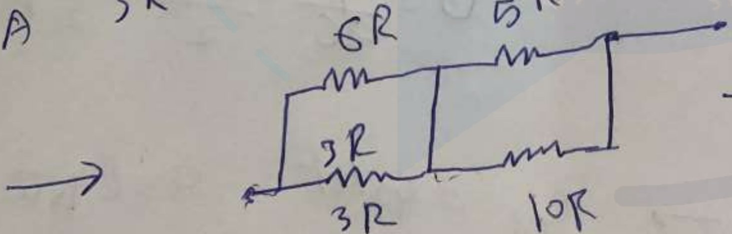


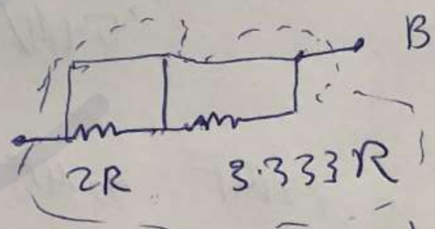


$$\Rightarrow C_{eq} = \left(\frac{1}{24} + \frac{1}{48}\right)^{-1} = 16\,MF$$

(2)

$R = 18\,\Omega$



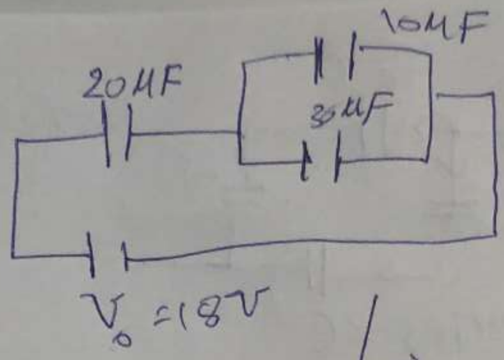


$\Rightarrow$ 2R and (3.333 R) are connected in series

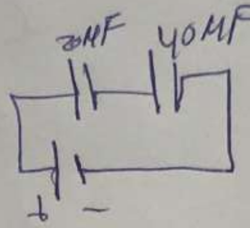
$$\Rightarrow R_{eq} = 2R + 3.3333R = \frac{16}{3}R$$

$$\Rightarrow R_{eq} = \frac{16}{3} \times 18 = 96\,\Omega$$

(3)



$Q_1 = ??$



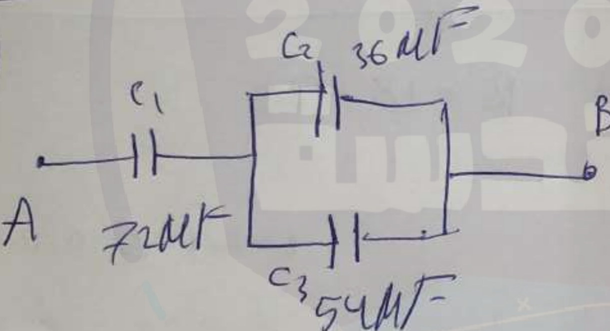
$Q_1 = Q_{total} = C_{eq} V_0$

$C_{eq} = 13.333\,\mu F \rightarrow Q = 13.333\times10^{-6} * 18 = 240\times10^{-6}\,C$

$\boxed{Q = 0.24\,mC}$

---

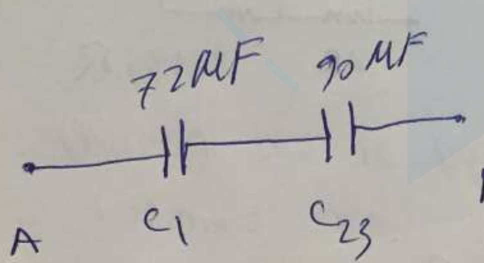
(4)



$V_A - V_B = \Delta V = 50\,V$

$U = ??$ @ $C = 54\,\mu F = ??$

$U = \frac{q^2}{2C} = \frac{CV^2}{2} = \frac{1}{2} qV$



$\rightarrow C_{eq} = 40\,\mu F$ $\quad Q = C\Delta V$

$Q_{total} = 40\times10^{-6} * 50$

$Q = 2\times10^{-3}\,C$

$\Rightarrow V_{23} = \frac{Q_{23}}{C_{23}} = 22.222\,V$

$Q_1 = Q_{23}$

$\Rightarrow \boxed{U_3 = \frac{C_3 V_{23}^2}{2} = 13.33\times10^{-3}\,J = \boxed{13.3\,mJ}}$

(5)

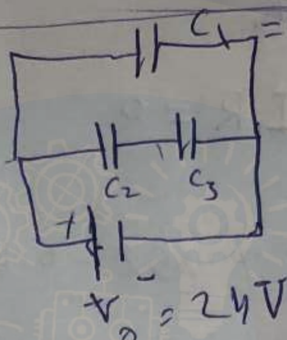
$l = 30\,m \quad A = 5\times10^{-6}\,m^2 \quad \rho = 1.7\times10^{-8}\,\Omega m$

$R = ??\ , \quad R = \rho\frac{L}{A} = 0.102\,\Omega = 0.10\,\Omega$

$\rightarrow \boxed{R = 0.1\,\Omega}$

---

(6)



$C_1 = 5\mu F$

$C_2 = 15\mu F$

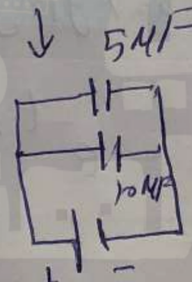
$C_3 = 30\mu F$

$V_2 = ??$

$V_2 = \frac{q_2}{C_2}$

$q_3 = q_2$!!

$V_1 = V_{23} = 24V$



$\Rightarrow C_{23} = 10\mu F$

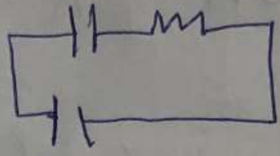
$\rightarrow V_{23} = 24V$

$\rightarrow q_{23} = q_2 = q_3 = C_{23}V_{23}$

$\boxed{q_{23} = 2.4\times10^{-4}\,C}$

$\rightarrow \boxed{V_2 = \frac{q_{23} = q_2 = q_3}{C_2} = \frac{q_2}{C_2} = 16\,V}$

(7)



ε

$\tau = ??$

$V_{capacitor} = 85\ V_{max}$

$V_{max} = \varepsilon$

$t = 2.4s$

$\Rightarrow \Sigma V = 0$

$\varepsilon - V_c - V_R = 0$

$\varepsilon - 0.85\varepsilon - IR = 0$

$IR = 0.15\,\varepsilon \rightarrow \varepsilon - 0.85\varepsilon - 0.15\varepsilon = 0 \rightarrow$ no result

from capacitor charging equation

$\frac{q(t)}{C} = \frac{Q_{max}}{C}(1 - e^{-t/\tau})$, $V_C = \frac{q(t)}{C}$

$V_c = \varepsilon(1 - e^{-t/\tau})$ $\qquad \frac{Q_{max}}{C} = \varepsilon$

$\Rightarrow 0.85\,\varepsilon = \varepsilon(1 - e^{-t/\tau})$ $\qquad V_C = 0.85\,\varepsilon$

$0.85 = (1 - e^{-t/\tau}) \longrightarrow$ solve for τ

$\Rightarrow \boxed{\tau = 1.265\ s = 1.27s}$

(8)

$P = I^2 R$

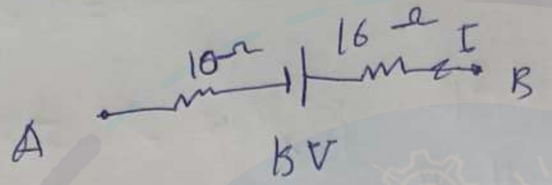
$I = 4A$

$R = 2\Omega$

$P = 32W$

---

(9)



$V_B - V_A$

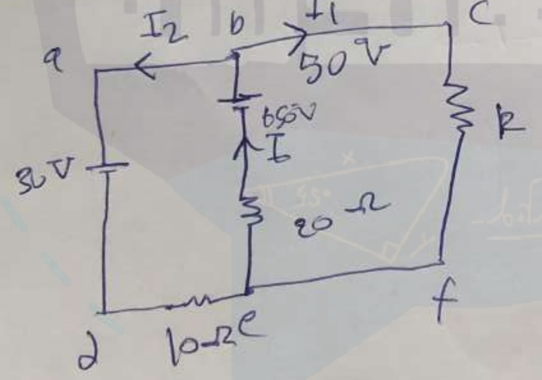
$I = 0.5A$

$\Sigma V = 0 \rightarrow V_B - (0.5 * 16) - (15) - (0.5 * 10) - V_A = 0$

$\rightarrow V_B - V_A - 28 = 0 \rightarrow V_B - V_A = +28V$

---

(10)

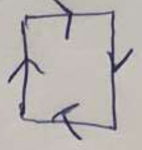


$I = 1.5\Omega$

$R = ??$

$1.5 = I_1 + I_2$ (1)

bcfeb



$\Sigma V = 0 \rightarrow +50 - (20 * 1.5) - (I_1 R) = 0$ ($=30$)

$20V = I_1 R$ (2)

abeda →

$\Sigma V = 0 \rightarrow +50 - (20 * 1.5) - (30) - (10 * I_2) = 0$

Assumption

abcda

$\Sigma V = 0 \rightarrow (50 - 20 \times 1.5) - (30) - (10 I_2) = 0$

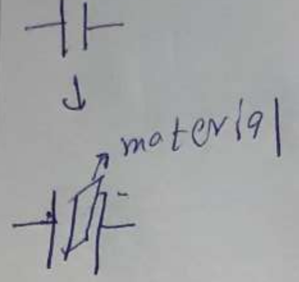
$\Rightarrow -10 = 10 I_2 \rightarrow \boxed{I_2 = -1 A}$

From eq ① $I_1 + I_2 = 1.5 \rightarrow \boxed{I_1 = 2.5 A}$

from eq ② $20 = I_1 R \rightarrow 20 = 2.5 R$

$\rightarrow \boxed{R = 8 \Omega}$

① [C] charge will stay the same
inserting an dielectric material
only increases the capacitance
not the charge



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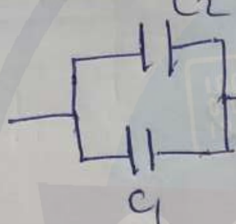
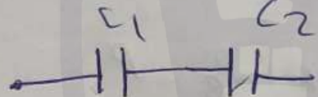
②



$\rightarrow$ $C_1 + C_2 = 10\ pF$ ①



$\rightarrow$ $\frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{1.6}$

$\rightarrow$ $\frac{C_1 C_2}{C_1 + C_2} = \frac{5}{8}$ ②

$\rightarrow 5(C_1 + C_2) = 8C_1C_2$

$\rightarrow 5C_1 + 5C_2 = 8C_1C_2 \rightarrow$ no result

The equation will yield results that are not in the choices

$\Rightarrow$ the best way to solve is to try the choices

try $(C_1, C_2) = (8, 2) \Rightarrow$ The answer is $(8, 2)$

$\left(\frac{1}{8} + \frac{1}{2}\right)^{-1} = 1.6$ ✓ $8 + 2 = 10$ ✓

(3) $q = 4\,nC$ $\qquad d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$

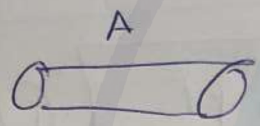
$(x_1, y_1) = (-1.2, 1.1)\ mm$ $\qquad d = 3.53\ mm$

$(x_2, y_2) = (1.4, -1.3)$

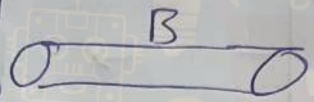
$\boxed{p = qd = 14.2 \times 10^{-12}\ C}$

---

(4)



material same
same length



$R_A = 3R$ $\qquad \boxed{L_A = L_B,\ \rho_A = \rho_B}$ $\qquad R_B = R$

$L_A = L,\ \rho_A = \rho$ $\qquad A_B,\ L_B = L_A,\ \rho_B = \rho$

$\dfrac{A_B}{A_A} = ??$ $\qquad R_A = \rho \dfrac{L}{A_A} = 3R \Rightarrow A_A = \frac{1}{3} A$

$R_B = \rho \dfrac{L}{A_B} = R \rightarrow \boxed{A_B = 3A_A}$

$\rightarrow \boxed{\dfrac{A_B}{A_A} = 3}$ answer

---

(5) $I = Anq\,V_d \rightarrow V_d = \dfrac{I}{Anq} = 1.04 \times 10^{-4}\ m/s$

$I = 10A$

$q = +e$ $\qquad \boxed{V_d = 1.04 \times 10^{-4}\ m/s \text{ answer A}}$

$d = 3mm$

$n = 8.5 \times 10^{+28}$

$A = \pi \left(\frac{d}{2}\right)^2 = \frac{\pi}{4} d^2$

(6) $P = \frac{V^2}{R} \rightarrow R = \frac{V^2}{P} = 11.1\ \Omega$

$V = 120\ V$

$P = 1.3\ kW$

$R = 11.1\ \Omega$ answer

---

(7) $RC = 0.5$

$R = 100\ \Omega$

$C = 5000\ \mu F$

$t = 1\ s$, $\varepsilon = 120\ V$

$I(t) = I_{max}\, e^{-t/RC}$

$I_{max} = \frac{\varepsilon}{R} = 1.2\ A$

$I(t) = 1.2\, e^{-1/0.5)}$

$I(t) = 1.2\, e^{-2} = 0.16\ A$

---

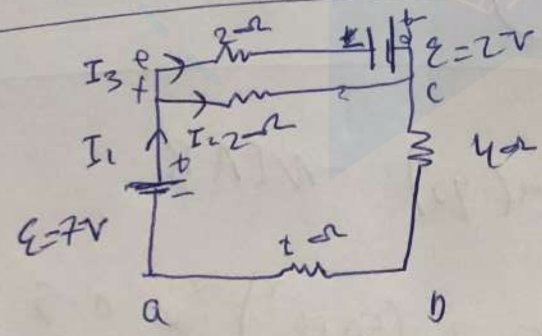
(8) $\varepsilon - Ir = IR$

$150 - 14r = 9.9 * 14$

$\rightarrow r = 0.8\ \Omega$

---

(9)



$I_3 = 1.17\ A$

$I_1 = I_2 + I_3$

$I_1 = I_2 + 1.17$

$(I_1, I_2) = (1.33, 0.17)$

cdefc

$\Sigma V = 0 \rightarrow -2 + (2 \times 1.17) - (2 I_2) = 0$

$\rightarrow 2I_2 = 2.34 - 2 \rightarrow I_2 = 0.17\ A$

(10)

$\vec{V} = i - j + 2k$ $\rightarrow \vec{F}_B = q * (\vec{V} \times \vec{B})$

$\vec{B} = (i - j - \hat{k})$

$\rightarrow \vec{V} \times \vec{B} = (3, 3, 0) \rightarrow |\vec{V} \times \vec{B}| = \sqrt{3^2 + 3^2}$

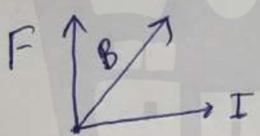
$= 4.24 \frac{m\,T}{s}$

$\rightarrow F_B = q(\vec{V} \times \vec{B}) = 1.6 \times 10^{-19} \times 4.24 = 6.8 \times 10^{-19} N$ answer

---

(11)

$\frac{F}{L} = IB \rightarrow B = \frac{F}{IL} = 0.008 T$



$\vec{F} = I\vec{L} \times \vec{B}$

using the ~~righ~~ right hand rule

$\Rightarrow$ B is into the page

$B = 0.008 \otimes = -0.008 \hat{k}$

---

(12)

$\tau_{max} = NIAB \sin(90^\circ) = NIAB$

$\tau = 30 * 5 * \pi (5 \times 10^{-2})^2 * 0.5$

$\tau = 0.59\ Nm$ answer

(1)

$A = 5\times10^{-6}\,m^2$ $\rho = 3.5\times10^{-5}\,\Omega m$, $\Delta V = 15\,V$

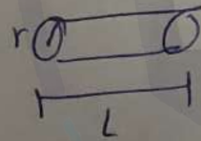
$I = 4\times10^{-3}\,A$, $L = ??$, $R = \frac{\Delta V}{I} = \frac{\rho L}{A}$

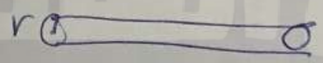
$\frac{\Delta V}{I} = \frac{\rho L}{A} \rightarrow L = \frac{\Delta V}{I} \times \frac{A}{\rho} = 535.71\,\Omega$

$R = 536\,\Omega$ answer

---

(2)





$A = \pi r^2$ $A = \pi r^2$

L_1 $L_2 = 2L_1$

$R_1 = \rho \frac{L_1}{A}$ $R_2 = \rho \frac{L_2}{A} = \rho \frac{2L_1}{A}$

$R_2 = 2R_1$ answer

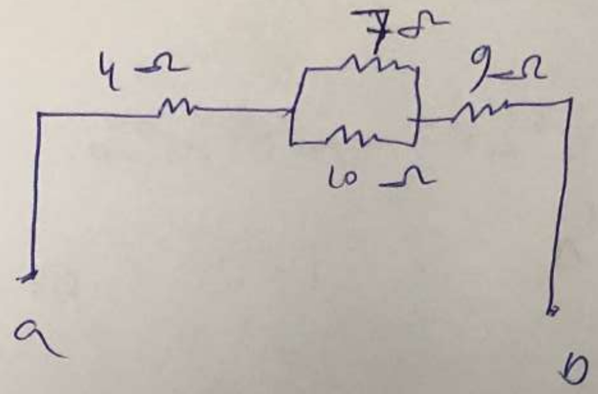
Note if volume was constant and $L_2 = 2L_1$

$V_1 = AL_1 \rightarrow V_2 = A_2 L_2$, $L_2 = 2L_1 \rightarrow A_2 = \frac{1}{2} A_1$

Then $R_2 = 4R_1$

(14)

(3)



$R_{eq} = ??$

$$R_{eq} = 4 + \left(\frac{1}{7} + \frac{1}{10}\right)^{-1} + 9 = 17.11\ \Omega$$

$R_{eq} = 17\ \Omega$ answer

(4)

$R = 1\ M\Omega \quad C = 5\mu F \quad t = 10\ s$

$\tau = 5\ s \quad \varepsilon = 30\ V \quad I = ??$

$$I(t) = I_0 e^{-t/\tau} \rightarrow I_0 = \frac{\varepsilon}{R}$$

$$I(t=10) = \frac{30}{10^6} * e^{-\frac{10}{5}} \rightarrow I = 4.06\ \mu A$$

$$I = 4.06 \times 10^{-6}\ A = 4.06\ \mu A$$

$V_c = 0.8\ \varepsilon \quad t = ??$

$$V_c = \varepsilon(1 - e^{-t/\tau}) \rightarrow 0.8\varepsilon = \varepsilon(1 - e^{-t/\tau})$$

$$\rightarrow 0.2 = e^{-t/\tau} \rightarrow \ln 0.2 = -\frac{t}{\tau} \Rightarrow t = 1.6\tau$$

answer

(14)

⑥ Halved $C = \frac{A\varepsilon_0}{d}$, $V = \frac{Q}{C}$

$\downarrow$

$C_2 = \frac{A\varepsilon_0}{\frac{1}{2}d} = 2C$, $V_2 = \frac{Q}{2C} = \frac{1}{2}V$

$V_2 = \frac{1}{2}V$ ⇒ answer

---

⑦

$F = qVB\sin\theta \rightarrow \sin\theta = \frac{F}{qVB}$

$\rightarrow \theta = \sin^{-1}\left(\frac{F}{qVB}\right) = \sin^{-1}\left(\frac{8.2\times10^{-13}}{4\times10^{6}\times1.7\times1.6\times10^{-19}}\right)$

$\theta = 48.9^0$

---

⑧

$\vec{V} = 3\,km/s\ \hat{i}$ $q_- = -6\mu C$

$\vec{B} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ $m = 2mg$

$a = ??$

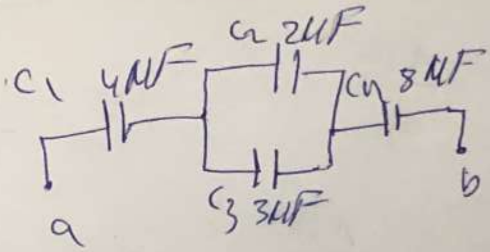
$\rightarrow \Sigma\vec{F} = m\vec{a}$ $q\vec{V}\times\vec{B} = m\vec{a}$

$6\times10^{-6}\left(-12\hat{j} + 9\hat{k}\right) = 2\times10^{-6}\,\vec{a}$

$\vec{a} = \left(-36\hat{j} + 27\hat{k}\right)$

$\vec{a} = 36\hat{j} - 27\hat{k}$

(a)



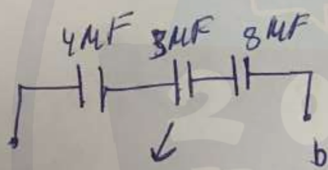
$\Delta V_{ab} = 25V$

$q @ C = 2\mu F$

$q @_{C=2\mu F} = V_{@C=2\mu F} * 2\times10^{-6}$ ($v_2 C_2$)

$Q = \Delta V_{ab} C_{eq}$, $C_{eq} = \left[\left(\frac{1}{(2+3)}\right) + \left(\frac{1}{4}\right) + \left(\frac{1}{8}\right)\right]^{-1}$

$C_{eq} = \left(\frac{1}{5} + \frac{1}{4} + \frac{1}{8}\right)^{-1}$



$C_{eq} = 1.739\,\mu F$

$\boxed{Q = 40\mu C}$ $Q = q_2 = q_3$

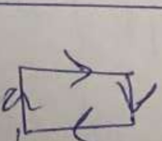
$V_{23} = \frac{Q}{5\times10^{-6}} = 8V$ ~~13.33V~~ $\rightarrow$ ~~$q_2 = 13.33 * 2\times10^{-6}$~~

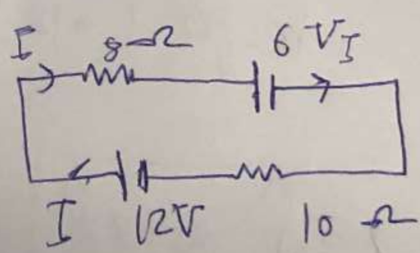
$q_2 = 8 * 2\times10^{-6}$

answer $\boxed{q_2 = 16\mu C}$

~~answer~~

(b) $\Sigma V = 0$





$\rightarrow 12 - 8I - 6 - (10I) = 0$

$6 = 18I \rightarrow \boxed{I = 0.3333\ A}$

$\boxed{P = I^2 R = (0.3333)^2 * 10 = 1.1\ W}$

(14) ~~$I\,C$~~

(14) $q(t) = q_0\, e^{-t/RC}$

$q_0 = 5\mu C$

$t = 0.5s$

~~$RC = 500s$~~

$RC = 0.5s$

$q = 5\times10^{-6}\, e^{-\frac{0.5}{0.5}}$

$q = 5\times10^{-6}\, e^{-1}$

$\boxed{q = 1.84\mu C}$

---

(15) $R_{eq} = \left(\frac{1}{4} + \frac{1}{2}\right)^{-1} + 4$

$\left(\frac{1}{\left(\frac{1}{4}+\frac{1}{2}\right)^{-1}} + \frac{1}{2}\right)^{-1} + 6$

$R_{eq} = \left(\frac{1}{1.333} + \frac{1}{2}\right)^{-1} + 6 = 6.8\Omega$

$\rightarrow \boxed{I = \frac{6}{6.8} = 0.88\,A}$

---

①

$R = 4\,\Omega$ $\quad I = 4A$ $\quad t = 60 \times 5$

$t = 300\,s$

$n = ??$

$q = ne \quad q = It$

$ne = It \rightarrow n = \frac{It}{e} = 7.5 \times 10^{21}$ electrons

---

②

when the cylinder wire length is reduced the cross sectional area increase by the same amount

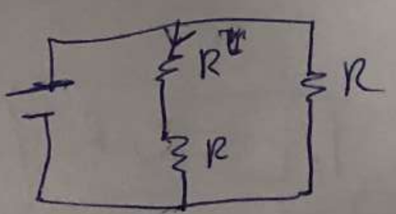
$\Rightarrow R_2 = \rho \frac{\frac{1}{4}L}{4A} = \frac{1}{16} \rho \frac{L}{A} = \frac{1}{16} R_1$

$\rightarrow$ $R_2 = \frac{1}{16} R$ answer

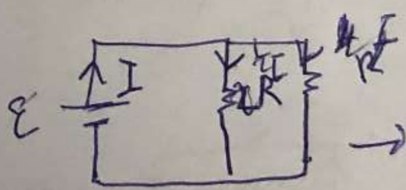
---

most thermal energy = most power consuming

③



$\rightarrow$



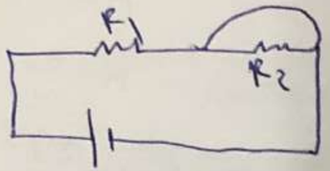
$\rightarrow$

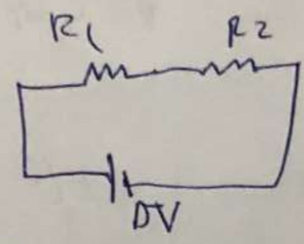
$I_1 = \frac{\varepsilon}{2R}, \quad I_2 = \frac{\varepsilon}{R} \rightarrow I_2 > I_1 \rightarrow P_2 > P_1$

$\Rightarrow$ $P = I^2 R$ answer C

case ①

(4) case ②





$R_{eq} = R_1 + R_2$

$I_1 = \frac{DV}{R_1 + R_2}$

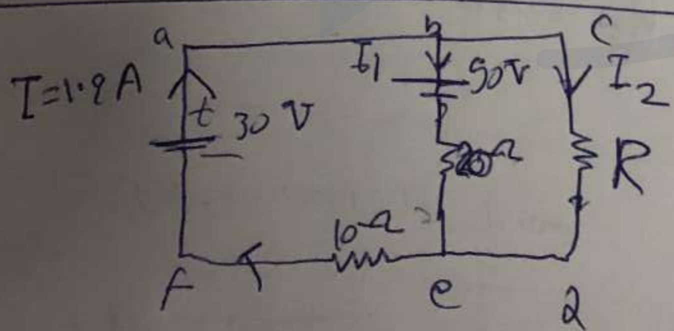
There 2nd resistor will be neglected Because the conducting wire will allow the the current to pass without passing through the resistor

$\Rightarrow R_{eq} = R_1 \rightarrow I_2 = \frac{\varepsilon}{R_1} > I_1$

$\Rightarrow$ $P = I^2 R \rightarrow P_2 > P_1 \rightarrow$ increase

---

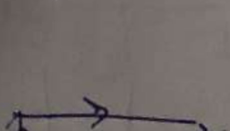
(5)



$I = I_1 + I_2$

$1.9 = I_1 + I_2$ ①

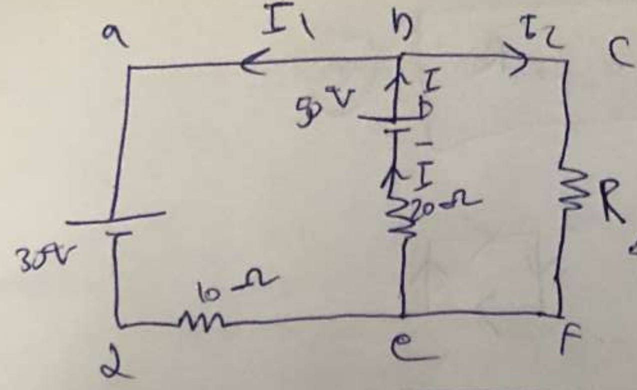
acdfa



$11 = I_2 R$

$\Sigma V = 0 \Rightarrow +30 - (10 \times 1.9) = I_2 R$

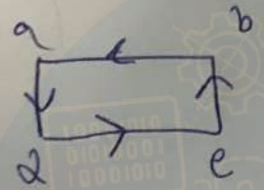
(5)



$I = 1.9A$

$I = I_1 + I_2 \rightarrow$ $1.9 = I_1 + I_2$ (1)

abeda



$\Sigma V = 0 \rightarrow +50 - (20 \times 1.9) - 30 - 10 I_1 = 0$

$\rightarrow I_1 = \frac{-18}{10} = -1.8A \rightarrow$ $I_1 = 1.8A$ ← left

---

(6) $r = \frac{mv}{qB} \rightarrow \quad r \rightarrow 2r$ How??

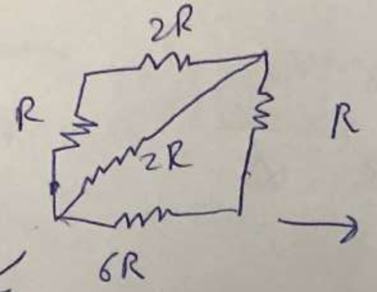
$r = \frac{mv}{q(\frac{1}{2}B)} \rightarrow B_2 = \frac{1}{2} B_1 = \frac{1}{2}(0.2) = 0.1T$

---

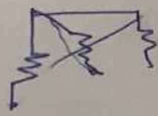
(7) $V_b - \cancel{Ir} + E - \cancel{IR} - V_a = 0$

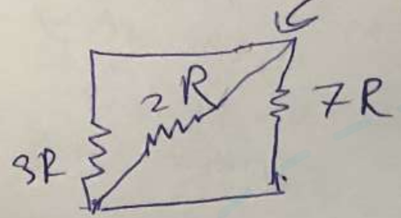
$V_b - V_a - 4 - 8 + 9 \rightarrow$ $V_b - V_A = 3V$

(8)



$R = 25\,\Omega$

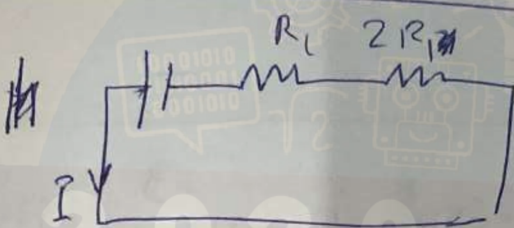




$R_{eq} \approx R = 25\,\Omega$

---

(9)



same current

$I_1 = I_2 = I$

answer

---

(10)

The current in the battery after a long time $I = \frac{\varepsilon}{R}$

the current in the resistor however is zero

---

(11)

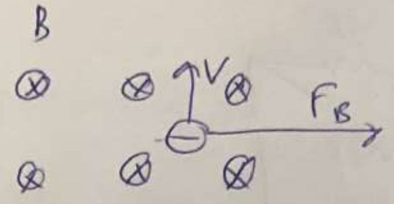
a ✗ $F_B = 0$, $v = 0$ $\quad F_B = qvB \rightarrow v = 0 \rightarrow F_B = 0$

b ✗ $F_E = \frac{kq_1q_2}{r^2}$ dosen't depend on velocity

c ✗ F_E is independent of velocity

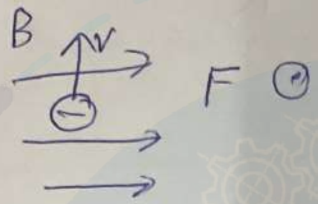
d ✓ $F_B = qvB$, $F_E = \frac{kq_1q_2}{r^2}$ ✓

(12) out of the page using the right hand rule



~~case~~ 1 Example

electron (−) goes in the opposing direction of a positive charge



---

(13) $E = VB = 1.6\times10^{7} \times 20\times10^{-3} = 320\ k\ V/m$

---

(14) $d\vec{F} = IB\,d\vec{L}\sin\theta \qquad dL = R\,d\theta$

$\vec{F} = IB\int R\,d\theta \sin\theta$

$F = IBR\hat{k}\int_0^{\pi}\sin\theta \cdot d\theta = IRB\hat{k}\cos\theta\Big]_{\pi}^{0}$

$\boxed{F = 2IRB\,\hat{k}}$

---

(15) ~~answer~~ postion I $\theta = 0$, $\tau = IAB\sin\theta$ → $\sin\theta = 0 \rightarrow \theta = 0$

answer a position I

(1) $q = 4t^3 + 5t + 6 \quad @\ t = 1 \quad I = ??$

$I = \frac{dq}{dt} = 12t^2 + 5 \rightarrow t = 1 \rightarrow \boxed{I = 17A}$

---

(2) $P = 30\ W \quad , \Delta V = 120V \quad t = 60\ S \quad , q = ??$

$q = It \quad , I = \frac{P}{\Delta V} = \frac{1}{4} A \rightarrow \boxed{q = 15C}$

---

(3)

$L_1 \qquad\qquad L_2$

volume

V = constant

$A_1 \qquad\qquad A_2$

$\rho \qquad\qquad \rho$

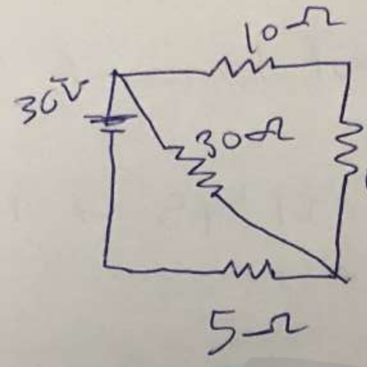
$V = AL$

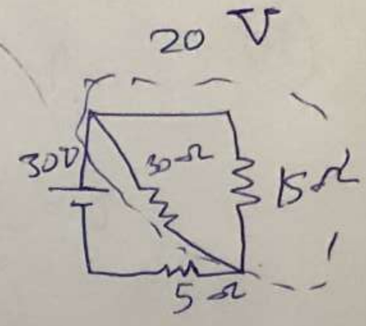
$V_1 = A_1 L_1$

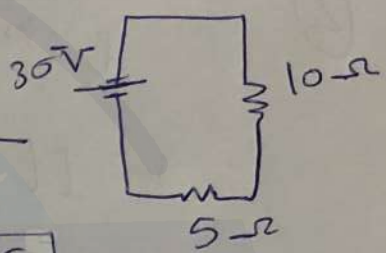
$\boxed{V_1 = V_2 = V = 4L_1 * \frac{1}{4} A_1 \Rightarrow A_2 = \frac{1}{4} A_1}$

$\rightarrow R_2 = \rho \frac{4L}{\frac{1}{4}A} = 16R \rightarrow \boxed{R_2 = 16R_1}$

(4)





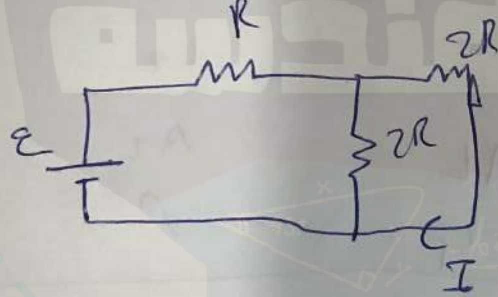


$V_2 = 10 \times 2 = 20V$ ← $I = \frac{30}{15} = 2A$ ←

$$\Rightarrow P = \frac{V_2^2}{30} = \frac{20^2}{30} = 13.33\ W$$

---

(5)



$R = 24\Omega$

$\varepsilon = ??$

$I = 0.5A$

$$R_{eq} = \frac{2R}{2} + R = 2R = 48\Omega$$

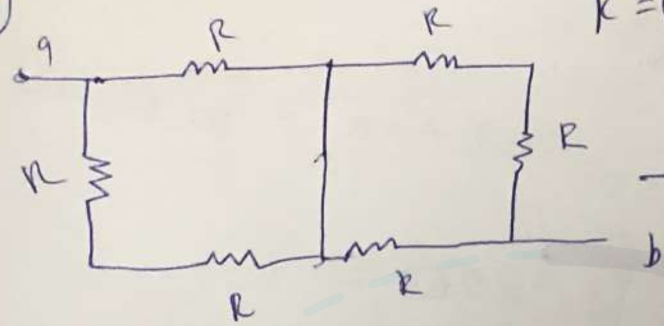
* $\varepsilon = I R_{eq} = 24V$ → $\varepsilon = 24V$

---

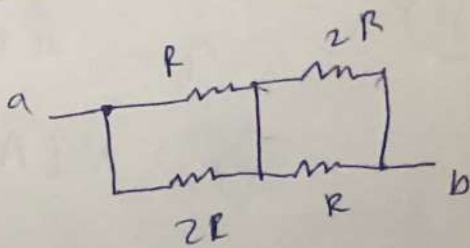
(6) $V_B + 12 + (1.5 \times 20) - 20 - V_A = 0$

$V_B - V_A + 22 = 0 \rightarrow V_B - V_A = -22V$

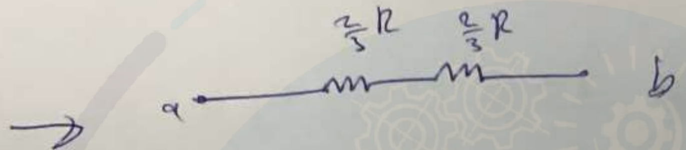
(7) $R = 12\,\Omega$



→



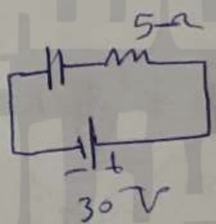
→



→ $R_{eq} = \frac{4}{3} R = 16\,\Omega$

---

(8) $\mathcal{E} = 30\,V$ $R = 5\,\Omega$



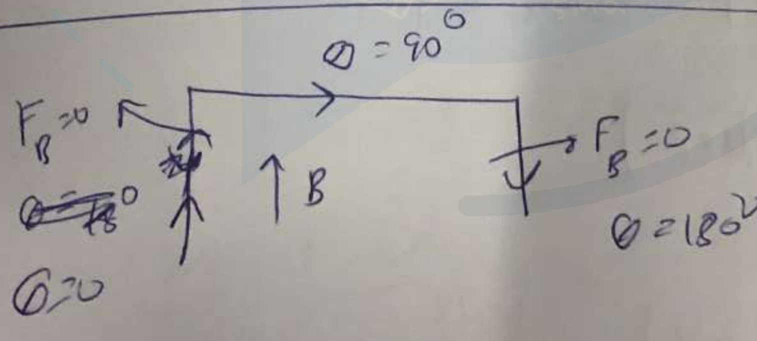
initially $I = \frac{\mathcal{E}}{R} = 6A$

---

(9) . . . . .

---

(10)



use the right hand rule

$F_B = I(2L)B\hat{k} = 2ILB$

(11)

$\vec{A} = \pi(0.5^2) * \frac{(2\hat{i} - 3\hat{j} + 2\hat{k})}{3}$

$I = 3A \qquad \vec{B} = 2\hat{i} - 6\hat{j}$

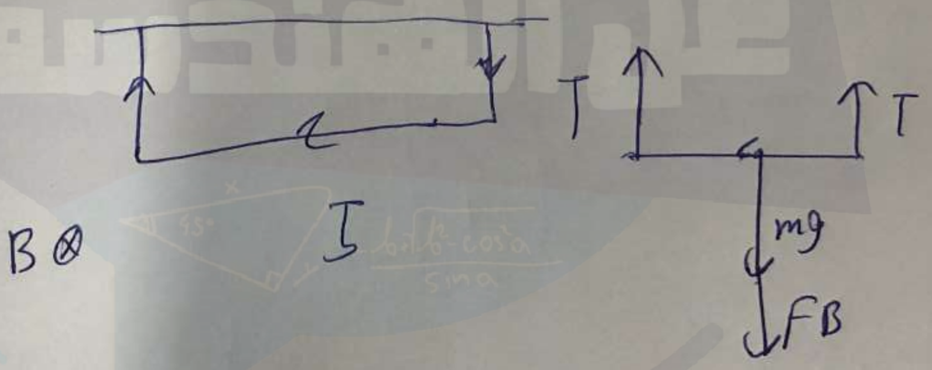
$\Rightarrow \mu = I\vec{A} = \frac{\pi}{4}(2\hat{i} - 3\hat{j} + 2\hat{k})$

$\tau = \vec{\mu} \times \vec{B} = \frac{\pi}{4}(12\hat{i} + 4\hat{j} - 6\hat{k})$

$\tau_x = 9.4\hat{i}$

---

(12)



$\Rightarrow \Sigma\vec{F} = 0 \rightarrow 2T = mg + ILB$

$\Rightarrow T = \frac{mg + ILB}{2} = 0.34$

$\boxed{T = 0.34\ N}$

$m = 50\times10^{-3}\ kg$

$L = 0.4\ m$

$I = 8A$

$B = 60\times10^{-3}\ T$

(1) $\vec{E} = (4\hat{i} + 3\hat{j})$ N/C

A (2, 3)

B (5, 7)

$\Delta V = ??$

$\Delta V = \vec{E} \cdot \vec{d}$

$d = \vec{AB}$

$d = (5-2)\hat{i} + (7-3)\hat{j}$

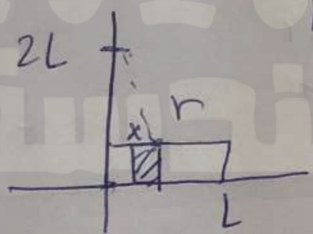
$d = 3\hat{i} + 4\hat{j}$

$\rightarrow \Delta V = (4\hat{i} + 3\hat{j}) \cdot (3\hat{i} + 4\hat{j})$

$\Delta V = 12 + 12 = 24 V$

---

(2)



$b = 40 \times 10^{-9}$ nC

$\lambda(x) = 40 \times 10^{-9} x$

$L = 0.2 m$

$\Delta V = ??$

$$V = k \int \frac{dq}{r} = k \times 40 \times 10^{-9} \int_0^{0.2} \frac{x\,dx}{\sqrt{x^2 + 0.16}}$$

$r = \sqrt{x^2 + 0.16}$

$$V = 9 \times 40 \int_0^{0.2} \frac{x\,dx}{\sqrt{x^2 + 0.16}}$$

$dq = \lambda\,dx$

$dq = bx\,dx$

$\Delta V = 7 V$

(3) $V_a - V_b = \int_a^b \vec{E} \cdot \vec{dl}$

from Gauss's law $E = \frac{\rho r}{3\varepsilon_0}$

$\Rightarrow V_a - V_b = \frac{\rho}{3\varepsilon_0} \int_0^{4\times10^{-2}} r\,dr$

$\Delta V = 3\ V$ answer

---

(4) $R = 20\,\Omega$ $t = 10\,min$ $\Delta V = 30\ V$

$n = ??$ $q = ne$, $q = It$, $I = \frac{\Delta V}{R}$

~~$q = 2.5\times10^{-3}\ C$~~ , **$n = \frac{q}{e} = 5.6\times10^{21}$** answer

$\rightarrow I = 1.5\ A$, $q = 900\ C$

---

(5) stretched

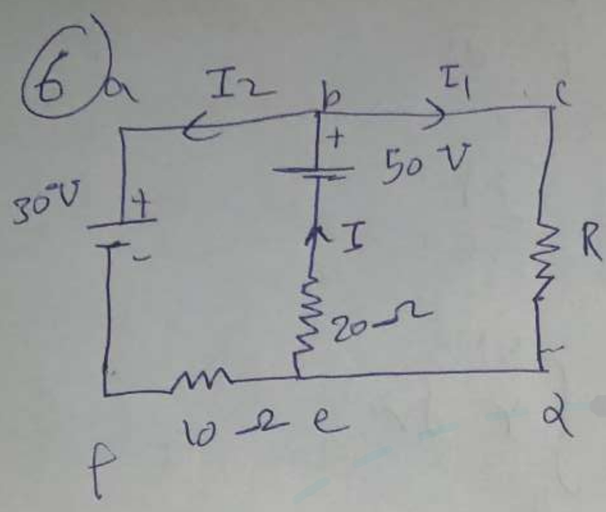
↓ volume remains constant

	L	$4L$
	A	$\frac{1}{4}A$
	ρ	ρ

$V = AL$ $R = \rho\frac{L}{A}$ $R = \frac{\rho 4L}{\frac{1}{4}A} = 16R$

$\Rightarrow$ **$R_2 = 16R$**

(6)



$I = 1.5\,A$

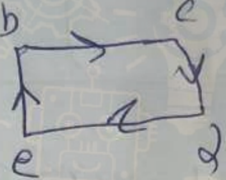
$R = ?!$

$I = I_1 + I_2$

$1.5 = I_2 + I_1$

bcdeb

~~cdef~~



$\Sigma V = 0 \rightarrow +50 - (20 \times 1.5) - I_1 R = 0$

$\rightarrow 20 = I_1 R \rightarrow 20 = 2.5\,R$

~~$R = 40\,\Omega$~~

abefa

$+30 + (20 \times 1.5) + 10 I_2 - 50 = 0$

~~$10 = 10 I_2 \rightarrow I_2 = 1\,A \rightarrow I_1 = 0.5\,A$~~

$\Rightarrow 10 = -10 I_2 \rightarrow I_2 = -1\,A \rightarrow I_1 = 2.5\,A$

$20 = I_1 R \rightarrow 20 = 2.5\,R \rightarrow R = 8\,\Omega$

answer

(7) $\frac{K_c \varepsilon_0 A}{d}$ is not a capacitance

K_c → coulmob's constant

K = dielectric constant

if it was $\frac{K \varepsilon_0 A}{d}$ → parellel plate capacitor

---

(8)

$P = 7.5 W \quad V = 125 V$

$\alpha = 4.5 \times 10^{-3} / ^\circ C, \quad R_0 = ??$

$T_0 = 20^\circ C, \quad T = 7 T_0 = 140^\circ C$

$R = R_0 [1 + \alpha (T - T_0)] \rightarrow R_0 = \frac{R}{1 + \alpha (T - T_0)}$

$\rightarrow R = \frac{\Delta V^2}{P} = 2083.33 \rightarrow$ ~~2083.33~~

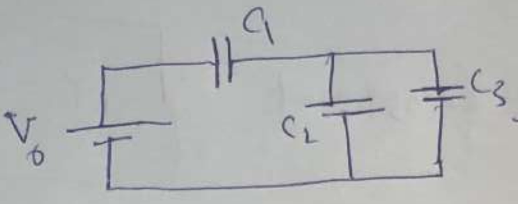
$R_0 = \frac{2083.33}{1 + 4.5 \times 10^{-3} * (140 - 20)} = 1352.81$

$R_0 = 1352.8 \ \Omega$

(9)

$$U = \frac{q^2}{2C} = \frac{1}{2} q V = \frac{C V^2}{2}$$

$V_0 = 18\,V$
$C_1 = 15\,\mu F$
$C_2 = 6\,\mu F$
$C_3 = 20\,\mu F$



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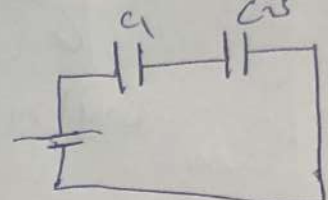

$C_{eq} = C_{23} + C_1$, $C_{23} = C_2 + C_3 = 30\,\mu F$

$$C_{eq} = \left(\frac{1}{30} + \frac{1}{15}\right)^{-1} = 10\,\mu F$$

$$Q = C_{eq} V_0 = 1.8 \times 10^{-4}\,C$$

$$V_{23} = \frac{Q}{C_{23}} = 6\,V \longrightarrow U_3 = \frac{C_3 V_{23}^2}{2}$$

$$U_3 = 3.6 \times 10^{-4}\,J = 0.36\,mJ$$

answer $U_2 = \frac{C_2 V_{23}^2}{2} = 0.18\,mJ$

$$U_1 = \frac{Q^2}{2C_1} = 1.1\,mJ$$

(10)

$V_C = 0.85\,\mathcal{E}$, $t = 2.4\,s$ $\tau = ??$

$$V_C = \mathcal{E}(1 - e^{-t/\tau}) \rightarrow 0.85\,\mathcal{E} = \mathcal{E}(1 - e^{-\frac{2.4}{\tau}})$$

$\rightarrow$ $\tau = 1.265\,s = 1.3\,s$ answer

(11)

$q(t) = Q_0 e^{-t/RC}$

$R = 45\,\Omega$

$C = 85\,\mu F$

$U_i = 100\%\, U$

$U_f = 0.8\, U_i$

$\rightarrow U = \frac{q^2}{2C}, \quad U_f = \frac{q^2(t)}{2C}$

$U_i = \frac{Q_0^2}{2C}$

$U_i = U$

$U_f = 0.8\,U$

$\downarrow$

$\boxed{\frac{U_f}{U_i} = 0.8}$

$\frac{U_f}{U_i} = \frac{q^2}{Q_0^2} \rightarrow 0.8 = \frac{q^2}{Q_0^2}$

$\rightarrow \boxed{\frac{q}{Q_0} = \sqrt{0.8}}$

$q = Q_0 e^{-t/RC} \longrightarrow \frac{q}{Q_0} = e^{-t/RC} \longrightarrow t = -RC \ln\left(\frac{q}{Q_0}\right)$

$\boxed{t = 0.4\,ms}$ answer

$\rightarrow \boxed{t = 4.06 \times 10^{-4}\,s = 0.4\,ms}$

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(12)

$P = 1200\,W, \quad \Delta V = 120\,V \quad L = 4\,m$

$A = 0.33 \times 10^{-6}\,m^2, \quad \rho = ??$

$R = \frac{\rho L}{A}, \quad R = \frac{V^2}{P} \rightarrow \boxed{R = 12\,\Omega}$

$\boxed{\rho = \frac{RA}{L} = 9.9 \times 10^{-7}\,\Omega m}$ answer