لجنة اسألني عن الهندسة

تقدم لكم

# حلول اسئلة سنوات

# فيزياء 101


ASKMEABOUTENG

اسألني عن الهندسة

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اسم مدرس المادة:

رقم الشعبة: الرقم المتسلسل:

**The University of Jordan**
**Faculty of Science**
**Physics Department**

**Final Exam**

**General Physics (1) (0302101)**
**First Semester 2016/2017**
**Exam Duration: 120 minutes**

- **Student's Name:**....[redacted]**Student's ID**...[redacted]...

Note 1: Following are *simple* 25 multiple-choice questions. Write the symbol of correct answer in the answers' table. ***Only*** the answers in the table will be graded.
Note 2: Ignore air resistance in all problems and take $|g| = 9.8\ m/s^2$ at the Earth's surface.
Note 3: The significant digit notation is not taken into account throughout the given answers.

## Answers' Table

| Question number | Symbol of correct answer | Question number | Symbol of correct answer |
|---|---|---|---|
| 1 | d | 14 | b |
| 2 | c | 15 | a |
| 3 | e | 16 | c |
| 4 | c | 17 | e |
| 5 | a | 18 | d |
| 6 | e | 19 | b |
| 7 | d | 20 | e |
| 8 | b | 21 | a |
| 9 | b | 22 | c |
| 10 | a | 23 | d |
| 11 | d | 24 | b |
| 12 | c | 25 | a |
| 13 | e | | |

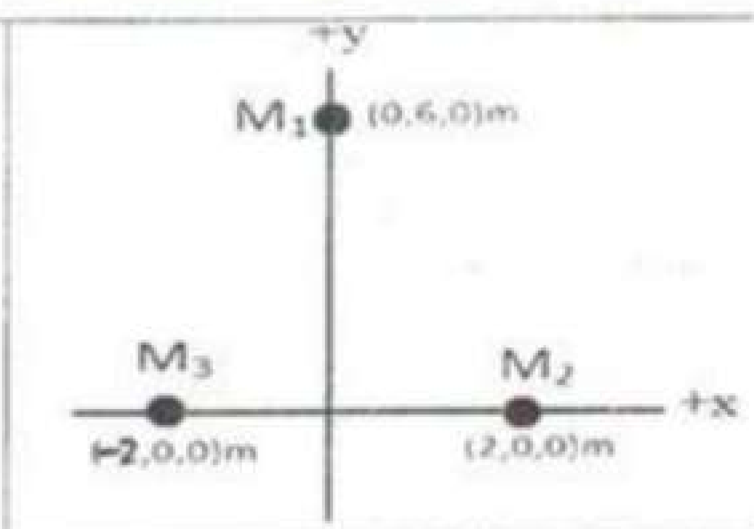
Omega academy

Q.1: A particle moves along the x-axis. Its position varies with time according to the expression: $X(t) = 3t^3 - 4t^2 + 2t - 5$, where X is in meters and t is in seconds. The magnitude of the particle's acceleration (in $m/s^2$) at t = 2 sec is:

a. 50 b. 40 c. 13 d. 28 e. zero

Q.2: The adjacent figure shows the positions of three masses with their x, y and z coordinates. If $M_1$ = 10 kg, $M_2$ = 20 kg and $M_3$ = 70 kg. The coordinates (in meters) of the center of mass of the adjacent set up are:

a. (0, 0, 0) b. (2, 0.3, 0) c. (-1, 0.6, 0)
d. (1, -2, 0) e. (0.3, 2, 0)

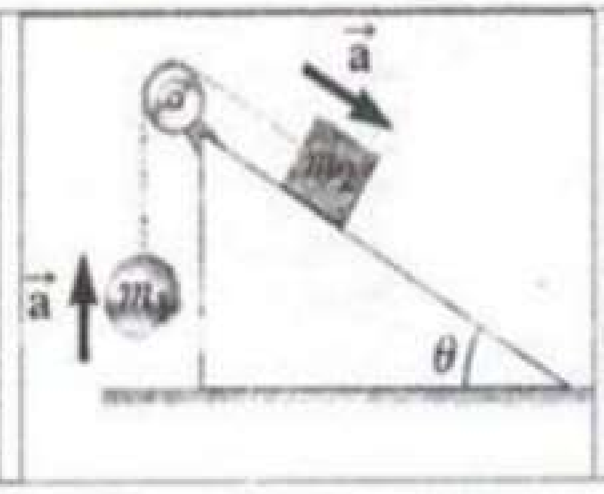


Q.3: A ball is fired with an initial velocity of 30 m/s that makes an angle of $60^0$ above the horizontal direction. The speed (in m/s) of the ball after 2 sec of its launch is:

a. Zero b. 9.8 c. 20.0 d. 26.3 e. 16.3

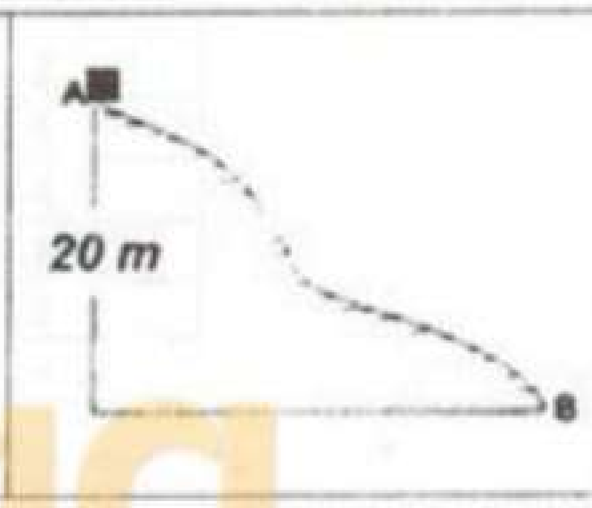
Q.4: A 2-kg hanging mass ($m_1$) is connected by a string over a pulley to a 20-kg block ($m_2$) that is sliding on a $50^0$ fixed inclined plane (see the adjacent figure). If the pulley's mass and the mass of the string are negligible, and all surfaces are frictionless, the magnitude of the acceleration (in $m/s^2$) of the moving system is:

a. 8.56 b. 9.80 c. 5.93
d. 1.15 e. 0.48




Q.5: A 50-kg object slides from rest from point A on the rough track shown in the adjacent figure. If the speed of the particle at point B is 10 m/s. The work (in J) done by frictional forces is:

a. -7300 b. +3700 c. -3700
d. -2567 e. -5000

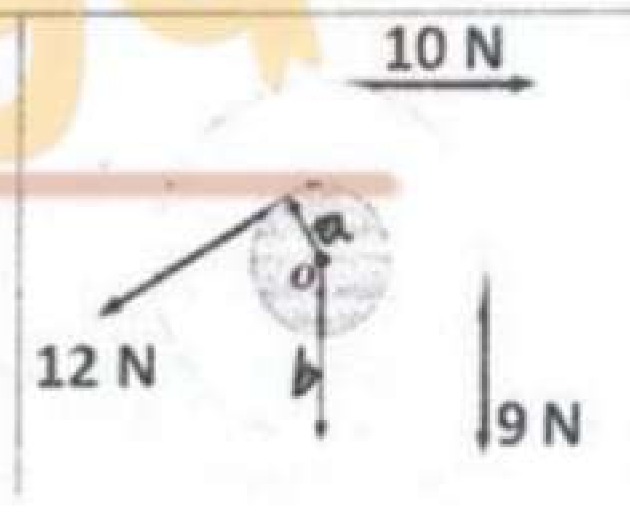



Omega academy

Q.6: Three forces are acting on the wheel shown in the adjacent figure. If a = 10.0 cm and b = 25.0 cm, then the net torque (in N.m) on the wheel about the axle through O is:

[Note: we use the convention that torques are positive if the rotation tendency is counterclockwise and are negative if the rotation tendency is clockwise]

a. +5.53 b. -5.53 c. -7.00 d. 7.00 e. -3.55




Q.7: In a collision, a 1500 kg car initially moving at 30 m/s comes to a stop in 0.1 second. The magnitude of the average force (in N) on the car during the crash is:

a. 30000 b. 25000 c. 15000 d. 450000 e. Zero

Q.8: True or False:
"The work done by a non-conservative force on a particle moving through any closed path is zero"

a. True b. False

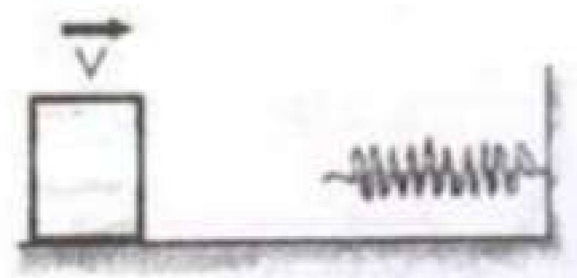
Q.9: An object of mass 3 kg, moving with an initial velocity of $5\hat{i}$ m/s, collides with and sticks to an object of mass 2 kg moving with an initial velocity of $-3\hat{j}$ m/s. The velocity of the composite object (measured in m/s) is:

a. $(3\hat{i}-3.2\hat{j})$ b. $(3\hat{i}-1.2\hat{j})$ c. $(\hat{i}+2\hat{j})$ d. $(5\hat{i}-7\hat{j})$ e. $(-8\hat{i}+2\hat{j})$

Q.10: A ball of mass 2 kg is fired straight up with an initial speed of 20 m/s. It rises to its maximum height, and then falls down to its starting point. Neglecting air resistance, the work (in J) done on the ball by gravitational force through the entire trip is:

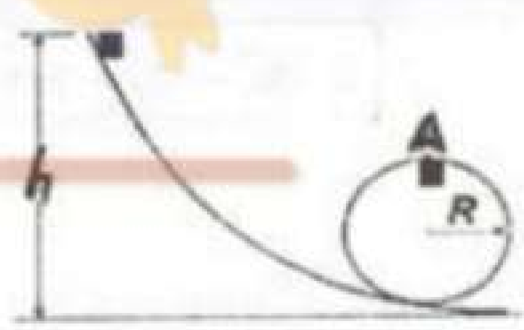
a. Zero b. 20.4 c. -20.4 d. 40.8 e. -40.8

Q.11: The adjacent figure shows a box of mass 2 kg moving on a horizontal, frictionless surface with a speed of 4 m/s towards an unstretched spring of negligible mass that is attached horizontally to a rigid wall. The box collides with the spring and stops momentarily before reversing direction. If the spring constant is 1000 N/m, the maximum compression (in m) of the spring is:



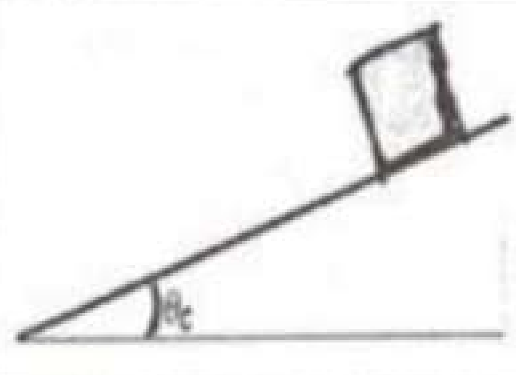

a. 0.250 b. 0.653 c. 0.357
d. 0.179 e. 0.742

Q.12: A box slides without friction around a loop-the-loop (see adjacent figure). The box is released from a height h = 7 m. If point A is 4 m above the ground, the speed of the box (in m/s) at point A is:




a. Zero b. 4.90 c. 7.67 d. 2.31 e. 9.80

Q.13: A block of mass M rests on an inclined rough surface. The inclination angle of the surface is increased to $\theta_c$ at which point the block becomes on the verge of slipping. The coefficient of static friction of the surface is:




a. $\sin(\theta_C)$ b. $\cos(\theta_C)$ c. $\sin(2\theta_C)$
d. $\cos^2(\theta_C)$ e. $\tan(\theta_C)$

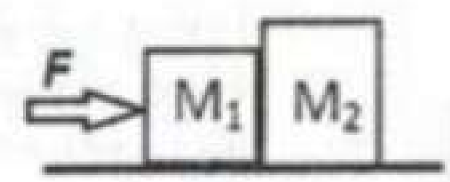
Q.14: A potential energy function for a two-dimensional force is of the form: $U(x,y)=(3x^2y-7x)$ J. The magnitude of the force (in N) that acts at the point (1, 2) m is:

a. 3.77 b. 5.83 c. 9.80 d. 12.65 e. 25.41

Q.15: True or false: "The total linear momentum of an isolated system is ***always*** conserved"
[Hint: an isolated system is a system that has no net external force acting upon it.]

a. True  b. False

Q.16: Two blocks $M_1 = 3$ kg and $M_2 = 5$ kg are in contact with each other on a frictionless, horizontal surface, as shown in the adjacent figure. If a horizontal force $F = 16$ N is applied to $M_1$, the magnitude (in N) of the contact force between the two blocks is:




a. 2  b. 4  c. 10  d. 9.8  e. Zero

Q.17: Earth exerts a gravitational force on the moon, which causes the moon to rotate around Earth. Assuming that the orbit of the moon around Earth is circular with radius R, the work the Earth's gravitational force does on the moon as is makes one revolution is:

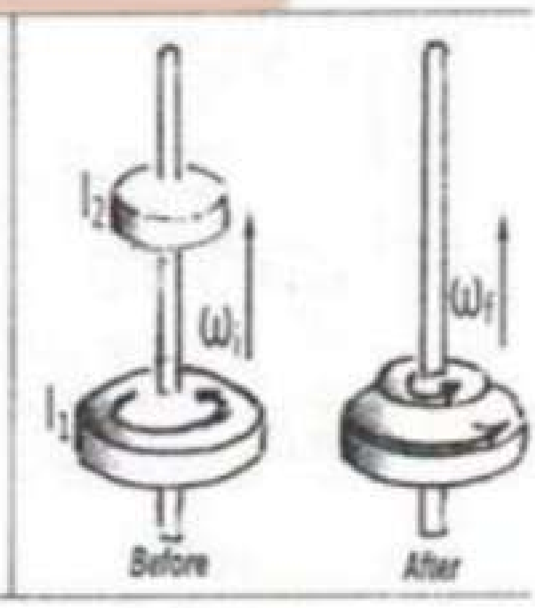
a. 0.5R  b. $2\pi R^2$  c. $2\pi R$  d. 7R  e. Zero

Q.18: A 2 kg particle is moving with a velocity $\vec{v} = (6\hat{i} - 2\hat{j} + 4\hat{k})$ m/s. The angular momentum (measured in kg.m$^2$/s) of this particle about the origin when the particle passes the point (1, 2, -2) m is:

a. $(24\hat{i} - 6\hat{j} - 8\hat{k})$  b. $(12\hat{i} - 3\hat{j} - 4\hat{k})$  c. $(8\hat{i} + 14\hat{j} - 13\hat{k})$

d. $(8\hat{i} - 32\hat{j} - 28\hat{k})$  e. $(4\hat{i} - 13\hat{j} - 11.5\hat{k})$

Q.19: A cylindrical disk with moment of inertia $I_1$ rotates about a vertical, frictionless axle with angular speed $\omega_i$. A second cylindrical disk of moment of inertia $I_2$ and initially not rotating drops onto the first disk as shown in the adjacent figure where they eventually have the same angular speed $\omega_f$. The ratio $(\omega_f/\omega_i)$ is:




a. $(I_1+I_2)/2I_1$  b. $I_1/(I_1+I_2)$  c. $I_1/2(I_1+I_2)$

d. $5I_2/(I_1+I_2)$  e. 1

Q.20: An engine exerts a constant torque of magnitude 600 N.m in turning a wheel 100 revolutions. The amount of work (in J) done by the engine is:

a. $7.23\times10^{+7}$  b. $0.77\times10^{+5}$  c. $1.15\times10^{+6}$  d. $9.04\times10^{-5}$  e. $3.77\times10^{+5}$

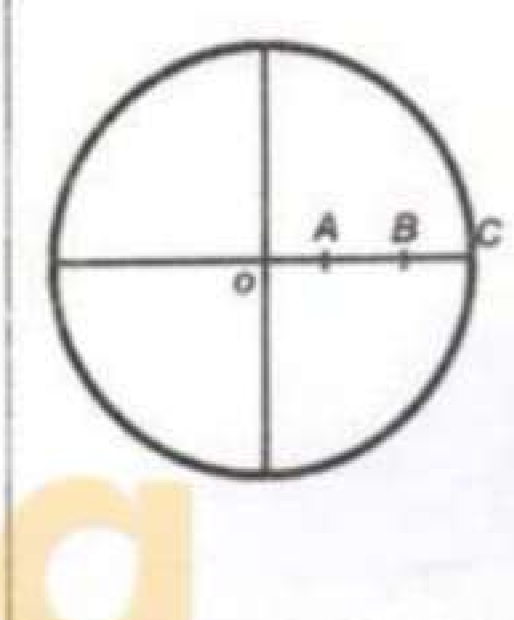
Q.21: At $t = 0$, a wheel rotating about a fixed axis at a constant angular acceleration has an angular velocity of 2 rad/s. Two seconds later it has turned through 5 complete revolutions. The magnitude of the angular acceleration (in rad/s$^2$) of this wheel is:

a. 13.7 b. 9.8 c. 2.65 d. 5.0 e. Zero

Q.22: The angular position of a swinging rigid body is given by: $\theta(t) = (5 + 100\,t + 2t^2 - 4t^3)$ rad. The magnitude of the angular velocity (in rad/s) of this body at $t = 2$ sec is:

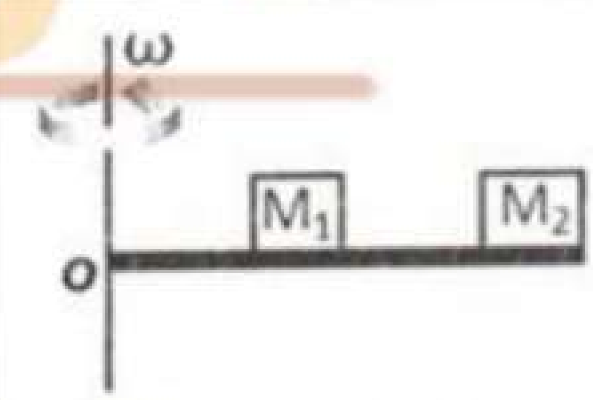
a. 20 b. 40 c. 60 d. 80 e. 100

Q.23: The disk in the adjacent figure rotates with an angular speed $\omega$ about an axle passing through point O and perpendicular to the plane of the disk. If $\omega$, $\alpha$ and V represent the angular speed, angular acceleration and linear speed, respectively, then which of the following statements is entirely correct:



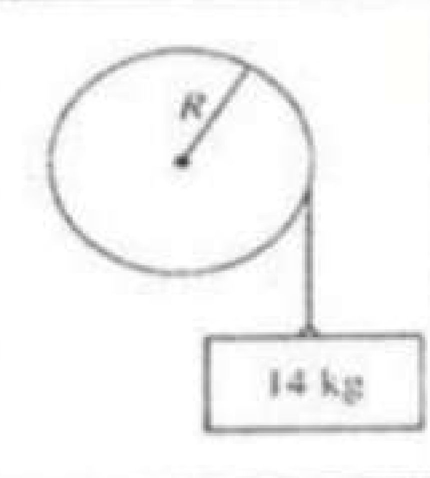

a. $V_A = V_B = V_C$ and $\omega_A > \omega_B > \omega_C$
b. $V_A > V_B > V_C$ and $\omega_A = \omega_B = \omega_C$
c. $\alpha_A > \alpha_B > \alpha_C$ and $V_A = V_B = V_C$
d. $\omega_A = \omega_B = \omega_C$ and $V_C > V_B > V_A$
e. $\omega_A = \omega_B = \omega_C$ and $V_A = V_B = V_C$

Q.24: Two masses $M_1 = 2$ kg and $M_2 = 4$ kg are attached by a rigid rod of negligible mass. The rod rotates in the horizontal plane about an axle that passes through o as shown in the adjacent figure with an angular speed of 8 rad/s. If $M_1$ is at a distance 0.5 m from o and $M_2$ is at a distance 1 m from o, the rotational kinetic energy (in J) of the entire setup is:




a. 250 b. 144 c. 177 d. 100 e. 312

Q.25: In the adjacent figure, a very light rope is wrapped around a wheel of radius $R = 2$ m. The wheel is mounted with frictionless bearings on an axle through its center. A block of mass 14 kg is suspended from the end of the rope. When the system is released from rest it is observed that the block descends with constant acceleration of magnitude 5 m/s$^2$. The moment of inertia (measured in kg.m$^2$) of the wheel relative to the rotation axle is:




a. 53.76 b. 37.21 c. 12.98 d. 23.27 e. 9.80

***Good Luck!!!***

First Semester 2016/2017 - Final exam

Q1: $X(t) = 3t^3 - 4t^2 + 2t - 5$ , $a(2) = ?$

$V(t) = 9t^2 - 8t + 2$

$a(t) = 18t - 8 \implies a(2) = 28\ m/s^2$

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Q2: $M_1 = 10Kg$ , $M_2 = 20Kg$ , $M_3 = 70\ Kg$ , $C_m = ?$

$X_{cm} = \frac{10(0) + 20(2) + 70(-2)}{100} = -1$

$Y_{cm} = \frac{1\cancel{0}(6) + 20(0) + 70(0)}{10\cancel{0}} = 0.6$

$Z_{cm} = 0$

cm $(-1, 0.6, 0)$

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Q3:- $V_1 = 30\ m/s$ , $\theta = 60°$ , $t = 2\ sec$ , speed = ?

$V_x = 30\cos(60) = 15\ m/s$

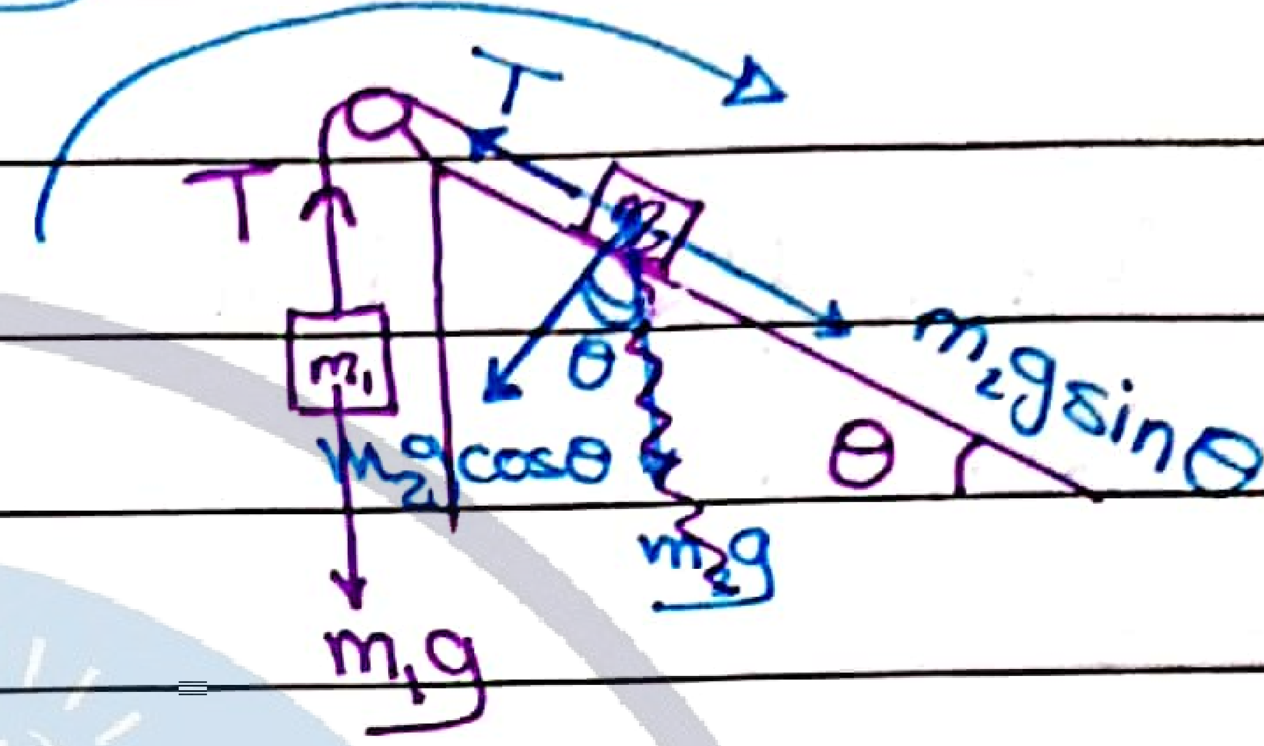
$V_{y_1} = 30\sin(60) = 25.98\ m/s$

$V_{y_2} = V_{y_1} - gt \implies V_{y_2} = 6.38\ m/s$

$\therefore$ speed $= \sqrt{V_x^2 + V_{y_2}^2} = 16.3\ m/s$

- سَيفهمون مِن ترميم اليأس جيلٌ شديدُ البأس جبّارٌ عنيد =)

$Q_4$: $m_1 = 2\ Kg$ , $m_2 = 20 Kg$ , $\theta = 50°$




$$m_2 g \sin\theta - T = m_2 a \quad \text{--- (1)}$$

$$\boxed{150 - T = 20a}$$

$$T - m_1 g = m_1 a \quad \text{--- (2)}$$

$$\boxed{T - 19.6 = 2a} \Rightarrow a = 5.93\ m/s^2$$

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$Q_5$: $m = 50 Kg$ , $V_A = 0$ , $V_B = 10$ , $W_f = ?$ , $h_1 = 20$

$$E_1 + W_f = E_2$$

$$\cancel{\frac{1}{2} m (V_1)^2} + mgh_1 + W_f = \frac{1}{2} m V_2^2 + \cancel{mgh_2}$$

$$\therefore W_f = -7300\ J$$


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Subject Date No.

Q6: $a = 0.1\ m$ , $b = 0.25\ m$ , $\tau = ?$

$|F_1| = 10$ , $|F_2| = 9$ , $|F_3| = 12$

$\tau_1 = r_1 F_1 \sin\theta$

$= (0.25)(10)(-1) = -2.5\ N.m$

$\tau_2 = (0.25)(9)(-1) = -2.25\ N.m$

$\tau_1 = (0.1)(12)(1) = +1.2\ N.m$

$\Rightarrow \tau_{total} = -3.55$

Q7: $m_{car} = 1500$ , $V_{car(1)} = 30$ , $V_{car(2)} = 0$ , $t = 0.1$

$|F| = ?$

$F = m\underline{\underline{a}}$

$V_2 = V_1 + ta$

$0 = 30 + (0.1)a$

$\therefore a = -300\ m/s^2$

$= 1500 \times -300$

$= -450000$

$|F| = 450000\ N$

Subject Date No.

* يوماً ما ستدرك بأن هذا الطريق الطويل (المتعب) هو الذي صنعك "

# اسألني - عن - الهندسة ^^

$Q_9$: $m_A = 3Kg$ , $V_1 = 5\hat{i}$
$m_B = 2Kg$ , $V_1 = -3\hat{j}$ } $V_2 = ?$

$$m_A V_1 + m_B V_1 = (m_A + m_B) V_2$$

$$\Rightarrow V_2 = \frac{15\hat{i} - 6\hat{j}}{5} \Rightarrow V_2 = 3\hat{i} - 1.2\hat{j}$$

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$Q_{10}$: $m = 2Kg$ , $V_1 = 20$ , $W = ?$
(عند أقصى ارتفاع) $V_2 = 0$

$$V_2^2 = V_1^2 + 2a\Delta y$$
$$0 = (20)^2 - 2(9.8)\Delta y$$
$$\Rightarrow \Delta y = 20.4m$$ (وهي صاعدة)
$$\Delta y = -20.4m$$ (وهي هابطة)

$\therefore r = 0$ (مسار مغلق) $\Rightarrow W = 0$

Subject Date No.

Q11: $m = 2Kg$ , $V = 4$ , $K = 1000$ , $\Delta X = ?$

$$\tfrac{1}{2} m v_1^2 + \cancel{\tfrac{1}{2} K x_1^2}^{\,0} = \cancel{\tfrac{1}{2} m v_2^2}^{\,0} + \tfrac{1}{2} K x_2^2$$

$$\therefore x_2^2 = \frac{m v_1^2}{K}$$

$$= 0.032 \Rightarrow X = 0.179 \text{ m}$$

Q12: $h = 7m$ , $h_A = 4m$ , $V_A = ?$

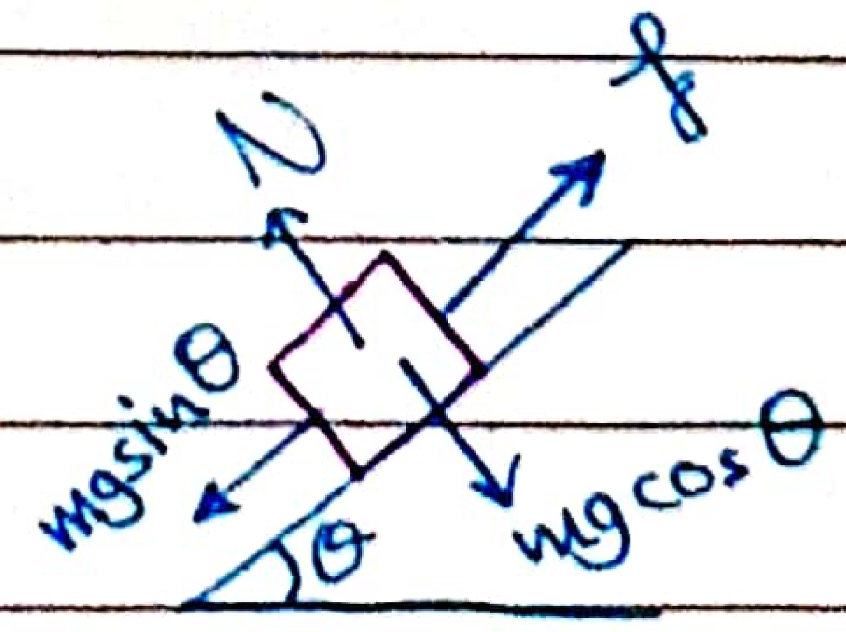
$$\cancel{m} g h_1 + \cancel{\tfrac{1}{2} \cancel{m} v_1^2}^{\,0} = \cancel{m} g h_A + \tfrac{1}{2} \cancel{m} v_A^2$$

$$\therefore V_A^2 = (g h_1 - g h_A)\, 2$$

$$= 2g\,(h_1 - h_A)$$

$$\therefore V_A = 7.67 \text{ m/s}$$

Q13:- $N = mg\cos\theta$




$$mg\sin\theta - f_s = 0$$

$$f_s = mg\sin\theta \quad (f_s = N \cdot \mu_s) \Rightarrow \mu_s = \tan\theta$$

اسألني عن الهندسة 2020

Subject Date No.

Q14: $U(x,y) = 3x^2y - 7x$ , $p(1,2)$

$$F = -\frac{dU}{dx}\hat{i} - \frac{dU}{dy}\hat{j}$$

$$= (6xy - 7)\hat{i} - 3x^2\hat{j}$$

$$F\Big|_{(1,2)} = 5\hat{i} - 3\hat{j}$$

$$|\vec{F}| = \sqrt{25+9} = 5.83$$

Q16:- $M_1 = 3Kg$ , $M_2 = 5Kg$ , $F = 16$

$$F = M_{tot}\, a$$

$$\Rightarrow a = \frac{16}{8} = 2m/s^2$$

$$F_{contact} = M_2 a \Rightarrow F = 5*2 = 10N$$

Q17: شغل القوة المحافظة عبر مسار مغلق = صفر

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Q18 :- $m = 2\,Kg$ , $\vec{v} = 6\hat{i} - 2\hat{j} + 4\hat{k}$ , $\vec{L} = ?$

Point $(1, 2, -2)$

$$\vec{r} = 1\hat{i} + 2\hat{j} - 2\hat{k}$$

$$\vec{L} = m(\vec{r} \times \vec{v})$$

$$\begin{bmatrix} 1 & 2 & -2 \\ 6 & -2 & 4 \end{bmatrix} = 4\hat{i} - 16\hat{j} - 14\hat{k}$$

$$= 2(4\hat{i} - 16\hat{j} - 14\hat{k})$$

$$= (8\hat{i} - 32\hat{j} - 28\hat{k})$$

Q19 :

$$I_i \omega_i = I_f \omega_f$$

$$I_1 \omega_{i(1)} + I_2 \cancel{\omega_{i(2)}}^{0} = (I_1 + I_2)\omega_f$$

$$\therefore \frac{\omega_f}{\omega_i} = \frac{I_1}{I_1 + I_2}$$

Q20. $\tau = 600$ , $\theta = 100$ , $W = ?$

$$W = F * S$$
$$= \underbrace{F r}\theta$$
$$= \tau \theta$$
$$= 600(100 * 2\pi)$$
$$= 3.77 * 10^5$$

$S = r\theta$

100 rev ⇒ 100 * 2π rad

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Subject Date No.

Q21 : $\omega_1 = 2$ at $t=0$ , $\alpha = ?$

$\theta = 5rev$ at $t=2$

$= 5 * 2\pi \, rad$

$\omega_2 = \frac{\theta}{t} = \frac{2*5\pi}{2} = 5\pi$

$\therefore \alpha = 13.7 \, rad/s^2$

Q22 : $\theta(t) = 5 + 100t + 2t^2 - 4t^3$ , $\omega(2) = ?$

$\omega(t) = 100 + 4t - 12t^2$

$\omega(2) = 60 \, rad/s$

$Q_{24}$ : $M_1 = 2Kg$ , $M_2 = 4Kg$ , $\omega = 8$

$X_1 = 0.5m$ , $X_2 = 1m$

$I_1 = 2(0.5)^2$

$I_2 = 4(1)^2$

$I_{tot} = 4.5$

$K = \frac{1}{2} I \omega^2 \Rightarrow K = 144 \, J$

2020 اسألني عن الهندسة

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| | |
|---|---|
| 1 | A uniform ladder 15 m long is leaning against a frictionless wall at an angle of 53 degrees above the horizontal. The weight of the ladder is 30 N. A 75 N boy climbs 6.0 m up the ladder. The magnitude of the friction force (in N) exerted on the ladder by the floor is: |
| 2 | Three particles each of mass 6.0 kg are located at (0, 0), (7, 1), and (11, 11). If the distances are in meters, then the angle (in radians) their center of mass vector makes with the horizontal is: |
| 3 | Four objects of equal mass (m = 2 kg) are located at the corners of a square of edge 30 cm. The magnitude of the gravitational force (in N) on any of the four objects is: Hint: G = 6.67E-11 N.m^2/kg^2 and the objects are isolated from the rest of the Universe. |
| 4 | Two objects of masses m1 = 450 kg and m2 = 330 kg are separated by 4.00 m. At what position, between them relative to m1 (other than infinety), can a 53.0 kg object placed so as to experience a net force of zero from the other two objects? |
| 5 | A mattress of a water bed is 10.0 cm deep. The pressure (in Pa) exerted by the water bed on the floor, assuming that the lower surface of the bed makes contact with the floor, is: Hint: density of fresh water = 1000 kg/m^3. |
| 6 | Water is flowing at 6.5 m/s in a circular pipe. If the diameter (القطر) of the pipe decreases to 1/2 its former value, the velocity of the water (in m/s) downstream is: |
| 7 | The water level in a reservoir (خزان مائي كبير) is maintained at a constant level. The exit velocity (in m/s) in an outlet pipe 9.0 m below the water surface is: |
| 8 | The pressure inside a commercial airliner (طائرة) is maintained at 1.0 ATM (1.0E+05 N/m^2). If the outside pressure is 0.30 ATM, the outward force (in kilo Newton) exerted on a 0.85 m by 2.1 m cabin door is: |
| 9 | A puck on a frictionless air hockey table has a mass of 5 g and is attached to a cord passing through a hole in the surface as in the figure. The puck is revolving at a distance 2.0 m from the hole with an angular velocity of 3.0 rad/s. The cord is then pulled from below, shortening the radius to 1.0 m. The new angular velocity (in rad/s) is: |
| 10 | Four particles are connected by rigid rods of neglected mass. The origin is at the center. Let M1 = 7 kg, M2 = 4 kg, M3 = 9 kg, M4 = 4 kg, A = 3 m, and B = 5 m, and the system rotates in the xy plane about the z-axis with an angular speed of 4.00 rad/sec, then the rotational kinetic energy of the system (in kilo Joules) is: |
| 11 | A 4.00 kg particle has a velocity of (4.00 i + 5.00 j) m/s. The magnitude of its momentum (in kg. m/s) is: |
| 12 | A 1000 kg car slides 30 m down a smooth incline that makes an angle of 30 degrees with the horizontal . The change in the car's potential energy (in kJ) is: |
| 13 | A car having a total mass of 1650 kg and traveling at 120 km/h smashes into a tree. The car is stopped in 0.410 second. The average force (in Newton) acting on the car during the collision is: |
| 14 | A 6 kg object is released from rest 80 m above the ground. When it has fallen 60 m, it's kinetic energy (in J) is: (Consider g = 9.8 m/s^2) |
| 15 | It takes 220 J of work to stretch a spring 11.0 cm from its unstressed length. The force constant (in kN/m) is: |

| | |
|---|---|
| 16 | A 0.4 kg object is swung in a vertical circular path on a string 0.50 m long. If its speed is 4.00 m/s at the top of the circle, the tension (in Newton) in the string there is: |
| 17 | A particle of unknown mass has a momentum of 26 kg.m/s. After 7.3 seconds, the momentum of the particle is 67 kg.m/s. Assuming straight line motion, the magnitude of the force (in Newton) acting on the particle during the interval is: |

Q9

$$F = \frac{I}{T} = \frac{P_2 - P_1}{T}$$

$$120 \ \frac{km}{hour}$$

$$= \frac{120000}{3600} \ m/s$$

$$F = \frac{\frac{120000}{3600} * 1650}{0.41}$$

$$= 1.3 * 10^5$$

Q10

$$mgh_1 = mgh_2 + K.E$$

$$6 * 9.81 * 80 = 6 * 9.81 * 20 + KE$$

$$= 3528 \ J$$

Q11

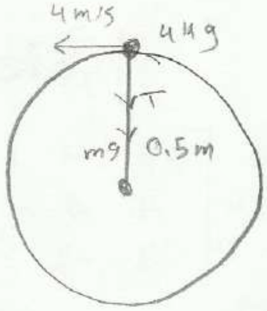
$$U_s = \frac{1}{2} K x^2$$

$$220 = \frac{1}{2} * K * 0.11^2$$

$$K = 36363 \ N$$

$$\simeq 36 \ KN$$

Q12




$$F = \frac{mV^2}{R}$$

$$T + mg = \frac{mV^2}{R}$$

$$T + 0.44 * 9.8 = \frac{0.44 * 4^2}{0.5}$$

$$T = 8.9 \ N$$

Q13

$$P_1 = 26 \ kg.m/s$$

$$P_2 = 67 \ kg.m/s$$

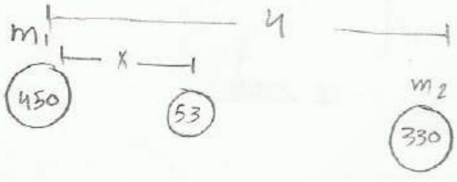
$$T = 7.3 \ s$$

$$F = \frac{\Delta P}{T} = \frac{67 - 26}{7.3}$$

$$= 5.6 \ N$$

Zenon

Q. 4




$\Sigma F = 0 \Rightarrow F_1 = F_2$

$\cancel{G} * \frac{m_1 * \cancel{m}}{r_1^2} = \cancel{G} * \frac{m_2 * \cancel{m}}{r_2^2}$

$\frac{450}{x^2} = \frac{330}{(4-x)^2}$

$450(16 - 8x + x^2) = 330x^2$

$7200 - 3600x + 450x^2 = 330x^2$

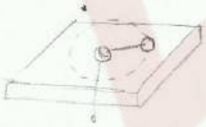
$120x^2 - 3600x + 7200 = 0$

$x_1 = 2.15$

$x = 27.8$ (impossible)

so $x = 2.15$ m

Q. 5



$m = 5g$ $\quad d_1 = 2$ m $\quad V = 3$ rad/s

$d_2 = 1$

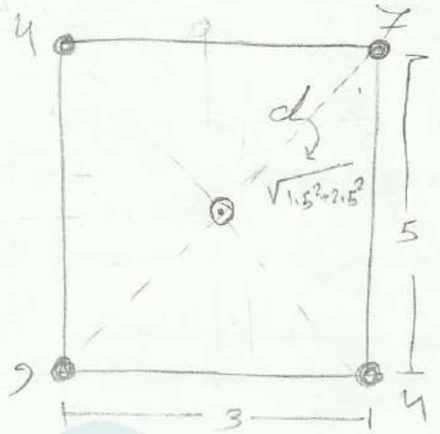
$\cancel{m} * V_1 * d_1 = \cancel{m} * V_2 * d_2$

$3 \frac{rad}{s} * 2\pi * 2 = 12\pi$ m/s

$12\pi * 2 = V_2 * 1$

$= 24\pi$ m/s $= \frac{24\pi}{2\pi * 1} = \boxed{12 \text{ rad/s}}$

Q. 6




$d = 2.9$

$I = * 2.9^2(7+4+9+4)$

$= 201$ kg.m²

$K = \frac{1}{2} I \omega^2$

$= \frac{1}{2} * 201 * 4^2 = 1614.7$ J

$= 1.6$ kJ

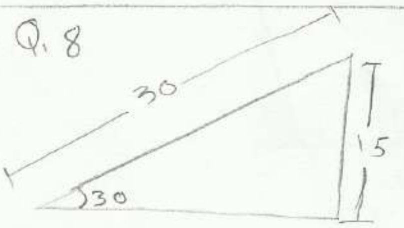
Q. 7

$P = m * v$

$V = \sqrt{4^2 + 5^2}$

$P = 4 * \sqrt{16 + 25} = 25.6$

Q. 8




$U = mgh$

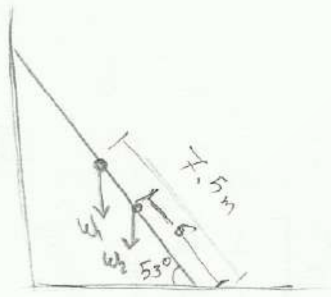
$= 1000 * 9.81 * 15$

$= 147150$ J

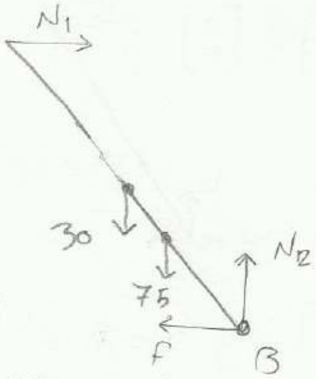
Loss $= -147$ kJ

zenon

Q. 1




FBD on ladder

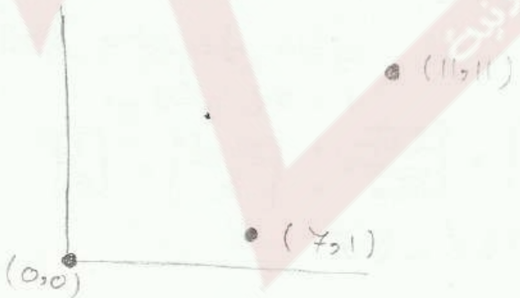



$\Sigma F_x = 0 \Rightarrow f = N_1$

$\Sigma M_B = 0 : -N_1 * 15 \sin 53 + 30 * 8 \cos 53 + 75 * 6 \cos 53 = 0$

$N_1 = 34 = f$

Q. 2



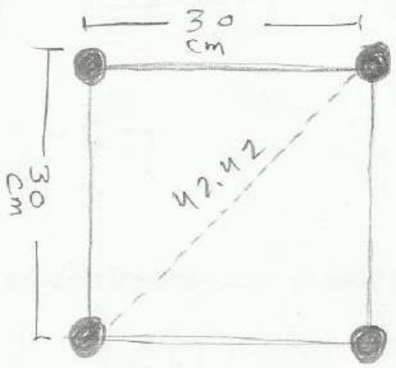

$CM_x = \dfrac{\Sigma 6 (7+0+11)}{3*6} = 6$

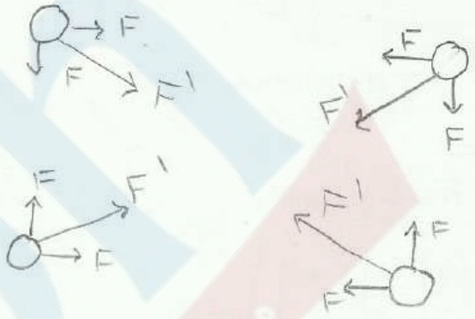
$CM_y = \dfrac{\Sigma 6 (0+1+11)}{3*6} = 4$

$\theta = \tan^{-1} \dfrac{y}{x} = 33.7^\circ$

$= 33.7 * \dfrac{\pi}{180} = 0.59$ Rad

Q. 3




$F = G * \dfrac{m_1 m_2}{r^2}$

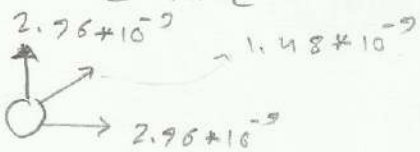
$6.67 * 10^{-11} * \dfrac{2*2}{0.3^2}$

$= 2.96 * 10^{-9} N$

$F' = 6.67 * 10^{-11} * \dfrac{2*2}{(0.4242)^2}$

$= 1.48 * 10^{-9} N$

so we have




the resultant of them

$1.48*10^{-9} + \sqrt{(2.96*10^{-9})^2 + (2.96*10^{-9})^2}$

$= 5.67 * 10^{-9} N$

| Q_Number | Q_text |
|---|---|
| 1 | A horizontal uniform meter stick is supported at the 50 cm mark has a mass of 0.50 kg hanging from it at the 20 cm mark and a 0.30 kg mass hanging from it at the 60 cm mark. The position (in cm) on the meter stick at which one would hang a third mass of 0.60 kg to keep the meter stick balanced is: |
| 2 | A uniform square metal plate with side L = 16 cm and mass 1.3 kg is located with its lower side corners at (0, 0) and (L, 0). A square with side L/4, its lower side is located at (0, 0) and (L/4, 0), is removed from the plate. The distance from the origin (in cm) of the center of mass of the remaining plate is: |
| 3 | A satelite operates at an altitude of 360 km. If the satelite weighs 5.22E+06 N at the earth's surface, its weight (in N) when it is in orbit is: Hint: consider g = 9.8 m/s^2; G = 6.67E-11 N.m^2/kg^2; M(earth) = 5.97E+24 kg; R(earth) = 6.37E+06 m) |
| 4 | Two objects of masses m1 and m2 attract each other with a gravitational force of magnitude 3.26E-09 N when separated by 32.0 cm. If the total mass of the objects is 4.50 kg, then m1 and m2 (in kg) are: Consider G = 6.67E-11 N.m^2/kg^2 |
| 5 | If some water creatures (مخلوقات مائية) can live at depths of one kilometer, the total pressure (in ATM) they will experience at this depth is: (Hint: density of sea water = 1020 kg/m^3; 1 ATM = 1.013E+05 N/m^2; and g = 9.8 m/s^2.) |
| 6 | Two students pull on a horse, also in the xy- plane, where F1 = 120 N, F2 = 80 N, theta 1 = 60 degrees, and theta 2 = 75 degrees. The magnitude of the force (in Newton) that a third student would have to exert on the horse to make the resultant force equal to zero is: |
| 7 | A Boeing 727 airliner (طائرة) has a mass of 23,000 kg and the total area of both wings (top or bottom) is 140 m^2. The pressure difference (in N/m^2) between the top and bottom surface of each wing, when the airplane is in flight, must be: |
| 8 | Two blocks, m1 = 1.1 kg and m2 = 2.2 kg, are connected by a light string as shown in the figure. If the radius of the pulley is 1.0 m and its moment of inertia is 5.0 kg · m^2, the acceleration of the system (in m/s^2) is: (g = 9.8 m/s^2) |
| 9 | A puck on a frictionless air hockey table has a mass of 4.0 kg and is attached to a cord passing through a hole in the surface as in the figure. The puck is revolving at a distance 5.0 m from the hole with an angular velocity of 3.0 rad/s. The angular momentum of the puck (in kg × m^2/s) is |
| 10 | A wheel rotates about a fixed axis with a constant angular acceleration of 4.0 rad/s^2. The diameter (القطر) of the wheel is 40 cm. The linear speed ( in cm/s) of a point on the rim (الإطار الخارجي) of this wheel at an instant when that point has a total linear acceleration with a magnitude of 1.2 m/s^2 is: |

| | |
|---|---|
| 11 | A 1850 kg truck traveling at a speed of 5.5 m/s makes a 90 degrees turn in a time of 3.9 s and emerges from this turn with a speed of 3.3 m/s. The magnitude of the average resultant force (in kN) on the truck during this turn is: |
| 12 | Two stars of masses m1 = M and m2 = 2 M are separated by a distance D. The distance (measured from m1) to a point at which the net gravitational force on a third mass would be zero is: |
| 13 | A hydraulic lift raises 1650 kg car when a 700 N force is applied to the smaller piston. If the smaller piston has an area of 8 cm^2, the cross sectional area (in cm^2) of the larger piston is: |
| 14 | A constant torque of 25.0 N.m is applied to a wheel, initially at rest, whose moment of inertia is 0.130 kg.m^2. The angular speed (in rad/sec) of the wheel after it has made 15.0 revolutions is: |
| 15 | A force (F = 20*t + 14) exerted on an object of mass 16 kg varies with time where t is in seconds and F in Newtons. If the velocity of the body was zero at t = 0, its velocity (in m/s) at t = 5 seconds is: |
| 16 | A wheel starts from rest and rotates with constant angular acceleration to reach an angular speed of 18.0 rad/s in 3.00 s. The angle (in radians) through which it rotates in this time is: |
| 17 | A particle moves uniformly around the circumference of a circle whose radius is 16.0 cm with a period of 0.185 second. The angular velocity (in rad/s) of the particle is: |

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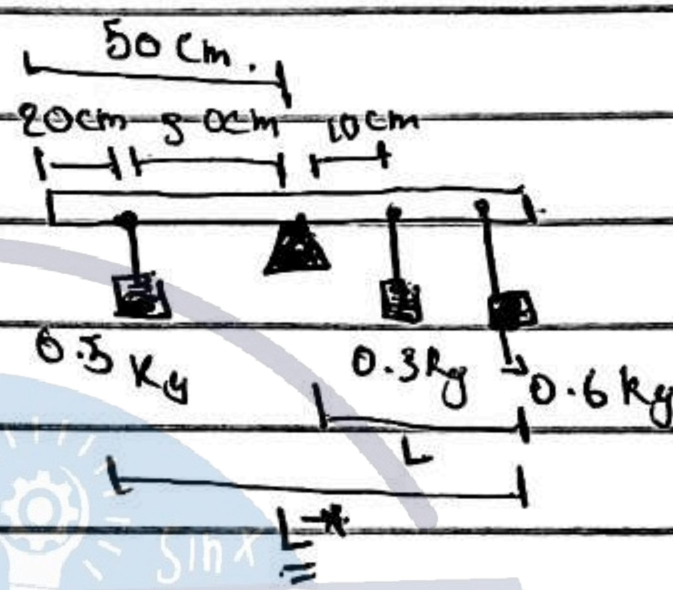
$\boxed{Q\ 1}$




balanced $\Rightarrow \Sigma \text{Torque} = 0$

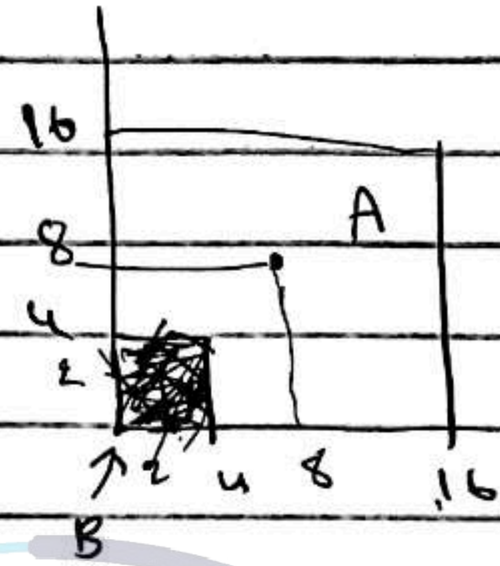
$$\left(0.5\times 30g - 0.3\times 10\times g - 0.6\times L\times g = 0\right)\times \frac{1}{g}$$

$$0.5\times 30 - 0.3\times 10 - 0.6\times L = 0$$

$$0.6L = 15 - 3 \rightarrow L = \frac{12}{0.6} = 20$$

$$L^{*} = 50 + 20 = \boxed{70\text{ cm}}$$

Q 2




① uniforme

$$\frac{m_A}{\text{area}A} = \frac{m_B}{\text{area}B}$$

$$\frac{m_A}{L \times L} = \frac{m_B}{\frac{L}{4} \times \frac{L}{4}}$$

$$m_A = m_B \times 16$$

$$m_B = \frac{m_A}{16}$$

$$x = \frac{m_A x_A - m_B x_B}{x_A - x_B} \rightarrow \frac{m_A \times 8 - 2 \times \frac{m_a}{16}}{8 - 2}$$

$$x = \frac{m_A\left(8 - \frac{1}{8}\right)}{6} = \frac{1.8 \times 7.875}{6} = 1.7$$

$y = x = 1.7 \qquad d = \sqrt{y^2 + x^2} = 2.4$ cm

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$\boxed{Q\ 3} \Rightarrow$ $w = m \times g \rightarrow 5.22 \times 10^{6} = m \times 9.81$

$m = 5.82 \times 10^{5}$ Kg

$$F = \frac{G m_1 m_2}{r^2} = \frac{6.67 \times 10^{-11} \times 5.32 \times 10^{5} \times 5.97 \times 10^{24}}{(360 \times 10^{3} + 6.37 \times 10^{6})^2}$$

$F = 4.677 \times 10^{6}$ N

2020

## Q4

$$m_1 + m_2 = 4.5 \quad \text{— (1)}$$

$$m_2 = 4.5 - m_1$$

$$F = \frac{G m_1 m_2}{r^2} \rightarrow \frac{F \times r^2}{G} = m_1 m_2 \rightarrow \frac{F \times r^2}{G} = m_1(4.5 - m_1)$$

$$\Rightarrow \frac{8.26 \times 10^{-9} \times (0.32)^2}{6.67 \times 10^{-11}} = 4.5 m_1 - m_1^2$$

$$5 = 4.5 m_1 - m_1^2 \rightarrow m_1^2 - 4.5 m + 5 = 0$$

$m_1 = 2$ , $m_1 = 2.5$

$m_2 = 2.5$ $\qquad$ $m_2 = 2$

* The masses are $\underline{\underline{2}}$ and $\underline{\underline{2.5}}$

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## Q5

$\rho \rightarrow$ density

$$P = \rho \times g \times h$$

$$P = 1020 \times 9.81 \times 1000 = 10006200 \ N/m^2$$

$$\frac{10006200}{1.013 \times 10^5} = 98.75 \ ATM$$

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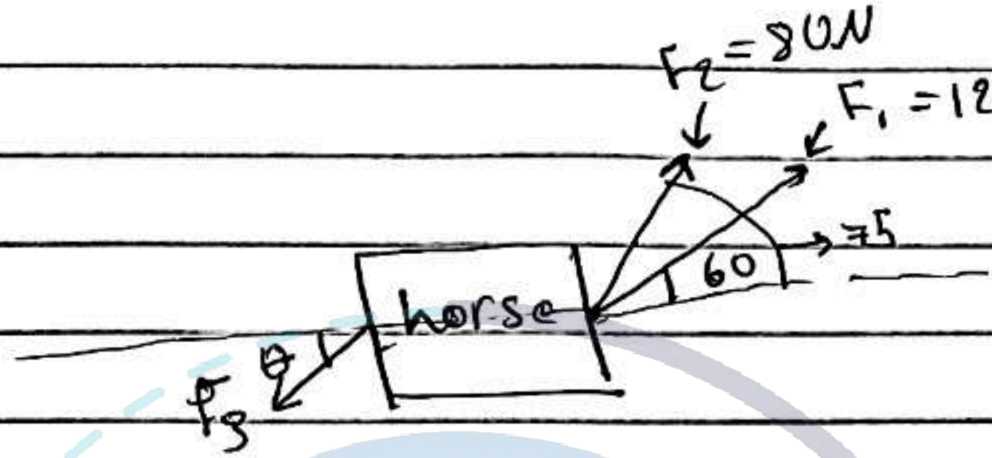
Q 6




$\Sigma F = 0$

$\Sigma F_x = 0 \rightarrow F_{1x} + F_{2x} + F_{3x} = 0 \rightarrow 120 \times \cos(60) + 80 \times \cos(75) = -F_{x3}$

$-F_{3x} = 80.7N \rightarrow F_{x3} = -80.7N$

$\Sigma F_y = 0 \rightarrow F_{1y} + F_{2y} + F_{3y} = 0$

$\rightarrow 120 \times \sin(60) + 80 \times \sin(75) = -F_{3y}$

$F_{3y} = -181.197 \ N$

$F_3 = \sqrt{(F_{3x})^2 + (F_{3y})^2} = 198.35 \ N$

$\theta = \tan^{-1}\left(\frac{181.197}{80.7}\right) = 66^\circ$

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## Q 7

$$P = \frac{F}{Area} = \frac{mg}{Area} = \frac{23000 \times 9.81}{140} = 1611.64\ N/m^2$$

## Q 8


① $I_p = m_p \times r^2$

$5 = m_p \times (1)^2 \rightarrow \boxed{m_p = 5\ kg}$

$m_{total} = 5 + 2.2 + 1.1 = 8.3\ kg$

② $\Sigma F = m \times a \Rightarrow 2.2 \times 9.81 - 1.1 \times 9.81 = m_{total} \times a =$

$10.791 = 8.3 \times a$

$a = 1.3\ m/s^2$

Page $\underline{\underline{14}}$

$\boxed{Q\ 9}$

$\underbrace{L}_{\text{angular momentum}} = I \times \omega = m \times r^2 \times \omega$

$= 4 \times (5)^2 \times 8 = 800 \left(\frac{kg \cdot m^2}{s}\right)$

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Page 14 Q 10

$\alpha = 4$ rad/s  $d = 40$ cm  $a = 1.2\ m/s^2$

$\hookrightarrow r = 20$ cm*  $\hookrightarrow a = 120\ cm/s^2$*

$\Rightarrow v\,(\text{in cm/s}) = ??$

$a_t = \alpha \times r = 4 \times 20 = 80\ cm/s^2$

$a_n = w^2 \times r = w^2 \times 20$

$(a_{total})^2 = a_n^2 + (a_t)^2$

$(120)^2 = (w^2 \times r)^2 + 80^2 \rightarrow (w^2 r)^2 = (120)^2 - (80)^2$

$\sqrt{(w^2 \times 20)^{\cancel{2}}} = \sqrt{8000} \rightarrow w^2 \times 20 = 89.44$

$\sqrt{w^2} = \sqrt{4.47} \rightarrow w = 2.114$

$v = rw$

$v = 2.114 \times 20 = \boxed{42.29\ cm/s}$

Q11: $F_{x\,avg} = \frac{\Delta P_x}{\Delta t} = \frac{m(v_{xf} - v_{xi})}{t_f - t_i}$

$= \frac{1850(0 - 5.5)}{3.9} = -2609\ N$

$F_{y\,avg} = \frac{\Delta P_y}{\Delta t} = \frac{1850(3.3 - 0)}{3.9} = 1565\ N$

AVG Resultant Force $\Rightarrow F_{avg} = \sqrt{F_{x\,avg} + F_{y\,avg}}$

$= 3042\ N = 3.042\ kN$

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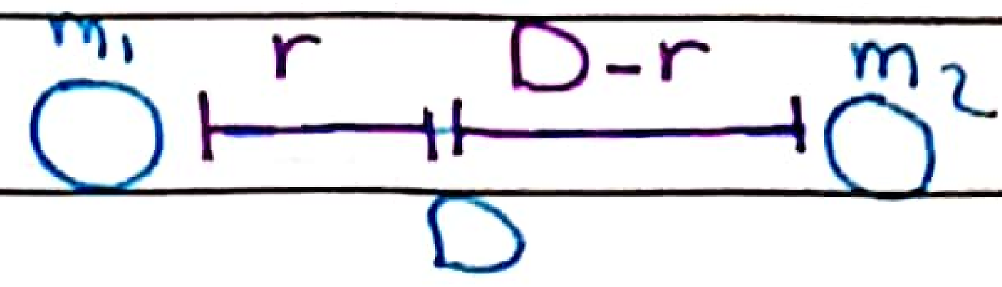
Subject Date No.

Q12: $m_1 = M$, $m_2 = 2M$

$$F = G\frac{m_1 m_3}{r^2} = \frac{G M m_3}{r^2}$$




$$F = G\frac{m_2 m_3}{(D-r)^2} = \frac{G(2M)m_3}{(D-r)^2}$$

$$\frac{\cancel{G}\cancel{M}\cancel{m_3}}{r^2} = \frac{\cancel{G}(2\cancel{M})(\cancel{m_3})}{(D-r)^2}$$

$$\frac{1}{r^2} = \frac{2}{(D-r)^2} \Rightarrow 2r^2 = (D-r)^2$$

$$\sqrt{2}\, r = D - r$$

$$r = \frac{D}{\sqrt{2}+1}$$

Q13: $m_{car} = 1650$, $F_{sp} = 700$

$A_{sp} = 8 \times 10^{-4}\ m^2 = 8\ cm^2$

$A_{Lp} = ?$

$$P = \frac{F_1}{a_1} = \frac{F_2}{a_2}$$

$$\frac{700}{8} = \frac{mg}{a_2} \Rightarrow a_2 = 184.8\ cm^2$$

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Subject Date No.

Q14: $\tau = 25$ , $I = 0.13$ , $\omega = ?$ , $\theta = 15 rev$
$= 15 * 2\pi rad$

$$W = \tau \Delta\theta = \frac{1}{2} I \omega_f^2 - \cancel{\frac{1}{2} I \omega_i^2}^{0}$$

$$\tau \Delta\theta = \frac{1}{2} I \omega_f^2 \Rightarrow \omega_f = 190 \text{ rad/sec}$$

Q15: $F = 20t + 14$ , $m = 16$ , $V_1 = 0$
$V_2 = ?$ at $t = 5$

$$F = ma \Rightarrow a = 1.25t + 0.875$$

$$a(2) = 7.125 \text{ m/s}^2$$

$$V_2 = \cancel{V_1} + at$$
$$= 35.625 \text{ m/s}$$

Q16: $\omega_1 = 0$ , $\omega_2 = 18$ , $t = 3$ , $\theta = ? (rad)$

$$\alpha = \frac{\omega_f - \omega_i}{t} \Rightarrow \alpha = 6 \text{ rad/s}^2$$

$$\theta(t) = \cancel{\omega_i t}^{0} + \frac{1}{2}\alpha t^2 \Rightarrow \theta = 27 \text{ rad}$$

Q17: $R = 16cm = 0.16m$ , $t = 0.185$ , $\omega = ?$

$$\Delta\theta = 2\pi R \Rightarrow \Delta\theta = 1.01 \text{ rad}$$

$$\omega = \frac{\Delta\theta}{\Delta t} = 5.43 \text{ rad/s}$$


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University of Jordan
Faculty of Science
Department of Physics

Date : 16/8/2009
Summer Semester
Time : 15:00 – 17:00

## General Physics I – PHYS. 0302101
## Final Exam

Name (In Arabic) :
Student's Number :

Instructor :
Section :

---

Constants : $g = 9.8\ m/s^2$

---

*Choose the correct answer and fill the Answer Table*

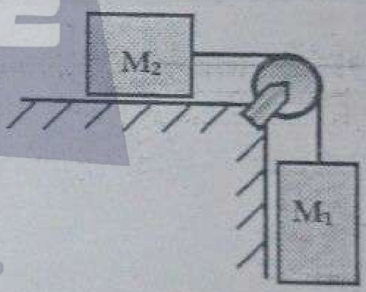
**Q1)** A wheel rotating about a fixed axis has an angular position given by $\theta = 3.0 - 2.0t^3$, where θ is measured in radians and $t$ in seconds. The angular acceleration ( in rad/s$^2$ ) of the wheel at $t = 2.0$ s is:

(a) -1.0 ; (b) -24 ; (c) -2.0 ; (d) -4.0 ; (e) -3.6 ;

**Q2)** A wheel rotates about a fixed axis with an initial angular velocity of 20 rad/s. During a 5.0-s interval the angular velocity decreases to 10 rad/s. Assume that the angular acceleration is constant during the 5.0-s interval. How many radians does the wheel turn through during the 5.0-s interval?

(a) 95 ; (b) 85 ; (c) 65 ; (d) 75 ; (e) 125 ;

**Q3)** A mass ($M_1$ = 5.0 kg) is connected by a light cord to a mass ($M_2$ = 4.0 kg) which slides on a smooth surface, as shown in the figure. The pulley (radius = 0.20 m) rotates about a frictionless axle. The acceleration of $M_2$ is 3.5 m/s$^2$. The moment of inertia ( in kg.m$^2$ ) of the pulley is:




(a) 0.29 ; (b) 0.42 ; (c) 0.20 ;
(d) 0.62 ; (e) 0.60 ;

**Q4)** A 2000-kg truck traveling at a speed of 6.0 m/s makes a 90° turn in a time of 4.0 s and emerges from this turn with a speed of 4.0 m/s, where i and j are unit vectors along x and y, respectively. The magnitude of the average resultant force (in kN ) on the truck during this turn is:

(a) 4.0 ; (b) 5.0 ; (c) 0.67 ; (d) 6.4 ; (e) 3.6 ;

**Q5)** A 3.0-kg ball with an initial velocity of (4**i** + 3**j**) m/s collides with a wall and rebounds with a velocity of (– 4**i** + 3**j**) m/s. The impulse vector (in N.s ) exerted on the ball by the wall is:

(a) +24 **i** ; (b) -24 **i** ; (c) -18 **j** ; (d) +18 **j** ; (e) +8 **i** ;

Q6) A 2.0-kg object moving 5.0 m/s collides with and sticks to an 8.0-kg object initially at rest. The kinetic energy ( in J ) lost by the system as a result of this collision is:

(a) 20 ; (b) 15 ; (c) 30 ; (d) 25 ; (e) 5.0 ;

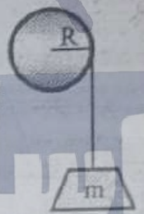
Q7) A car moving along a straight track changes its velocity from 40 m/s to 80 m/s in a distance of 200 m. The (constant) acceleration (in $m/s^2$ ) of the car during this time is:

(a) 8.0 ; (b) 9.6 ; (c) 0.20 ; (d) 6.9 ; (e) 12 ;

Q8) If the only forces acting on a 2.0-kg mass are $\mathbf{F}_1 = (3\mathbf{i} - 8\mathbf{j})$ N and $\mathbf{F}_2 = (5\mathbf{i} + 3\mathbf{j})$ N, what is the magnitude of the acceleration (in $m/s^2$ ) of the particle is:

(a) 1.5 ; (b) 4.7 ; (c) 6.5 ; (d) 9.4 ; (e) 7.2 ;

Q9) A wheel (radius R = 12 cm) is mounted on a frictionless, horizontal axle that is perpendicular to the wheel and passes through the center of mass of the wheel. A light cord wrapped around the wheel supports a mass m = 0.40 kg, as shown in the next figure. If released from rest, the object is observed to fall with a downward linear acceleration of 3.0 $m/s^2$. The moment of inertia (of the wheel in $kg.m^2$) about the given axle is:




(a) 0.023 ; (b) 0.020 ; (c) 0.013 ; (d) 0.016 ; (e) 0.035 ;

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Q10) The tension in a string from which a 4.0-kg object is suspended in an elevator is equal to 44 N. The acceleration (in m/s2 ) of the elevator is:

(a) 1.2 up ; (b) 11 up ; (c) 1.2 down ; (d) 10 up ; (e) 2.4 down ;

Q11) A pendulum is made by letting a 2.0-kg object swing at the end of a string that has a length of 1.5 m. The maximum angle the string makes with the vertical as the pendulum swings is 30°. The speed ( in m/s ) of the object at the lowest point in its trajectory is:

(a) 2.5 ; (b) 2.2 ; (c) 2.0 ; (d) 2.7 ; (e) 3.1 ;

Q12) A 12-kg projectile is launched with an initial vertical speed of 20 m/s. It rises to a maximum height of 18 m above the launch point. The work (in kJ) done by the dissipative (air) resistive force on the projectile during this ascent is:

(a) -0.64 ; (b) -0.40 ; (c) -0.52 ; (d) -0.28 ; (e) -0.76 ;

**Q13)** A 2.0-kg block is projected down a plane that makes an angle of 20° with the horizontal with an initial kinetic energy of 2.0 J. If the coefficient of kinetic friction between the block and plane is 0.40, how far will the block slide down the plane before coming to rest?

(a) 3.0 m ; (b) 1.8 m ; (c) 0.3 m ; (d) 1.0 m ; (e) 1.3 m ;

**Q14)** If the resultant force acting on a 2.0-kg object is equal to $(3\hat{i}+4\hat{j})$ N, what is the change in kinetic energy as the object moves from $(7\hat{i}-8\hat{j})$ m to $(11\hat{i}-5\hat{j})$ m?

(a) +36 J ; (b) +28 J; (c) +32 J; (d) +24 J; (e) +60 J;

**Q15)** The only force acting on a 2.0-kg body moving along the $x$ axis is given by $F_x = (2.0x)$ N, where $x$ is in m. If the velocity of the object at $x = 0$ is +3.0 m/s, the velocity of the object (in m/s) at $x = 2.0$ m is:

(a) 4.2 ; (b) 3.6 ; (c) 5.0 ; (d) 5.8 ; (e) 2.8 ;

**Q16)** Two vectors $\vec{A}$ and $\vec{B}$ are given by $\vec{A} = 5\hat{i}+6\hat{j}+7\hat{k}$ and $\vec{B} = 3\hat{i}-8\hat{j}+2\hat{k}$. If these two vectors are drawn starting at the same point, what is the angle between them?

(a) 106° ; (b) 97° ; (c) 110°; (d) 113°; (e) 102°;

**Q17)** A 4.0-kg mass on the end of a string rotates in a circular motion on a horizontal frictionless table. The mass has a constant speed of 2.0 m/s and the radius of the circle is 0.80 m. The magnitude of the resultant force (in N) acting on the mass is:

(a) 39 ; (b) 44 ; (c) 20 ; (d) 0 ; (e) 30 ;

## Answer Table

Fill the appropriate square of the correct answer.

| Q's | a | b | c | d | e | Q's | a | b | c | d | e |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | 10 | | | | | |
| 2 | | | | | | 11 | | | | | |
| 3 | | | | | | 12 | | | | | |
| 4 | | | | | | 13 | | | | | |
| 5 | | | | | | 14 | | | | | |
| 6 | | | | | | 15 | | | | | |
| 7 | | | | | | 16 | | | | | |
| 8 | | | | | | 17 | | | | | |
| 9 | | | | | | ** | ** | ** | ** | ** | ** |

1

$\theta = 3 - 2t^3$

$\omega = -6t^2$

$\omega(2) = -24$ rad/s$^2$

---

2

$\omega_1 = 20$

$\omega_2 = 10$

$t = 5$

$\alpha \equiv$ constant

$\theta = ?$

$* \ \omega_2 = \omega_1 + \alpha t$

$10 = 20 + 5\alpha$

$\boxed{\alpha = -2}$

$* \ \omega_2^2 = \omega_1^2 + 2\alpha\theta$

$100 = 400 + 2 * -2 * \theta$

$\boxed{\theta = 75 \text{ rad}}$

---

3

$m_1 = 5$

$m_2 = 4$

$r = 0.2$

$a = 3.5$

$T_2 = m_2 a \rightarrow T_2 = 14$ N

$mg - T_1 = m_1 a \rightarrow T_1 = 31.5$ N

$(T_1 - T_2) r = I \alpha \rightarrow \alpha = \frac{a}{r}$

$(31.5 - 14) * 0.2 = I * \frac{3.5}{0.2}$

$\boxed{I = 0.2 \text{ kg.m}^2}$

---

4

$m = 2000$

$v_o = 6$

$t_* = 6$

$v = 4$

$F_{avg} = ?$

$F_{x avg} = \frac{\Delta P_x}{\Delta t} = \frac{m(v_{xf} - v_{xi})}{t_f - t_i} = \frac{2000(0-6)}{4} = -3000$

$F_{y avg} = \frac{\Delta P_y}{\Delta t} = \frac{m(v_{yf} - v_{yi})}{t_f - t_i} = \frac{2000(4-0)}{4} = 2000$

$F_{avg} = \sqrt{F_x^2 + F_y^2} = \sqrt{(-3000)^2 + (2000)^2}$

$\boxed{F_{avg} = 3600 \text{ N}}$

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5

$$\vec{J} = \Delta \vec{P} = m(v_2 - v_1)$$

$$= 3(-4i + 2j - 4i - 3j)$$

$$= -24j$$

---

6

$$k_i = k_f$$

$$\frac{1}{2} m_1 v_{1i} + \frac{1}{2} m_2 \cancel{v_{2i}}^{0} = k_f$$

$$\frac{1}{2} * 2 * 25 = k_f$$

$$\boxed{k_f = 25\ J}$$

---

7

$v_1 = 40$

$v_2 = 80$

$S = 200$

$a = ?$

$$v_2^2 = v_1^2 + 2aS$$

$$(80)^2 = (40)^2 + 2 * a * S$$

$$\boxed{a = 12\ m/s^2}$$

---

8

$m = 2$

$F_1 = (3i - 8j)$

$F_2 = (5i + 3j)$

$$x \text{ axis} \rightarrow \overset{F_{1x}}{3} + \overset{F_{2x}}{5} = m a_x \rightarrow \boxed{a_x = 4\ m/s^2}$$

$$y \text{ axis} \rightarrow -8 + 3 = m a_y \rightarrow \boxed{a_y = -2.5\ m/s^2}$$

$$a = \sqrt{a_x^2 + a_y^2} = 4.7\ m/s^2$$

---

9

$m = 0.4$

$a = 3$

$$mg - T = ma$$

$$0.4 * 9.81 - T = 0.4 * 3$$

$$T = 2.724$$

$$Tr = I\alpha \rightarrow \alpha = \frac{a}{r}$$

$$2.724 * 0.12 = I * \frac{3}{0.12}$$

$$\boxed{I = 0.013}$$

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10

$m = 4$

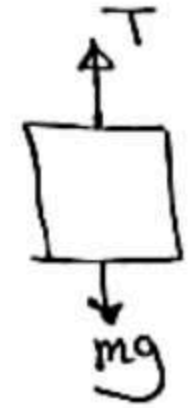
$T = 44$

$a = ?$

$$T - mg = ma$$

$$44 - 4 * 9.81 = 4a$$

$$\boxed{a = 1.2\, m/s^2} \text{ upward}$$

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11

$m = 2$

$L = 1.5$

$\theta = 30°$

$v = ?$

$$\cancel{m} gh = \frac{1}{2} \cancel{m} v^2$$

$$9.81\,(1.5 - 1.5\cos 30) = \frac{1}{2} v^2$$

$$\boxed{v = 2\, m/s}$$

---

12

$m = 12$

$v_1 = 20$

$h = 18$

work = ?

$$E_f = E_i + W_{other}$$

$$mgh = \frac{1}{2} * m * v^2 + W_{other}$$

$$12 * 9.81 * 18 = \frac{1}{2} * 12 * (20)^2 + W_{other}$$

$$\boxed{W = -283.2\, J}$$

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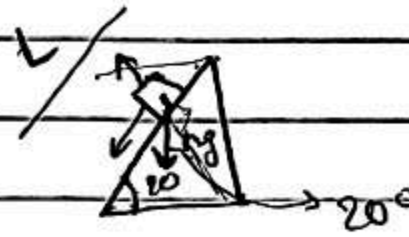
Q 18

① $v_i \Rightarrow \quad KE = \frac{1}{2} m v^2 \rightarrow 2 = \frac{1}{2} \times 2 \times v^2$

$v_1^2 = 2 \rightarrow v_1 = \sqrt{2}$

② $\Sigma F_L = m \times a_L$




$F_s - mg \sin 20 = m \times a_L$

$N \times \mu_s - mg \sin 20 = m a_L$

$N = mg \times \cos 20$

$= 18.436\ N$

$18.43 \times 0.4 - 6.71 = 2 a_L$

$a_L = 0.331\ m/s^2$

$v_2^2 = v_1^2 + 2aL$

$0 = 2 + 2 \times 0.331 \times L$

$-1 = 0.331 L$

$L = -3\ m = 3\ m$

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Q 14 page 23

$\Delta K = W$

$W = \vec{F} \cdot \vec{x} = (3i + 4j) \cdot ((11i - 5j) - (7i - 8j))$

$= (3i + 4j) \cdot (4\hat{i} + 3\hat{j})$

$= (3 \times 4 + 4 \times 3) = 24\ J$

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Q 13

$$\Delta U = -\int F \cdot dx$$

$$= -\int_0^2 2x\,dx = -x^2 \Big|_0^2 = -4\ J$$

$$\Delta K = -\Delta U$$

$$\Delta K = \frac{1}{2} m \Delta v^2 \rightarrow +4 = \frac{1}{2} \times 2 \times (v^2 - (3)^2)$$

$$4 + 9 = v^2$$

$$13 = v^2 \rightarrow v = 3.6\ m/s$$

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Q 16

$$\cos\theta = \frac{\vec{A}\cdot\vec{B}}{|A|\times|B|} \quad ; \quad \vec{A} = 5i + 6j + 7K$$

$$\vec{B} = 8i - 8j + 2K$$

① $|A| = \sqrt{(5)^2 + (6)^2 + (7)^2} = 10.48$

② $|B| = \sqrt{(8)^2 + (-8)^2 + (2)^2} = 8.77$

$$\vec{A}\cdot\vec{B} = (5i + 6j + 7K)\cdot(8i - 8j + 2K)$$

$$= 15 - 48 + 14 = -19$$

$$\cos\theta = \frac{-19}{10.48 \times 8.77} \Rightarrow \theta = \cos^{-1}\left(\frac{-19}{92}\right) \rightarrow \theta = \underline{\underline{102}}$$

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$\boxed{Q\ 17}$

constant speed $\rightarrow a_t = 0$

$\Sigma F_n = m a_n \rightarrow \Sigma F_n = m \times \frac{v^2}{r} = \frac{4 \times (2)^2}{0.8} = \underline{\underline{20\ N}}$

$\Sigma F_t = m a_t = 0$

$\boxed{\Sigma F = 20}$

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