UNIVERSITY OF JORDAN | **FINAL EXAM** | **Date: May 12, 2016**

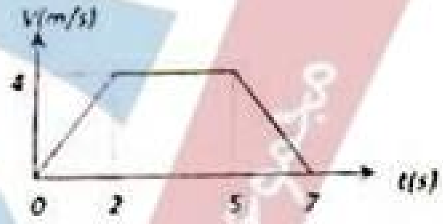
Department of Physics | **GENERAL PHYSICS - 101** | **Time: 14:00 - 16:00**

Student's Name: | **Registration No.** | **Lecturer's Name:**

You MUST fill in your answers (Capital Letters *only*) in the Two Tables on the LAST PAGE.

Take $g = 9.8\ m/s^2$.

Q1) In the graph shown, the *average* acceleration (in m/s^2) between $t = 0\,s$ and $t = 5\,s$ is:



A) 0 B) 3.0 C) 1.2
D) 2.0 E) 0.8

Q2) If $\vec{A} = 5.6\,\hat{i} + 0.9\,\hat{j}$ and $\vec{B}$ is as shown, what is the *magnitude* of the vector $\vec{C} = \vec{A} + \vec{B}$?

A) 20.0 B) 9.0 C) 5.0
D) 10.0 E) 7.0

Q3) Ali drove for 30 minutes at 50 km/h and then stopped for 15 minutes. He then drove for 45 minutes at 40 km/h. His *average speed* (in km/h) for the entire trip is:

A) 37 B) 44 C) 60 D) 40 E) 73

Q4) A stone is projected **horizontally** from the top of a 20 - m high building with a speed of 4 m/s. The horizontal distance (in m) it travels before it hits the ground is:

A) 16.2 B) 14.1 C) 12.7 D) 5.5 E) 8.1

Q5) A mass of 5.0 kg is suspended (معلقة) by a string from the ceiling of an elevator (سقف مصعد) that is moving upward and *decelerating* at $3.0\ m/s^2$. What is the tension (in N) in the string?

A) 10 B) 34 C) 49 D) 64 E) 59

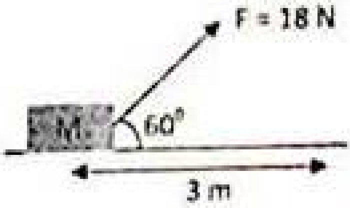
Q6) A block is released from rest on a 27^0 incline and slides 6.0 m during 2.0 s. Then the coefficient of kinetic friction between the block and the surface of the incline is:

A) 0.28 B) 0.22 C) 0.35 D) 0.17 E) 0.12

Q7) A 1500 kg car is to go round a *horizontal* circular path of radius 30 m. If the coefficient of static friction is 0.3, the maximum speed (in m/s) at which the car can round the path without slipping is:

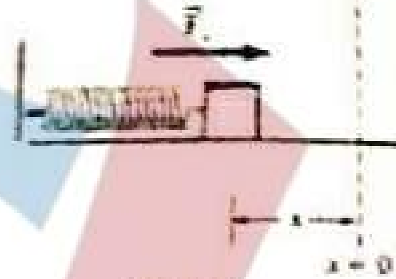
A) 6.6 B) 1.7 C) 5.5 D) 9.4 E) 19.0

Q8) The work (in J) done by the constant force **F** as the block of mass M moves 3.0 m on the smooth surface is:



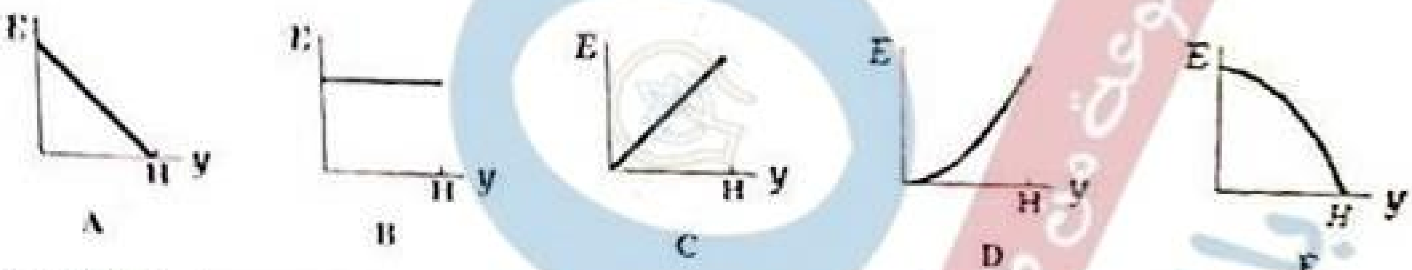
A) 27.0 B) 54.0 C) zero D) 108 E) 90.0

Q9) A block of mass 1.6 kg is attached to a horizontal spring that has a force constant of 1000 N/m. The spring is compressed 2.0 cm and is then released from rest, as in the figure. The speed (in m/s) of the block as it passes through the equilibrium position x = 0 if the surface is frictionless is:



A) 0.0 B) 5.0 C) 0.5 D) 2.0 E) 3.0

Q10) A ball is released from a height H above the floor. If air resistance is ignored, which of the five graphs below correctly gives the total mechanical energy E of the Earth-ball system as a function of the altitude (ارتفاع) y of the ball?



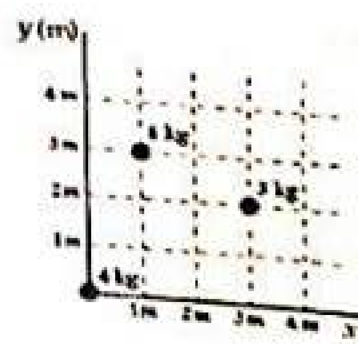
Q11) A block of mass m = 2 kg slides on a **rough path ABC**. If the sphere starts from rest at point A and has a speed of 20 m/s at point C, then the work done (in J) by the force of friction is:

A) -188 B) -332 C) 988 D) 0 e) 256

Q12) An object of mass m_1 = 4.0 kg is traveling at 9.0 m/s in the positive x - direction. It undergoes a head-on elastic collision with a stationary object of mass m_2 = 8.0 kg. The velocity (m/s) of the 4.0 kg object after the collision is:

A) 1.0 B) -3.0 C) 3.0 D) 5.0 E) - 5.0

Q13) The x and y coordinates (in m) of the center of mass of the three-particle system shown are:



A) 0, 0
B) 1.3, 1.7
C) 1.4, 1.9
D) 1.9, 2.5
E) 1.4, 2.5

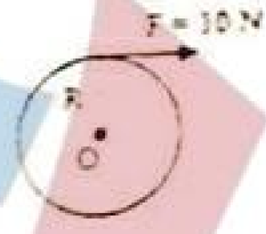
Q14) At t = 0, a wheel rotating about a fixed axis at a constant angular acceleration has an angular velocity of 2.0 rad/s. Two seconds later it has turned through 5.0 complete revolutions. What is its angular acceleration (in rad/s^2)?

A) 17.1 B) 11.2 C) 20.6 D) 13.7 E) 22.6

Q15) Two particles (m_1 = 0.80 kg, m_2 = 1.20 kg) are positioned at the ends of a 2.0-m long rod of negligible mass, as shown. What is the moment of inertia (in kg m^2) of this rigid body about the y-axis that passes through the middle of the rod?

A) 0.5 B) 4.8 C) 3.2 D) 0.0 E) 2.0

Q16) In the figure shown, the mass of the disk is M = 10 kg and its radius is R=20 cm (its moment of inertia $I = MR^2/2$). The disk rotates about an axis perpendicular to the page through point O under the action of force F. The angular acceleration of the disk (rad/s²) is:



A) 10 B) 15 C) 0 D) 20 E) 5.0

Q17) The rigid body shown is rotated about an axis perpendicular to the paper and through point P. If $M = 0.40$ kg, $a = 30$ cm, and $b = 50$ cm, how much work is required to take the body from rest to an angular speed of 5.0 rad/s? (Neglect the mass of the connecting rods and treat the masses as particles.)

A) 2.9 B) 3.1 C) 1.6 D) 3.4 E) 2.6

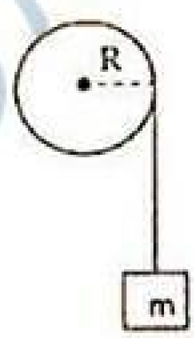
Q18) A disk has a constant angular acceleration of 2 rad/s². If it starts from rest, how long will it take (in s) to reach an angular speed of 20 rad/s?

A) 2.0 B) 3.0 C) 0 D) 10.0 E) 5.0

Q19) At a given instant, the position vector of a 1-kg particle is $\vec{r} = 2\hat{i} + 3\hat{j}$ and it velocity is $\vec{v} = \hat{i} + 4\hat{j}$. At this instant, the angular momentum (in kg.m²/s) of the particle about the origin is:

A) 0 B) $5\hat{k}$ C) $-5\hat{k}$ D) $10\hat{j}$ E) $-10\hat{j}$

Q20) A light cable is wrapped around a solid disk (pulley) of mass 60 kg and radius R=0.3 m ($I = \frac{1}{2}MR^2$). A block of mass m = 20 kg is tied to the free end of the cable. At the instant the mass m is moving down at 3 m/s, the total angular momentum (in kg. m²/s) of the system about the axis of the pulley is:



A) 150 B) 15 C) 45

D) 18 E) 3.0

Write down your answers (in CAPITAL LETTERS) in the two tables below:

Question	1	2	3	4	5	6	7	8	9	10
Answer										

Question	11	12	13	14	15	16	17	18	19	20
Answer										

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

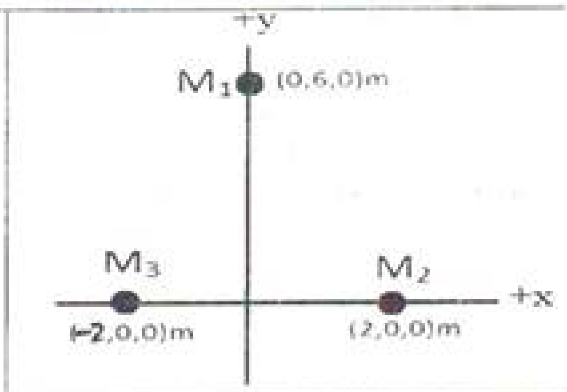
Question number	Symbol of correct answer	Question number	Symbol of correct answer
1	d	14	b
2	c	15	a
3	e	16	c
4	c	17	e
5	a	18	d
6	e	19	b
7	d	20	e
8	b	21	a
9	b	22	c
10	a	23	d
11	d	24	b
12	c	25	a
13	e		

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)

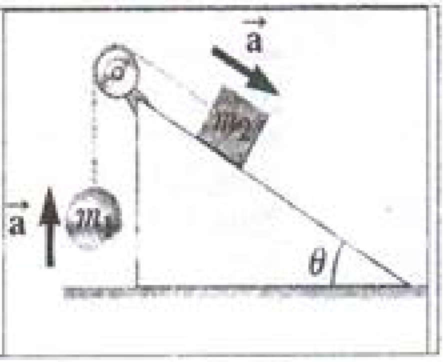


Q.3: A ball is fired with an initial velocity of 30 m/s that makes an angle of 60^0 above the horizontal direction. The speed (in m/s) of the ball after 2 sec of its launch is:

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



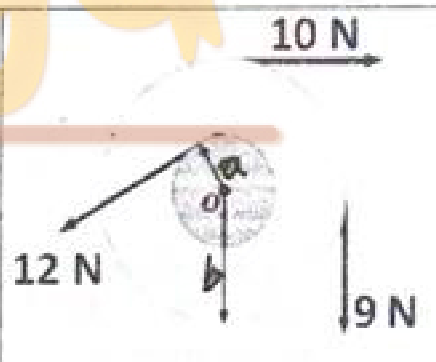
Q.5: A 50-kg object slides from rest from point A on the rough track shown in the adjacent figure. If the speed of the particle at point B is 10 m/s. The work (in J) done by frictional forces is:

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

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. $(-8\hat{i} + 2\hat{j})$

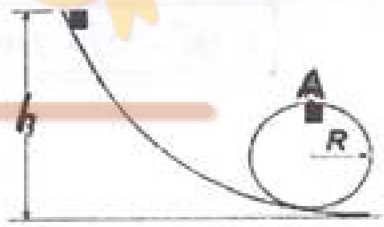
Q.10: A ball of mass 2 kg is fired straight up with an initial speed of 20 m/s. It rises to its maximum height, and then falls down to its starting point. Neglecting air resistance, the work (in J) done on the ball by gravitational force through the entire trip is:

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:

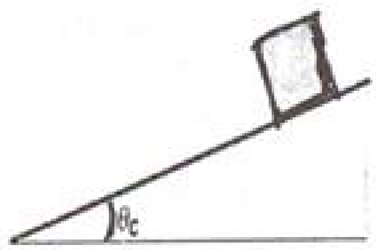
a. 0.250 b. 0.653 c. 0.357
d. 0.179 e. 0.742

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 θ_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. $\tan(\theta_C)$

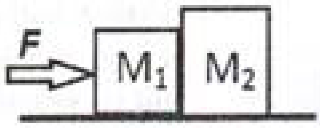
Q.14: A potential energy function for a two-dimensional force is of the form: $U(x, y) = (3x^2y - 7x)$ J. The magnitude of the force (in N) that acts at the point (1, 2) m is:

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:

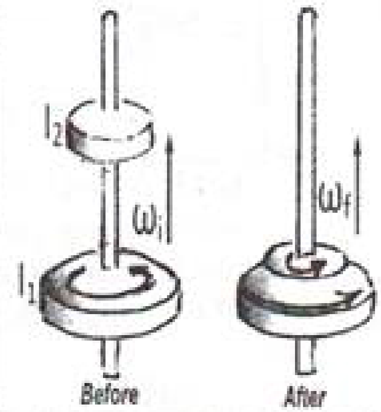
a. 0.5R   b. $2\pi R^2$ c. $2\pi R$ d. 7R   e. Zero

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 ω_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 ω_f. The ratio (ω_f/ω_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. 9.04×10^{-5} e. $3.77\times10^{+5}$

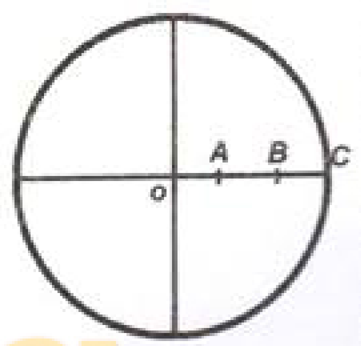
Q.21: At $t = 0$, a wheel rotating about a fixed axis at a constant angular acceleration has an angular velocity of 2 rad/s. Two seconds later it has turned through 5 complete revolutions. The magnitude of the angular acceleration (in rad/s^2) of this wheel is:

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:

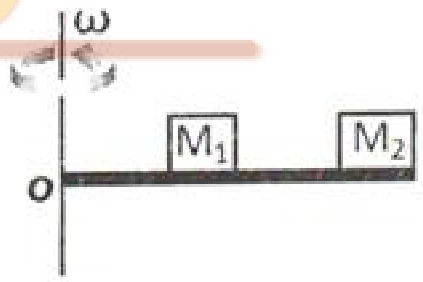
a. 20 b. 40 c. 60 d. 80 e. 100

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



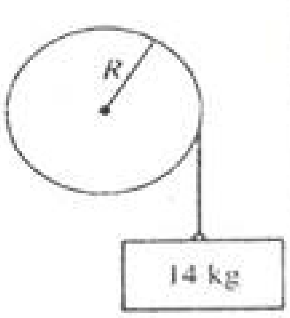
a. $V_A = V_B = V_C$ and $\omega_A > \omega_B > \omega_C$
b. $V_A > V_B > V_C$ and $\omega_A = \omega_B = \omega_C$
c. $\alpha_A > \alpha_B > \alpha_C$ and $V_A = V_B = V_C$
d. $\omega_A = \omega_B = \omega_C$ and $V_C > V_B > V_A$
e. $\omega_A = \omega_B = \omega_C$ and $V_A = V_B = V_C$

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!!!

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:

h -> 3600 s

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

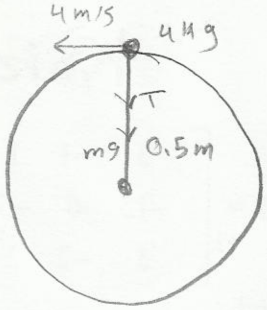
$$U_s = \frac{1}{2} K x^2$$

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

$$K = 36363 \ N$$

$$\simeq 36 \ KN$$

Q12



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

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

$$T + 0.4 * 9.8 = \frac{0.4 * 4^2}{0.5}$$

$$T = 8.9 \ N$$

Q13

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

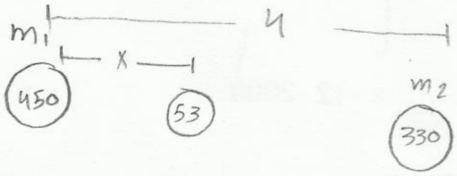
$$P_2 = 67 \ kg.m/s$$

$$T = 7.3 \ s$$

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

$$= 5.6 \ N$$

Q.4



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

$\not{G} * \frac{m_1 * \not{m}}{r_1^2} = \not{G} * \frac{m_2 * \not{m}}{r_2^2}$

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

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

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

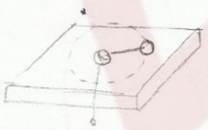
$120x^2 - 3600x + 7200 = 0$

$x_1 = 2.15$

$x = 27.8$ (impossible)

so $x = 2.15$ m

Q.5



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

$d_2 = 1$

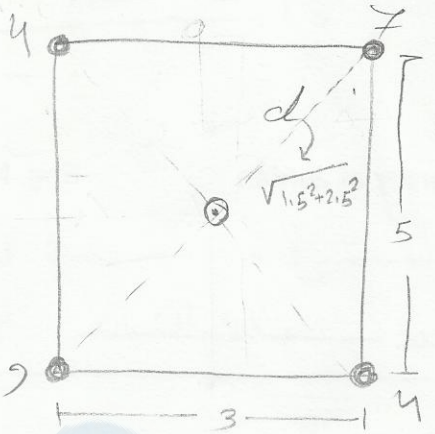
$\not{m} * v_1 * d_1 = \not{m} * v_2 * d_2$

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

$12\pi * 2 = v_2 * 1$

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

Q.6



$d = 2.9$

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

$= 201$ kg.m²

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

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

$= 1.6$ kJ

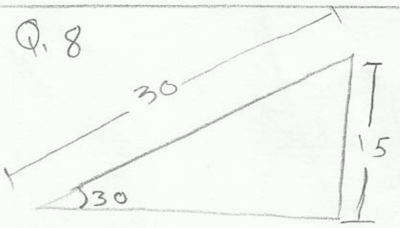
Q.7

$P = m * v$

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

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

Q.8



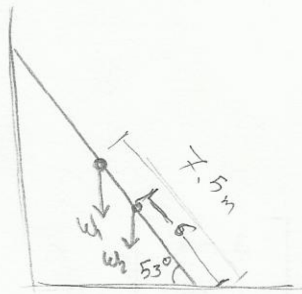
$u = mgh$

$= 1000 * 9.81 * 15$

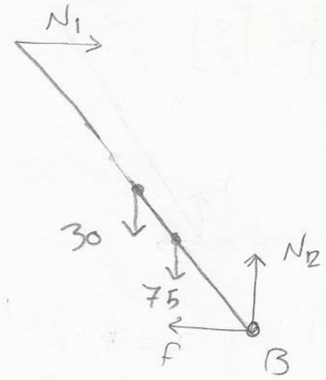
$= 147150$ J

Loss $= -147$ kJ

Q. 1



FBD on ladder

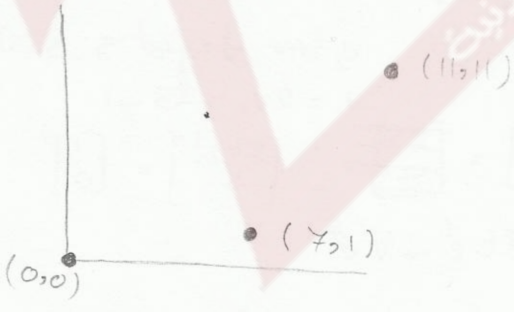


$\Sigma F_x = 0 \Rightarrow f = N_1$

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

$N_1 = 34 = f$

Q. 2



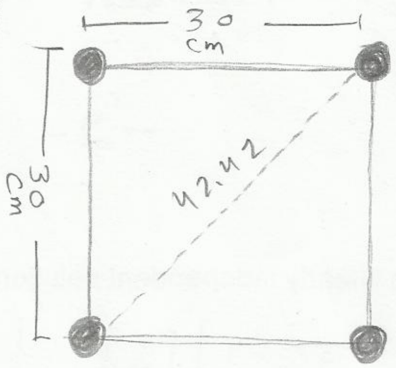
$$CM_x = \frac{\Sigma 6 (7+0+11)}{3*6} = 6$$

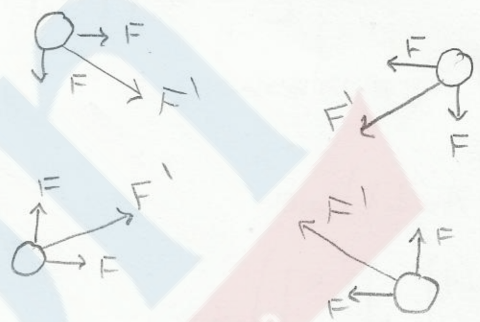
$$CM_y = \frac{\Sigma 6 (0+1+11)}{3*6} = 4$$

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

$$= 33.7 * \frac{\pi}{180} = 0.59 \text{ Rad}$$

Q. 3





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

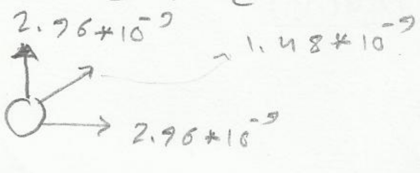
$$6.67 * 10^{-11} * \frac{2*2}{0.3^2}$$

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

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

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

so we have



the resultant of them

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

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

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:

13. In the text book, one reads that for the bob m suspended from a string l of the conical pendulum, the magnitude of the angular momentum about the vertical dashed line is, $L = \left(\frac{m^2 l^3 g \sin^4\theta}{\cos\theta}\right)^{1/2}$ as shown in the figure beside. Imagine that this pendulum is moved and relocated on the surface of planet X. The radius of the planet X is one-third that of earth and its mass is one-fourth that of earth. The magnitude of the angular momentum calculated on the surface of planet X becomes:

A) (9/4) L B) (4/9) L C) L
D) (3/2) L E) (2/3) L

14. A bead of mass m = 0.275 kg swings ([illegible]) in a vertical circular path on a string L= 0.85 m long as displayed in the figure beside. The tension (in N) in the string at the top of the circle when the bead's speed is 5.2 m/s is:

A) 6.05 B) 8.75 C) 11.44 D) 0 E) 2.70

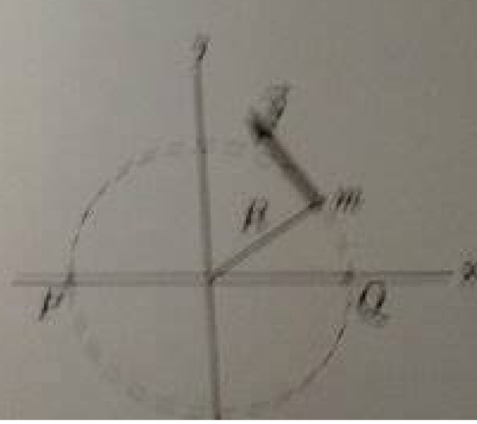
15. Two forces of magnitude 50 N, as shown in the figure beside, act on a cylinder of radius 4 m and mass 6.25 kg. The cylinder sits on a frictionless surface.
Knowing that the moment of inertia of the cylinder about the axle through • is $(1/2)MR^2$, the magnitude of the angular acceleration of the cylinder (in rad/s²) is:

A) 2 B) 8 C) 4 D) [illegible] E) 16

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

A) +11j B) -1.2j C) +1.2j D) [illegible] E) -2.4j

17. An object of mass m undergoes a uniform circular motion of radius R with velocity $\vec{v}$ as displayed in the figure beside. The work done in moving m from point Q to point P by the force causing (تسبب) this motion is:



A) $mv^2/2$ B) 0 C) mv^2/R
D) 2mgR E) $mv^2/2 + 2mgR$

... a particle of mass m moving with linear momentum $\vec{p}$.

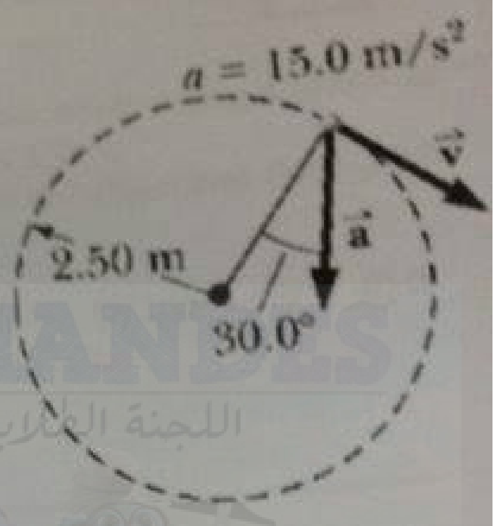
1. This particle is located at the vector position $\vec{r}$. The term $\left(\frac{d\vec{r}}{dt} \times \vec{p}\right)$ gives:

A) $\vec{F}$ B) $\vec{p}$ C) 0 D) $\vec{r}$ E) $\vec{L}$

2. This particle gains (يكتسب) kinetic energy K. If the momentum is reduced by half, the kinetic energy for the same particle will be:

A) K B) 2K C) K/2 D) 4K E) K/4

3. The total acceleration of a particle moving in a circle at a certain moment is shown in the figure beside. The speed (in m/s) of the particle at this snapshot (اللقطة) is:



A) 0

B) 4.3

C) 6.1

D) 32.5

E) 5.7

4. The figure beside shows two identical uniform rods of length L and mass m each. Both rods are rotating with an angular speed ω about an axis perpendicular to them; one passing through its center of mass (I_{center}), and the other one through its end (I_{end}). The work needed to set the two rods into rotation with the same ω is:

I_{center} =

I_{end} =

A) $W_{end} = W_{center}$ B) $W_{end} = 4 * W_{center}$

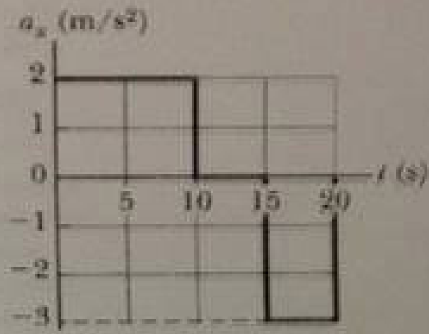
C) $W_{end} = 3 * W_{center}$

D) $W_{end} = (1/3) * W_{center}$

E) $W_{end} = (1/4) * W_{center}$

A merry-go-round of radius R = 2.0 m has a moment of inertia I = 100 k... and is rotating at 10 rev/min (revolutions per minute) about a frictionl... vertical axle (محور). A 25 kg child jumps out (قفز) from the edge of the pl... toward the ground.

7. A particle starts from rest and accelerates as shown in the figure beside. The speed (in m/s) of the particle at t = 14 s is:

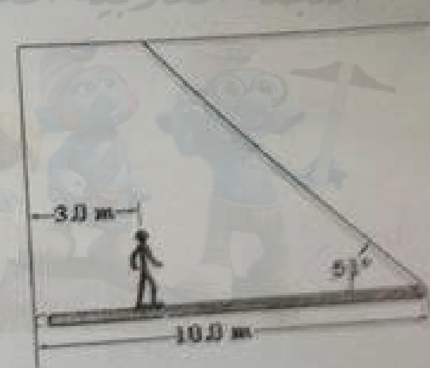


A) 0
B) 20
C) 10
D) 100
E) 24

8. A 40 kg object initially at rest is pushed 5 m horizontally along a rough (خشن) floor with a constant applied horizontal force of 130 N.
Knowing that the coefficient of friction between the object and floor is 0.3, the final speed of the object (in m/s) is:

A) 7.87 B) 61.9 C) 3.1 D) 1.76 E) 0

9. The figure beside shows a uniform, horizontal beam (length = 10 m, mass = 25 kg) that is pivoted (مثبتة) at the wall, with its far end supported by a cable that makes an angle of 51° with the horizontal.
As a "101 PHY" freshman (mass = 60 kg) stands 3.0 m from the pivot, the tension (in N) in the cable is:



A) 3000
B) 420
C) 300
D) 380
E) 830

10&11 The position vector of a particle of mass 2 kg as a function of time is given by $\vec{r} = 3\hat{i} + 2t\hat{j}$, where $\vec{r}$ is in meters and t is in seconds.

10. The angular momentum (in Kg.m²/s) of the particle about the origin is:
A) +8t $\hat{k}$ B) 0 C) +12$\hat{k}$ D) +4t$\hat{k}$ E) -8t $\hat{k}$

11. The net torque (in N.m) on the particle about the origin is:
A) +8 $\hat{k}$ B) 0 C) -8t $\hat{k}$ D) -4 $\hat{k}$ E) +4 $\hat{k}$

12. A ball of mass 0.2 kg with a velocity of 1.5i m/s meets a second ball of mass 0.3 kg with a velocity of -0.4i m/s in a head-on elastic collision.
The relative velocity (in m/s) of the two balls after the collision, ($v_{1f} - v_{2f}$), is:

A) +1.9i B) -1.9i C) +1.1i D) -1.1i E) -0.78i

University of Jordan
Department of Physics

Physics 101
Final Exam

Date: 28/12/2014
Time: 120 min

Name in Arabic:

No:

Instructor name:

Section:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E

$G=6.67\times10^{-11}\ N.m^2/kg^2$, $g=9.8\ m/s^2$

1. A particle located at the position vector $\vec{r}=(1.0\hat{i}-1.0\hat{j}+2.0\hat{k})$ m has a force $\vec{F}=(2.0\hat{i}+\hat{j})$ N acting on it. The magnitude of the torque about the origin (in N . m) is

a. 11 b. 16 c. 20 d. 5.4 e. 27

2. A 5.0-kg car moves with a speed of 20 m/s on a circular track of radius 50 m. What is the magnitude of its angular momentum (in kg · m²/s) relative to the center of the track?

a. 7.5×10^3 b. 1.5×10^2 c. 5.0×10^2 d. 2.5×10^3 e. 0.3×10^2

3. A force acts on a 5.0 kg particle such that its position vector is $\vec{r}(t)=(7.0+4.0t+5.0t^2)m$ calculate the power at t=2.0s (in kW)

a. 0.96 b. 1.20 c. 1.8 d. 0.72 e. 3.0

4. Calculate the work in (kJ) which must be done to accelerate a 13.5 kg particle from a speed of 12.0 m/s to a speed of 19.0 m/s?

a. 1.46 b. 1.95 c. 2.33 d. 7.15 e. 0.98

5. Calculate the kinetic energy in (J) of a rotating circular disk (mass 4.00 kg and radius 25.0cm) whose centripetal acceleration is 101 m/s²? $(I=1/2\,M\,R^2)$

a. 25.3 b. 225 c. 100 d. 120 e. 56.3

6. A particle started motion from origin with initial velocity ($\vec{v}=(2.0\hat{i}+4.0\hat{j})\ m/s$), and acceleration $\vec{a}=-2.0\hat{j}\ m/s^2$), the final speed of the particle (in m/s) at t=3.0s is

a. 1.0 b. 4.5 c. 2.0 d. 6.0 e. 2.8

7. Given that $\vec{A}\cdot\vec{B} = 0.75|\vec{A}\times\vec{B}|$, calculate the angle between $\vec{A}$ and $\vec{B}$

a. 25°   b. 53°   c. 76°   d. 63°   e. 12°

8. A 4.0-kg ball falling from rest vertically from 20 height hits the floor and rebounds with a speed of 1.5 m/s. What is the magnitude of the impulse caused by collision of the ball and the floor (kg . m/s)?

a. 85   b. 30   c. 43   d. 77   e. 50

9. At $t = 0$, a wheel rotating about a fixed axis at a constant angular acceleration has an angular velocity of 2.0 rad/s. Four seconds later it has turned through 5.0 complete revolutions. What is the angular acceleration of this wheel (in rad/s²)?

a. 14   b. 5.6   c. 2.9   d. 7.1   e. 2.2

10. A 3.0-kg particle moving in the positive x direction has a one-dimensional elastic collision with a a 2.0-kg particle initially at rest. After the collision the second particle has a velocity of 4.0 m/s in the positive x direction. What was the initial speed of the first object in (m/s)?

a. 4.7   b. 7.5   c. 5.3   d. 1.5   e. 3.3

11. A 2.00 kg and 4.00 kg objects are separated by 6.00m. At what distance in (m) from the second object will a 50.0 kg object be placed and experience a zero net force?

a. 7.22   b. 2.34   c. 3.51   d. 6.05   e.1.17

12. A wheel rotating about a fixed axis has an angular position given by $\theta = 5t - t^3$ rad, where θ is measured in radians and t in seconds. What is the magnitude of the average angular velocity in (rad/s) of the wheel between $t=0$ and $t=2$ s?

a. 4.0   b. 1.0   c. 19   d. 13   e. 11

13. A 4.00-kg particle is shot from ground level with an initial speed of 3.00 m/s at an angle of 45°. What is the magnitude of its angular momentum in (kg. m²/s) relative to the launch point when it is at its highest point in its trajectory?

a. 4.02   b. 2.93   c. 1.46   d. 1.95   e. 0.98

14. Calculate the coordinates of the center of gravity of three particles of identical mass if they are located at the points (0,0), (4,0) and (6,3).

a.(4.3 ,1)   b. (3 , 1)   c. (3.3 , 1)   d. (2.3 , 1)   e. (1.5 , 1)

15. calculate the resultant force in (N) acting on 5.00 kg particle moving on a circular track of radius of 4.00 m with a constant speed of 13.0 m/s ?

a. 24.5   b. 42.3   c. 122   d. 211   e. 84.5

16. A particle was shot horizontally from the top of a 30.0 m height building, what is the time in (s) needed by the particle to reach the ground?

a. 3.19   b. 2.86   c. 5.12   d. 2.47   e. 1.13

17. A 70.0 kg person rides in an elevator that has an upward acceleration of 1.50 m/s². What is the magnitude of the force in (N) exerted by the elevator floor on the person?

a. 861   b. 791   c. 668   d. 931   e. 710

Good luck!

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

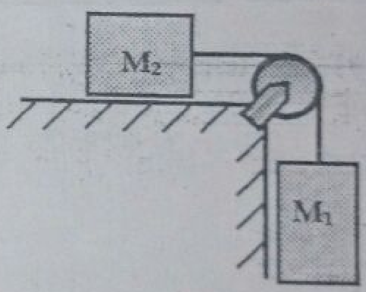
Q1) A wheel rotating about a fixed axis has an angular position given by $\theta = 3.0 - 2.0t^3$, where θ is measured in radians and t in seconds. The angular acceleration (in rad/s^2) of the wheel at $t = 2.0$ s is:

(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 ;

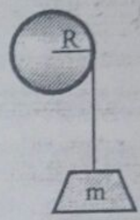
Q7) A car moving along a straight track changes its velocity from 40 m/s to 80 m/s in a distance of 200 m. The (constant) acceleration (in m/s^2) of the car during this time is:

(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 ;

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						**	**	**	**	**	**