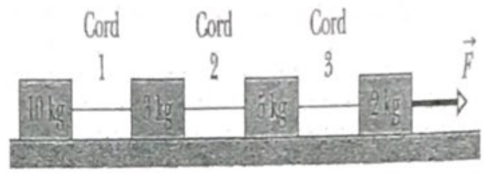
1) Four blocks are being pulled and accelerated across a frictionless floor by force F as shown. Rank the cords according to their tension, greatest first.



a) Cord1, cord2, cord3
b) Cord1, cord3, cord2
c) Cord2, cord1, cord3
d) Cord2, cord3, cord1
e) Cord3, cord2, cord1

2) Two bodies, A and B, have equal kinetic energies. The mass of A is nine times that of B. The ratio of the momentum of A to that of B (p_A/p_B) is:

a) 1/9
b) 1/3
c) 1/1
d) 3/1
e) 9/1

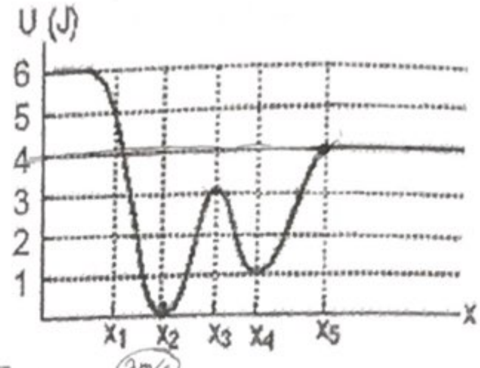
3) Block A of mass 4 kg, is moving with a speed of 2 m/s while block B of mass 8 kg is moving in the opposite direction with a speed of 3 m/s. The center of mass of the two block-system is moving with the velocity of:

a) 1.3 m/s in the same direction as A
b) 2.7 m/s in the same direction as A
c) 1 m/s in the same direction as B
d) 1.3 m/s in the same direction as B
e) 5 m/s in the same direction as A

4) The SI unit of Kinetic energy is:

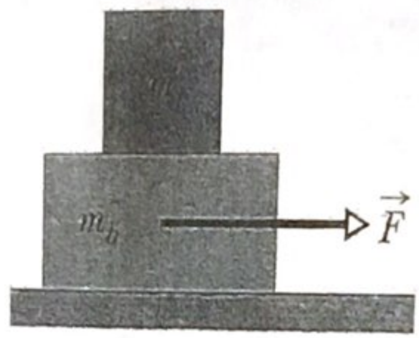
a) Kg.(m/s)
b) $N.m^2$
c) $Kg.(m/s)^2$
d) J/s
e) $Kg.(m/s^2)$

5) The potential energy curve U(x) of a 2 kg mass moving along the x-axis is shown in the figure. The speed of the particle at x_2 equals 2 m/s. The speed of the particle at x_5 in (m/s) is:



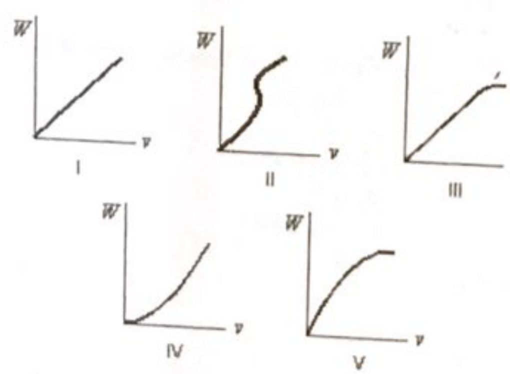
a) 3
b) 1
c) 2
d) 0
e) 4

6) A block of mass m_t = 2 kg is placed on a second block of mass m_b = 4 kg. The system is initially at rest on a smooth table. If $\mu_s = 0.5$ and $\mu_k = 0.25$ between the two blocks, the maximum horizontal force F applied to the lower block such that the two blocks move with the same acceleration is:



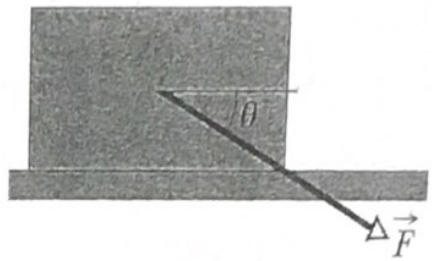
a) 0 N
b) 5.3 N
c) 15.2 N
d) 24.9 N
e) 29.4 N

7) A box is initially at rest on a horizontal frictionless table. A constant horizontal force *F is* applied to the box. Which of the following five graphs is a correct plot of work W done by the force as a function of box speed *v*?



a) I
b) III and V
c) III
d) IV
e) V

8) A box of weight W is pushed by a force F on a rough horizontal floor. The force F is directed at angle θ below the horizontal as shown. The coefficient of static friction between the box and the floor is μ_s. The minimum value of the force F that will move the box is given by:



a) $F = \frac{\mu_s W}{(1-\mu_s \tan\theta)\cos\theta}$

b) $F = \frac{W}{(1-\mu_s \cos\theta)\tan\theta}$

c) $F = \frac{\mu_s W}{(1-\mu_s)\tan\theta\cos\theta}$

d) $F = \frac{\mu_s W}{(1-\mu_s)\tan\theta}$

e) $F = \frac{\mu_s W}{(1-\mu_s)\sin\theta\tan\theta}$

$f\cos\theta = (mg + f\sin\theta)\mu_s$

$f\cos\theta - f\sin\theta\,\mu_s = mg\,\mu_s$

$f(\cos\theta - \sin\theta\,\mu_s) = W\mu_s$

$f = \frac{W\mu_s}{(\cos\theta - \sin\theta\,\mu_s)}$

9) A raindrop with radius R = 1.5 mm falls from a cloud that is at height h = 1200 m above the ground. The drag coefficient C = 0.6. Assume the drop is spherical. The terminal speed of the drop is:

a) 7.4 m/s
b) 47 m/s
c) 27 m/s
d) 4.7 m/s
e) 74 m/s

$R = 1.5 \times 10^{-3}$ m

$h = 1200$ m

$C = 0.6$

$mg = \frac{1}{2} C\rho A V^2$ $\rho_w = 1000$

$V = \sqrt{\left(\frac{2mg}{C\rho A}\right)}$

$= \frac{2 \times \frac{4}{3}\pi R^3 \times 1000 \times 9.8}{0.6 \times 1.2 \times \pi R^2}$

10) A block of mass 100 kg is pulled at constant speed by of 5 m/s across a horizontal force of 122 N directed 37° above the horizontal. The rate at which the force does work on the block is:

a) 487 W
b) 847 W
c) 1020 W
d) 748 W
e) 13 W

m = 100 Kg

v = 5 m/s

122 N

θ = 37°

P = f.V

= 122 × Cos 37° × 5

11) A stone of mass 8 kg is at rest on a top of a spring as shown. The spring is compressed 10 cm by the stone. Then, you pushed down the stone an additional 30 cm and then released. The elastic potential energy in (Joules) stored in the spring just before the release is:

a) 7.84
b) 0.0784
c) 784
d) 62.7
e) 0.627

x 0.1 m

0.3 m

$K x = mg$ $\quad \frac{1}{2} K x^2 = mgh$

$K \times 0.1 = 8 \times 9.8$ $\quad \frac{1}{2} k x^2 =$

$K = 784$ $\quad \frac{1}{2} \times 784 (0.4)^2$

12) The mass of the Sun is 329390 times the mass of the Earth. The mean distance from the center of the Sun to the center of the Earth is 1.496×10^8 km. Treat the Sun and Earth as small particles with each mass concentrated at the respective geometric center. The location of the center of mass of the Sun-Earth system is:

a) 454 km away from the center of the Sun
b) 454 km away from the center of the Earth
c) 7.48×10^7 km away from the center of the Earth
d) 7.48×10^7 km away from the center of the Sun
e) At the surface of Earth near to the North pole

earth 1.496×10^8 Km sun

$m_s = 329390\ m_{earth}$

$Y_{cm} = \frac{(m_s - m_e) \times 7.48 \times 10^7}{m_s + m_e} = \frac{329389 \times 7.4}{329391}$

$- 7.48 \times 10^7$

13) Two particles (جسمان), Particle A of mass m is moving toward Particle B which is of mass $12m$ and stationary. The two particles collide elastically. The initial kinetic energy of particle A is 1.6×10^{-13} J. The final kinetic energy in (Joules) of particle A after collision is:

a) 1.6×10^{-13}
b) 1.3×10^{-14}
c) 1.15×10^{-13}
d) 4.54×10^{-13}
e) 4.54×10^{-14}

$m_A = m$

$m_B = 12m$

$\frac{1}{2} m v^2 = 1.6 \times 10^{-13}$

$V_1^2 = \frac{3.2 \times 10^{-13}}{m}$

$\sqrt{\frac{3.2 \times 10^{-13}}{m}} = V_1' + 12 V_2'$

$m v_1 = m v_1' + 12 m v_2'$

$\sqrt{\frac{3.2 \times 10^{-13}}{m}} = V_2' - V_1'$

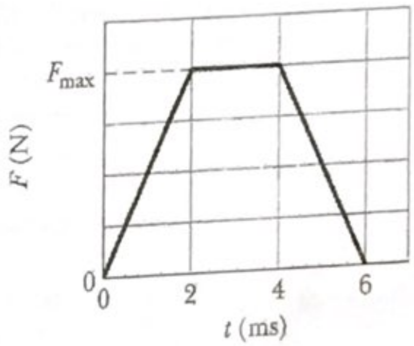
$2 \sqrt{\frac{3.2 \times 10^{-13}}{m}} = 13 V_2'$

$V_2' = \sqrt{\frac{1.89 \times 10^{-15}}{m}}$

$\frac{1}{2} m v_1^2 = \frac{1}{2} m v_1'^2 + \frac{1}{2} m v_2'^2$

$1.6 \times 10^{-13} = \frac{1}{2} m v_1'^2 + \frac{1}{2} 12 m \frac{1.89}{m}$

14) A ball of mass 58 g collides with a wall. The initial velocity of the ball is 34 m/s perpendicular to the wall, the ball rebounds directly back with approximately the same speed perpendicular to the wall. The plot to the right shows the force magnitude versus time during the collision with the wall. The maximum magnitude of the force F_{max} in (Newton) on the ball from the wall during the collision is:



a) 986
b) 0.986
c) 986000
d) 495
e) 1980

15) A bullet of mass 10 g is stopped inside a stationary block of wood of mass 5 kg. The speed of the wood-bullet system immediately after collision is 0.6 m/s. The speed of the bullet in (m/s) before colliding with the wooden block is:

a) 0.3
b) 3000
c) 301
d) 20
e) 13

16) When an object experiences uniform circular motion, the direction of the net force is:

a) directed away from the center of the circular path.
b) directed toward the center of the circular path.
c) in the same direction as the motion of the object.
d) in the opposite direction of the motion of the object.
e) Counterclockwise

17) Inelastic collision is a collision in which kinetic energy is:

a) conserved.
b) not conserved.
c) increases.
d) decreases.
e) Does not exist

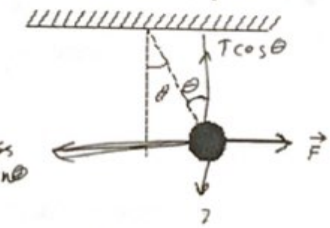
A single conservative force $\vec{F} = (2x + 4)\hat{\imath}$ acts on a 5-kg particle where F is in Newton and x is in meters. The particle moves along the x axis from x = 1 m to x = 5 m. The speed of the particle at x =1 m is 3 m/s. Answer the following TWO questions:

18) The work in (Joules) done by this force is:
a) 40
b) 62.5
c) 77.5
d) 15
e) 13.5

19) The kinetic energy of the particle at x = 5 m is:
a) 40
b) 62.5
c) 77.5
d) 15
e) 13.5

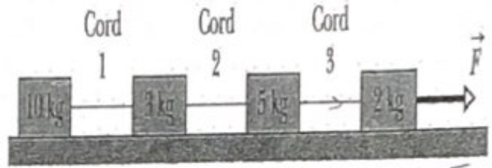
20) The coefficient of static friction between the road and the tires of a race car is 0.6. The car will round a level curve of 30.5 m radius. The speed in (km/h) that will put the car on the verge of sliding as it rounds this curve is (على وشك الإنزلاق عند الإنعطاف مع المنحنى):
a) 408
b) 1470
c) 48.2
d) 13.4
e) 4

21) A pendulum bob (كرة البندول) of weight 2 N is held at an angle θ from the vertical by a 2-N horizontal force F as shown. The tension in the string supporting the pendulum bob (in Newton) is:



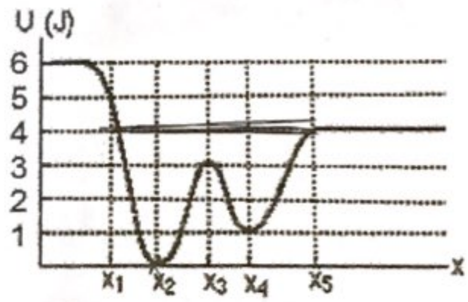
a) cos θ
b) 2
c) $2\sqrt{2}$
d) tan θ
e) We need more information to calculate the tension

1) Four blocks are being pulled and accelerated across a frictionless floor by force F as shown. Rank the cords according to their tension, smallest first.



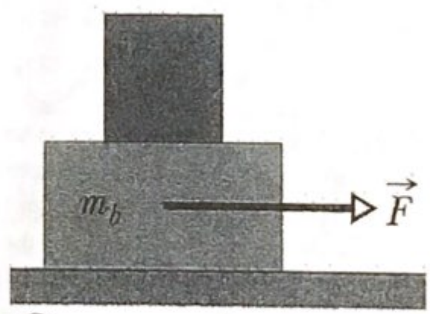
a) Cord1, cord2, cord3
b) Cord1, cord3, cord2
c) Cord2, cord1, cord3
d) Cord2, cord3, cord1
e) Cord3, cord2, cord1

2) The potential energy curve U(x) of a 2 kg mass moving along the x-axis is shown in the figure. The speed of the particle at x_2 equals 2 m/s. The speed of the particle at x_5 in (m/s) is:



a) 3
b) 1
c) 2
d) 0
e) 4

3) A block of mass $m_t = 2$ kg is placed on a second block of mass $m_b = 4$ kg. The system is initially at rest on a smooth table. If $\mu_s = 0.5$ and $\mu_k = 0.25$ between the two blocks, the maximum horizontal force F applied to the lower block such that the two blocks move with the same acceleration is:



a) 0 N
b) 5.3 N
c) 15.2 N
d) 24.9 N
e) 29.4 N

A single conservative force $\vec{F} = (2x + 4)\hat{i}$ acts on a 5-kg particle where F is in Newton and x is in meters. The particle moves along the x axis from x = 1 m to x = 5 m. The speed of the particle at x =1 m is 3 m/s. Answer the following TWO questions:

4) The work in (Joules) done by this force is:
- a) 40
- b) 62.5
- c) 77.5
- d) 15
- e) 13.5

$W = \int_1^5 F_x\,dx = \int_1^5 (2x+4) = x^2 + 4x \Big|_1^5 = (25-1) + (20-4) = 40$

5) The kinetic energy of the particle at x = 5 m is:
- a) 40
- b) 62.5
- c) 77.5
- d) 15
- e) 13.5

$W = \Delta K$

$40 = K_{E5} - K_{E1}$

$40 = K_{E5} - \frac{1}{2}(5)(3)^2$

$40 + 22.5 = K_{E5}$

$K_{E5} = 62.5$

6) The coefficient of static friction between the road and the tires of a race car is 0.6. The car will round a level curve of 30.5 m radius. The speed in (km/h) that will put the car on the verge of sliding as it rounds this curve is (على وشك الإنزلاق عند الإنعطاف مع المنحنى):
- a) 408
- b) 1470
- c) 48.2
- d) 13.4
- e) 4

$\frac{mV^2}{R} = \mu_s mg$

$V = \sqrt{R\mu_s g} = \sqrt{30.5 \times 0.6 \times 9.8} = 13.4$ m/s

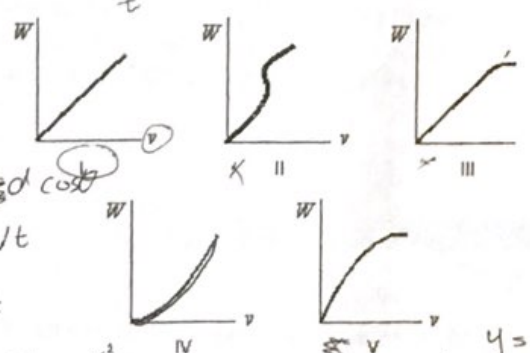
$\frac{13.4 \times 3600}{1000}$

7) When an object experiences uniform circular motion, the direction of the net force is:
- a) directed away from the center of the circular path.
- b) directed toward the center of the circular path.
- c) in the same direction as the motion of the object.
- d) in the opposite direction of the motion of the object.
- e) Counterclockwise

8) Two bodies, A and B, have equal kinetic energies. The mass of A is nine times that of B. The ratio of the momentum of A to that of B (p_A/p_B) is:
   a) 1/9
   b) 1/3
   c) 1/1
   d) 3/1
   e) 9/1

9) Block A of mass 4 kg, is moving with a speed of 2 m/s while block B of mass 8 kg is moving in the opposite direction with a speed of 3 m/s. The center of mass of the two block-system is moving with the velocity of:
   a) 1.3 m/s in the same direction as A
   b) 2.7 m/s in the same direction as A
   c) 1 m/s in the same direction as B
   d) 1.3 m/s in the same direction as B
   e) 5 m/s in the same direction as A

10) A box is initially at rest on a horizontal frictionless table. A constant horizontal force F *is* applied to the box. Which of the following five graphs is a correct plot of work W done by the force as a function of box speed v?



   a) I
   b) III and V
   c) III
   d) IV
   e) V

11) The SI unit of Kinetic energy is:
   a) Kg.(m/s)
   b) $N.m^2$
   c) $Kg.(m/s)^2$
   d) J/s
   e) $Kg.(m/s^2)$

12) Inelastic collision is a collision in which kinetic energy is:

a) conserved.
b) not conserved.
c) increases.
d) decreases.
e) Does not exist

13) A bullet of mass 10 g is stopped inside a stationary block of wood of mass 5 kg. The speed of the wood-bullet system immediately after collision is 0.6 m/s. The speed of the bullet in (m/s) before colliding with the wooden block is:

a) 0.3
b) 3000
c) 301
d) 20
e) 13

$10\times10^{-3} V_i = (10\times10^{-3}+5)0.6$

$V_i = 300.6$ m/s $= 301$ m/s

14) The mass of the Sun is 329390 times the mass of the Earth. The mean distance from the center of the Sun to the center of the Earth is 1.496×10^8 km. Treat the Sun and Earth as small particles with each mass concentrated at the respective geometric center. The location of the center of mass of the Sun-Earth system is:

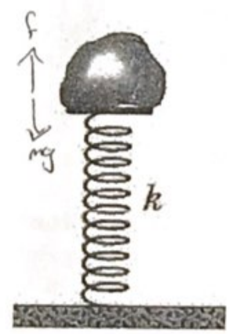
a) 454 km away from the center of the Sun
b) 454 km away from the center of the Earth
c) 7.48×10^7 km away from the center of the Earth
d) 7.48×10^7 km away from the center of the Sun
e) At the surface of Earth near to the North pole

m_E 1.496×10^8 km $329390\, m_E$

$x_{com} = \frac{m_E(0) + m_E\, 329390(1.496)}{329391\, m_E}$

454 Km

15) A stone of mass 8 kg is at rest on a top of a spring as shown. The spring is compressed 10 cm by the stone. Then, you pushed down the stone an additional 30 cm and then released. The elastic potential energy in (Joules) stored in the spring just before the release is:



a) 7.84
b) 0.0784
c) 784
d) 62.7
e) 0.627

$mg - Kx = 0$

$mg = Kx$

$8(10) = K(\frac{1}{10})$

$K = 800$

$\Delta U_s = \frac{1}{2}Kx^2 = \frac{1}{2}(800)(0.4)^2 = 64$ J

$m_a V_{a1} = m_a V_{a2} + m_b V_b$

$m_a V_{a1} = m_a V_{a2} + 12 m_a V_b$

$V_{a1} = V_{a2} + 12 V_b$

$V_{a1} = V_b - V_{a2}$

$\frac{1}{2} m V_a^2 = \frac{1}{2} m V_{aa}^2 + \frac{1}{2}(12m) V_{ba}^2$

16) Two particles (جسمان), Particle A of mass m is moving toward Particle B which is of mass $12m$ and stationary. The two particles collide elastically. The initial kinetic energy of particle A is 1.6×10^{-13} J. The final kinetic energy in (Joules) of particle A after collision is:

a) 1.6×10^{-13}
b) 1.3×10^{-14}
c) 1.15×10^{-13}
d) 4.54×10^{-13}
e) 4.54×10^{-14}

$V_{a1} = 13 V_b$

$V_{a2} = V_{a1} - 12 V_b$

$V_{a2} = 13 V_b - 12 V_b$

$V_{a2} = 1 V_{b2}$

$\Delta K = \Delta K$

$K_{Ab} = K_{Aa} + K_{ba}$

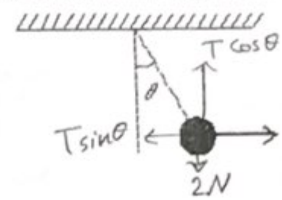
$V_a - V_b = -(V_a - V_b)$

$K_A = K_{Aa} + \frac{1}{2}(12) m V_{ca}^2$

$V_a = V_b - V_a$

$11 K_{Aa} + 12 K_{ba}$

17) A pendulum bob (كرة البندول) of weight 2 N is held at an angle θ from the vertical by a 2-N horizontal force F as shown. The tension in the string supporting the pendulum bob (in Newton) is:



a) $\cos\theta$
b) 2
c) $2\sqrt{2}$
d) $\tan\theta$
e) We need more information to calculate the tension

$T\cos\theta = 2$

$T\sin\theta = 2$

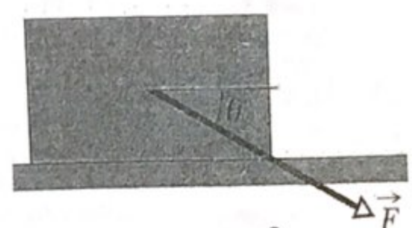
$\tan\theta = \frac{2}{2}$

$\theta = 45°$

$T\cos\theta = 2$

$2\sqrt{2}$

18) A box of weight W is pushed by a force F on a rough horizontal floor. The force F is directed at angle θ below the horizontal as shown. The coefficient of static friction between the box and the floor is μ_s. The minimum value of the force F that will move the box is given by:



a) $F = \frac{\mu_s W}{(1-\mu_s \tan\theta)\cos\theta}$

b) $F = \frac{W}{(1-\mu_s \cos\theta)\tan\theta}$

c) $F = \frac{\mu_s W}{(1-\mu_s)\tan\theta\cos\theta}$

d) $F = \frac{\mu_s W}{(1-\mu_s)\tan\theta}$

e) $F = \frac{\mu_s W}{(1-\mu_s)\sin\theta\tan\theta}$

$f\cos\theta > f_{s\,max}$

$f_{s\,max} = \mu_s N$

$= \mu_s (mg + f\sin\theta)$

$f\cos\theta = \mu_s(mg + f\sin\theta)$

$f = \frac{\mu_s W}{\cos\theta} + \mu_s f \tan\theta$

$f\cos\theta = \mu_s W + \mu_s f\sin\theta$

$f\cos\theta - f\sin\theta = \mu_s W$

$f(\cos\theta - \mu_s\sin\theta) = \mu_s W$

$f = \frac{\mu_s W}{(\cos\theta - \mu_s\sin\theta)} = \frac{\mu_s W}{(1-\mu_s\tan\theta)\cos\theta}$

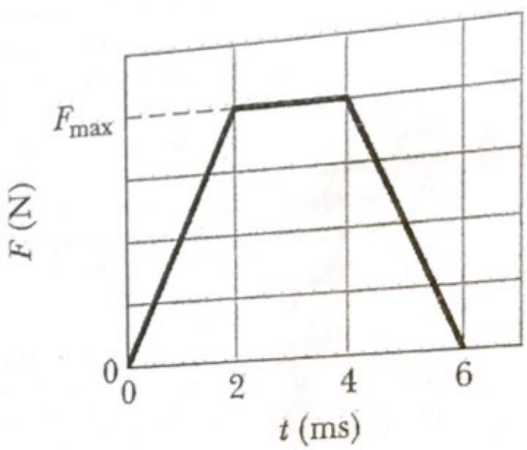
19) A raindrop with radius R = 1.5 mm falls from a cloud that is at height h = 1200 m above the ground. The drag coefficient C = 0.6. Assume the drop is spherical. The terminal speed of the drop is:

a) 7.4 m/s
b) 47 m/s
c) 27 m/s
d) 4.7 m/s
e) 74 m/s

20) A block of mass 100 kg is pulled at constant speed by of 5 m/s across a horizontal force of 122 N directed 37° above the horizontal. The rate at which the force does work on the block is:

a) 487 W
b) 847 W
c) 1020 W
d) 748 W
e) 13 W

21) A ball of mass 58 g collides with a wall. The initial velocity of the ball is 34 m/s perpendicular to the wall, the ball rebounds directly back with approximately the same speed perpendicular to the wall. The plot to the right shows the force magnitude versus time during the collision with the wall. The maximum magnitude of the force F_{max} in (Newton) on the ball from the wall during the collision is:



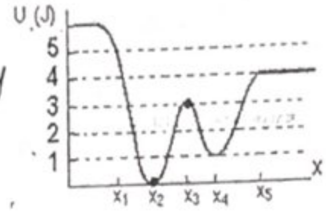
a) 986
b) 0.986
c) 986000
d) 495
e) 1980

1. A 2 kg block is compressed 10 cm on a frictional surface with $\mu_k = 0.5$ against a horizontal spring with spring constant k=20 N/cm. When released, The block will come to rest in a distance from the compression point of

(a) 5 m
(b) 2 m
(c) 3 m
(d) 4 m
(e) 1 m

2. The potential energy curve U(x) of a 2 kg mass moving along the x-axis is shown in the figure. The speed of the particle at x_2 equals 2 m/s. The speed of the particle at x_3 is

(a) 0.0 m/s
(b) 1.0 m/s
(c) 1.7 m/s
(d) 3.5 m/s
(e) 4.6 m/s



3. An isolated body of mass m moving along the positive x-axis with velocity v_0 exploded (انفجر) into two bodies of equal mass. The first is moving with a velocity of v_0 along the positive y-axis. The velocity of the second body is

(a) $v = v_o\hat{\imath} - 2v_o\hat{\jmath}$
(b) $v = 2v_o\hat{\imath} - v_o\hat{\jmath}$
(c) $v = v_o\hat{\imath} + 2v_o\hat{\jmath}$
(d) $v = 2v_o\hat{\imath} + v_o\hat{\jmath}$
(e) $v = v_o\hat{\imath} - v_o\hat{\jmath}$

4. Block A, with a mass of 4 kg, is stationary, while block B, with a mass of 8 kg, is moving at 3 m/s. the center of mass of the two block system has a speed in m/s of:

(a) 0.0
(b) 1.5
(c) 3.0
(d) 2.0
(e) 4.0

5. A ball of mass 0.4 kg is thrown horizontally to the right against a wall. It hits the wall with a speed of 30 m/s and rebounds horizontally to the left with a speed of 20 m/s. The impulse (in N.s) of the net force on the ball during its collision with the wall is:

(a) 20 to the right
(b) 20 to the left
(c) 4 to the right
(d) 4 to the left
(e) 10 to the right

6. A 5.0 kg object is moving horizontally at 6.0 m/s. In order to change its speed to 10.0 m/s the net work done in Joule on the object must be:

(a) 160
(b) -160
(c) 90
(d) -90
(e) 20

7. A water pump is moving water from a lake to a storage tank at 24 meters above ground. If the pump moves 5 m^3 of water (density = 10^3 kg/m^3) in 10 minutes, the pump must have at least a power of

(a) 40 KW
(b) 20 KW
(c) 1 KW
(d) 2 KW
(e) 100 KW

8. A wooden block starts from rest on a smooth inclined plane which makes an angle of 30 degrees with the horizontal. The speed of the block after it has gone 3.6 m down the incline is

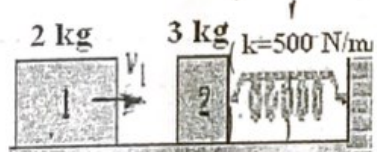
(a) 5 m/s
(b) 2 m/s
(c) 6 m/s
(d) 12 m/s
(e) 15 m/s

9. The work done by an applied force $\vec{F} = 2\hat{\imath} + 4y\hat{\jmath}$ N in moving an object from $\vec{r}_1 = 2\hat{\imath} + 3\hat{\jmath}$ to $\vec{r}_2 = -4\hat{\imath} - 3\hat{\jmath}$ is equal to

(a) 0 Joule
(b) -6 Joule
(c) +6 Joule
(d) -12 Joule
(e) +12Joule

10. In the figure shown block 1 is moving with speed 5m/s towards block 2 which is at rest, on a frictionless surface. If the blocks stick together after collision, then the maximum compression in the spring is:

(a) 15 *cm*
(b) $10\sqrt{10}$ *cm*
(c) 5 *cm*
(d) 25 *cm*
(e) 20 *cm*



11. Two objects orbiting earth, one at a distance d_1 from earth center and the other is at a distance d_2. If the first object has period of 1 month while the second one has a period of 8 months then the ratio d2 / d1 is

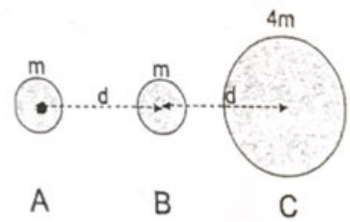
(a) 1
(b) 2
(c) 3
(d) 4
(e) 5

12. The power required to increase the kinetic energy of an object from 360 J to 1800 J in 3 minutes is:

(a) 0.25 *Watt*
(b) 4.3 *Watt*
(c) 8.0 *Watt*
(d) 240 *Watt*
(e) 25 *Watt*

13. The following diagram shows two smaller planets of mass m and one larger planet of mass 4m, aligned and separated by distance d between each planet. Which one of the following gravitational forces is strongest?

(a) The force by Planet A on Planet B.
(b) The force by Planet C on Planet A.
(c) The force by Planet B on Planet A.
(d) The force by Planet A on Planet C.
(e) The force by Planet B on Planet C.



14. Two masses A and B have equal linear momentum, If the mass of B is 9 times the mass of A, then the ratio(نسبة) of the kinetic energy of A to B is

(a) 1:3
(b) 3:1
(c) 1:1
(d) 1:9
(e) 9:1

15. The escape speed from the surface of a planet is 6.1 km/s. For another planet with the same mass and twice the radius, the escape speed would be:

(a) 7.7 km/s
(b) 5.3 km/s
(c) 4.2 km/s
(d) 8.6 km/s
(e) 2.5 km/s

16. An object is under the influence of a conservative force, which has a potential energy $U(x) = x^2 - 3x - 6$ and has mechanical energy 4 Joule. The turning points of the object are:

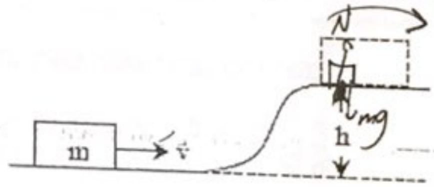
(a) $X_1 = +5, X_2 = -2$
(b) $X_1 = -5, X_2 = -2$
(c) $X_1 = -2, X_2 = +2$
(d) $X_1 = -1, X_2 = +2$
(e) $X_1 = -2, X_2 = +1$

$U(x) = x^2 - 3x - 6$. $E = 4$
$E = U$
$4 = x^2 - 3x - 6$
$x^2 - 3x - 10 = 0$
$(x-5)(x+2) = 0$
$x^2 - 5x - 10 + 2x$
$x^2 - 3x - 10$
$x = 5$, $x = -2$.

17. A block of mass m slides with speed v without friction on a horizontal surface and then rises up a hill of height h. What must be its minimum speed to complete this trajectory?

(a) $\sqrt{4gh}$
(b) $\sqrt{gh/2}$
(c) $\sqrt{gh}$
(d) $2\sqrt{2gh}$
(e) $\sqrt{2gh}$

$(U+K)_f = (U+K)_i$
$mgh + 0 = 0 + \frac{1}{2}mv^2$
$gh = \frac{1}{2}v^2$
$v = \sqrt{2gh}$



18. In a two dimensional elastic collision with equal masses and a stationary target, the two masses will be deflected at angles θ_1 and θ_2 from the line of collision such that

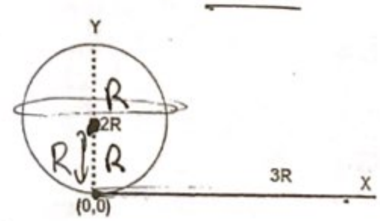
(a) $\theta_1 - \theta_2 = 45^o$
(b) $\theta_1 + \theta_2 = 45^o$
(c) $\theta_1 - \theta_2 = 90^o$
(d) $\theta_1 + \theta_2 = 90^o$
(e) $\theta_1 + \theta_2 = 180^o$

$(m_1 v_1 = m_1 v_1 \cos\theta_1 + m_2 v_2 \cos\theta_2)\ x$
$(m_1 v_1 = m_1 v_1 \sin\theta_1 + m_2 v_2 \sin\theta_2)\ y$

19. A rod of mass m and length 3R along the x-axis, and a ring of mass m and radius R on the y-axis as shown. The position of the center of mass of the system (x_{cm}, y_{cm}) is:

(a) R/2, R/2
(b) 3R/4, R/2
(c) R/2, R/4
(d) 0, R/2
(e) R/3, 3R/4

$X_{cm} = \frac{m_1 x_1 + m_2 x_2}{m+m} = \frac{m(3R) + 0}{2m} = \frac{3R}{2} \rightarrow$ x-axis
$= 2Rm$



20. The angle between two vectors $\vec{A} = 3\hat{\imath} + 4\hat{\jmath} + 3\hat{k}$ and $\vec{B} = 1\hat{\imath} + 2\hat{\jmath} - 2\hat{k}$ is

(a) 30 degrees
(b) 47 degrees
(c) 66 degrees
(d) 73 degrees
(e) 22 degrees

$A \cdot B = 3(1) + 4(2) - 2(3)$
$= 3 + 8 - 6$
$= 11 - 6$
$= 5$
$5 = \sqrt{9+16+9} \times \sqrt{1+4+4} \cos\theta$.
$5 = 5.8 \times 3$
$\cos\theta = 0.28$

(1) A particle moves along the x-axis under the influence of a force given by $F = 3x^2 - 1$, where F is in Newton and x is in meters. If x = 0 is taken to be the zero of potential energy, then the potential energy of the particle in joules at x = 2 m is equal to :

(a) 1 J
(b) -1 J
(c) 6 J
(d) -6 J
(e) 0 J

(2) The work done by an applied force $\vec{F} = 2\hat{i} + 3\hat{j}$ N in moving an object from the origion to $\vec{r} = 4\hat{i} - \hat{j}$ is equal to

(a) 0 Joule
(b) +5 Joule
(c) -6 Joule
(d) -12 Joule
(e) +11 Joule

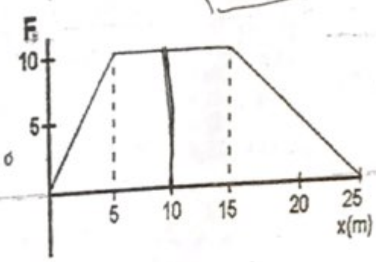
(3) A 2 kg block is compressed 0.1 m on a frictional surface with $\mu_k = 0.25$, against a horizontal spring with spring constant k=2000 N/m. When released, The block will come to rest in a distance of approximately

(a) 0.2 m
(b) 0.5 m
(c) 2.0 m
(d) 4.0 m
(e) 5.0 m

(4) A water pump is moving water from a lake to a storage tank at 12 meters above ground. If the pump moves 5 m^3 of water (density = 10^3 kg/m^3) in 10 minutes, the pump must have at least a power of approximately

(a) 4 kW
(b) 2 kW
(c) 5 kW
(d) 1 kW
(e) 3 kW

(5) The diagram represents the force acting on a 6 kg mass along the x-axis. If the mass is at rest at the origin, find the velocity of the mass at x=10 m.



(a) 1.0 m/s
(b) 2.5 m/s
(c) 3.5 m/s
(d) 5.0 m/s
(e) 10.0 m/s

(6) Body A with velocity v_0 collides elastically along a straight line with body B of equal mass. Which statement is TRUE

- (a) The two bodies exchange momentum
- (b) Body A will bounce back with the same initial speed
- (c) Both bodies will move forward with velocity v_0
- (d) Both bodies will move forward with velocity $v_0/2$
- (e) The kinetic energy of the system is not conserved

(7) The impulse given to a body by the force $f(t) = 2t - 3$, with f(t) in Newtons, during the first 4 seconds of action is

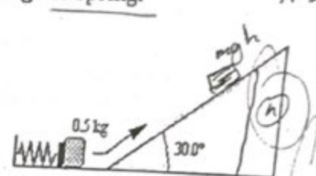
- (a) 16 kg m/s
- (b) 8 kg m/s
- (c) 10 kg m/s
- (d) 12 kg m/s
- (e) 4 kg m/s

(8) The center of mass of the moon-earth system is

- (a) Between earth and moon and closer to moon.
- (b) Between earth and moon and closer to earth.
- (c) Between earth and moon and halfway between them.
- (d) At the center of the earth
- (e) At the center of the moon

(9) A spring of constant k = 200 N/m compressed a distance of 0.5 m, is used to launch a 0.5 kg up a frictionless slope at an angle 30° as shown. Find the maximum distance along the slope that the mass moves after leaving the spring.

- (a) 2.0 m
- (b) 4.0 m
- (c) 5.0 m
- (d) 8.0 m
- (e) 10.0 m



(10) A 0.50-kg mass attached to the end of a string swings in a vertical circle (radius = 2.0 m). When the string is horizontal, the speed of the mass is 8.0 m/s. What is the tension in the string at this position?

- (a) 16 N
- (b) 18 N
- (c) 21 N
- (d) 32 N
- (e) 25 N

(11) A 2.0 kg mass is projected vertically upward from ground level with an initial speed of 30 m/s. The mass rises to a maximum height of 35 m above ground level. How much work is done on the mass by air resistance between the point of projection and the point of maximum height?

(a) - 0.50 kJ
(b) +0.50 kJ
(c) - 0.40 kJ
(d) +0.30 kJ
(e) -0.20 kJ

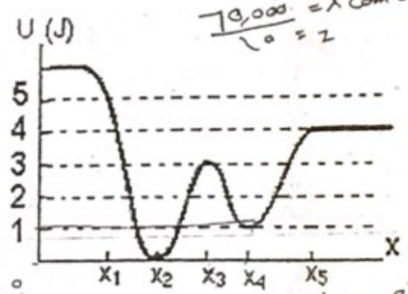
(12) A 6.0 kg object moving 5.0 m/s collides with and sticks to a 2.0 kg object. After the collision the composite object is moving 2.0 m/s in a direction opposite to the initial direction of motion of the 6.0 kg object. Determine the speed of the 2.0 kg object before the collision.

(a) 15 m/s
(b) 7.0 m/s
(c) 8.0 m/s
(d) 23 m/s
(e) 11 m/s

(13) A 2000 kg car is traveling at constant speed of 110 km/hr. A heavy truck of mass 5000 kg is traveling in the opposite direction at a constant speed of 30 km/hr. When passing each other, their center of mass is moving at

(a) 0 km/hr
(b) 53 km/hr
(c) 70 km/hr
(d) 10 km/hr
(e) 20 km/hr

(14) The potential energy curve U(x) of a 2 kg object moving along the x-axis is shown in the figure. The speed of the object at x_2 equals 2 m/s. The speed of the object at x_4 is



(a) 1.0 m/s
(b) 1.4 m/s
(c) 1.7 m/s
(d) 2.0 m/s
(e) 2.4 m/s

(15) The angle between the vector $\vec{A} = 3\hat{\imath} + 3\hat{\jmath} - \sqrt{7}\,\hat{k}$ and the y-axis is

(a) 30°
(b) 45°
(c) 60°
(d) 53°
(e) 37°

(16) Two masses A and B have equal linear momentum, If $M_B = 3\ M_A$, then the ratio(نسبة) of the kinetic energy of A to B is

(a) 1:3
(b) 3:1
(c) 1:1
(d) 1:9
(e) 9:1

(17) The work done in stretching a relaxed spring with k=100 N/m 10 cm is.

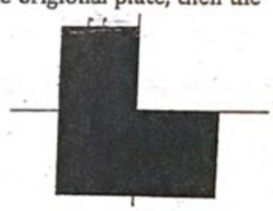
(a) +0.5 J
(b) +2.0 J
(c) +0.0 J
(d) -0.5 J
(e) -0.2 J

(18) A 4 kg object is at rest at the origin when it explodes into three pieces. The first, with mass 1 kg, moves along the x-axis at 15 m/s. The second, with mass 2 kg, moves along the y-axis at 10 m/s. Find the speed of the third piece.

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

(19) One fourth of a square metal sheet of length L is cut from the corner as shown in the figure. Consider the origion to be at the cenetr of the origional plate, then the center of mass of the remaining part is located at

(a) -L/2, -L/3
(b) -L/12, -L/12
(c) -L/4, +L/3
(d) +L/12, -L/6
(e) +L/6, +L/6



(20) A 60 kg boy is standing at one end of a 20 kg slab that is initially at rest on a frictionless floor. The slab is 8.0 m long. The boy walks to the other end of the slab. How far did slab move with respect to the floor?

(a) 6.0 m
(b) 8.0 m
(c) 4.0 m
(d) 1.0 m
(e) 2.0 m

X ch.8

1. A projectile of mass 2 kg is fired with an initial speed of 10 m/s at an angle of 60° above the horizontal. The potential energy (relative to ground level) of the projectile at its highest point is:

A) 100 J
B) 18.75 J
C) 25 J
D) 75 J
E) 12.5 J

$KE = \frac{1}{2} m v^2 = \frac{1}{2}(2)100 = 100$

$E = KE + PE = 100 + 0 = 100$

$V_x = V\cos\theta = 10\cos 60 = 5$

$KE = \frac{1}{2} m v^2 = 0.5(2)(25) = 25$

$E = K + U \rightarrow E - K = U$

$100 - 25 = U = 75$

✓ ch7

2. An elevator has a mass of 400 kg moves 20 m up in 40 sec at constant speed. The average power of the elevator motor is:

A) 800 W
B) 2000 W
C) 250 W
D) 5000 W
E) 2500 W

m = 400, d = 20, t = 40

$P_{avr} = \frac{W}{\Delta t} = \frac{mgd}{\Delta t} = \frac{400 \times 10 \times 20}{40}$

8000

✓ ch9

3. A 0.50-kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. The total mechanical energy is 25 J. The maximum speed of the block is:

A) 0.69 m/s
B) 5 m/s
C) 7.1 m/s
D) 10 m/s
E) 0.85 m/s

mgh

m = .50, K = 80, E = 25

$E_m = K + U = \frac{1}{2} m v^2 + \frac{1}{2} k x^2$

$E - U = K$

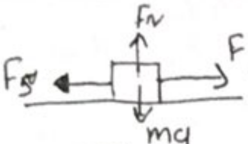
$25 - 0 = \frac{1}{2} m v^2$

✓

4. A force acting on a particle is conservative if:

A) it obeys Newton's second law
B) its work equals the change in the kinetic energy of the particle
C) it is not a frictional force
D) it obeys Newton's third law
E) its work depends only on the end points of the motion, not the path between them

5. A 36-N horizontal force is applied to a 8-kg block initially at rest on a rough horizontal surface. If the coefficients of friction are $\mu_s = 0.5$ and $\mu_k = 0.4$, the magnitude of the frictional force on the block is:

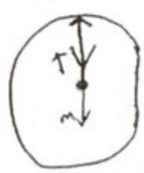


A) 32 N
B) 26 N
C) 36 N
D) 18 N
E) 40 N

6. The potential energy of a 1.0 kg particle is given by:
$U(x) = 9/x^2 + 9/x$; $x > 0$. If the total mechanical energy $E = 4$ J, then the turning point for the particle is at x = :

A) 0.25 m
B) 1.5 m
C) 0.75 m
D) 1.0 m
E) 3.0 m

7. A 2-kg object attached to the end of a string swings in a vertical circle (radius = 80 cm). At the top of the circle the speed of the object is 6 m/s. What is the magnitude of the tension in the string at this position?



A) 3.1 N
B) 70 N
C) 20 N
D) 31 N
E) 110 N

8. F is the only force acting on a 4 kg particle. The position of the particle is given by: $x = 3t - 6t^2 + t^3$ with x in meters and t in seconds. The work done by F from t = 0 to t = 2 s is:

A) 180 J
B) 60 J
C) 224 J
D) 0 J
E) 144 J

9. The potential energy of a 0.7-kg particle moving along the x axis is given by $U(x) = 3x^2 - 5x^4$ J. When the particle is at x = 1.0 m, its acceleration is:

A) 0
B) 10 m/s²
C) 20 m/s²
D) - 20 m/s²
E) - 40 m/s²

10. A 6.0 kg spherical ball that has a radius of 5.0 cm and a drag coefficient C = 1.60, falls through air whose density is 1.20 kg/m³. The terminal speed v_t of the ball is;

A) 49 m/s
B) 105 m/s
C) 89 m/s
D) 112 m/s
E) 15 m/s

11. A car travels around an unbanked highway curve (radius 0.15 km) at a constant speed of 20 m/s. What is the magnitude of the resultant force acting on the 75 kg driver?

A) 550 N
B) 750 N
C) 0 N
D) 333 N
E) 200 N

12. At time t = 0 a 2-kg particle has a velocity in m/s of $4\hat{i} - 3\mathbf{j}$. At t = 3 s its velocity in m/s is $6\hat{i} + 3\mathbf{j}$. During this time the work done on it was:

A) 0 J
B) 38 J
C) 20 J
D) -12 J
E) -40 J

13. The potential energy of a 0.4-kg particle moving along the x axis is given by $U(x) = 8x^2 + 2x^4$, where U is in joules and x is the coordinate of the particle in meters. If the particle has a speed of 5.0 m/s when it is at x = 1.0 m, its speed when it is at the origin is:

A) 18.7 m/s
B) 11.2 m/s
C) 0
D) 8.7 m/s
E) 5.7 m/s

14. A car is traveling at a speed of 24 m/s where the coefficients of friction with the road are $\mu_s = 0.8$ and $\mu_k = 0.6$. The shortest distance in which the car can stop is:

A) 78 m
B) 52 m
C) 48 m
D) 25 m
E) 36 m

15. The work done by a force $\mathbf{F} = 3x^2\,\mathbf{i} + 2y\,\mathbf{j} - 4z\,\mathbf{k}$, with x, y and z are in meters, that moved a particle from $\mathbf{r}_1 = 2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$ m, to $\mathbf{r}_2 = -3\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$ m is:

A) 54 J
B) - 31 J
C) - 49 J
D) - 41 J
E) - 35 J