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# Final practice exam Solutions

Please do not hesitate to reach out with any questions.

Q1. A simple watermelon launcher is designed as a spring with a light platform for the watermelon. When an 8.00 kg watermelon is put on the launcher, the launcher spring compresses by 10.0 cm. The watermelon is then pushed down by an additional 30.0 cm and it's ready to go. Just before the launch, how much energy is stored in the spring?

A) 35 J
B) 63 J
C) 120 J
D) 140 J
E) 160 J

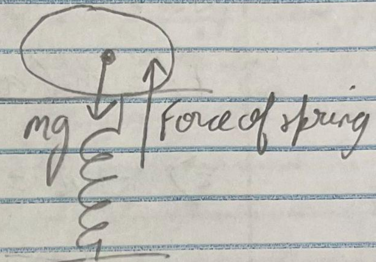
Ans (B)

Q1) Energy stored in spring $= \frac{1}{2} K x^2$

How to find K? $\Rightarrow$ We know that $F = -Kx$

$F = -Kx$

(spring compresses by 0.10m (because of weight of watermelon)




$-mg = -Kx \Rightarrow K = \frac{mg}{x} = \frac{8(9.8)}{0.1}$

$K = 784\ N/m$

Energy stored in spring $= \frac{1}{2} K x^2 = \frac{1}{2}(784)(0.1+0.3)^2$

$= 62.72 \approx 63J$ (B)

Q2. A 2 kg block sliding along a rough table hits a spring and comes to a stop after the spring is compressed 0.2 m. If the spring constant is 20 N/m and the coefficient of friction between the block and the table is 0.15, what was the speed of the block right before it hit the spring?

A) 0.2 m/s

B) 0.4 m/s

C) 0.6 m/s

D) 0.8 m/s

E) 1.0 m/s

Ans (E)

Q2) Sum of work done on the particle = change in KE

∴ Work by friction ($W_f$) + Work by spring ($W_s$) = $\Delta KE$

$W_f = F_{friction} \cdot d = (-\mu N)d = -\mu mgd = -0.588 J$

$W_s = -\frac{1}{2}kx^2 = -\frac{1}{2}(20)(0.2)^2 = -0.4 J$

Sum of work done on system = $\Delta KE$

$W_f + W_s = KE_f - KE_i \Rightarrow -0.588 - 0.4 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$\Rightarrow -0.988 = \frac{1}{2}m(v_f^2 - v_i^2) \Rightarrow -0.988 = \frac{1}{2}(2)(0 - v_i^2)$

$\Rightarrow -0.988 = -v_i^2 \Rightarrow v = \sqrt{0.988} \simeq 1 m/s$ (E)

Q3. A 80kg silverback gorilla is standing atop a spring in an elevator as it accelerates upwards at $3 m/s^2$. The spring constant is 2500N/m. By how much is the spring compressed?

A) 0.21 m/s

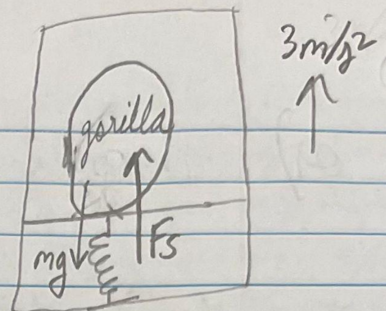
B) 0.41 m/s

C) 0.61 m/s

D) 0.81 m/s

E) 1.01 m/s

Ans (B)




Q3) $\Sigma F = ma$

$F_{spring} - mg = ma$

$F_s = ma + mg = m(a+g)$

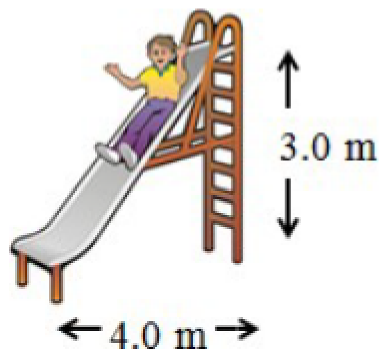
$F_s = m(a+g) \Rightarrow -kx = 80(3+9.8)$

$\Rightarrow -x = \frac{80(3+9.8)}{K} \Rightarrow x = \frac{-80(12.8)}{2500}$

$x = -0.4096 \approx -0.41m$

The spring is compressed by 0.41m (B)

Q4. Starting from rest, a 28 kg child goes down a slide 3.0 m high and 4.0 m wide (see diagram).If her speed at the bottom is 2.5 m/s, how much energy has been lost to friction?




Ans (D)

Q4) Sum of work done on the object $= \Delta KE$

$W_{gravity} + W_{friction} = KE_f - KE_i$

$W_g = mgh = 28(9.8)(3) = 823.2\ J.$

$\Rightarrow W_g + W_f = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 = \frac{1}{2} m(v_f^2 - v_i^2)$

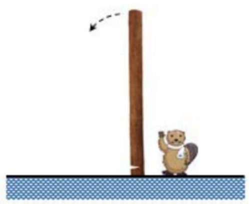
$\Rightarrow 823.2 + W_f = \frac{1}{2}(28)(2.5^2 - 0^2)$

$\Rightarrow W_f = \frac{1}{2}(28)(2.5)^2 - 823.2 = -735.7\ J$

$\therefore$ energy lost $= |-735.7| = 735.7 \approx 740\ J$ (D)

Q5. An industrious beaver manages to chew through the base of a wooden tree trunk 18 m tall, causing it to fall over. If the base of the trunk does not slide while it falls over, how fast is the other end of the trunk moving right before it hits the ground? [The thin rod moments of inertia are useful here.]

A) 17 m/s B) 20 m/s C) 23 m/s D) 26 m/s E) 29 m/s



Ans (C)

Q5) Conservation of energy $E_i = E_f$

$E_i$ = potential energy of the trunk $= mg\left(\frac{L}{2}\right)$

$E_i = mg\left(\frac{L}{2}\right)$ [why $\frac{L}{2}$? ⇒ because centre of mass of the trunk is at $\frac{L}{2}$]

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

I of trunk about its end $= \frac{mL^2}{3}$

$\Rightarrow E_f = \frac{1}{2}\left(\frac{mL^2}{3}\right)\omega^2.$

$\Rightarrow E_i = E_f \Rightarrow \cancel{m}g\left(\frac{L}{2}\right) = \frac{1}{2}\left(\frac{\cancel{m}L^2}{3}\right)\omega^2$

$\Rightarrow \omega^2 = \frac{3g}{L} = \frac{3(9.8)}{18}$

$\Rightarrow \omega = \sqrt{\frac{3(9.8)}{18}} = 1.278$ rad/s.

Velocity of other end $v = \omega r = 1.278(18) = 23$ m/s

(C)

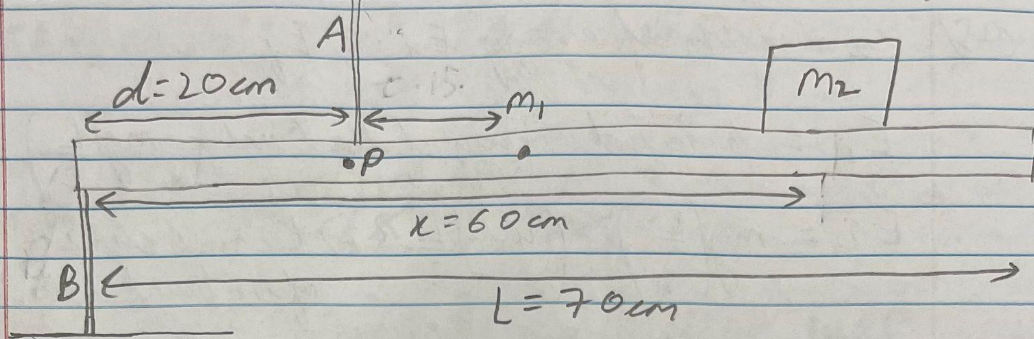
Q6. The diagram shows a uniform horizontal bar of mass m1 = 3 kg supporting a box of mass m2 = 10 kg. The bar is held up from the ceiling by String A and the bar is held down by String B tied to the floor. Both strings are pulling vertically. Use d = 20 cm, x = 60 cm, and L = 70 cm. What is the tension in String B when the system is in equilibrium?

A) 220 N B) 240 N C) 260 N D) 270 N E) 280 N

Ans (A)

Let us consider a point P on the bar as shown in the diagram below.

Q6)




Let us consider that the bar would rotate about P as labeled in the diagram.

∴ In equilibrium, sum of all torques = 0

⇒ $\tau_B + \tau_A + \tau_{m_1} + \tau_{m_2} = 0$ ($\tau_B$ is torque due to string B)

⇒ We know $\tau = F \times r$

$\tau_{m_1} = m_1 g$ (distance from P) $= m_1 g\left(\frac{0.7}{2} - 0.2\right) = m_1 g(0.15)$

$\tau_{m_2} = m_2 g(0.4)$; $\tau_A = T_A(0) = 0$; $\tau_B = T_B(-0.2)$

$\tau_B + \tau_A + \tau_{m_1} + \tau_{m_2} = 0 = (-0.2)T_B + \cancel{0 T_A}^{0} + 0.15 m_1 g + 0.4 m_2 g$

$-0.2T_B + 0.4 m_2 g + 0.15 m_1 g = 0$

⇒ $T_B = \frac{0.4 m_2 g + 0.15 m_1 g}{0.2} = 218.05 \approx 222N$ (A)

Q7. A circular pulley of mass M and radius R has a light cord wrapped around it and initially supports an anvil of mass m. Unfortunately the pulley gets loose and starts rotating (in place) freely, allowing the cord to unravel. What is the total kinetic energy of the system when the anvil reaches the speed v? [Use moment of inertia for pulley $I = \frac{MR^2}{2}$]

A) m $v^2/2$
B) M $v^2/2$
C) (m+M/2) $v^2/2$
D) (m+M) $v^2/2$
E) (m/2+M) $v^2/2$

Ans (C)

Q7) KE of anvil $= \frac{1}{2} m v^2$ . KE of pully $= \frac{1}{2} I \omega^2$

$$KE_{pulley} = \frac{1}{2} I\omega^2 = \frac{1}{2}\left(\frac{MR^2}{2}\right)\frac{v^2}{R^2} = \frac{1}{2}\left(\frac{M}{2}\right)v^2$$

$$KE \text{ of system} = KE_{anvil} + KE_{pulley} = \frac{1}{2} mv^2 + \frac{1}{2}\left(\frac{M}{2}\right)v^2$$

$$= \frac{v^2}{2}\left(m + \frac{M}{2}\right) = \underline{(C)}$$

Q8. A potter's wheel (a solid, uniform disk) of mass 6.5 kg and radius 0.50 m spins about its central axis. A 2.1 kg lump of clay is then dropped onto the wheel at a distance 0.40 m from the axis. What is the moment of inertia for the combined system about the axis? (Use moment of inertia for the disk)

A) 0.81 kg $m^2$
B) 1.15 kg $m^2$
C) 1.31 kg $m^2$
D) 3.25 kg $m^2$
E) 0.71 kg $m^2$

Ans (B)

Q8) parallel axis theorem $\Rightarrow I_{new} = I_{cm} + md^2$

Where $I_{cm}$ is the inertia about the center of mass
$d$ is the distance from center of mass.

$\therefore I_{new} = I_{cm} + md^2 = \frac{MR^2}{2} + md^2$

$\Rightarrow \frac{(6.5)(0.5)^2}{2} + 2.1(0.4)^2 = 1.1485 \approx 1.15 \text{ Kgm}^2$

(B)

Q9. Prof. Swarzenegger picks up his 45 kg brief case on the 17th floor of his office building (85 m above the ground) and prepares to go to class. He walks 24 meters straight to the elevator at 1.5 m/s, takes the elevator to the ground floor at a steady 3 m/s, and walks 175 m in a straight line at 2 m/s south to the classroom, where he deposits his briefcase on the floor. About how much work has he done on the briefcase over the entire trip?

A) 40kJ
B) 4kJ
C) zero
D) -40kJ
E) -4kJ

Ans (D)

Work = $F \circ D \; = \; FDcos(\theta)$ θ is the angle between force and displacement.
Professor is applying a force of mg = 45g to hold the suitcase. (g is acc due to gravity). Professor goes from 17th floor to ground (85m down), while applying this force on the suitcase.
Therefore work done
$W = F \circ D = FD\,cos(180) \; = \; (45g)(85)(-1) \; = \; -38250$, close to option D.

Q10. A thin rod of mass m=3kg and L=5m length is rotating about an axis located at a distance D=0.28m from the edge. What is its moment of inertia?

A) 27 m

B) 25 m

C) 18 m

D) 16 m

E) 21 m

Ans (E)

Q10) parallel axis theorem $\Rightarrow I_{new} = I_{cm} + md^2$

I about center of mass of a rod $= \frac{mR^2}{12}$

$R$ = length of rod = 5m

$d$ = distance of axis from center of mass $= 2.5 - 0.28 = 2.22m$

$I_{new} = I_{cm} + md^2 = \frac{mR^2}{12} + md^2 = \frac{3(5)^2}{12} + 3(2.22)^2$

$I_{new} = 21.0352\,m \approx 21$ (E)

Q11. One can easily find the center of mass for a complex body by locating balancing points and drawing vertical lines (see figure). The center of mass is at the intersection of these lines. Where should one place the axle with predetermined direction so that the moment of inertia for rotation about this axle is the smallest possible?

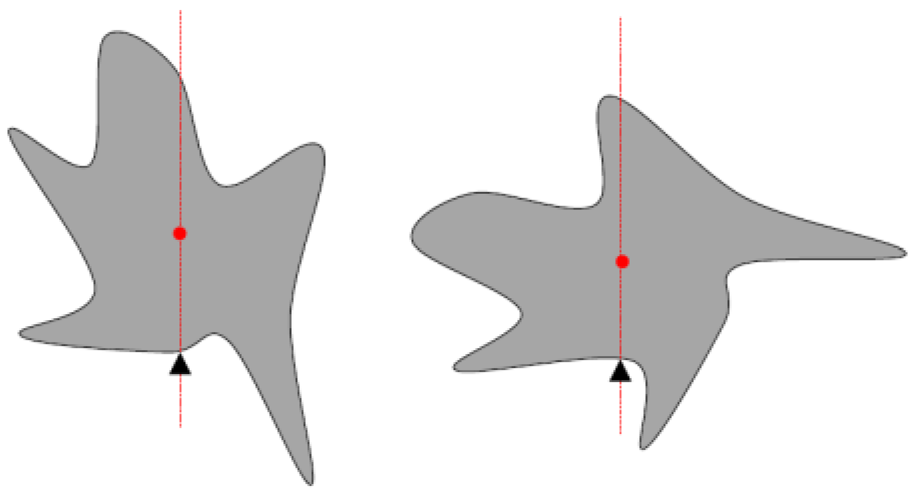
A) As far from the center of mass as possible

B) Anywhere on the edge

C) Through the center of mass

D) In the middle of the balancing line

E) There is no easy way to figure it out



Ans (C)

To minimize the moment of inertia, we try to place the mass as close as possible to the axis of rotation, since the moment of inertia increases as R increases. Therefore, the smallest possible R we would have is when the axle is rotated about its center of mass.

Q12. A monkey sits in a tree 60 m off the ground. He throws a 0.5 kg banana up and through the branches at 45 m/s (101 mph). (This monkey pitches for the New York Yankees during baseball season.) The banana lands on the ground 75 m away. Which of the following is closest to the banana's speed right before it hits the ground? (You may neglect air drag.)

A) 80 m/s

B) 60 m/s

C) 40 m/s

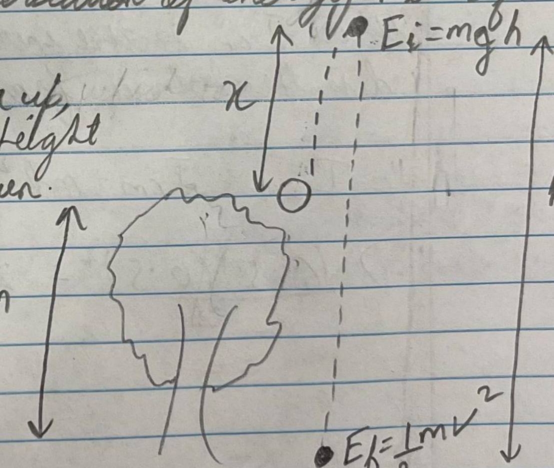
D) 30 m/s

E) not enough information

Ans (B)

Q12) To find $v$, we do conservation of energy. $E_i = E_f$.

monkey throws the banana up, which reaches some max height before it starts falling down.




$V_f$ at highest point $= 0$

$v_i = 45$ m/s

$x = \frac{v_f^2 - v_i^2}{2a}$

$x = \frac{0^2 - 45^2}{2(-9.8)} = 103.3$ m

$\therefore h = x + 60 = 103.3 + 60 = 163.3$ m

Conservation of energy $\Rightarrow E_i = E_f \Rightarrow \cancel{m}gh = \frac{1}{2}\cancel{m}v^2$

$\Rightarrow v^2 = 2gh \Rightarrow v^2 = 2(9.8)(163.3)$ $v = \sqrt{2(9.8)163.3} \simeq 60$ m/s

(B)

Q13. In the figure, four point masses are placed as shown. The x and y coordinates of the center of mass are closest to

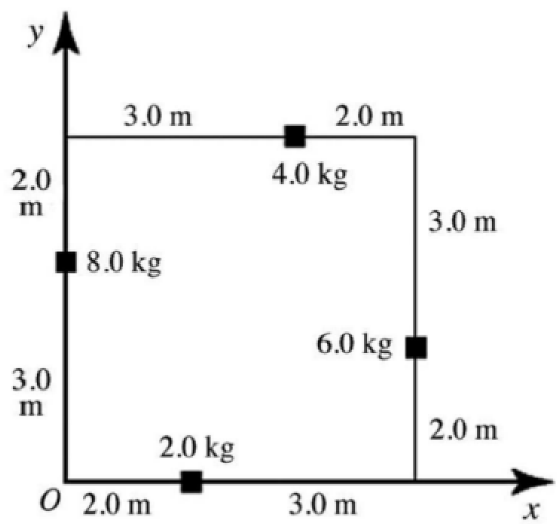
A) (2.2 m, 2.6m)

B) (2.2 m, 2.7m)

C) (2.3 m, 2.6m)

D) (2.3 m, 2.7m)

E) (2.3 m, 2.8m)




Ans (E)

Q13) $x_{cm} = \dfrac{m_1x_1 + m_2x_2 + m_3x_3 + m_1x_4}{m_1 + m_2 + m_3 + m_4}$

$\Rightarrow x_{cm} = \dfrac{2(2) + 6(5) + 4(3) + 8(0)}{2+6+4+8} = \dfrac{46}{20} = 2.3m$

$x_{cm} = 2.3$ m from origin.

$y_{cm} = \dfrac{m_1y_1 + m_2y_2 + m_3y_3 + m_4y_4}{m_1 + m_2 + m_3 + m_4} = \dfrac{2(0) + 6(2) + 4(5) + 8(3)}{2+6+4+8} = \dfrac{56}{20} = 2.8m$

$y_{cm} = 2.8$ m from origin $\therefore (x, y) = (2.3, 2.8)$ (E)

Q14. A ball is released from rest on a no-slip surface, as shown in the figure. After reaching the lowest point, the ball begins to rise again, this time on a frictionless surface as shown in the figure. When the ball reaches its maximum height on the frictionless surface it is

A. at a greater height than when it was released
B. at a lesser height than when it was released
C. at the same height as when it was released
D. impossible to answer without knowing its mass
E. impossible to answer without knowing its radius.

Ans (B)

When the ball is on the no slip surface, it is only rolling. Rolling can only happen with friction. So while the ball rolls on the no slip surface, it loses energy to friction. Since it loses energy, it would not be able to reach the same height it was released from. Therefore the max height ball reaches on the other surface is at a lesser height than when it was released.

Q15. A hollow sphere (moment of inertia I=(2/3)MR2 ) is rolling along a horizontal floor at 5.0 m/s when it comes to a 300 incline. How far up the incline does it roll before reversing direction?

A) 3.35 m

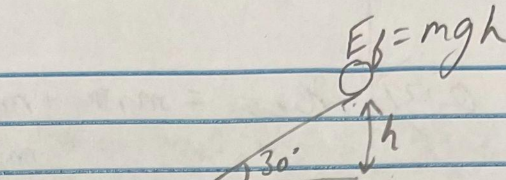
B) 3.50 m

C) 3.85 m

D) 4.25 m

E) 4.05 m

Ans (D)




Q 15) Initial energy of sphere $E_i$

$$E_i = \underbrace{\frac{1}{2}mv^2}_{\text{Translational KE}} + \underbrace{\frac{1}{2}I\omega^2}_{\text{Rotational KE.}}$$

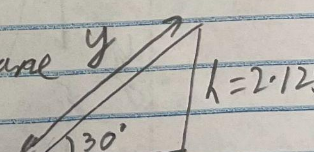
$$E_i = \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{3}mR^2\right)\frac{v^2}{R^2} \quad \left(I_{\substack{sphere\\ hollow}} = \frac{2}{3}mR^2 \text{ and } \omega = \frac{v}{R}\right)$$

$$E_i = \frac{1}{2}mv^2 + \frac{1}{3}mv^2 = \frac{5}{6}mv^2$$

$$E_f = mgh \Rightarrow E_f = E_i \Rightarrow \cancel{m}gh = \frac{5}{6}\cancel{m}v^2$$

$$\Rightarrow h = \frac{5v^2}{6g} \Rightarrow \frac{5(25)}{6(9.8)} = 2.125\,m$$

we have to find height along inclined plane y




$$\sin\theta = \frac{h}{y} \Rightarrow y = \frac{h}{\sin 30^\circ} = \frac{2.125}{1/2} = 4.25$$

$$\boxed{y = 4.25\,m} \quad \text{(D)}$$

Q16. A father and his daughter are out having a running race. The father is running with half the kinetic energy of his daughter, but she has half the mass of her father. If the daughter is running at speed v, then how fast is the father running?

A. 0.25v

B. 0.5v

C. v

D. 2v

E. 4v

Ans (B)

Q16) Let mass of daughter be m and running at speed v

Let mass of father be M and running at speed $v_0$.

KE of daughter $= \frac{1}{2}mv^2$

Fathers kinetic energy = half of daughter's KE $= \frac{KE}{2}$

Fathers kinetic energy $\Rightarrow \frac{1}{2}Mv_0^2 = \frac{KE}{2}$

$=2m$ $\quad \Rightarrow \frac{1}{\cancel{2}}(2m)v_0^2 = \frac{1}{2}KE \Rightarrow \cancel{m}v_0^2 = \frac{1}{2}\left(\frac{1}{2}\cancel{m}v^2\right)$

$\Rightarrow v_0^2 = \frac{1}{4}v^2 \Rightarrow v_0 = \sqrt{\frac{1}{4}v^2} \Rightarrow v_0 = \frac{1}{2}v = 0.5v$

(B)

Q17. A 1000-kg coal-powered train engine rolls by a coal bin at 11 mph. As the engine passes, a 250-kg load of coal is suddenly dropped straight down onto the engine. How fast is the engine moving right after the coal has landed?

A) 4 mph
B) 6 mph
C) 9 mph
D) 11 mph
E) 44 mph

Ans (C)

Q17) momentum conservation $\Rightarrow P_i = P_f$

$P_1 = m_1 v_1 = 1000(11) = 11000 \text{ kgm/s}$.

$P_2 = m_2 v_2 \Rightarrow (1000+250) v_2 = 1250 v_2$

$P_1 = P_2 \Rightarrow 11000 = 1250 v_2 \Rightarrow v_2 = \frac{11000}{1250} = 8.8 \approx 9$

$v_2 = 8.8 \approx 9$ mph (C)

Q18. Typical torque for tightening a lug nut on the wheels of a Mustang is 95 ft-lbs (129 Nm). How hard would a mechanic need to push on the end of a 0.5 m torque wrench to achieve this?

A) 258 N
B) 228 N
C) 278 N
D) 298 N
E) 238 N

Ans (A)

Q18) $\tau = F \times r \Rightarrow 129 = F(0.5) \Rightarrow F = \frac{129}{0.5} = 258 N$ (A)

Q19. The Sun’s mass is $2.0 \times 10^{30}$ kg, its radius is $7.0 \times 10^{5}$ km, and it has a rotational period of approximately 28 days. If the Sun should collapse into a neutron star of radius 15 km, what would its period be if no mass were ejected (not realistic but let’s assume) and a sphere of uniform density can model both the Sun and the neutron star?

A) 100 s

B) 10 s

C) 1 s

D) 0.01 s

E) 0.001 s

Ans (E)

Q19) momentum remains conserved.

$$L_1 = L_2 \Rightarrow I_1 \omega_1 = I_2 \omega_2$$

$$\Rightarrow \cancel{\tfrac{2}{5}} \cancel{m} R_1^2 \omega_1 = \cancel{\tfrac{2}{5}} \cancel{m} R_2^2 \omega_2 \Rightarrow R_1^2 \omega_1 = R_2^2 \omega_2$$

$$\Rightarrow (7 \times 10^5)^2 \left(\frac{\cancel{2\pi}}{T_1}\right) = (15)^2 \frac{\cancel{2\pi}}{T_2} \Rightarrow T_2 = \frac{(15)^2 T_1}{(7 \times 10^5)^2}$$

$$\Rightarrow T_2 = \frac{225(28 \times 24 \times 3600)}{49 \times 10^{10}} \simeq 0.0012 \ (E)$$

Q20. Suppose the polar ice sheets broke free and quickly floated toward Earth's equator without melting. What would happen to the duration of the day on Earth?
A) It will remain the same
B) Days will become longer
C) Days will become shorter

Ans (B)

Angular momentum remains conserved. $L = I\omega$. Moment of inertia I increases if R (the distance of mass from axis of rotation) increases.
When the mass of ice is at the poles, R (distance of ice from the axis) is less, therefore the moment of inertia is less.
When mass moves at the equator, R (the distance of mass from the axis of rotation) increases, and therefore moment of inertia I increases.
$L = I\omega$. Angular momentum is conserved, so if I increases, then ω decreases.
We know that time period of circular motion $T = \frac{2\pi}{\omega}$. Therefore, when ω decreases, T increases, and hence the days will become longer.

Q21. What's the dot product of $(2i + 2j) \cdot (4i + 2k)$?

A) 8
B) 12
C) 24
D) 48
E) 0

Ans (A)

$(2i + 2j) \cdot (4i + 2k) = 2i \circ 4i + 2j \circ 2k = 8 + 0 = 8$. ($2j \circ 2k = 0$ because j and k point in perpendicular directions, and dot product of perpendicular vectors is 0.

Q22. .Safety standards call for a 1900-kg car colliding at 12 m/s with a concrete wall to experience an average force (during the collision) not greater than 50,000 N. What is the minimum permissible time for the car to come to a stop during such a collision?

A) 0.12 s

B) 0.18 s

C) 0.22 s

D) 0.38 s

E) 0.46 s

Ans (E)

Q22) Impulse $J = F\Delta T$

Impulse $J$ = change in momentum $= 1900 \times 12 - 1900 \times 0$

$\Rightarrow J = 22800$ Kgm/s

$J = F\Delta T \Rightarrow 228\cancel{00} = 500\cancel{00}\,\Delta T$

$\Delta T = \dfrac{228}{500} = 0.456 \approx 0.45$ (E)

Q23. Kendall pulls on a suitcase strap at an angle 36° above the horizontal. If 650J of work is done by the strap while moving the suitcase a horizontal distance of 15m, what is the tension in the strap?

A) 54N

B) 61N

C) 44N

D) 66N

Ans (A)

Q23) $W = F\ (\text{dot})\ d = F \cdot d = Fd\cos\theta$

$W = Fd\cos\theta \Rightarrow 650 = F(15)\cos 36$

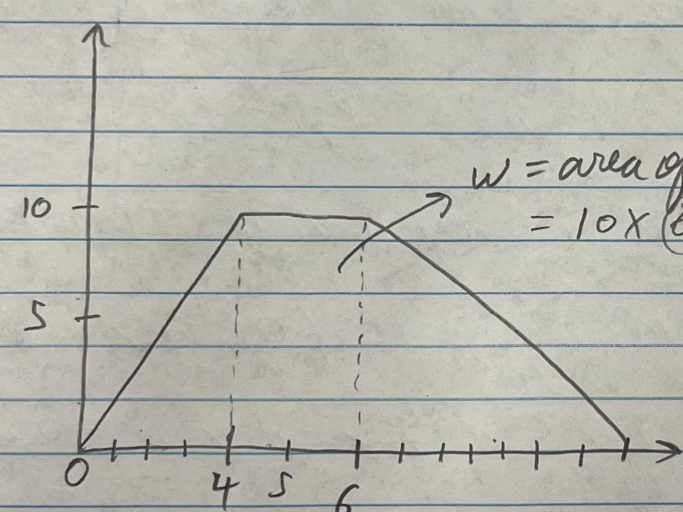
$\Rightarrow F = \dfrac{650}{15\cos 36} = 53.56 \approx 54N$ (A)

Q24. An object is acted upon by a force that is represented by the force vs. position graph in the figure. What is the work done as the object moves from 4m to 6m?

A) 0J B) 10J C)20J D)30J E)40J

Ans (C)

Q24)




$w$ = area of this rectangle

$= 10 \times (6-4) = 20J$ (C)

Q25. A 7-kg bowling ball moving at +21 m/s collides with a bowling pin of mass 7 kg in ahead-on elastic collision. What is the velocity of the ball immediately after the collision?

A. 10.5 m/s B. –10.5 m/s C. 3 m/s D. –3 m/s E. 0 m/s

Ans (E)

Q25) during elastic collision $\Rightarrow V_{1f} = \frac{m_1 - m_2}{m_1 + m_2} V_{1i}$

$\Rightarrow V_{1f} = \frac{7-7}{7+7}(21) = 0$ (E)

Q26. A Ford Escort of mass 800 kg collides with a Mack Truck of mass 12,000 kg at rest. The Escort's incoming speed is 30 m/s and after the collision it bounces straight back with a speed of 15 m/s. If the collision lasts 2.0 seconds, what is the average force of the truck on the car during this time?

A. 6 kN B. 18 kN C. 27 kN D. 36 kN E. 270 kN

Ans (B)

Q26) change in momentum of mack truck $\Delta P$ = impulse $J$

$\Delta P = P_f - P_i = 800(30) - 800(-15) = 36000 \text{ kgm/s} = J$

$J = F\Delta t \Rightarrow F = \frac{J}{\Delta t} = \frac{36000}{2} = 18000 N$

$F = 18000 J = 18 kN$ (B)

Q27. Jocko the clown (who has a mass of 60 kg) is standing still at the center of the ice rink when his rival Bozo throws a 7 kg bowling ball in his direction at 10 m/s. Assuming Jocko Catches the ball, how much energy is lost in the collision?

A. 207 J
B. 412 J
C. 313 J
D. 540 J
E. 820 J

Ans (C)

Q27) Since jocko catches the ball, collision is inelastic

momentum conserved $\Rightarrow P_1 = P_2$

$P_1 = m_{Jocko} V_{Jocko} + m_{ball} V_{ball} = 60(0) + 7(10) = 70$

$P_2 = (m_{Jock} + m_{ball}) V_{system} = (60+7)v = 67v$

$P_1 = P_2 \Rightarrow 70 = 67v \Rightarrow v = \frac{70}{67} = 1.04478 \, m/s.$

Initial KE $= \frac{1}{2} m_{ball} V_{ball}^2 = \frac{1}{2} \times 7 \times 10^2 = 350.$

Final KE $= \frac{1}{2} M v_f^2 = \frac{1}{2} (67) \times (1.04478)^2 = 36.567$

KE lost $= 350 - 36.567 \, J = 314 \approx 313 \, J$

(C)

Please do not hesitate to reach out with any questions.