Dr. Mohammad Hussein PHY 105 Recitation Session - FINAL Exam

1.

Take ρ as the density of water. A rubber ball floats in three fluids X, Y and Z of densities: 0.9ρ, ρ and 1.1ρ, respectively. One of the following statements is true:
The three fluids exert the same buoyant force on the ball
The buoyant force of fluid X is greater than the buoyant forces of the other two fluids
The buoyant force of fluid Z is greater than the buoyant forces of the other two fluids
The volume of the fluid displaced by the ball is the same for the three fluids
The buoyant force of fluid Z is smaller than the buoyant forces of the other two fluids

2.

In your physiology textbook, you read that the blood is pumped by heart through a series of contractions known as heartbeats. The pressure created by the heart's contraction varies from point to point in the heart. Assume that 70 cm^3 of blood is pumped during one heartbeat under a blood pressure of 150 mm-Hg. If the heart performs 80 of such heartbeats per minute, then the power (in W) delivered by the heart is: (Recall that 76 cm-Hg = 1 atm = 101.3 kPa)

1.87 0.47 3.33 0.89 2.67

3.

A radiation oncologist treats cancer with two species of radioactive nuclei, X and Y. The initial number of nuclei for each species (at t = 0) is N_0. At t = 100 s, the oncologist observes that $N_X = 100\ N_Y$. If $\tau_X = 2\ \tau_Y$, the value of τ_Y (in s) is: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

10.86 61.77 0.50 4.07 36.36

4.

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21.72 0.50 34.34 5.07 59.41

5.

A cup filled with milk to a depth of 9.8 cm is held in an elevator that is accelerating upward. With constant acceleration, the elevator is speeding up from 0 m/s to 2.4 m/s during 2.9 s. The change in the pressure (in Pa) exerted by the milk on the bottom of the cup during the period of acceleration is: (Recall that the density of milk is 1027 kg/m^3)

+83.3 -100.6 zero +78.1 -63.1

1.

Take ρ as the density of water. A rubber ball $\boxed{\text{floats}}$ in three fluids X, Y and Z of densities: 0.9ρ, ρ and 1.1ρ, respectively. One of the following statements is true:

The three fluids exert the same buoyant force on the ball

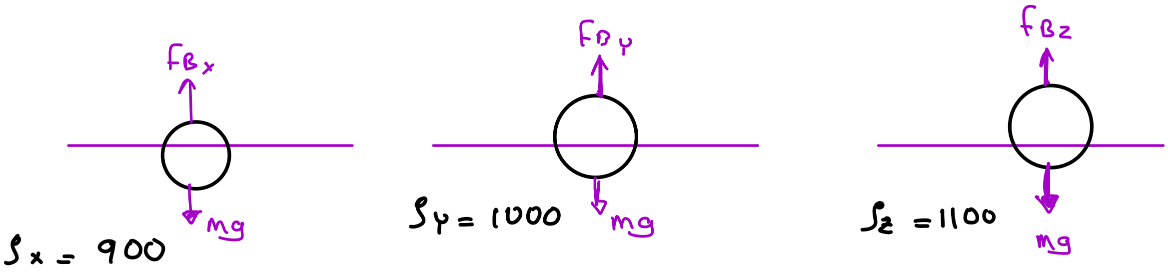
The buoyant force of fluid X is greater than the buoyant forces of the other two fluids

The buoyant force of fluid Z is greater than the buoyant forces of the other two fluids

The volume of the fluid displaced by the ball is the same for the three fluids

The buoyant force of fluid Z is smaller than the buoyant forces of the other two fluids

$\rho_x = 0.9\rho_w$, $\rho_y = \rho_w$, $\rho_z = 1.1\rho_w$



$F_{Bx} = mg$ $\qquad F_{By} = mg$ $\qquad F_{Bz} = mg$

∴ The three fluids exert the same buoyant force on the ball

2. In your physiology textbook, you read that the blood is pumped by heart through a series of contractions known as heartbeats. The pressure created by the heart's contraction varies from point to point in the heart. Assume that 70 cm^3 of blood is pumped during one heartbeat under a blood pressure of 150 mm-Hg. If the heart performs 80 of such heartbeats per minute, then the power (in W) delivered by the heart is: (Recall that 76 cm-Hg = 1 atm = 101.3 kPa)

$\boxed{1.87}$	0.47	3.33	0.89	2.67

$V = 70 * 10^{-6}\ m^3$ $\qquad P = 1.99 * 10^4\ Pa$

$70\ cm^3 \longrightarrow$ one heartbeat

$X \longrightarrow 80$ heartbeat

$\therefore X = 5600\ cm^3$

Power = QP

Power $= 9.3 * 10^{-5} * 1.99 \times 10^4$

$= 1.86$ W

$$Q = \frac{\Delta V}{\Delta T} = \frac{5600 * 10^{-6}\ m^3}{60\ s}$$

$\therefore Q = 9.3 * 10^{-5}\ m^3/s$

3.

A radiation oncologist treats cancer with two species of radioactive nuclei, X and Y. The initial number of nuclei for each species (at t = 0) is N_0. At t = 100 s, the oncologist observes that $N_X = 100\ N_Y$. If $\tau_X = 2\ \tau_Y$, the value of τ_Y (in s) is: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

$\boxed{10.86}$ 61.77 0.50 4.07 36.36

$N_{o_x} = N_o$ | $N_{o_y} = N_o$ | $t = 100\ s$, $N_x = 100\ N_y$ | $\tau_x = 2\tau_y$

step 3

$\tau_y = \frac{1}{\lambda_y} = \frac{1}{0.0921}$

$\therefore \tau = 10.86$

step 2

$N_x = N_{o_x} * e^{-\lambda_x t}$

$N_y = N_{o_y} * e^{-\lambda_y t}$

$100\ N_y = N_o * e^{-0.5\lambda_y t}$

$N_y = N_o * e^{-\lambda_y t}$

$100 = \frac{e^{-0.5 \times 100 \times \lambda_y}}{e^{-100\lambda_y}}$

$\therefore \lambda_y = 0.0921\ s^{-1}$

step 1

$\tau_x = 2\ \tau_y$

$\frac{1}{\lambda_x} = 2 * \frac{1}{\lambda_y}$

$\lambda_y = 2\lambda_x$

4.

A radiation oncologist treats cancer with two species of radioactive nuclei, X and Y. The initial number of nuclei for each species (at t = 0) is N_0. At t = 100 s, the oncologist observes that N_X = 100 N_Y. If $\tau_X = 2\ \tau_Y$, the value of τ_X (in s) is: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

$\boxed{21.72}$ 0.50 34.34 5.07 59.41

$N_{0x} = N_0$ | $N_{0y} = N_0$ | $t = 100\ s$, $N_x = 100\ N_y$ | $\tau_x = 2\tau_y$

step $\underline{\underline{1}}$

$$\tau_x = 2\ \tau_y$$

$$\frac{1}{\lambda_x} = 2 * \frac{1}{\lambda_y}$$

$$\lambda_y = 2\ \lambda_x$$

step $\underline{\underline{2}}$

$$N_x = N_{0x} * e^{-\lambda_x t}$$

$$N_y = N_{0y} * e^{-\lambda_y t}$$

$$N_x = N_0 * e^{-\lambda_x t}$$

$$\frac{N_x}{100} = N_0 * e^{-2\lambda_x t}$$

$$100 = \frac{e^{-100\lambda_x}}{e^{-200\lambda_x}}$$

$$\lambda_x = 0.0461\ s^{-1}$$

step $\underline{\underline{3}}$

$$\tau_x = \frac{1}{\lambda_x} = \frac{1}{0.0461}$$

$$\tau_x = 21.714$$

5.

A cup filled with milk to a depth of 9.8 cm (h) is held in an elevator that is accelerating upward. With constant acceleration, the elevator is speeding up from 0 m/s to 2.4 m/s during 2.9 s. The change in the pressure (in Pa) exerted by the milk on the bottom of the cup during the period of acceleration is: (Recall that the density of milk is 1027 kg/m^3)

$\boxed{+83.3}$ -100.6 zero +78.1 -63.1

$$F_N - mg = ma$$

$$F_N = m(g+a)$$

$$a = \frac{2.4 - 0}{2.9} = 0.83\ m/s^2$$

$$\Delta P = P_2 - P_1$$

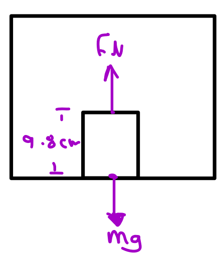
$$\Delta P = \rho_m * (g+a) * h - \rho_m g h$$

$$\Delta P = \rho_m h (g + a - g)$$

$$\Delta P = \rho_m h a$$

$$\therefore \Delta P = 1027 \times 9.8 \times 10^{-2} \times 0.83$$

$$\therefore \Delta P = 83.5$$

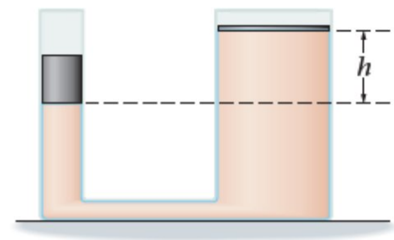


6.

A cup filled with milk to a depth of 9.8 cm is held in an elevator that is accelerating downward. With constant acceleration, the elevator is speeding up from 0 m/s to 2.4 m/s during 2.9 s. The change in the pressure (in Pa) exerted by the milk on the bottom of the cup during the period of acceleration is: (Recall that the density of milk is 1027 kg/m^3)

-83.8 zero +100.6 -78.1 +63.1

7.

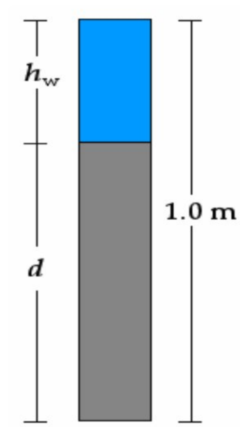


The schematic diagram for a hydraulic lift shows two pistons in a container filled with a fluid of density 750 kg/m^3. The larger piston on the right has a diameter of 13 cm and a mass of 3.6 kg, while the piston on the left has a diameter of 5.1 cm and a mass of 2.3 kg. The height difference h (in m) between the two pistons is:

1.1 0.28 0.93 1.74 0.02

8.

The figure belongs to problems 8 & 9



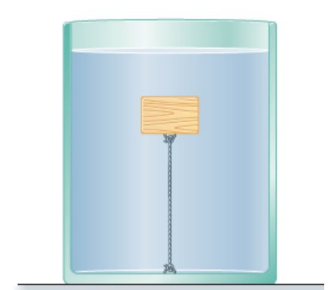
The figure shows a 1.0 m tall vessel that is open to the atmosphere at the top. It is filled with mercury (of density of 13.6 10^3 kg/m^3) up to a depth d, and the rest of it is filled with water (of density of 10^3 kg/m^3). If the pressure at the bottom of the vessel is two atmospheres, what is the depth d (in cm)? (Recall that 1 atm = 101.3 kPa)

74 76 78 80 72

9.

The figure shows a 1.0 m tall vessel that is open to the atmosphere at the top. It is filled with mercury (of density of 13.6 10^3 kg/m^3) up to a depth d, and the rest of it is filled with water (of density of 10^3 kg/m^3). If the pressure at the bottom of the vessel is two atmospheres, what is h_w (in cm)? (Recall that 1 atm = 101.3 kPa) 26 24 22 20 28

10.



The figure shows a wooden block attached with a rope to the bottom of a water-filled vessel. Knowing that the volume of the block is 8 x 10^{-6} m^3, what is the tension (in N) in the rope? (Recall that the density of wood is 706 kg/m^3 and that of water is 10^3 kg/m^3).

0.023 0.079 0.056 0.135 0.033

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A cup filled with milk to a depth of 9.8 cm is held in an elevator that is accelerating downward. With constant acceleration, the elevator is speeding up from 0 m/s to 2.4 m/s during 2.9 s. The change in the pressure (in Pa) exerted by the milk on the bottom of the cup during the period of acceleration is: (Recall that the density of milk is 1027 kg/m^3)

$\boxed{-83.8}$ zero +100.6 -78.1 +63.1

$mg - F_N = ma \longrightarrow F_N = m(g-a)$

$a = 0.83\ m/s^2$

$\Delta P = \rho_m (g-a)h - \rho_m g h$

$\Delta P = \rho_m h (g-a-g)$

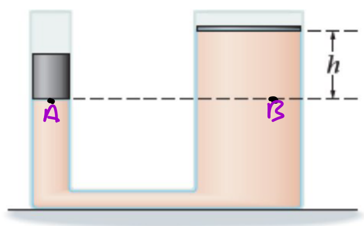
$\Delta P = \rho_m h * -a$

$\therefore \Delta P = 1027 * 9.8 * 10^{-2} * -0.83$

$\therefore \Delta P = -83.5$

7.

The schematic diagram for a hydraulic lift shows two pistons in a container filled with a fluid of density 750 kg/m^3. The larger piston on the right has a diameter of 13 cm and a mass of 3.6 kg, while the piston on the left has a diameter of 5.1 cm and a mass of 2.3 kg. The height difference h (in m) between the two pistons is:



1.1 0.28 0.93 1.74 0.02

step 1

$A\ Large = \pi * \left(\frac{13*10^{-2}}{2}\right)^2 = 0.013\ m^2$

$F\ Large = 3.6 * 9.8 = 35.3\ N$

$A\ small = \pi * \left(\frac{5.1*10^{-2}}{2}\right)^2 = 2.04 * 10^{-3}$

$F\ small = 22.54\ N$

$P\ small = 1.1 * 10^4\ Pa$

$P\ Large = 2.715 * 10^3\ Pa$

step 2

$P_A = P_B + \rho_c g h$

$1.1 * 10^4 = 2.715 * 10^3 + 750 * 9.8 * h$

$\therefore h = 1.13\ m$

8.

The figure shows a 1.0 m tall vessel that is open to the atmosphere at the top. It is filled with mercury (of density of 13.6 10^3 kg/m^3) up to a depth d, and the rest of it is filled with water (of density of 10^3 kg/m^3). If the pressure at the bottom of the vessel is two atmospheres, what is the depth d (in cm)? (Recall that 1 atm = 101.3 kPa)

$\boxed{74}$ 76 78 80 72

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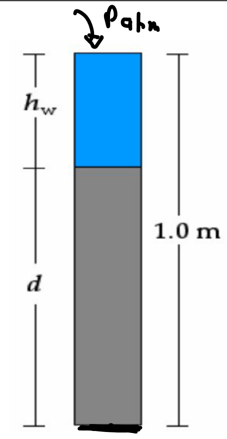
$\boxed{26}$ 24 22 20 28

The figure belongs to problems 8 & 9



8) $2\,atm = 1\,atm + \rho_m g d + \rho_w g(1-d)$

$1\,atm = \rho_m g d + \rho_w g - \rho_w g d$

$1\,atm - \rho_w g = \rho_m g d - \rho_w g d$

$101.3 \times 10^3 - 10^3 \times 9.8 = 13.6 \times 10^3 \times 9.8 \times d - 10^3 \times 9.8\, d$

$91500 = 123480\, d$

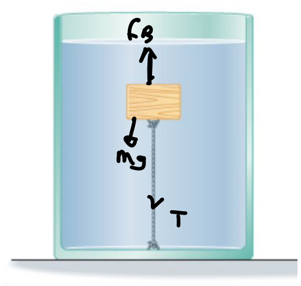
$d = 0.74\,m \quad \therefore d = 74\,cm$

9) $h = 1 - d \quad \therefore h = 1 - 0.74 = 0.26\,m \longrightarrow 26\,cm$

10.

The figure shows a wooden block attached with a rope to the bottom of a water-filled vessel. Knowing that the volume of the block is 8 x 10^{-6} m^3, what is the tension (in N) in the rope? (Recall that the density of wood is 706 kg/m^3 and that of water is 10^3 kg/m^3).

$\boxed{0.023}$ 0.079 0.056 0.135 0.033



$V_o = 8 \times 10^{-6}\,m^3$

$F_B = mg + T$

$T = F_B - mg \longrightarrow T = \rho_w V_w g - \rho_o V_o g$ But $V_w = V_o$

$T = V_o g (\rho_w - \rho_o)$

$T = 8 \times 10^{-6} \times 9.8 (1000 - 706)$

$\therefore T = 0.023 \text{ N}$

$N_o = 1 \cancel{g} \times \frac{1 \cancel{\text{mol Ra}}}{226 \cancel{g}} \times \frac{6.02 \times 10^{23}}{1 \cancel{\text{mol Ra}}} = 2.66 \times 10^{21}$

$A_o = 3.7 \times 10^{10}$ decay /s $t_{1/2}$

$A_o = \lambda N_o$

$3.7 \times 10^{10} = \lambda \times 2.66 \times 10^{21}$

$\lambda = 1.391 \times 10^{-11}$

$t_{1/2} = \frac{\ln(2)}{\lambda}$

$t_{1/2} = \frac{\ln(2)}{1.391 \times 10^{-11}} = 4.98 \times 10^{10} \text{ s}$

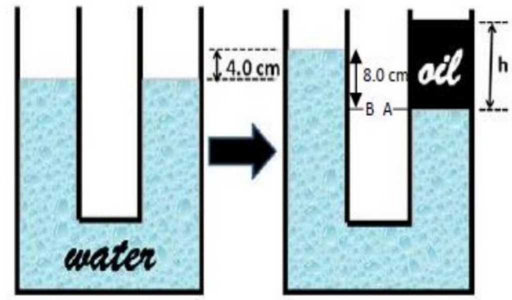
$4.98 \times 10^{10} \times \cancel{s} \times \frac{1 \cancel{\text{min}}}{60 \cancel{s}} \times \frac{1 \cancel{\text{hour}}}{60 \cancel{\text{min}}} \times \frac{1 \cancel{\text{day}}}{24 \cancel{h}} \times \frac{1 \text{ year}}{365 \cancel{\text{day}}}$

$= 1580.2$

D الجواب

11.

To the left, an open U-shaped tube contains water (of density of 1 g/cm^3) in equilibrium. To the right, the same tube contains water and oil (of density of 0.8 g/cm^3) in equilibrium. The length (in cm) of the oil column (h) is: (Recall that 1 atm = 101.3 kPa)



10 16 17 12 9

12.

A 4-kg steel ball (of density of 7.8 x 10^3 kg/m^3) suspended from a rope is partially immersed in water (of density of 10^3 kg/m^3). If one third of the ball's volume is below the surface of the water, the tension (in N) in the rope is: (Recall that 1 atm = 101.3 kPa)

37.5 39.2 40.9 35.8 42.6

13.

Assume that blood flows into the aorta at 1.0 m/s for 0.5 s, from which it flows then through an artery at 0.6 m/s for another 0.5 s. The average speed (in m/s) of the blood through the total time elapsed is:

0.8 1.0 0.6 zero 1.6

14.

Assume that blood flows into the aorta at 1.0 m/s over a distance of 0.5 m, from which it flows then through an artery at 0.6 m/s for another 0.5 m. The average speed (in m/s) of the blood over the total specified distance is:

0.75 0.83 1.0 0.6 zero

15.

A car travels in a straight line towards north at 23.6 m/s. If the car's acceleration is 1.15 m/s^2 towards south, it's velocity (in m/s) after 7.1 s is:

15.4 north 31.8 north 15.4 south 31.8 south 23.6 north

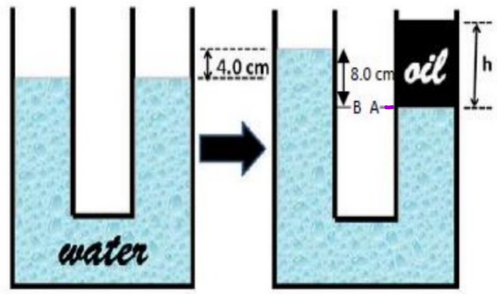
16.

Arabian horse, with an initial velocity of +9.2 m/s, runs in a straight line in the positive direction while slowing down uniformly at a rate of 1.81 m/s^2 in the negative direction. After a while, the velocity of the horse becomes +5.5 m/s. The time (in s) elapsed for the specified change in velocity is:

2.04 8.12 3.04 1.67 7.35

11.

To the left, an open U-shaped tube contains water (of density of 1 g/cm^3) in equilibrium. To the right, the same tube contains water and oil (of density of 0.8 g/cm^3) in equilibrium. The length (in cm) of the oil column (h) is: (Recall that 1 atm = 101.3 kPa)



10 16 17 12 9

$P_A = P_B$

$\rho_{oil}\, g\, h + \cancel{P_{atm}} = \rho_w \times g \times 8 + \cancel{P_{atm}}$

$0.8 \times h = 1 \times 8 \qquad \therefore h = 10 \text{ cm}$

12.

A 4-kg steel ball (of density of 7.8 x 10^3 kg/m^3) suspended from a rope is partially immersed in water (of density of 10^3 kg/m^3). If one third of the ball's volume is below the surface of the water, the tension (in N) in the rope is: (Recall that 1 atm = 101.3 kPa)

37.5 39.2 40.9 35.8 42.6

$V_o = \frac{m_o}{\rho_o} \qquad \therefore V_o = 5.13 \times 10^{-4}$

$T + F_B = m_o g \longrightarrow T = m_o g - F_B$

$T = m_o g - \rho_w V_w g$

$T = 4 \times 9.8 - 10^3 \times 1.71 \times 10^{-4} \times 9.8$

$\therefore T = 37.5 \text{ N}$

$V_w = \frac{1}{3} V_o$

$\therefore V_w = 1.71 \times 10^{-4}$

13.

Assume that blood flows into the aorta at 1.0 m/s for 0.5 s, from which it flows then through an artery at 0.6 m/s for another 0.5 s. The average speed (in m/s) of the blood through the total time elapsed is: 0.8 1.0 0.6 zero 1.6

$d_1 = 1 \times 0.5 = 0.5 \text{ m}$

$d_2 = 0.6 \times 0.5 = 0.3 \text{ m}$

average speed $= \frac{0.3 + 0.5}{1} = 0.8 \text{ m/s}$

14.

Assume that blood flows into the aorta at 1.0 m/s over a distance of 0.5 m, from which it flows then through an artery at 0.6 m/s for another 0.5 m. The average speed (in m/s) of the blood over the total specified distance is: 0.75 0.83 1.0 0.6 zero

$t_1 = \frac{0.5}{1} = 0.5$ s

$t_2 = \frac{0.5}{0.6} = \frac{5}{6} = 0.83$ s

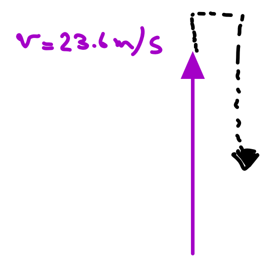
average speed $= \frac{1}{1.333}$

average speed $= 0.75$

15.

A car travels in a straight line towards north at 23.6 m/s. If the car's acceleration is 1.15 m/s^2 towards south, it's velocity (in m/s) after 7.1 s is:

15.4 north 31.8 north 15.4 south 31.8 south 23.6 north



$V_2 = V_1 + a * t$

$V_2 = 23.6 - 1.15 * 7.1$

$V_2 = 15.44$ north

16.

Arabian horse, with an initial velocity of +9.2 m/s, runs in a straight line in the positive direction while slowing down uniformly at a rate of 1.81 m/s^2 in the negative direction. After a while, the velocity of the horse becomes +5.5 m/s. The time (in s) elapsed for the specified change in velocity is:

2.04 8.12 3.04 1.67 7.35

$V_2 = V_1 + at$

$5.5 = 9.2 - 1.81\, t$

$\therefore t = 2.04$ s

17.

An object travels in a straight line in the positive direction while speeding up uniformly at a rate of +6.24 m/s^2 in the positive direction for 0.45 s. At the end of this time, the object's velocity is +9.31 m/s. What was the object's initial velocity (in m/s)?

+6.5 +12.12 -2.81 +2.81 -6.5

18.

A PHY 105 student on the Moon released an apple from a height of 1.25 m above the surface of the Moon. The speed (in m/s) of the apple just before it hit the Moon's surface is:
(Recall that the acceleration of gravity on the Moon is one-sixth that on the Earth)

2.02 4.95 zero 4.08 24.50

19.

A person whose mass is 75.0 kg is exposed to a whole absorbed dose of 30.0 rad. How many joules of energy are deposited in the person's body? (Recall that 1 Ci = 3.7 x 10^{10} Bq)

a) 22.5 b) 0.30 c) 2250 d) 30 e) 750

20.

A substance has absorbed 20 joules of energy. If its absorbed dose is 0.4 Gy, then its mass (in kg) is approximately: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

a) 50 b) 0.02 c) 2250 d) 20 e) 8

21.

A 60.0-kg radiation worker absorbs 24 joules of energy. His absorbed dose (in rad) is:
(Recall that 1 Ci = 3.7 x 10^{10} Bq)

a) 40 b) 0.4 c) 2.5 d) 2500 e) 250

22.

The absorbed dose of a radiation worker is 20 rad due to alpha radiation. His equivalent dose in units of Sievert is: (For alpha radiation RBE = 20, and recall that 1 Ci = 3.7 x 10^{10} Bq)

a) 4 b) 0.4 c) 400 d) 20 e) 0.2

23.

The effective dose of a radiation worker due to alpha radiation is 30 rem. His absorbed dose (in Gy) is: (For alpha radiation RBE = 20, and recall that 1 Ci = 3.7 x 10^{10} Bq)

a) 0.015 b) 1.5 c) 300 d) 30 e) 15

17.

An object travels in a straight line in the positive direction while speeding up uniformly at a rate of $+6.24\ m/s^2$ in the positive direction for 0.45 s. At the end of this time, the object's velocity is +9.31 m/s. What was the object's initial velocity (in m/s)?

+6.5 +12.12 -2.81 +2.81 -6.5

$$V_2 = V_1 + at \longrightarrow 9.31 = V_1 + 6.24 \times 0.45$$

$$V_1 = 6.502$$

18.

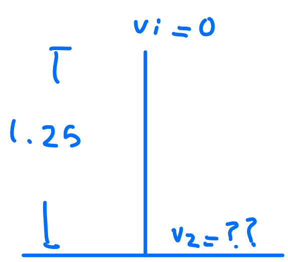
A PHY 105 student on the Moon released an apple from a height of 1.25 m above the surface of the Moon. The speed (in m/s) of the apple just before it hit the Moon's surface is:

$v_i = 0$

(Recall that the acceleration of gravity on the Moon is one-sixth that on the Earth)

$\boxed{2.02}$ 4.95 zero 4.08 24.50

$$g_m = \frac{1}{6} g_e$$



$$W_{nc} = \Delta K + \Delta U$$

$$\Delta k = -\Delta U$$

$$\frac{1}{2} \cancel{m} (v_2^2) = - -\cancel{m} g_m h$$

$$V_2 = \sqrt{2 g_m h}$$

$$\therefore V_2 = \sqrt{2 \times \frac{9.8}{6} \times 1.25}$$

$$\therefore V_2 = 2.02$$

19.

A person whose mass is 75.0 kg is exposed to a whole absorbed dose of 30.0 rad. How many joules of energy are deposited in the person's body? (Recall that 1 Ci = 3.7×10^{10} Bq)

m AD

$\boxed{\text{a) } 22.5}$ b) 0.30 c) 2250 d) 30 e) 750

$$AD = \frac{\text{energy}}{\text{mass}} \longrightarrow \text{energy} = 75\ \cancel{kg} \times 30 \times 0.01\ \frac{J}{\cancel{kg}}$$

energy = 22.5 Jole

20.

A substance has absorbed 20 joules of energy. If its absorbed dose is 0.4 Gy, then its mass (in kg) is approximately: (Recall that 1 Ci = 3.7×10^{10} Bq)

energy

$\boxed{\text{a) } 50}$ b) 0.02 c) 2250 d) 20 e) 8

$$mass = \frac{energy}{AD} \longrightarrow \frac{20}{0.4} = 50\ kg$$

21.

A 60.0-kg radiation worker absorbs 24 joules of energy. His absorbed dose (in rad) is: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

$\boxed{\text{a) 40}}$ b) 0.4 c) 2.5 d) 2500 e) 250

$$AD = \frac{24}{60}\ \frac{j}{kg} = 0.4\ Gy \longrightarrow 0.4 * 100\ rad$$

$$40\ rad$$

22.

The absorbed dose of a radiation worker is 20 rad due to alpha radiation. His equivalent dose in units of Sievert is: (For alpha radiation RBE = 20, and recall that 1 Ci = 3.7 x 10^{10} Bq)

a) 4 b) 0.4 c) 400 d) 20 e) 0.2

$$AD = 20\ rad \longrightarrow AD = 0.2\ Gy$$

$$ED = AD * RBE$$
$$= 0.2 * 20 = 4\ SV$$

23.

The effective dose of a radiation worker due to alpha radiation is 30 rem. His absorbed dose (in Gy) is: (For alpha radiation RBE = 20, and recall that 1 Ci = 3.7 x 10^{10} Bq)

a) 0.015 b) 1.5 c) 300 d) 30 e) 15

$$AD = \frac{ED}{RBE} = \frac{30}{20} = 1.5\ rad = 0.015\ Gy$$

24.

The radioactive source ^{99}Tc is used in medicine to treat and diagnose patients. The half-life of this source is 6.05 h. A drug contains 1.6 micrograms of this radioactive source was prepared for a patient. The activity (in Ci) of this source is approximately:
(Recall that 1 Ci = 3.7×10^{10} Bq and $N_A = 6.022 \times 10^{23}$)

a) 8.4 b) 0.14 c) 0.02 d) 3.08×10^{11} e) 3.08

25.

The radioactive source ^{99}Tc is used in medicine to treat and diagnose patients. The half-life of this source is 6.05 h. The activity of a drug that was prepared for a patient is 3.1 Ci. The mass (in micrograms) of the radioactive ^{99}Tc source contained in the drug is approximately:
(Recall that 1 Ci = 3.7×10^{10} Bq and $N_A = 6.022 \times 10^{23}$)

a) 0.59 b) 0.09 c) 9.10 d) 0.25 e) 2.15

26.

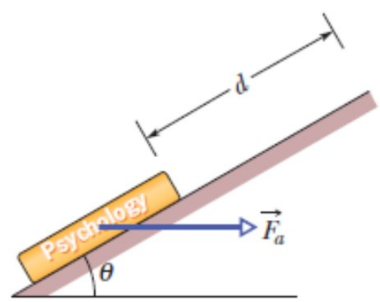
A ^{60}Co source with an activity of 26.0 μCi is embedded in a tumor that has a mass of 0.5 kg. The ^{60}Co emits gamma radiation each with energy of 1.25 MeV. Only half of the emitted gammas are absorbed by the tumor. Assuming the RBE for gamma radiation to be 1.0, what is the equivalent dose that is delivered to the tumor per second? (Recall that 1 Ci = 3.7×10^{10} Bq)

1.92×10^{-5} rem 2.05×10^{-5} rem 5.20×10^{-16} rem 26.00×10^{-5} Sv 1.25×10^{-5} Sv

27.

The figure shows a 3-kg psychology book, initially with zero kinetic energy, being displaced up a frictionless ramp ($\theta = 30^O$) by an applied force F_a (20 N). At the end of the displacement (d = 0.5 m), the speed (in m/s) of the book is:

0.94 1.31 zero 0.67 6.08



28.

With a 128 J of kinetic energy, a 4 kg ball starts sliding up a rough ramp with inclination of 30°. How far (in m) will it slide up the ramp knowing that the coefficient of kinetic friction between the ball and the ramp is 0.3?

4.3 17.2 13.6 3.7 3.2

24.

The radioactive source ^{99}Tc is used in medicine to treat and diagnose patients. The half-life of this source is 6.05 h. A drug contains 1.6 micrograms of this radioactive source was prepared for a patient. The activity (in Ci) of this source is approximately:
(Recall that 1 Ci = 3.7 x 10^{10} Bq and N_A = 6.022 x 10^{23})

$\boxed{\text{a) } 8.4}$ b) 0.14 c) 0.02 d) 3.08 x 10^{11} e) 3.08

$t_{1/2} = 6.05\ h$

$N_o = 1.6 \times 10^{-6}\ g$

$A_o = N_o \times \lambda$

$A_o = 9.73 \times 10^{15} \times 3.2 \times 10^{-5}$

$= 3.11 \times 10^{11}$

$A_o = 8.42\ ci$

$1.6 \times 10^{-6}\ \cancel{g} \times \frac{\cancel{1\ mol\ Tc}}{99\ \cancel{g}} \times \frac{6.02 \times 10^{23}}{\cancel{1\ mol\ Tc}}$

$N_o = 9.73 \times 10^{15}$

$\lambda = \frac{\ln(2)}{6.05 \times 60 \times 60} = 3.2 \times 10^{-5}\ s^{-1}$

25.

The radioactive source ^{99}Tc is used in medicine to treat and diagnose patients. The half-life of this source is 6.05 h. The activity of a drug that was prepared for a patient is 3.1 Ci. The mass (in micrograms) of the radioactive ^{99}Tc source contained in the drug is approximately:
(Recall that 1 Ci = 3.7 x 10^{10} Bq and N_A = 6.022 x 10^{23})

$t_{1/2} = 6.05$

$A_o = 3.1\ ci \longrightarrow 3.1 \times 3.7 \times 10^{10} = 1.147 \times 10^{11}\ Bq$

$A_o = N_o \lambda$

$N_o = \frac{1.147 \times 10^{11}}{3.2 \times 10^{-5}} = 3.59 \times 10^{15}$ decay

$3.59 \times 10^{15} \times \frac{1\ mol\ Tc}{6.02 \times 10^{23}} \times \frac{99\ g\ Tc}{1\ mol\ Tc}$

$= 0.59$ micrograms

$\lambda = \frac{\ln(2)}{6.02 \times 60 \times 60}$

$= 3.2 \times 10^{-5}\ s^{-1}$

26.

A ^{60}Co source with an activity of 26.0 µCi (A_o) is embedded in a tumor that has a mass of 0.5 kg (m). The ^{60}Co emits gamma radiation each with energy of 1.25 MeV. Only half of the emitted gammas are absorbed by the tumor. Assuming the RBE for gamma radiation to be 1.0, what is the equivalent dose that is delivered to the tumor per second? (Recall that 1 Ci = 3.7 x 10^{10} Bq)

1.92 x 10^{-5} rem 2.05 x 10^{-5} rem 5.20 x 10^{-16} rem 26.00 x 10^{-5} Sv 1.25 x 10^{-5} Sv

$A_o = 26 \times 10^{-6} \times 3.7 \times 10^{10} = 9.6 \times 10^{5}$ s^{-1}

$E_\gamma = 2.075 \times 10^{-13}$ jole

$E_{absorbed} = 1.0375 \times 10^{-13}$ jole

$$AD = \frac{1.0375 \times 10^{-13}}{0.5} = 2.075 \times 10^{-13} \text{ Gy} = 2.075 \times 10^{-11} \text{ rad}$$

rate $ED = AD \times RBE \times$ activity

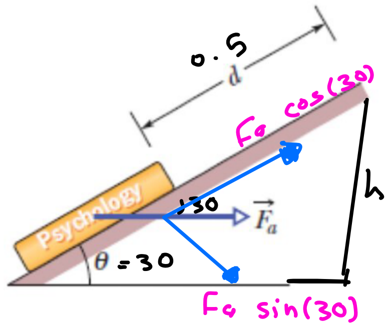
$= 2.075 \times 10^{-11} \times 9.6 \times 10^{5} \times 1$

$= 1.99 \times 10^{-5}$ rem/s

27.

The figure shows a 3-kg (m) psychology book, initially with zero kinetic ($k_i = 0$) energy, being displaced up a frictionless ramp (θ = 30°) by an applied force F_a (20 N). At the end of the displacement (d = 0.5 m), the speed (in m/s) of the book is:

0.94 1.31 zero 0.67 6.08



$W_{nc} = \Delta k + \Delta U$

$f_a \cos(30) \times 0.5 = \frac{1}{2} m (v_2^2) + mgh$

$20 \times \cos(30) \times 0.5 = \frac{1}{2} \times 3 \times v_2^2 + 3 \times 9.8 \times 0.25$

$1.31 = \frac{3}{2} v_2^2$

$\therefore V_2 = 0.94$ m/s

$\sin(30) = \frac{h}{0.5}$

$\therefore h = 0.25$ m

28.

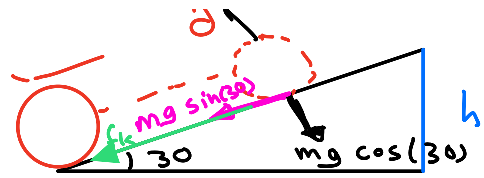
With a 128 J of kinetic energy, a 4 kg ball starts sliding up a rough ramp with inclination of 30°. How far (in m) will it slide up the ramp knowing that the coefficient of kinetic friction between the ball and the ramp is 0.3?

$\boxed{4.3}$ 17.2 13.6 3.7 3.2

μ

$m = 4\,kg$

$k_i = 128\,J$



$w_{nc} = \Delta k + \Delta U$

$-f_k d = -128 + mgh$

$-f_k d = -128 + mg \times d \sin(30)$

$-\mu_k N d = -128 + mg\,d \sin(30)$

$-0.3 * 33.95 \times d = -128 + 9.8 \times 4 \times \sin(30) \times d$

$29.8\,d = 128 \quad \therefore d = 4.3$

$\sin(30) = \frac{h}{d}$

$h = d \sin(30)$

$N = mg \cos(30)$

$N = 33.95\ N$

29.

Starting from rest, a car accelerates in a straight line, achieving speed v. The work needed to accomplish this acceleration is W. The work required to accelerate the same car from v/2 to v is:

¾ W 3/2 W ¼ W ⅜ W ½ W

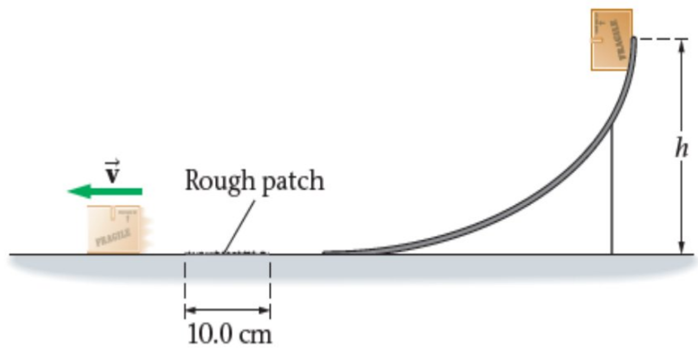
30.

Starting from rest, a car accelerates in a straight line, achieving speed v in T seconds. Assume that the power delivered by the car's engine remains constant, how much time does it take for the car to accelerate from v to 2v?

3T $\sqrt{2}$T 4T 2$\sqrt{2}$T 2T

31.

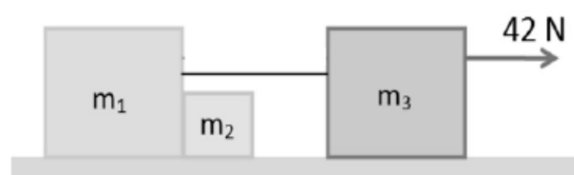
From rest, a 2.3 kg block slides down a frictionless hill and then across a rough patch that has a coefficient of kinetic friction of 0.64. As shown, the velocity of the block after crossing the rough patch is 3.5 m/s directed to the left. What is the vertical height of the hill; h (in m)?



0.69 0.56 1.06 0.62 0.96

32.

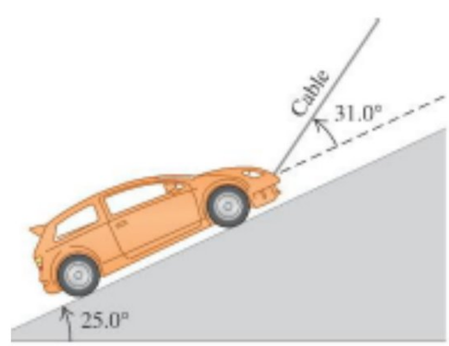
As shown, a 42 N force pulls block m_3, which is connected to block m_1, over a frictionless surface. Take m_1 = 1 kg, m_2 = 2 kg, and m_3 = 3 kg. What is the force (in N) exerted by m_1 on m_2?



14 42 21 28 0

33.

We wish to put a car in equilibrium by pulling it with a cable as shown in the figure. The 1130-kg car is held in place when the cable makes an angle 31.0° with the frictionless incline. The incline itself makes an angle of 25.0° with the horizontal. The normal force (in N) exerted on the car by the incline is:



7.2×10^3 1.1×10^4 4.8×10^2 1.0×10^3 2.4×10^3

29.

Starting from rest ($v_1 = 0$), a car accelerates in a straight line, achieving speed v ($v_2 = v$). The work needed to accomplish this acceleration is W. The work required to accelerate the same car from v/2 to v is:

¾ W   3/2 W   ¼ W   ⅜ W   ½ W

$$W = \Delta k \longrightarrow W = \frac{1}{2} m (v^2)$$

$$\bar{w} = \Delta k \longrightarrow \bar{w} = \frac{1}{2} m \left(v^2 - \frac{v^2}{4}\right)$$

$$\bar{w} = \frac{1}{2} m \left(\frac{3v^2}{4}\right) \longrightarrow \underbrace{\boxed{\frac{1}{2} m v^2}}_{w} \times \frac{3}{4}$$

$$\bar{w} = \frac{3}{4} w$$

30.

Starting from rest, a car accelerates in a straight line, achieving speed v in T seconds. Assume that the power delivered by the car's engine remains constant, how much time does it take for the car to accelerate from v to 2v?

3T $\sqrt{2}$T   4T   2$\sqrt{2}$T   2T

$$P = \frac{W}{T} \longrightarrow \frac{1}{2} m \frac{v^2}{T}$$

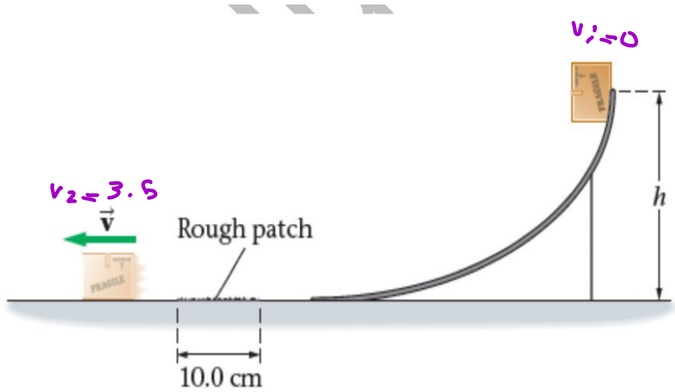
$$P = \frac{1}{2} \frac{m(4v^2 - v^2)}{\bar{T}} \longrightarrow \cancel{\frac{1}{2}} \cancel{m} \frac{\cancel{v^2}}{T} = \cancel{\frac{1}{2}} \cancel{m} \frac{3 \cancel{v^2}}{\bar{T}}$$

$$T = \frac{1}{3} \bar{T} \quad \therefore \bar{T} = 3T$$

31.

From rest, a 2.3 kg (m) block slides down a frictionless hill and then across a rough patch that has a coefficient of kinetic friction of 0.64 (μ). As shown, the velocity of the block after crossing the rough patch is 3.5 m/s directed to the left. What is the vertical height of the hill; h (in m)?

0.69   0.56   1.06   0.62   0.96



$$W_{nc} = \Delta K + \Delta U$$

$$-f_k d = \frac{1}{2} m (v_f^2 - v_i^2) - mgh$$

$$N = mg$$
$$N = 22.54$$

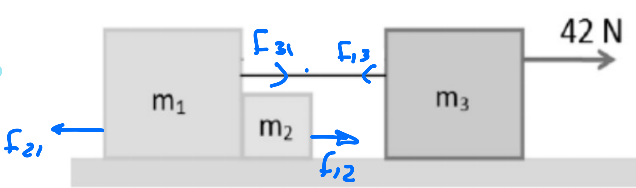
$$-\mu_k N d = \frac{1}{2} m (v_f^2) - mg\,h$$

$$-0.64 * 22.64 * 0.1 = \frac{1}{2} * 2.3 * (3.5)^2 - 2.3 * 9.8 * h$$

$$h = 0.689$$

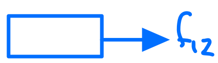
32.

As shown, a 42 N force pulls block m_3, which is connected to block m_1, over a frictionless surface. Take $m_1 = 1$ kg, $m_2 = 2$ kg, and $m_3 = 3$ kg. What is the force (in N) exerted by m_1 on m_2?



14 42 21 28 0

$m_1 = 1$ kg $m_2 = 2$ kg $m_3 = 3$ kg



$$f_{31} - f_{21} = m_1 a$$

one system

$$42 = 6\,a$$
$$\therefore a = 7 \text{ m/s}^2$$

$$42 - f_{13} = 3 * 7$$

$$f_{13} = 21 \text{ N}$$

$$21 - f_{21} = 1 * 7$$

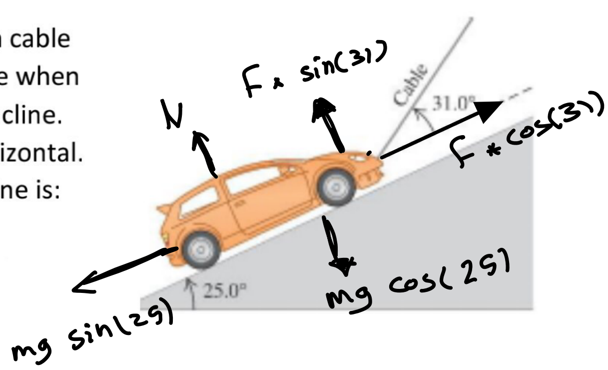
$$f_{21} = 14 \text{ N}$$

$$\therefore f_{12} = 14 \text{ N}$$

33.

We wish to put a car in equilibrium by pulling it with a cable as shown in the figure. The 1130-kg car is held in place when the cable makes an angle 31.0° with the frictionless incline. The incline itself makes an angle of 25.0° with the horizontal. The normal force (in N) exerted on the car by the incline is:

7.2×10^3 1.1×10^4 4.8×10^2 1.0×10^3 2.4×10^3



$m = 1130\,kg$

$F \cos(31) = \underline{mg} \sin(25)$

$\therefore F = 5460\ N$

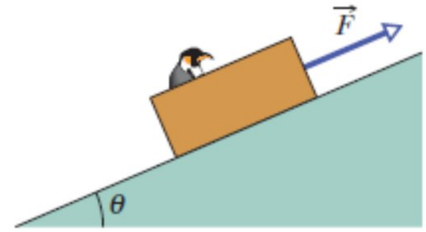
$F \sin(31) + N = mg \cos(25)$

$N = mg \cos(25) - F \sin(31)$

$N = 7224.4 \quad = 7.2 \times 10^3$

34.

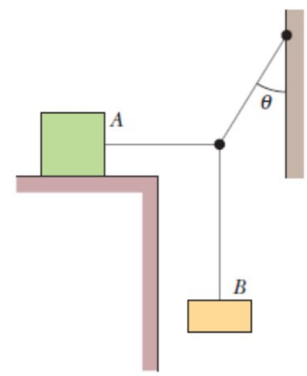
As shown, a penguin inside a box (total loaded mass 4 kg), initially with zero kinetic energy, is displaced up a frictionless inclined plane by a 50 N force. The magnitude of the normal force on the loaded box from the incline is 13.41 N. When the loaded box is displaced 3 m up the incline, it's speed (in m/s) is:



4.44 3.29 70.0 11.41 7.41

35.

An assembly of two connected blocks (A = 7 kg and B = 3 kg) is shown in the figure. The assembly is in equilibrium. However, block A would slip over the rough table if block B becomes any heavier than 3 kg. When θ is 30°, what is the coefficient of static friction between block A and the table?

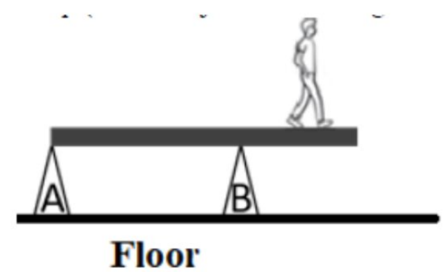


0.25 0.21 0.37 0.11 0.08

36.

The board shown is at a complete static equilibrium as it rests on the two pivots A and B, which are 4 m apart. A 60-kg PHY 105 student walks slowly towards the right end of the board until he feels that the board is about to tip and lose contact with pivot A. At the tipping moment, determine how far (in m) the student is from pivot A. Assume that the length of the board is 6 m and its mass is 90 kg.

The figure belongs to problems 36 & 37



5.5 4.5 4.8 5.0 6.0

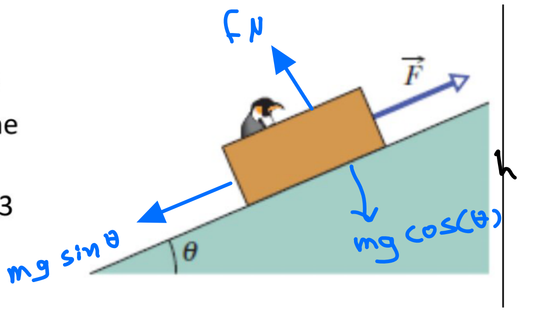
37.

The board shown is at a complete static equilibrium as it rests on the two pivots A and B, which are 4 m apart. A 60-kg PHY 105 student walks slowly towards the right end of the board until he feels that the board is about to tip and lose contact with pivot A. At the tipping moment, determine how far (in m) the student is from pivot B. Assume that the length of the board is 6 m and its mass is 90 kg.

1.5 0.5 0.8 1.0 2.0

34.

As shown, a penguin inside a box (total loaded mass 4 kg), initially with zero kinetic energy, is displaced up a frictionless inclined plane by a 50 N force. The magnitude of the normal force on the loaded box from the incline is 13.41 N. When the loaded box is displaced 3 m up the incline, it's speed (in m/s) is:



$\boxed{4.44}$ 3.29   70.0   11.41   7.41

$m = 4\ kg$

step 3

$W_{nc} = \Delta K + \Delta U$

$F * d = \frac{1}{2} m (v_f^2) + mgh$

$50 * 3 = \frac{1}{2} * 4 * v_f^2 + 4 * 9.8 * 2.8$

$V_f = 4.44$

step 1

$f_N = mg\ \cos(\theta)$

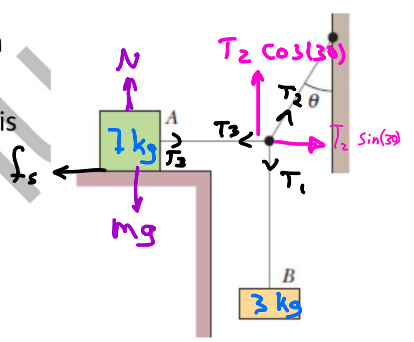
$\therefore \theta = 70°$

step 2

$\sin\theta = \frac{h}{3}$ $\therefore h = 2.8\ m$

35.

An assembly of two connected blocks (A = 7 kg and B = 3 kg) is shown in the figure. The assembly is in equilibrium. However, block A would slip over the rough table if block B becomes any heavier than 3 kg. When θ is 30°, what is the coefficient of static friction between block A and the table?



$\boxed{0.25}$ 0.21   0.37   0.11   0.08

$T_3 - f_s = 0 \longrightarrow f_s = T_3$

$T_1 = m_B g = 29.4\ N$

$T_1 = T_2 \cos(30)$

$\therefore T_2 = 33.95$

$T_3 = T_2 * \sin(30)$

$T_3 = 16.97$

$f_s = 16.97$

$f_s = \mu_s * N$

$\mu_s = 0.247$

$\mu_s = 0.25$

$N = m_A g$

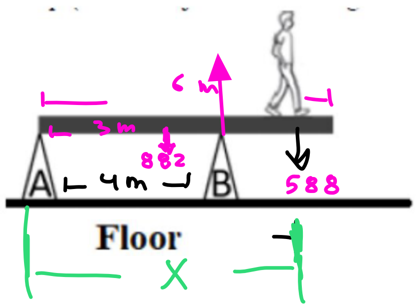
$N = 68.6$ newton

36.

The board shown is at a complete static equilibrium as it rests on the two pivots A and B, which are 4 m apart. A 60-kg PHY 105 student walks slowly towards the right end of the board until he feels that the board is about to tip and lose contact with pivot A. At the tipping moment, determine how far (in m) the student is from pivot A. Assume that the length of the board is 6 m and its mass is 90 kg.

$\boxed{5.5}$ 4.5 4.8 5.0 6.0

The figure belongs to problems 36 & 37



$\Sigma \tau = 0$ about A

$-882 \times 3 + F_B \times 4 - 588 \times X = 0$

$-882 \times 3 + 1470 \times 4 = 588\, X$

$\therefore X = 5.5$

$588 + 882 = F_B$

$F_B = 1470$

37.

The board shown is at a complete static equilibrium as it rests on the two pivots A and B, which are 4 m apart. A 60-kg PHY 105 student walks slowly towards the right end of the board until he feels that the board is about to tip and lose contact with pivot A. At the tipping moment, determine how far (in m) the student is from pivot B. Assume that the length of the board is 6 m and its mass is 90 kg.

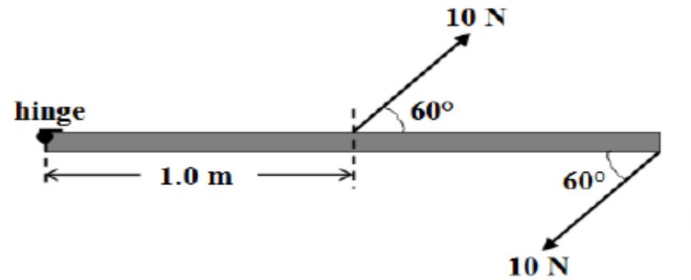
$\boxed{1.5}$ 0.5 0.8 1.0 2.0

$5.5 - 4 = 1.5$

تابع للسؤال الماضي

38.

A 2 m steel rod is hinged as shown. The net torque (in N.m) exerted by the two forces on the rod about a vertical axis passing through the hinge is:

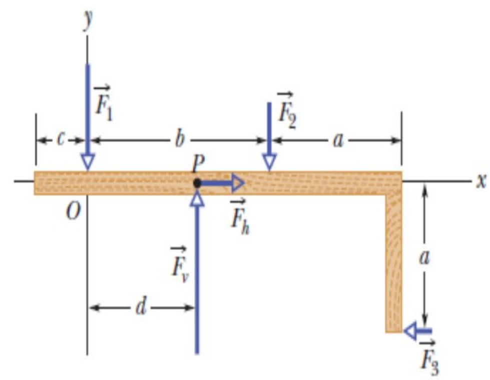


8.7, clockwise   8.7, counterclockwise

26, counterclockwise   26, clockwise   zero

39.

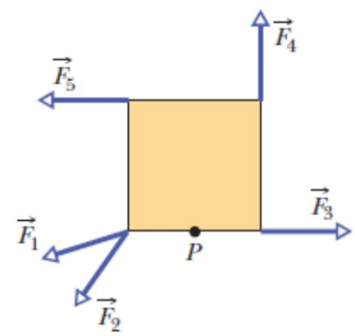
The figure shows three forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ acting on an unstable L-shaped tube. Once a fourth force is applied at point P, the tube has reached the static equilibrium. The fourth force has two components; $\mathbf{F}_v$ and $\mathbf{F}_h$. Take a = 2 m, b = 3 m, c = 1 m, F_1 = 20 N, F_2 = 10 N and F_3 = 5 N. The distance d (in m) is:



1.33   1.0   0.67   2.67   2.0

40.

A square of side L is free to rotate about the point P - at the middle of the lower side - as shown in the figure. All five forces acting on the square have the same magnitude. Rank the five torques, τ, produced by those forces, from the greatest to the smallest.



$\tau_5, \tau_4, \tau_2, \tau_1, \tau_3$ $\tau_5, \tau_4 = \tau_2, \tau_1, \tau_3$ $\tau_3 = \tau_4 = \tau_5, \tau_1, \tau_2$

$\tau_4, \tau_5, \tau_2, \tau_1, \tau_3$ $\tau_5, \tau_2, \tau_4, \tau_1, \tau_3$

41.

A sample consists of N_0 Radon isotopes (^{222}R) at time t = 0. The number of isotopes that remain after half of a half-life equal to: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

$\frac{1}{\sqrt{2}} N_0$ ¼ N_0 ¾ N_0 ⅛ N_0 $\frac{1}{\sqrt{8}} N_0$

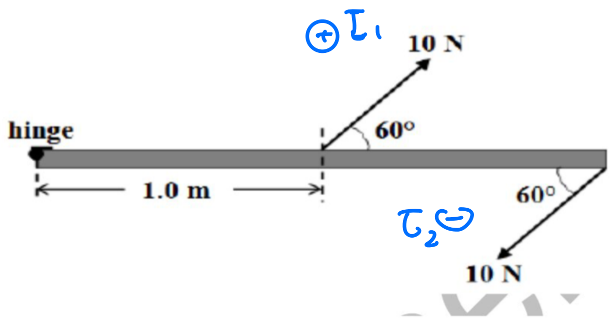
42.

^{15}O is commonly used as a tracer in medical tests. Its half-life is 122 s. How much time does it take for the number of ^{15}O nuclei in a given sample to decrease by a factor of 10^{-4}?
(Recall that 1 Ci = 3.7 x 10^{10} Bq)

27 minutes   1340 seconds   2.4 days   65 minutes

38.

A 2 m steel rod is hinged as shown. The net torque (in N.m) exerted by the two forces on the rod about a vertical axis passing through the hinge is:



8.7, clockwise   8.7, counterclockwise

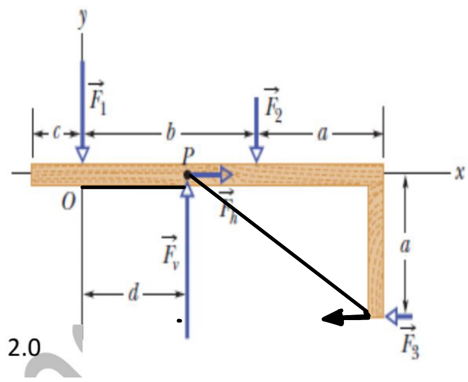
26, counterclockwise   26, clockwise   zero

$10*1*\sin(60) - 10*2*\sin(60)$

$= -8.66 \longrightarrow$ clockwise

39.

The figure shows three forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ acting on an unstable L-shaped tube. Once a fourth force is applied at point P, the tube has reached the static equilibrium. The fourth force has two components; $\mathbf{F}_v$ and $\mathbf{F}_h$. Take a = 2 m, b = 3 m, c = 1 m, F_1 = 20 N, F_2 = 10 N and F_3 = 5 N. The distance d (in m) is: $\boxed{1.33}$ 1.0   0.67   2.67   2.0



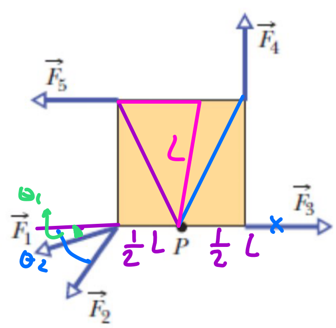
$F_1 * d - F_2(b-d) - F_3 * a = 0$

$20d - 10*3 + 10d - 5*2 = 0$

$30d = 40 \quad \therefore d = \frac{4}{3} = 1.33$

40.

A square of side L is free to rotate about the point P - at the middle of the lower side - as shown in the figure. All five forces acting on the square have the same magnitude. Rank the five torques, τ, produced by those forces, from the greatest to the smallest.



$\tau_5, \tau_4, \tau_2, \tau_1, \tau_3$ $\tau_5, \tau_4 = \tau_2, \tau_1, \tau_3$ $\tau_3 = \tau_4 = \tau_5, \tau_1, \tau_2$

$\tau_4, \tau_5, \tau_2, \tau_1, \tau_3$ $\tau_5, \tau_2, \tau_4, \tau_1, \tau_3$

$\tau_5 > \tau_4$ because $\overbrace{F_5 * L > F_4}^{\text{same}} * \frac{1}{2}L$

$\tau_2 > \tau_1$ because $F_2 * \frac{1}{2}L * \sin(\theta_2) > F_1 * \frac{1}{2}L * \sin\theta_1$

$F_5 * L > F_2 * \frac{1}{2} L * \underbrace{\sin(\theta_2)}_{\leq 1}$ so

$$\boxed{\tau_5 > \tau_4 > \tau_2 > \tau_1 > \tau_3}$$

41.

A sample consists of N_0 Radon isotopes (^{222}R) at time t = 0. The number of isotopes that remain after half of a half-life equal to: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

$\frac{1}{2} t_{1/2}$

$\boxed{\frac{1}{\sqrt{2}} N_0}$ ¼ N_0 ¾ N_0 ⅛ N_0 $\frac{1}{\sqrt{8}} N_0$

$N = N_0 \left(\frac{1}{2}\right)^n$

$N = N_0 (0.71)$

$N = 0.71 N_0$

$N = \frac{1}{\sqrt{2}} N_0$

$n = \frac{t}{t_{1/2}}$

$n = \frac{0.5 \cancel{t_{1/2}}}{\cancel{t_{1/2}}}$

$\therefore n = \frac{1}{2}$

42.

^{15}O is commonly used as a tracer in medical tests. Its half-life is 122 s. How much time does it take for the number of ^{15}O nuclei in a given sample to decrease by a factor of 10^{-4}? (Recall that 1 Ci = 3.7 x 10^{10} Bq)

$\boxed{\text{27 minutes}}$ 1340 seconds 2.4 days 65 minutes

$t_{1/2} = 122 s$

$N(t) = 10^{-4} N_0$

$N(t) = N_0 * \left(\frac{1}{2}\right)^n$

$10^{-4} = \left(\frac{1}{2}\right)^n$

$\therefore n = 13.3$

$n = \frac{t}{t_{1/2}}$

$\therefore t = 1621 s = 27 min$

43.

A pure gold isotope (^{198}Au) with a half-life of 2.70 days is used in cancer treatment. The mass (in milligram) of this isotope that is required to give an activity of 225 Ci is:
(Recall that 1 Ci = 3.7 x 10^{10} Bq and N_A = 6.022 x 10^{23})

0.92 1.07 0.06 0.76 4.03

44.

The initial activity of isotope M is twice that of isotope N. After two half-lives of isotope M have elapsed, the two isotopes have the same activity. The ratio of the half-life of N to the half-life of M is: (Recall that 1 Ci = 3.7 x 10^{10} Bq)

2 4 1 ½ ¼

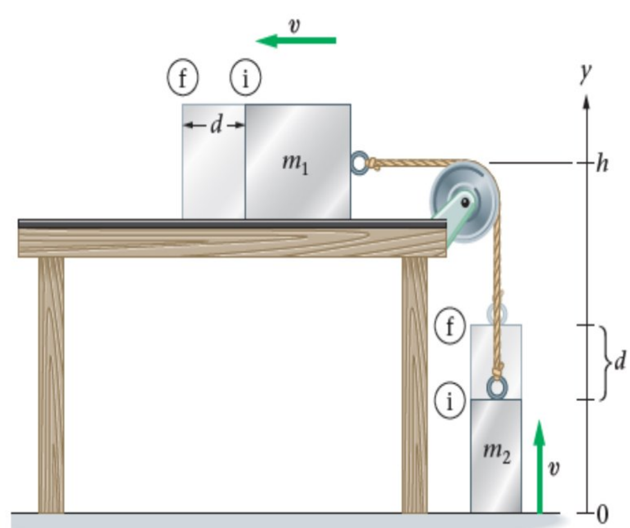
45.

In a nuclear laboratory hosted by JU, a PHY 105 student is investigating two radioactive sources, J and U. The initial activity of J is 16 Ci and that of U is 4 Ci, but after 8 days the two have the same activity of 0.25 Ci. The ratio of the half-life of U to the half-life of J is:
(Recall that 1 Ci = 3.7 x 10^{10} Bq)

1.54 0.66 1.08 2.00 0.25

46.

The two blocks shown (m_1 and m_2) are given an initial velocity, v, in the counterclockwise sense. After traveling the distance d, the two blocks came to a complete stop. Assume that the whole system is frictionless. The work exerted by the string on m_2 is:



$\frac{1}{2}m_1v^2$

$\frac{1}{2}(m_1 + m_2)v^2$

$m_2gd + \frac{1}{2}m_2v^2$

$\frac{1}{2}m_2v^2 - m_2gd$

$\frac{1}{2}m_2v^2$

43.

A pure gold isotope (^{198}Au) with a half-life of 2.70 days is used in cancer treatment. The mass (in milligram) of this isotope that is required to give an activity of 225 Ci is:
(Recall that 1 Ci = 3.7×10^{10} Bq and $N_A = 6.022 \times 10^{23}$)

0.92	1.07	0.06	0.76	4.03

$t_{1/2} = 2.7$ day

$A_o = 225 \times 3.7 \times 10^{10} = 8.36 \times 10^{12}$ Bq

$A_o = \lambda N_o$

$N_o = 2.81 \times 10^{18}$ decay

$\lambda = \frac{\ln(2)}{t_{1/2}}$

$\lambda = 3 \times 10^{-6}\ s^{-1}$

$$2.81 \times 10^{18} \times \frac{1\ mol\ Au}{6.02 \times 10^{23}} \times \frac{198\ g\ Au}{1\ mol\ Au} = 9.2 \times 10^{-4}\ g$$

$= 0.92$ mg

44.

The initial activity of isotope M is twice that of isotope N. After two half-lives of isotope M have elapsed, the two isotopes have the same activity. The ratio of the half-life of N to the half-life of M is: (Recall that 1 Ci = 3.7×10^{10} Bq)

$2\ t_{1/2_M}$

2	4	1	½	¼

$A^o_M = 2 A^o_N$ after $2\ t_{1/2_M}$ $A_M = A_N$

$A_M = A_{oM} \times (\frac{1}{2})^m$

$A_N = A_{oN} \times (\frac{1}{2})^n$

$1 = 2 \times (\frac{1}{2})^{m-n}$

$\frac{1}{2} = (\frac{1}{2})^{m-n}$

$m - n = 1$

$m = n + 1$

$m = \frac{2\ \cancel{t_{1/2}}_M}{\cancel{t_{1/2}}_M}$

$\boxed{\therefore m = 2 \quad n = 1}$

$n = \frac{2\ t_{1/2}\ M}{t_{1/2}\ N} \longrightarrow \frac{t_{1/2}\ N}{t_{1/2}\ M} = 2$

45.

In a nuclear laboratory hosted by JU, a PHY 105 student is investigating two radioactive sources, J and U. The initial activity of J is 16 Ci and that of U is 4 Ci, but after 8 days the two have the same activity of 0.25 Ci. The ratio of the half-life of U to the half-life of J is:
(Recall that 1 Ci = 3.7×10^{10} Bq)

$\boxed{1.54}$ 0.66 1.08 2.00 0.25

$A_{oJ} = 16$ ci | $A_{oU} = 4$ ci $\xrightarrow{\text{after 8 day}}$ $A_J = A_U = 0.25$ ci

step 1

$A_J = A_{oJ} \times \left(\frac{1}{2}\right)^n$

$\therefore n = 6$

$A_U = A_{oU} = \left(\frac{1}{2}\right)^m$

$m = 4$

step 2

$n = \frac{t}{t_{1/2 J}} \rightarrow t_{1/2 J} = \frac{4}{3}$ day

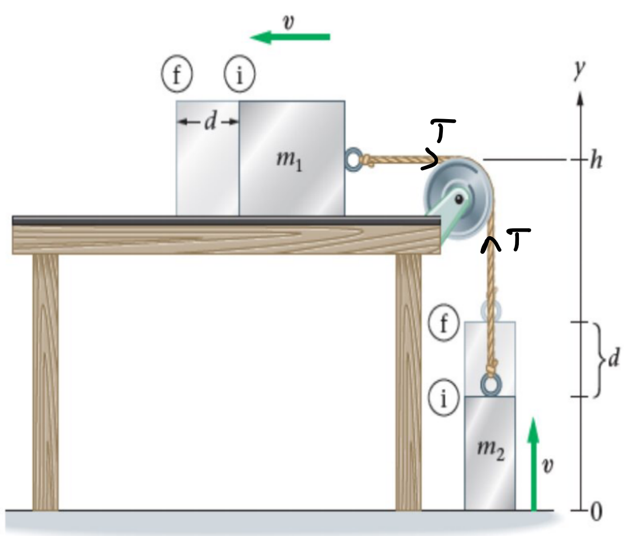
$m = \frac{t}{t_{1/2 U}} = t_{1/2 U} = 2$ day

step 3

$\frac{t_{1/2 U}}{t_{1/2 J}} = \frac{2}{\frac{4}{3}} = \frac{6}{4} = 1.5$

46.

The two blocks shown (m_1 and m_2) are given an initial velocity, v, in the counterclockwise sense. After traveling the distance d, the two blocks came to a complete stop. Assume that the whole system is frictionless. The work exerted by the string on m_2 is:



$\boxed{\frac{1}{2}m_1 v^2}$

$\frac{1}{2}(m_1 + m_2)v^2$

$m_2 g d + \frac{1}{2}m_2 v^2$

$\frac{1}{2}m_2 v^2 - m_2 g d$ ✗

$\frac{1}{2}m_2 v^2$

$$W_{nc} = \Delta K + \Delta U$$

$$Td = \frac{1}{2} m_2 \times (0 - v^2) + m_2 g d$$

$$\boxed{Td = m_2 g d - \frac{1}{2} m_2 v^2}$$

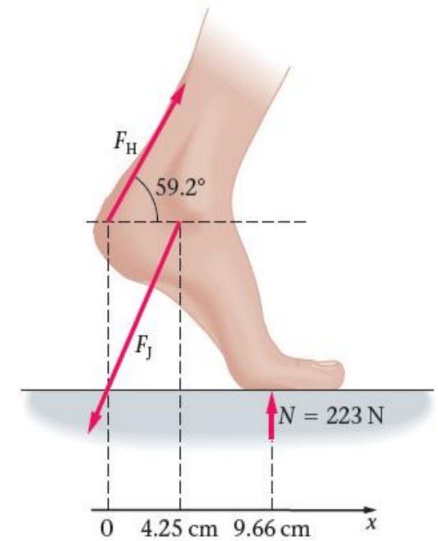
$$W_{nc} = \frac{1}{2} m_1 (0 - v^2)$$

$$-Td = -\frac{1}{2} m_1 v^2$$

$$\boxed{Td = \frac{1}{2} m_1 v^2}$$

47.

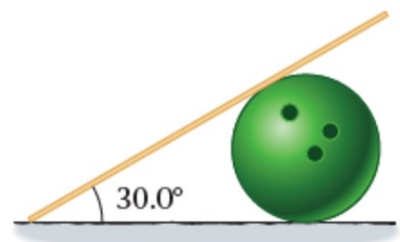
Three forces act on the foot as shown. F_H is the force exerted by the Achilles tendon on the heel. F_J is the force exerted by the ankle joint on the foot. N is the force exerted by the ground on the toes. The foot is in a complete static equilibrium at the moment of consideration. The magnitude of F_J (in terms of the magnitude of the force N) is:



2.39 * N   0.76 * N   1.07 * N   3.11 * N   2.80 * N

48.

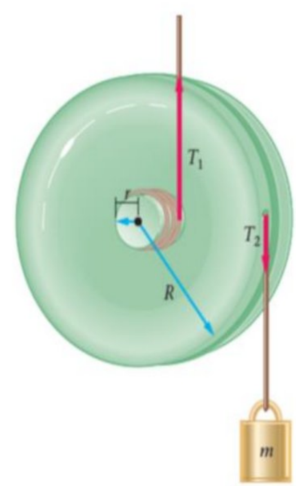
As shown, a wooden rod leans against a ball and rests on a rough horizontal level. The ball is made of pure silk and has a radius of 10.8 cm. The rod is 43.6 cm long and has a mass of 214 g. The rod is in a complete static equilibrium at the moment of consideration. The magnitude of the force (in N) exerted by the ball on the rod is:



0.98   1.22   0.47   1.93   0.47

49.

A PHY 105 student is investigating the rotational motion of a yo-yo with a mass of 100 g. The outer radius (R) of the yo-yo is 4.7 times greater than the inner radius (r), as shown in the figure. The PHY 105 student noticed that the yo-yo had reached a complete static equilibrium when a mass m was suspended from its outer edge. The hanging mass, m (in g) is:



27   39   104   19   8

50.

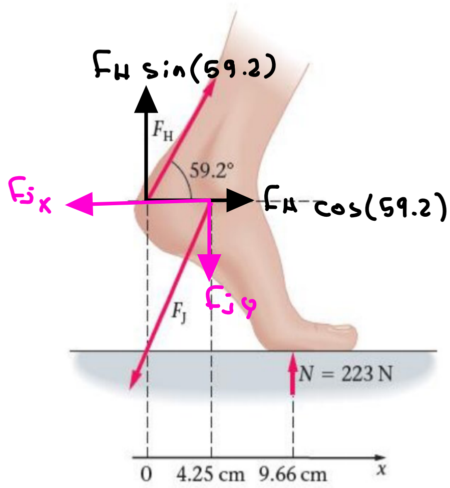
A 79-kg patient receives a dose of radiation by ingesting a radioactive medication containing ^{32}P, which emits β rays with an RBE of 1.50. The half-life of ^{32}P is 14.28 days, and the initial activity of the medication is 1.34 MBq. If the β rays each has an energy of 705 keV, what is the absorbed dosage (in rad) over a period of 7.00 days, assuming the radiation is absorbed by 125 g tumor. (Recall that 1 Ci = 3.7 x 10^{10} Bq)

62   153   93   230   98

47.

Three forces act on the foot as shown. F_H is the force exerted by the Achilles tendon on the heel. F_J is the force exerted by the ankle joint on the foot. N is the force exerted by the ground on the toes. The foot is in a complete static equilibrium at the moment of consideration. The magnitude of F_J (in terms of the magnitude of the force N) is:

$\boxed{2.39 * N}$	0.76 * N	1.07 * N	3.11 * N	2.80 * N



$\Sigma \tau = 0$ about F_j

$233 * 0.0541 - F_H * 0.0425 * \sin(59.2) = 0$

$F_H = 345.3\ N$

$\Sigma F_y = 0 \longrightarrow N + F_H \sin(59.2) = F_{jy}$

$\therefore F_{jy} = 529.6\ N$

$\Sigma F_x = 0 \longrightarrow F_H \cos(59.2) = F_{jx}$

$\therefore F_{jx} = 176.8\ N$

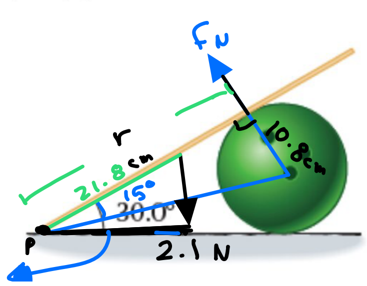
$F_J = \sqrt{F_{jx}^2 + F_{jy}^2} = 588.3\ N$

$\frac{588.3}{233} = 2.39$

48.

As shown, a wooden rod leans against a ball and rests on a rough horizontal level. The ball is made of pure silk and has a radius of 10.8 cm. The rod is 43.6 cm long and has a mass of 214 g. The rod is in a complete static equilibrium at the moment of consideration. The magnitude of the force (in N) exerted by the ball on the rod is:

$\boxed{0.98}$	1.22	0.47	1.93	0.47



$\tan(15) = \frac{0.108}{r}$

$\therefore r = 0.403$

$\Sigma \tau = 0$ about P

$-2.1 * 0.218 * \cos(30) + F_N * 0.403 = 0$

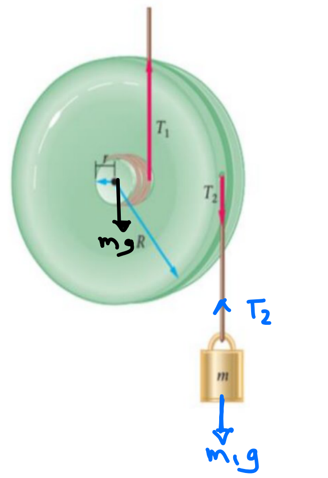
$F_N = 0.98$ N

49.

A PHY 105 student is investigating the rotational motion of a yo-yo with a mass of 100 g. The outer radius (R) of the yo-yo is 4.7 times greater than the inner radius (r), as shown in the figure. The PHY 105 student noticed that the yo-yo had reached a complete static equilibrium when a mass m was suspended from its outer edge. The hanging mass, m (in g) is:

27   39   104   19   8

50.



$R = 4.7 r$

$T_1 * r - T_2 * R = 0$

$T_1 r = T_2 R \longrightarrow T_1 \cancel{r} = T_2 * 4.7 \cancel{r}$

$\boxed{T_1 = 4.7\, T_2}$

$T_1 = T_2 + 980$

$4.7 T_2 = T_2 + 980$

$3.7 T_2 = 980$

$\therefore T_2 = 264.9 \ \frac{g \cdot m}{s^2}$

$T_2 = m_1 g$

$264.9 = 9.8 * m_1$

$\therefore m = 27$ g

50.

A 79-kg patient receives a dose of radiation by ingesting a radioactive medication containing ^{32}P, which emits β rays with an RBE of 1.50. The half-life of ^{32}P is 14.28 days, and the initial activity of the medication is 1.34 MBq. If the β rays each has an energy of 705 keV, what is the absorbed dosage (in rad) over a period of 7.00 days, assuming the radiation is absorbed by 125 g tumor. (Recall that 1 Ci = 3.7 x 10^{10} Bq)

$\boxed{62}$ 153 93 230 98

10

$t_{1/2} = 14.28$ day

$A_0 = 1.34 \times 10^6$ Bq

$\lambda = \frac{\ln(2)}{14.28}$

$\lambda = 5.6 \times 10^{-7}$

step 1

$$N_0 = \frac{1.34 \times 10^6}{5.6 \times 10^{-7}} = 2.4 \times 10^{12}$$

step 2

$$n = \frac{t}{t_{1/2}} = \frac{7}{14.28} = 0.49$$

$$N(t) = N_0 \left(\frac{1}{2}\right)^{0.49}$$

$$N(t) = 1.698 \times 10^{12}$$

Beta absorbed $= N_0 - N(t)$

$= 2.38 \times 10^{12} - 1.698 \times 10^{12}$

absorbed Beta $= 6.82 \times 10^{11}$

$$AD = \frac{(705 \times 10^3 \times 1.66 \times 10^{-19} \times 6.82 \times 10^{11})\ \text{J}}{0.125\ \text{kg}}$$

$AD = 0.63$ Gy $\rightarrow$ $AD = 63$ rad