FINAL PHYSICS 105

Final 021

Q1) Iodine ^{131}I is widely used in the treatment and diagnosis of the Thyroid gland. The radius (in fm) of this isotope is:
A) 131.0
B) 157.2
C) 5.2
D) 5.4
E) 6.1

Q2) A 55-kg person has absorbed a 20-rad dose. How many joules of energy are deposited in his body?
A)1.1
B) 20
C)11
D) 55
E) 1100

Q3) The activity of 1 gram of radium $^{226}_{88}Ra$ is exactly 1 Ci. The half-life of radium (in years) is:
A) 226
B) 1170
C) 2280
D) 1580
E) 1950

Q4) A 70-kg researcher absorbs 4.5×10^8 neutrons in a workday, each of energy 1.2 MeV. The relative
biological effectiveness (RBE) for these neutrons is 10. What is the equivalent dosage of the radiation exposure for this researcher, in mrem?
A) 1.2
B) 0.39
C) 0.77
D) 3.7
E) 12

Q5) A 2.0-mCi source of ^{32}P is implanted in a tumor to give it a 24-Gy dose. The half-life of 32P is 14.3 days, and 1mCi delivers 10 mGy/min. How long (in min) should the source remain implanted?

A) 12

B) 1200

C) 2400

D) 300

E) 800

Q6) Ionizing radiation can be used on meat products to reduce the levels of microbial pathogens. Assume that for refrigerated meat the upper allowed limit is 3.8 kGy. If a beam of electrons, each of energy 1.6 MeV, irradiates 3.0 kg of beef, how many electrons should the beef mass absorb to reach the upper allowed limit?

A) 3.8×10^{10}

B) 4.5×10^{10}

C) 3.8×10^{16}

D) 4.5×10^{16}

E) 1.6×10^{10}

Q7) A biological tissue of mass m is exposed to 60 rad of alpha radiation. How many rads of slow neutrons can cause the same damage to the same tissues? (For alpha RBE=20, for slow neutrons RBE = 5).

1) 240

B) 300

C) 60

D) 360

E) 1200

Q8) A blood vessel of radius r splits into two smaller vessels, each of radius r /3. If the velocity in the larger vessel is v, then the velocity in each of the smaller vessel is:

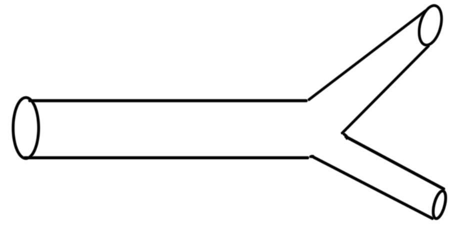
A) 9v

B) v/9

C) 2v/9

D) v

E) 9v/2



09) Water flows into the top floor of a 16 m high building through a pipe of constant 2 cm diameter. At the base of the building (ground level) the water flows into the pipe at a speed of 60 cm/s where the gauge pressure is 3.2 atm. The gauge pressure (in atm) in the pipe in the top floor is:

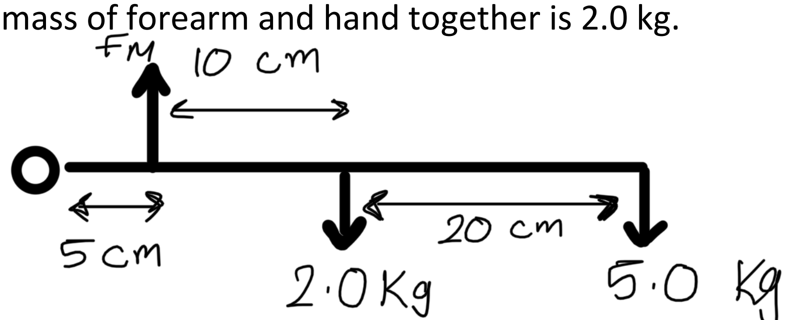
A) 0
B) 1.65
C) 2.65
D) 1.54
E) 3.2

Q10) The surface of water in a tank supplying water to a house is 7 m above the faucet (حنفية) in the house. If the faucet is 2.0-cm diameter, how long (in s) does it take to fill a 0.25-m^3 container in the house?

A) 95
B)57
C) 68
D) 80
E) 136

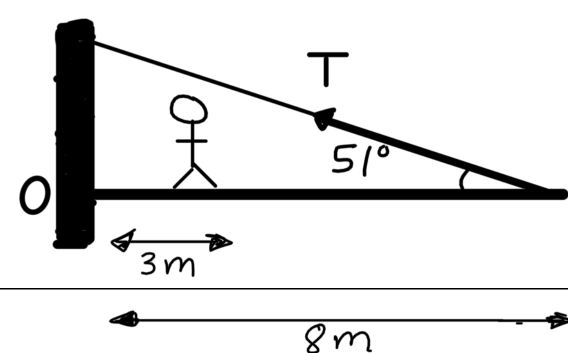
Q11) How much force (F_M in N) must the biceps muscle exert when a 5.0-kg mass is held in the hand with the forearm being in static equilibrium in a horizontal position as in the figure. Assume that the elbow joint, O, is 5 cm far from the point
of application of F_M, and that the mass of forearm and hand together is 2.0 kg.

A) 800
B) 402
C) 100
D) 200
E) 50



Q12) The figure shows a uniform, horizontal beam (length = 8 m, mass = 25 kg) that is pivoted to the wall by a hinge at point O, with its far end supported by a cable that makes an angle of 51° with the horizontal. If a person (mass = 60 kg) stands 3.0 m from the pivot, what is the horizontal component of the hinge force (in N) acting at point 0?

A) 380
B) 189



C) 0
D) 20
E) 278

Q13) The kinetic energy of a car moving along a horizontal road is 130 kJ. The driver applies the breaks, and the car stops in 20 m. The force of friction (in N) (assumed constant) is:
A) 260000
B) 2600
C) 130000
D) 6500
E) 1300

Q14) A 55-kg athlete climbs a 9 m long rope in 10s. His average power output (in W) is
A) 231
B) 485
C) 550
D) 90
E) 331

Q15) A 4.0 kg mass is placed on a rough surface that makes an angle of 20° with the horizontal. If the mass is on the verge of motion, then the coefficient of static friction (μ_s) is
A) 0.36
B) 0.94
C) 0.87
D) 0.11
E) 0.34

Q16) A student moves 6 m along the positive x-direction, then he turns around and moves 9 m along the
negative x-direction. His average velocity (in m/s) over the 7.0 s total interval of motion is:
A) -3
B) 0.43

C) 0.75
D) 3
E) -0.43

Q17) A stone is projected vertically upwards with a speed of 12 m/s from the top of an 18 m high building. The time (in s) it takes the stone to reach the ground is:
A) 4.1
B) 0.1
C) 3.5
D) 3.0
E) 0.6

ANSWERS:

Q1-E	Q2-C	Q3-D	Q4-A	Q5-B
Q6-D	Q7-A	Q8-E	Q9-B	Q10-C
Q11-B	Q12-E	Q13-D	Q14-B	Q15-A
Q16-E	Q17-C			

Q1) Iodine ^{131}I is widely used in the treatment and diagnosis of the Thyroid gland. The radius (in fm) of this isotope is:

A) 131.0
B) 157.2
C) 5.2
D) 5.4
E) 6.1

$A = 131$ $r = 1.2 \times 10^{-15} \sqrt[3]{A}$

$r = 1.2 \times 10^{-15} \times \sqrt[3]{131}$

$= 6.1 \times 10^{-15} = 6.1$ fm

Q2) A 55-kg person has absorbed a 20-rad dose. How many joules of energy are deposited in his body?

A)1.1
B) 20
C)11
D) 55
E) 1100

m=55kg

AD = 20rad

1Gy = 1J/1kg =

x = 20rad

x = 0.2 J / 1kg

1 kg → 0.2 J

55 kg → x

x = 11 J

Test Bank - Final - All Chapters.

Q3) The activity of 1 gram of radium $^{226}_{88}Ra$ is exactly 1 Ci. The half-life of radium (in years) is:
A) 226
B) 1170
C) 2280
D) 1580
E) 1950

$n(Ra) = \frac{m}{Mr} = \frac{1}{226} = 0.00442$ mol

1 mol → 6.022×10^{23} atoms (Ra)
0.00442 mol → x
$N = x = 0.02661 \times 10^{23}$ atoms (Ra)

$A = \lambda N$

$3.7 \times 10^{10} = \lambda \times 0.02661 \times 10^{23}$

$\lambda = 139 \times 10^{-13}\ s^{-1}$

$t_{\frac{1}{2}} = \frac{\ln(2)}{139 \times 10^{-13}} = 0.004986 \times 10^{13}\ s$

1 year = 60 × 60 × 24 × 365 (min, h, day, year)
1 year = 31,536,000 seconds
x = 0.004986×10^{13} s
x = 1580 years

Q4) A 70-kg researcher absorbs 4.5×10^8 neutrons in a workday, each of energy 1.2 MeV. The relative biological effectiveness (RBE) for these neutrons is 10. What is the equivalent dosage of the radiation exposure for this researcher, in mrem?
A) 1.2
B) 0.39
C) 0.77
D) 3.7
E) 12

$E_{neutrons} = 1.2$ MeV

RBE = 10

AD = $\frac{\text{Energy} \times \text{no. of neutrons}}{\text{mass}}$ (energy per neutron)

$= \frac{4.5 \times 10^8 \times 1.2 \times 10^6 \times 1.6 \times 10^{-19}}{70}$

$= 0.12342 \times 10^{-5}$ J/kg

Ed (neutron) = RBE × AD
$= (10)(0.1234 \times 10^{-5})$
$= 0.1234 \times 10^{-4}$ Sv

1 Sv = 100 rem
0.1234×10^{-4} Sv = x

$x = 0.1234 \times 10^{-2}$ rem
= 1.2 mrem

Q5) A 2.0-mCi source of ^{32}P is implanted in a tumor to give it a 24-Gy dose. The half-life of 32P is 14.3 days, and 1mCi delivers 10 mGy/min. How long (in min) should the source remain implanted?

A) 12
B) 1200
C) 2400
D) 300
E) 800

$A = 2\ miCi$, $1\ miCi \longrightarrow 10m\ Gy/min$

$AD = 24\ Gy$, $t_{\frac{1}{2}} = 14.3\ days$

$1\ miCi \longrightarrow 10m\ Gy/min$

$2\ miCi \longrightarrow x$

$rate = \frac{dose}{time}$

$x = 20\ mGy/min$

$= \frac{20 \times 10^{-3}\ Gy}{1min}$

$time = \frac{24}{20 \times 10^{-3}} = 1.2 \times 10^{3} = 1200 min$

Q6) Ionizing radiation can be used on meat products to reduce the levels of microbial pathogens. Assume that for refrigerated meat the upper allowed limit is 3.8 kGy. If a beam of electrons, each of energy 1.6 MeV, irradiates 3.0 kg of beef, how many electrons should the beef mass absorb to reach the upper allowed limit?

A) 3.8×10^{10}
B) 4.5×10^{10}
C) 3.8×10^{16}
D) 4.5×10^{16}
E) 1.6×10^{10}

$E_{electron\ (one)} = 1.6\ MeV$, $m = 3kg$ beef

$n \rightarrow$ no. of electrons absorbed by the beef

$AD_{(max)} = 3.8 \times 10^{3}\ Gy$

$\hookrightarrow AD = \frac{\text{Energy per electron} \times \text{no. of electrons}}{mass}$

$3.8 \times 10^{3} = \frac{1.6 \times 10^{6} \times 1.6 \times 10^{-19} \times n}{3}$

$n = 4.5 \times 10^{16}$ electrons

Q7) A biological tissue of mass m is exposed to 60 rad of alpha radiation. How many rads of slow neutrons can cause the same damage to the same tissues? (For alpha RBE=20, for slow neutrons RBE = 5).
1) 240
B) 300
C) 60
D) 360
E) 1200

AD = 60 rad of α-radiation

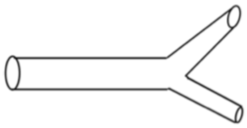
RBE (α) = 20 , RBE (neutrons) = 5

$ED_{(\alpha)} = ED_{(neutrons)}$

$(20)(60) = (5)(AD)$

AD = 240 rad

Q8) A blood vessel of radius r splits into two smaller vessels, each of radius r /3. If the velocity in the larger vessel is v, then the velocity in each of the smaller vessel is:
A) 9v
B) v/9
C) 2v/9
D) v
E) 9v/2

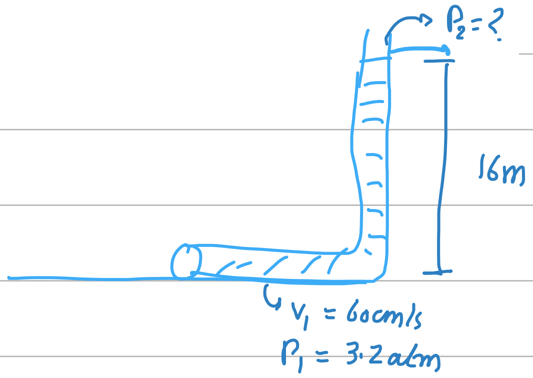


$A_1 V_1 = A_2 V_2$

$\pi \times (r)^2 v_1 = \pi \left(\frac{r}{3}\right)^2 \times v$

$v_1 = \frac{v}{9}$

09) Water flows into the top floor of a 16 m high building through a pipe of constant 2 cm diameter. At the base of the building (ground level) the water flows into the pipe at a speed of 60 cm/s where the gauge pressure is 3.2 atm. The gauge pressure (in atm) in the pipe in the top floor is:
A) 0
B) 1.65
C) 2.65
D) 1.54
E) 3.2



$P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$

$P_1 = P_2 + \rho g h_2$

$324160 = P_2 + 156800$

$P_2 = 167360$ Pa

$= 1.65$ atm

step1:- $A_1 V_1 = A_2 V_2$

A is constant, so v is constant

Q10) The surface of water in a tank supplying water to a house is 7 m above the faucet (حنفية) in the house. If the faucet is 2.0-cm diameter, how long (in s) does it take to fill a 0.25-m^3 container in the house?

A) 95

B) 57

C) 68

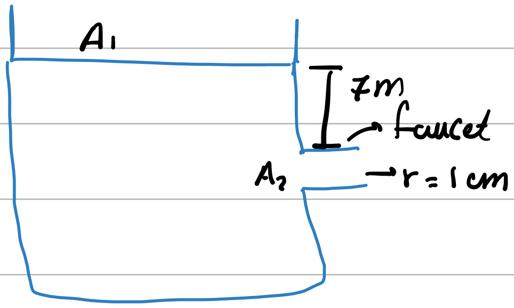
D) 80

E) 136

$A_1 >> A_2$

→ $v_1 << v_2$

→ $v_1 \approx 0$



$V_2 = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 7} = 11.7\ m/s$

$\frac{\Delta V}{\Delta t} = A_2 V_2$

→ $\frac{0.25}{\Delta t} = \pi \times (1 \times 10^{-2})^2 \times 11.7$

$\Delta t = 68\ s$

Q11) How much force (F_M in N) must the biceps muscle exert when a 5.0-kg mass is held in the hand with the forearm being in static equilibrium in a horizontal position as in the figure. Assume that the elbow joint, O, is 5 cm far from the point of application of F_M, and that the mass of forearm and hand together is 2.0 kg.

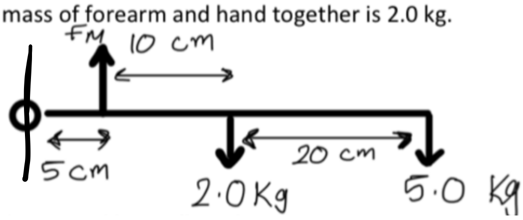
A) 800

B) 402

C) 100

D) 200

E) 50



$F_M (5 \times 10^{-2}) = (2 \times 9.8 \times 15 \times 10^{-2}) + (5 \times 9.8 \times 35 \times 10^{-2})$

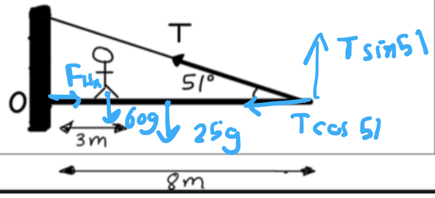
$F_M = 402\ N$

Q12) The figure shows a uniform, horizontal beam (length = 8 m, mass = 25 kg) that is pivoted to the wall by a hinge at point O, with its far end supported by a cable that makes an angle of 51° with the horizontal. If a person (mass = 60 kg) stands 3.0 m from the pivot, what is the horizontal component of the hinge force (in N) acting at point 0?

A) 380

B) 189

E) 278



$(60g)(3) + (25g)(4) = (T\sin 51)(8)$

$T = 441.35\ N$

Horizontal component $= T\cos 51° = 278\ N$

Q13) The kinetic energy of a car moving along a horizontal road is 130 kJ. The driver applies the breaks, and the car stops in 20 m. The force of friction (in N) (assumed constant) is:

A) 260000

B) 2600

C) 130000

D) 6500

E) 1300

- $KE = 130\ kJ$
- stopping distance = 20m
- $f = ?$

$W_{nc} = \Delta K$

$f \cdot (20)(-1) = 130 \times 10^3$

$f = -6.5 \times 10^3 = -6500\ N$

Q14) A 55-kg athlete climbs a 9 m long rope in 10s. His average power output (in W) is

A) 231

B) 485

C) 550

D) 90

E) 331

$m = 55\ kg,\ d = 9\ m,\ \Delta t = 10\ s$

$P = \frac{W}{t} = \frac{F_g \cdot d \cdot \cos 180}{t} = \frac{(55)(9.8)(9)}{10} = 485\ W$

Q15) A 4.0 kg mass is placed on a rough surface that makes an angle of 20° with the horizontal. If the mass is on the verge of motion, then the coefficient of static friction (μ_s) is

A) 0.36

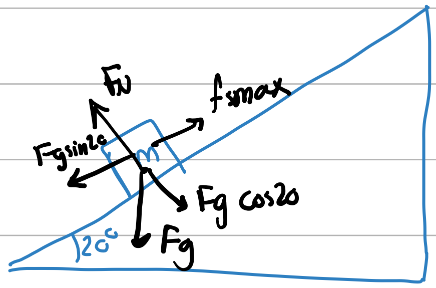
B) 0.94

C) 0.87

D) 0.11

E) 0.34

$m = 4\,kg$



$F_g \sin 20 + f_{smax} = 0$

$(4)(9.8)(\sin 20) = (\mu_s)(4)(9.8)(\cos 20)$

$\mu_s = 0.36$

Q16) A student moves 6 m along the positive x-direction, then he turns around and moves 9 m along the
negative x-direction. His average velocity (in m/s) over the 7.0 s total interval of motion is:

A) -3

B) 0.43

9 m (left)

6m (right)

$\Delta t = 7s$

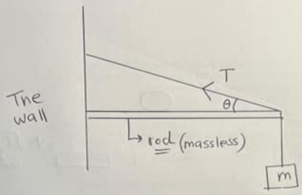
$\bar{v} = \frac{-3}{7} = -0.43$

final 022

1

(III) Assume a liter of milk typically has an activity of 2000 pCi due to $^{40}_{19}K$. If a person drinks two glasses (0.5 L) per day, estimate the total effective dose (in Sv and in rem) received in a year. As a crude model, assume the milk stays in the stomach 12 hr and is then released. Assume also that roughly 10% of the 1.5 MeV released per decay is absorbed by the body. Compare your result to the normal allowed dose of 100 mrem per year. Make your estimate for (*a*) a 60-kg adult, and (*b*) a 6-kg baby.

2



* which statement is correct?

a) at $\theta = 90° \rightarrow T = m\vec{g}$

b) at $\theta = 90° \rightarrow T = 0$

c) at $\theta = 0° \rightarrow T = m\vec{g}$

d) at $\theta = 0° \rightarrow T = 0$

e) at $\theta = 0° \rightarrow$ The force that the wall exerts on the rod equals to zero

Q1

1 L of milk → $2000 * 3.7 * 10^{10} * 10^{-12}$ decay per s

* a person drinks two glasses meaning (0.5 L) per day
* milk stays in stomach for <u>12 h</u> → 43200 s
* to find the total energy we need to find number of decays → time * decay per s

→ $2000 * 3.7 * 10^{10} * 10^{-12} * 43200$

$= 3196800$ → however this is for 1 L

for 0.5 L we just multiply by 0.5

no. decays for one day → 1598400

now energy per decay is → 1.5 Mev

tot energy per day → $1598400 * 1.5 * 1.6 * 10^{6} * 10^{-19}$

$= 3.83616 * 10^{-7}$

the body only absorbs around 10% of the tot released energy → $3.83616 * 10^{-7}$ J $* 0.1$

→ $3.83616 * 10^{-8}$ J per day

Now absorbed energy per year

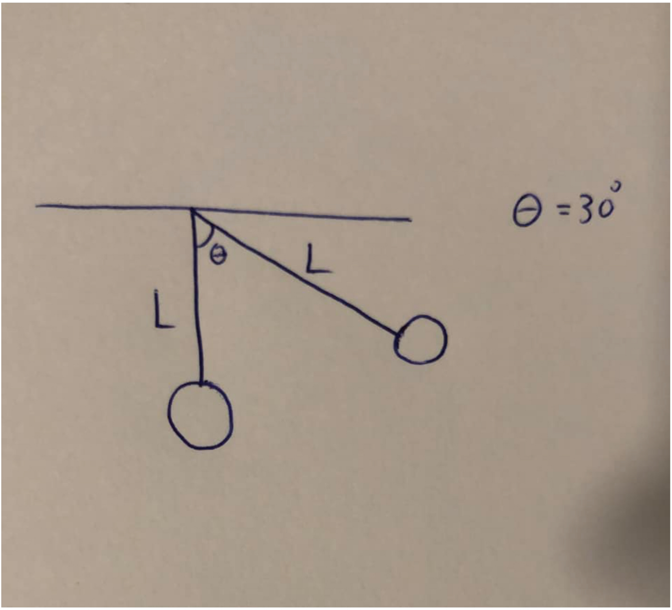
→ $3.83616 * 10^{-8} * 365 = 1.4 * 10^{-5}$ J

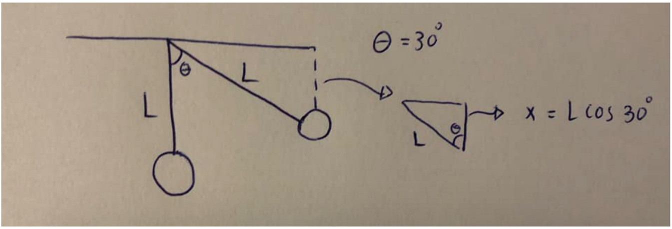
dose for adult $= \frac{1.4 * 10^{-5}}{60} = 2.33 * 10^{-7}$ SV/y or $2.33 * 10^{-2}$ mrem/y

" for child

$= \frac{1.4 * 10^{-5}}{6} = 2.33 * 10^{-6}$ SV/y or 0.233 mrem/y

3 . There was a question about a child on a swing with a mass of 25 kg. He started from rest and his speed reached 2 m/s. Request the loss of mechanical energy due to friction..





$$\Delta ME = \Delta K + \Delta U$$

$$= \frac{v_f^2 m}{2} - \underbrace{\frac{v_i^2 m}{2}}_{\text{zero}} + -mg(L - L\cos 30^\circ)$$

L=2.4m

4.. Avg pressure 1.33N/cm2 , The energy produced by the heart in 12 hours is sufficient to lift a body 15 m , The Mass of the body is 426 kg .
What is the Flow rate in Cm3/s..?

5) The figure displays a cylinder floating upright in water. The cylinder is half full of water. The volume of the cylinder is 640 ml, its diameter is 7.6 cm, and its mass when empty is 45 g. The length of the cylinder above the water level is d, as shown. Determine d (in cm). Hint: The density of water is 1000 kg/m3.

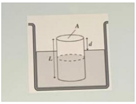
A) 3.77

B) 14.06

C) 5.08

D) 11.82

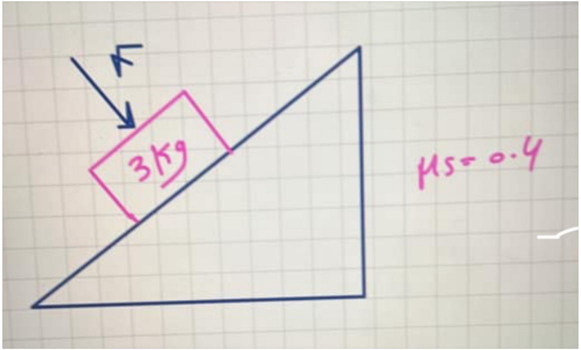
E) 6.06



6. Question about the central of mass .. A body in the shape of the letter L and given the values of x = 6 and x = 4, calculate the CM. The question did not give masses and the answers were in terms of m.

7. The speed of light in a medium is equal to 0.85, the speed of light in water, given the index of refraction of water 1.33. Calculate the index of refraction of this substance.

8. Calculate the value of F so that the body begins to move, knowing that these forces are perpendicular to it



final 023

1. **A 7279 m^3 balloon is filled with hot air with a density of 0.9447 kg/m^3. The surrounding air has a density of 1.25 kg/m^3. How much weight (in N) can the balloon hold (including the balloon skin)?**

   - **Answer:** To find the weight the balloon can hold, we calculate the buoyant force, which is the difference between the density of the surrounding air and the density of the hot air inside the balloon. The buoyant force is given by:

$$\text{Weight} = (\text{Density}_{\text{air, surrounding}} - \text{Density}_{\text{hot air}}) \times \text{Volume} \times g$$

$$= (1.25 - 0.9447)\,\text{kg/m}^3 \times 7279\,\text{m}^3 \times 9.81\,\text{m/s}^2$$

$$\approx 18431\,\text{N}$$

2. **The effective dose of alpha particles is 0.14 mSv. What is the absorbed dose? (RBE: 20)**

   - **Answer:** The absorbed dose can be calculated using the formula:

$$\text{Absorbed Dose} = \frac{\text{Effective Dose}}{\text{RBE}}$$

$$= \frac{0.14\,\text{mSv}}{20}$$

$$= 0.007\,\text{mSv} = 7\,\text{mGy}$$

3. **An iodine isotope has a half-life of 8.04 days. A sample for treatment had an activity of 5 mCi before shipment, and when received, it had an activity of 2.1 mCi. What is the time interval (in days) between shipment and receipt?**

- **Answer:** Using the decay formula:

$$\text{Activity} = \text{Activity}_0 \times e^{-\lambda t}$$

where λ is the decay constant:

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

Rearranging to solve for t:

$$t = \frac{\ln(\frac{\text{Activity}_0}{\text{Activity}})}{\lambda}$$

$$= \frac{\ln(\frac{5}{2.1})}{\frac{\ln(2)}{8.04}}$$

$$\approx 101 \text{ days}$$

4. **A diverging lens with focal length f has an object placed at $3f$ from the lens. What is d_i (the image distance)?**

- **Answer:** For a diverging lens, the lens equation is:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

where $d_o = 3f$:

$$\frac{1}{f} = \frac{1}{3f} + \frac{1}{d_i}$$

Solving for d_i:

$$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{3f} = \frac{2}{3f}$$

$$d_i = -\frac{3f}{2}$$

$$= -\frac{3}{4}f$$

5. **A water tank open to the atmosphere has a hole 21 m below the water level. The hole's area is $10^{-4}\ \mathrm{m}^2$. What is the volume flow rate?**

   - **Answer:** Using Torricelli's theorem:

$$v = \sqrt{2gh}$$

   where $h = 21\ \mathrm{m}$ and $g = 9.81\ \mathrm{m/s}^2$:

$$v = \sqrt{2 \times 9.81 \times 21} \approx 20.5\ \mathrm{m/s}$$

   The volume flow rate Q is:

$$Q = A \times v = 10^{-4}\ \mathrm{m}^2 \times 20.5\ \mathrm{m/s} \approx 2.05 \times 10^{-3}\ \mathrm{m}^3/\mathrm{s}$$

$$\approx 1.5 \times 10^{-3}\ \mathrm{m}^3/\mathrm{s}$$

6. **A converging lens with a power of 10 diopters. If the object distance d_o is 8 cm, what is d_i (the image distance)?**

   - **Answer:** The power P is related to the focal length f by:

$$P = \frac{1}{f}$$

   Thus, $f = \frac{1}{10}\ \mathrm{m} = 0.1\ \mathrm{m} = 10\ \mathrm{cm}$. Using the lens equation:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{10} = \frac{1}{8} + \frac{1}{d_i}$$

   Solving for d_i:

$$\frac{1}{d_i} = \frac{1}{10} - \frac{1}{8} = \frac{-1}{40}$$

$$d_i = -40\ \mathrm{cm}$$

7. **A box with a mass of 3 kg is on a 35-degree incline with a static friction coefficient of 0.4. What is the minimum applied force perpendicular to the incline needed to prevent the box from sliding?**

- **Answer:** To prevent sliding, the applied force must counteract the component of gravitational force parallel to the incline. The normal force N on the incline is:

  $$N = mg\cos\theta$$

  The frictional force F_f is:

  $$F_f = \mu N = \mu mg\cos\theta$$

  The component of gravitational force parallel to the incline is:

  $$F_{\text{parallel}} = mg\sin\theta$$

  Setting $F_f = F_{\text{parallel}}$:

  $$\mu mg\cos\theta = mg\sin\theta$$

  Solving for the applied force perpendicular to the incline:

  $$F_{\text{applied}} = F_{\text{parallel}} - \mu N$$

  $$F_{\text{applied}} = mg(\sin\theta - \mu\cos\theta)$$

10. **For a material with $R = 6 \times 10^{11}$ and $N = 2 \times 10^{15}$ atoms, what is the half-life (in minutes)?**

- **Answer:** The half-life $T_{1/2}$ can be calculated using:

$$T_{1/2} = \frac{\ln 2}{\lambda}$$

where $\lambda = \frac{R}{N}$:

$$\lambda = \frac{6 \times 10^{11}}{2 \times 10^{15}} \approx 3 \times 10^{-4}\ \mathrm{s}^{-1}$$

$$T_{1/2} = \frac{\ln 2}{3 \times 10^{-4}} \approx 2315\ \mathrm{s} \approx 38.5\ \mathrm{min}$$

11. **A question involving the application of Torricelli's theorem to find the volume flow rate: The equation $v = \sqrt{2gh}$ must be used to find the velocity of the liquid exiting the small opening. Then the velocity must be multiplied by the cross-sectional area (given) to find the volume flow rate.**

- **Answer:** Apply Torricelli's theorem:

$$v = \sqrt{2gh}$$

The volume flow rate Q is:

$$Q = A \times v$$

12. **The speed of light in a medium is 82% of the speed of light in water. Given that the refractive index of water is 1.33, what is the refractive index of that medium?**

- **Answer:** The refractive index n is given by:

$$n = \frac{c_{\text{water}}}{c_{\text{medium}}}$$

where $c_{\text{medium}} = 0.82 \times c_{\text{water}}$:

$$n = \frac{1.33}{0.82} \approx 1.62$$

13. **A converging lens with a power of 1 diopter. If the object was placed 30 cm away from the lens, how far was the image from the lens?**

- **Answer:** The power P is related to the focal length f by:

$$P = \frac{1}{f}$$

Thus, $f = \frac{1}{1}\ \text{m} = 1\ \text{m} = 100\ \text{cm}$. Using the lens equation:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{100} = \frac{1}{30} + \frac{1}{d_i}$$

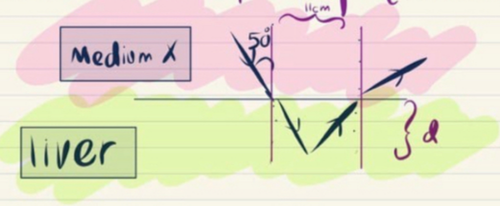
Solving for d_i:

$$\frac{1}{d_i} = \frac{1}{100} - \frac{1}{30} = \frac{-7}{300}$$

$$d_i \approx -40\ \text{cm}$$

Q14

Q) Ray of light passes from Medium X into the liver.
The speed of light in the liver gets reduced by 10%
what is the depth of the liver (d)?

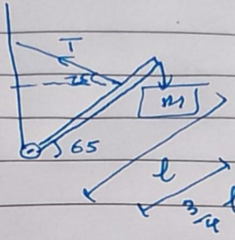


Q15

-What is horsepower?

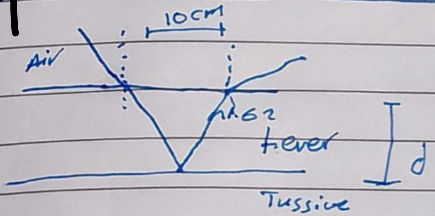
Ans: the rate which an object can do work

Q16



the wight of the load is 1400 N and a object wight 2000 N what is the magnitude of tension force?

Q17

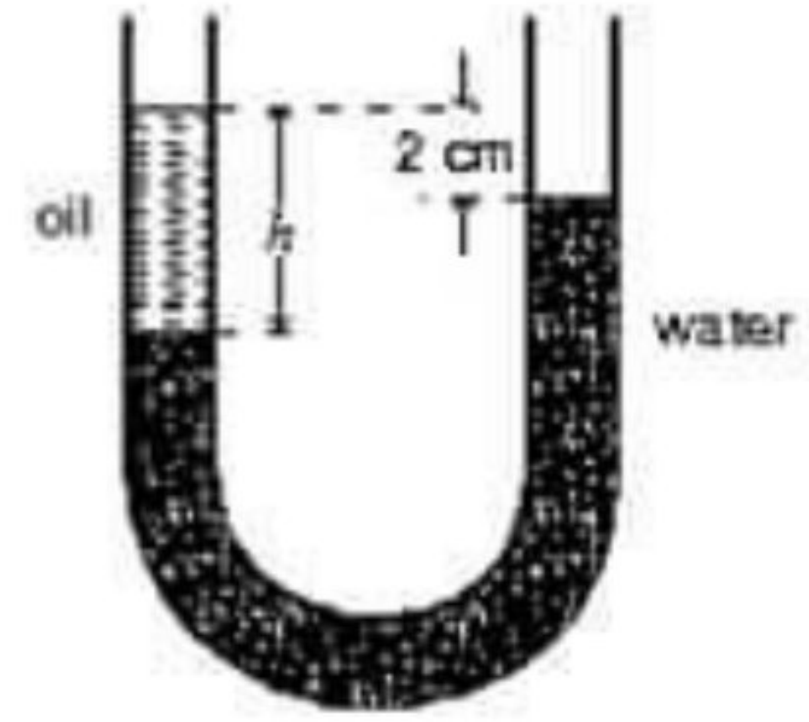


what is the magnitude of (d)?

The University Of Jordan **Faculty of Science**

Department Of Physics

1) The density of water is 1.0 g/cm^3. If $h = 20$ cm, the density of the oil in the left column of the U-tube shown below is:



A) 0.20 g/cm^3
B) 0.90 g/cm^3
C) 1.0 g/cm^3
D) 1.3 g/cm^3
E) 5.0 g/cm^3

2) One piston in a hydraulic lift has an area that is twice the area of the other. When the pressure at the smaller piston is increased by Δp the pressure at the larger piston:
A) increases by $2\Delta p$
B) increases by $\Delta p/2$
C) increases by Δp
D) increases by $4\Delta p$
E) does not change

3) A boat floating in fresh water displaces 16,000 N of water. How many newtons of salt water would it displace if it floats in salt water of specific gravity 1.10?
A) 12,800 N
B) 14,400 N
C) 16,000 N
D) 17,600 N
E) 19,200 N

4) An object hangs from a spring balance. The balance indicates 30 N in air, 20 N when the object is submerged in water. What does the balance indicate when the object is submerged in liquid with a density that is half of water?
A) 20 N
B) 25 N
C) 30 N
D) 35 N
E) 40 N

5) The dimensions of a wooden raft (density = 150 kg/m^3) are 3.0 m × 3.0 m × 1.0 m. What maximum load can it carry in sea water (density =1020 kg/m^3)?

A) 1350 kg7830 kg
B) 9200 kg
D) 19,500 kg
E) 24,300 kg

6) A lawn sprinkler is made of a 1.0 cm diameter garden hose with one end closed and 25 holes, each with a diameter of 0.050 cm, cut near the closed end. If water flows at 2.0 m/s in the hose, the speed of the water leaving a hole is:

A) 2.0 m/s
B) 32 m/s
C) 40 m/s
D) 600 m/s
E) 800 m/s

7) Water is streaming downward from a faucet opening with an area of 3.0×10^{-5} m^2. It leaves the faucet with a speed of 5.0 m/s. The cross sectional area of the stream 0.50 m below the faucet is:

A) 1.5×10^{-5} m^2
B) 2.0×10^{-5} m^2
C) 2.5×10^{-5} m^2
D) 3.0×10^{-5} m^2
E) 3.5×10^{-5} m^2

8) A fluid of density 9.1×10^2 kg/m^3 is flowing through a tube at a speed of 5.3 m/s. What is the kinetic energy density of the fluid?

A) cannot be calculated without knowing the pressure
B) cannot be calculated without knowing the elevation
C) 4.8×10^3 J/m^3
D) 1.3×10^4 J/m^3
E) 2.5×10^6 J/m^3

9) Water (density = 1.0×10^3 kg/m^3) flows downhill through a pipe of diameter 1.5 cm. Its speed at the top of the hill is 7.2 m/s. If the hill is 9.5 m high, what is the gravitational potential energy density of the water at the top of the hill relative to the bottom?

A) cannot be calculated without knowing the pressure
B) 120 J/m^3
C) 7.2 x 10^3 J/m^3
D) 9.5 x 10^3 J/m^3
E) 9.3 x 10^4 J/m^3

10) Water (density = 1.0×10^3 kg/m^3) flows through a horizontal tapered pipe. At the wide end its speed is 4.0 m/s. The difference in pressure between the two ends is 4.5 $\times 10^3$ Pa. The speed of the water at the narrow end is:
A) 2.6 m/s

B) 3.2 m/s
C) 4.0 m/s
D) 4.5 m/s
E) 5.0 m/s

11) A large tank filled with water has two holes in the bottom, one with twice the radius of the other. In steady flow the speed of water leaving the larger hole is__________the speed of the water leaving the smaller.
A) twice
B) four times
C) half
D) one-fourth
E) the same as

12) Some species of whales can dive to depths of one kilometer. What is the total pressure they experience at this depth? (ρ_{sea} = 1 020 kg/m^3 and 1.01×10^5 N/m^2 = 1 ATM.)
a. 9.00 ATM
b. 90.0 ATM
c. 100 ATM
d. 111 ATM
e. 130 ATM

13) Water is flowing at 4.0 m/s in a circular pipe. If the diameter of the pipe decreases to 1/2 its former value, what is the velocity of the water downstream?
a. 1.0 m/s
b. 2.0 m/s
c. 8.0 m/s
d. 16 m/s
e. 4.0 m/s

14) What is the net force inward acting on a spherical bathysphere of diameter 2.00 m at an ocean depth of 1 000 m? (The pressure inside the bathysphere is, hopefully, 1 ATM.) $\rho_{(sea\ water)} = 1.02 \times 10^3$ kg/m^3.
a. 1.26×10^4 N
b. 1.26×10^6 N
c. 1.26×10^8 N
d. 1.26×10^{10} N
e. 1.26×10^2 N

15) How much power is theoretically available from a mass flow of 1 000 kg/s of water when it falls a vertical distance of 100 meters?

a. 980 kW
b. 98 kW
c. 4 900 W
d. 980 W

e. 9 600 W

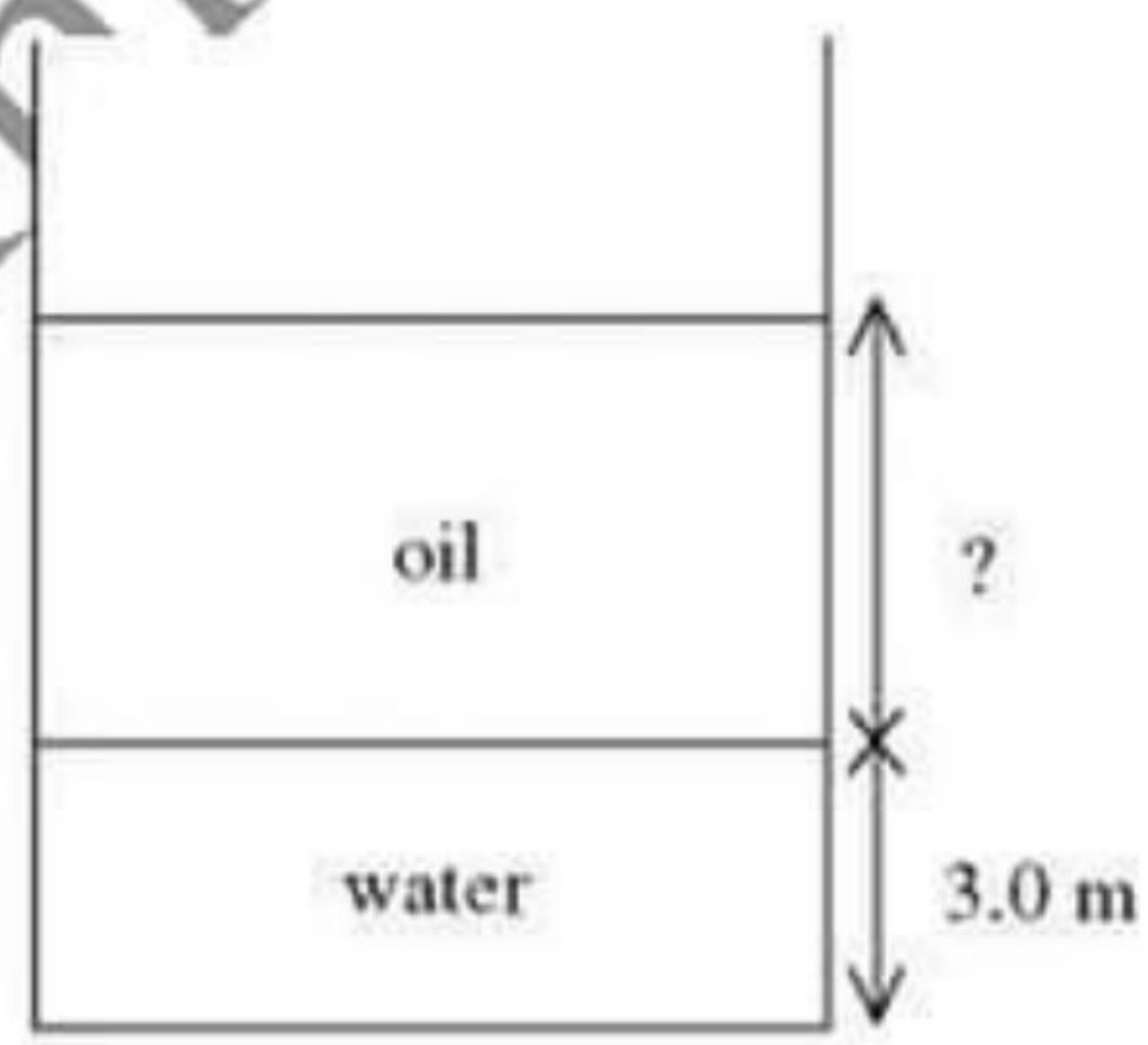
16) A cubical box, 5.00 cm on each side, is immersed in a fluid. The gauge pressure at the top surface of the box is 594 Pa and the gauge pressure on the bottom surface is 1133 Pa. What is the density of the fluid?

A) 1000 kg/m^3
B) 1100 kg/m^3
C) 1220 kg/m^3
D) 2340 kg/m^3
E) 12,000 kg/m^3

17) The weight of a car of mass 1.20×10^3 kg is supported equally by the four tires, which are inflated to the same gauge pressure. What gauge pressure in the tires is required so the area of contact of each tire with the road is 1.00×10^2 cm^2? (1 atm = 1.01×10^5 Pa.)

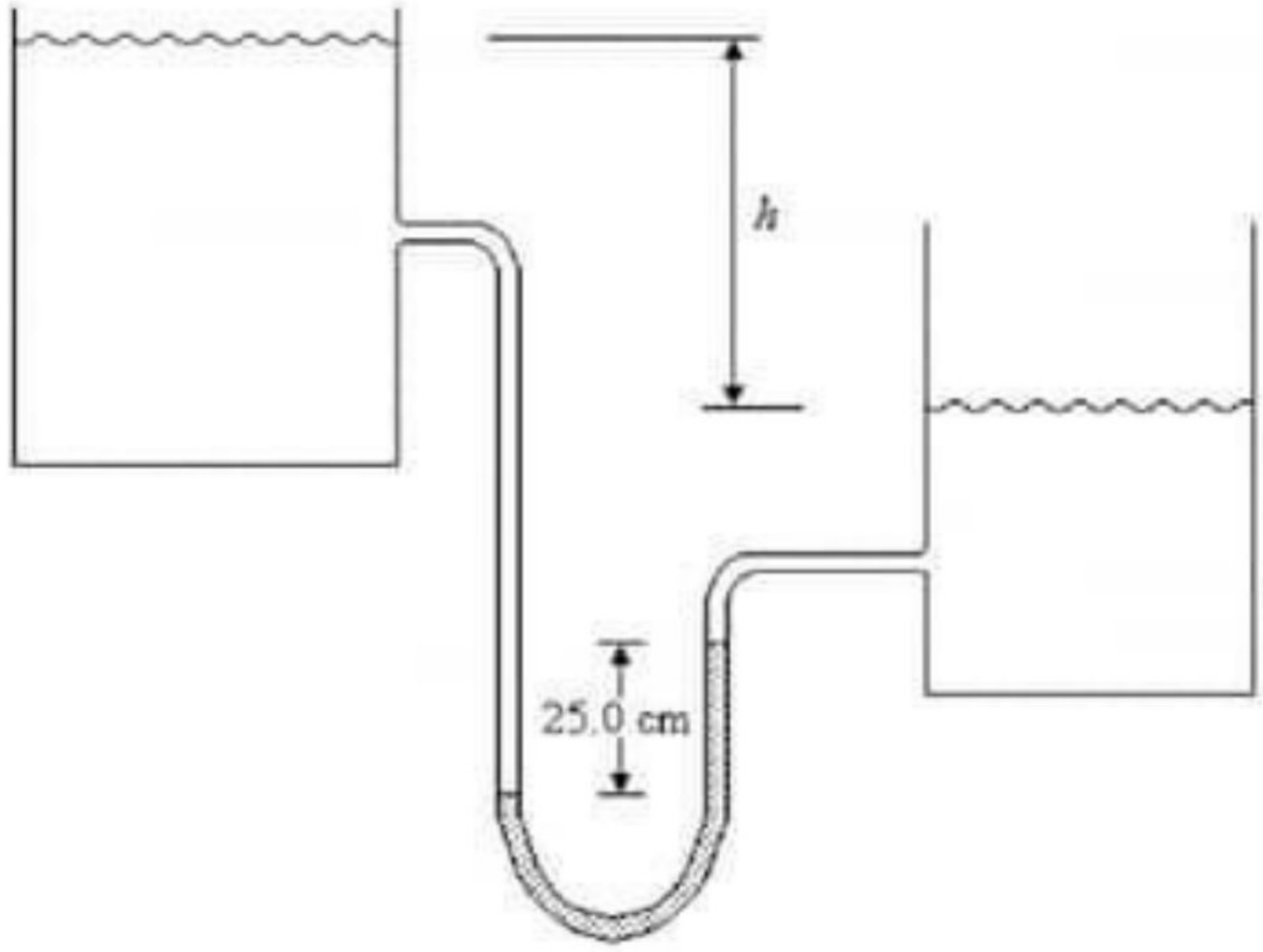
A) 11.6×10^5 Pa
B) 11.6×10^4 Pa
C) 2.94×10^5 Pa
D) 2.94×10^4 Pa
E) 2.94×10^3 Pa

18) In the figure, an open tank contains a layer of oil floating on top of a layer of water (of density 1000 kg/m^3) that is 3.0 m thick, as shown. What must be the thickness of the oil layer if the gauge pressure at the bottom of the tank is to be 5.0×10^4 Pa? The density of the oil is 510 kg/m^3.



Answer: 4.12 m

19) The two water reservoirs shown in the figure are open to the atmosphere, and the water has density 1000 kg/m^3. The manometer contains incompressible mercury with a density of 13,600 kg/m^3. What is the difference in elevation h if the manometer reading m is 25.0 cm?



A) 1.58 m
B) 4.20 m
C) 3.75 m
D) 3.40 m
E) 3.15 m

20) A board that is 20.0 cm wide, 5.00 cm thick, and 3.00 m long has a density 350 kg/m^3. The board is floating partially submerged in water of density 1000 kg/m^3. What fraction of the volume of the board is above the surface of the water?
A) 0.350
B) 0.650
C) zero
D) 0.200
E) The answer depends on which edge of the board is vertical.

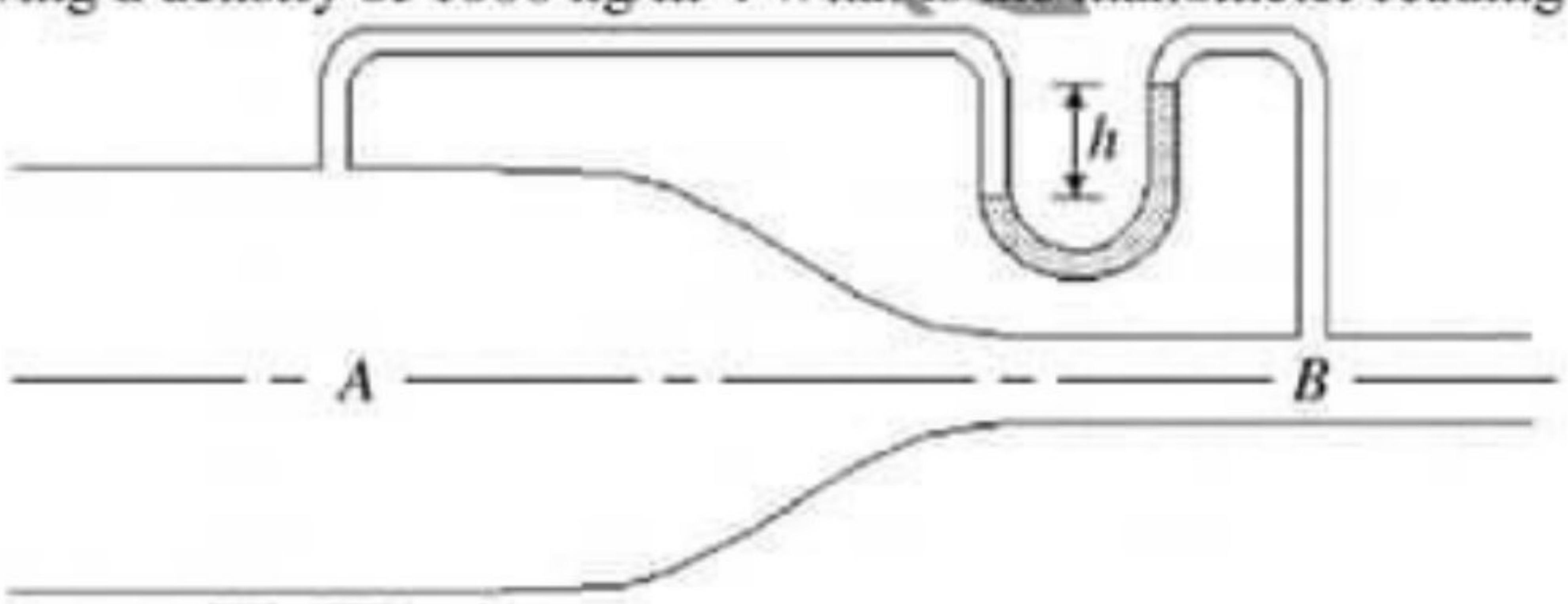
21) A person who weighs 550 N empties her lungs as much as possible and is then completely immersed in water (of density 1000 kg/m^3) while suspended from a harness. Her apparent weight is now 21.2 N. What is her density?
A) 1050 kg/m^3
B) 1040 kg/m^3
C) 1030 kg/m^3
D) 960 kg/m^3
E) 56.1 kg/m^3

22) A 7.8-kg solid sphere, made of metal whose density is 2500 kg/m^3, is suspended by a cord. When the sphere is immersed in water (of density 1000 kg/m^3), what is the

tension in the cord?
A) 46 N
B) 61 N
C) 76 N
D) 92 N
E) 110 N

23) Water flowing through a pipe suddenly comes to a section of pipe where the pipe diameter decreases to 86% of its previous value. If the speed of the water in the larger section of the pipe was 36m/s, what is its speed in this smaller section?
A) 49 m/s
B) 42 m/s
C) 31 m/s
D) 27 m/s

24) Water flows in the horizontal pipe shown in the figure. At point *A* the area is 25.0 cm^2 and the speed of the water is 2.00 m/s. At *B* the area is 16.0 cm^2. The fluid in the manometer is mercury, which has a density of 13,600 kg/m^3. We can treat water as an ideal fluid having a density of 1000 kg/m^3. What is the manometer reading *h*?



A) 0.546 cm
B) 1.31 cm
C) 2.81 cm
D) 2.16 cm
E) 3.36 cm

The University Of Jordan

Faculty of Science

Department Of Physics

1) A 100-kg box rolls down a 20° incline. A man tries to keep it from accelerating, and manages to keep its acceleration to 1.2 m/s^2. If the box rolls 5 m, what is the net work done on it by all the forces acting on it?
A) 60 J
B) 100 J
C) 600 J
D) 1000 J
E) 4900 J

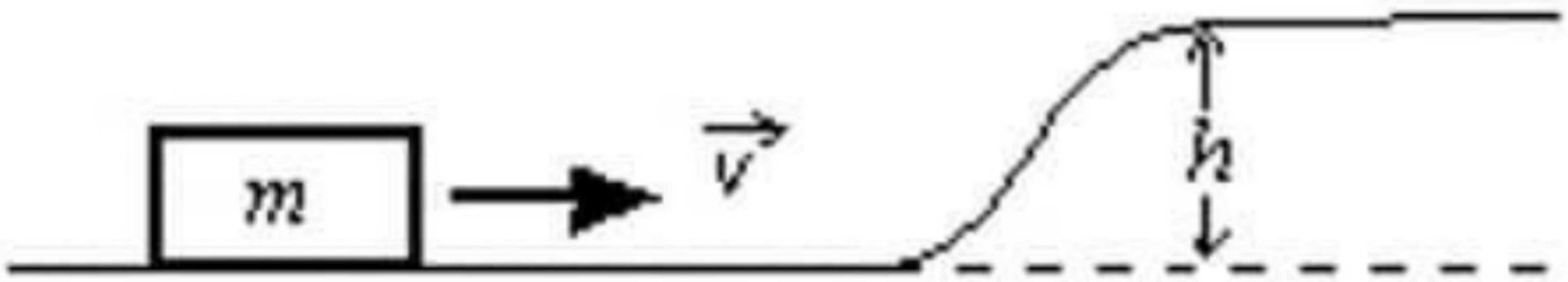
2) Two objects with masses, m_1 and m_2, have the same kinetic energy and are both moving to the right. The same constant force $\vec{F}$ is applied to the left to both masses. If m_1 = $4m_2$, the ratio of the stopping distance of m_1 to that of m_2 is: A) 1:4
B) 4:1
C) 1:2
D) 2:1
E) 1:1

3) A 4-kg cart starts up an incline with a speed of 3 m/s and comes to rest 2 m up the incline. The total work done on the cart is:
A) –6 J
B) –8 J
C) –12 J
D) –18 J
E) impossible to calculate without knowing the coefficient of kinetic friction

4) A 50-N force is the only force acting on a 2-kg crate that starts from rest. When the force has been acting for 2 s the rate at which it is doing work is:
A) 100 W
B) 1000 W
C) 2500 W
D) 5000 W
E) 63000 W

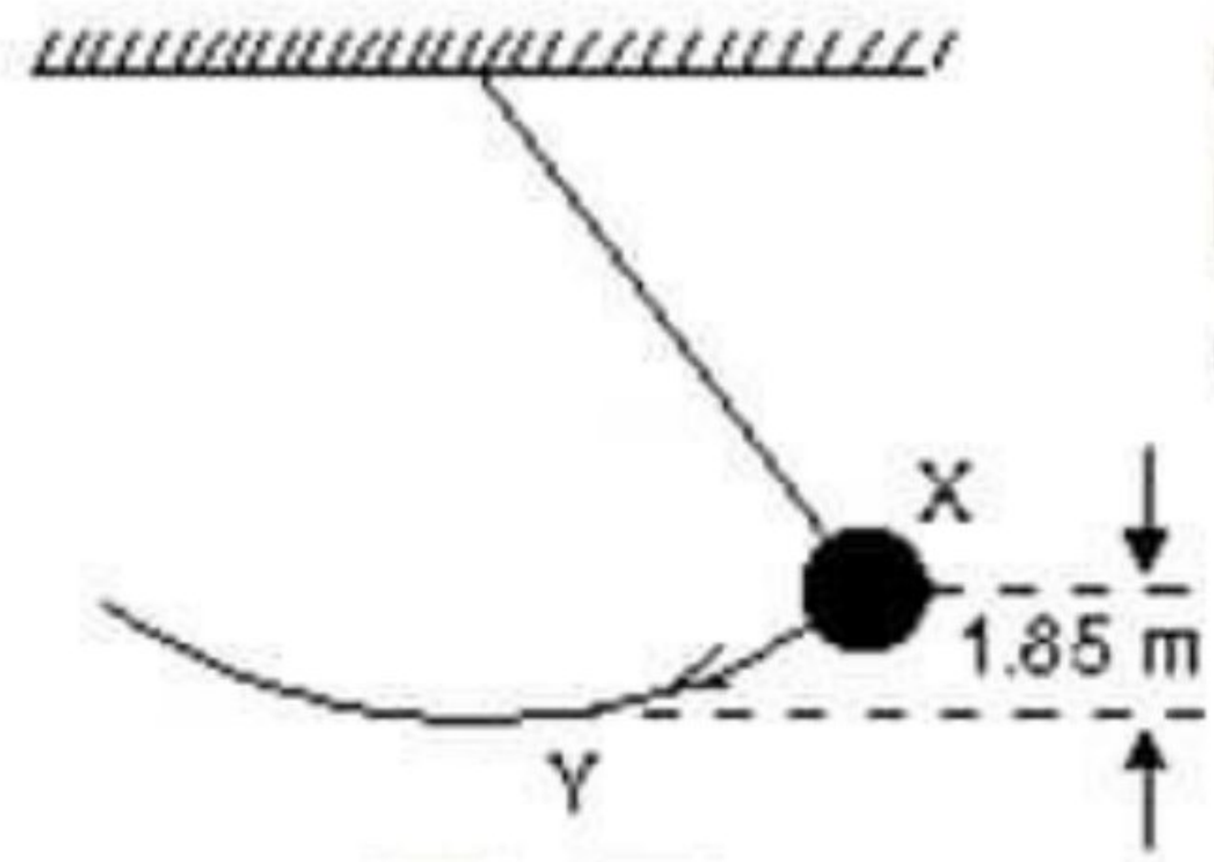
5) A 6.0-kg block is released from rest 80 m above the ground. When it has fallen 60 m its kinetic energy is approximately:
A) 4700 J
B) 3500 J
C) 1200 J
D) 120 J
E) 60 J

6) For a block of mass *m* to slide without friction up the rise of height *h* shown, it must have a minimum initial kinetic energy of:



A) *gh*
B) *mgh*
C) *gh*/2
D) *mgh*/2
E) 2*mgh*

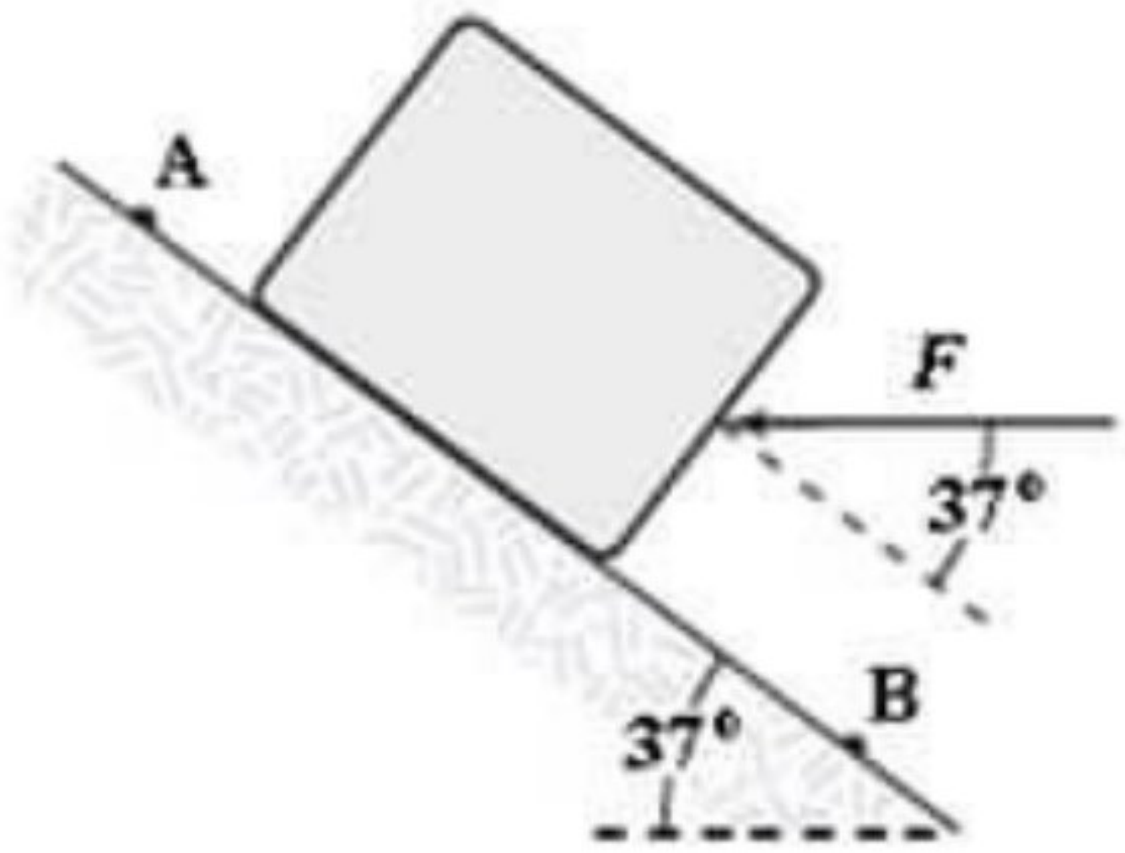
7) A simple pendulum consists of a 2.0 kg mass attached to a string. It is released from rest at X as shown. Its speed at the lowest point Y is:



A) 1.9 m/s
B) 3.7 m/s
C) 4.4 m/s
D) 6.0 m/s
E) 36 m/s

8) A 2.2-kg block starts from rest on a rough inclined plane that makes an angle of 25° with the horizontal. The coefficient of kinetic friction is 0.25. As the block goes 2.0 m down the plane, the mechanical energy of the whole system changes by:
A) 0 J
B) –9.8 J
C) 9.8 J
D) –18 J
E) 18 J

12) A 4.0-kg block is lowered down a 37° incline a distance of 5.0 m from point A to point B. A horizontal force (F = 10 N) is applied to the block between A and B as shown in the figure. The kinetic energy of the block at A is 10 J and at B it is 20 J. How much work is done on the block by the force of friction between A and B?

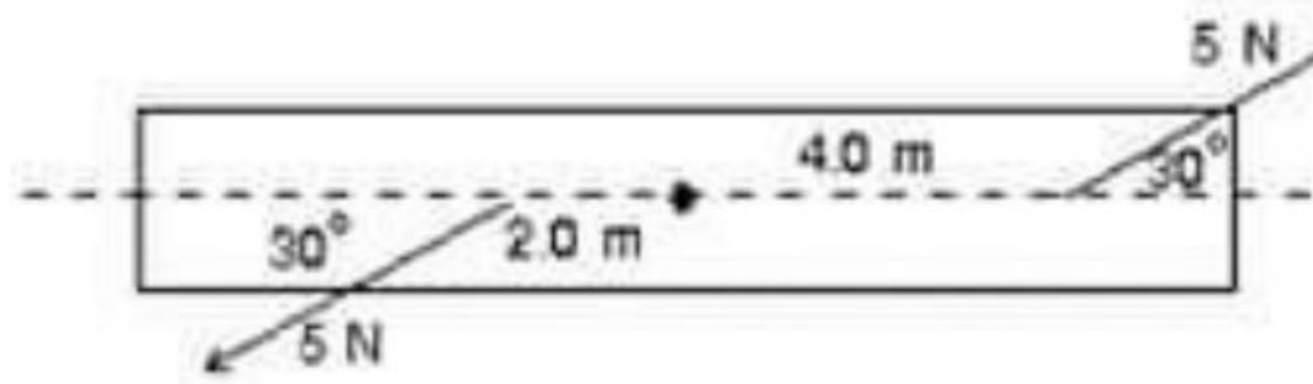


a. −58 J
b. −53 J
c. −68 J
d. −63 J
e. −47 J

13) A 0.60-kg object is suspended from the ceiling at the end of a 2.0-m string. When pulled to the side and released, it has a speed of 4.0 m/s at the lowest point of its path. What maximum angle does the string make with the vertical as the object swings up?
a. 61°
b. 54°
c. 69°
d. 77°
e. 47°

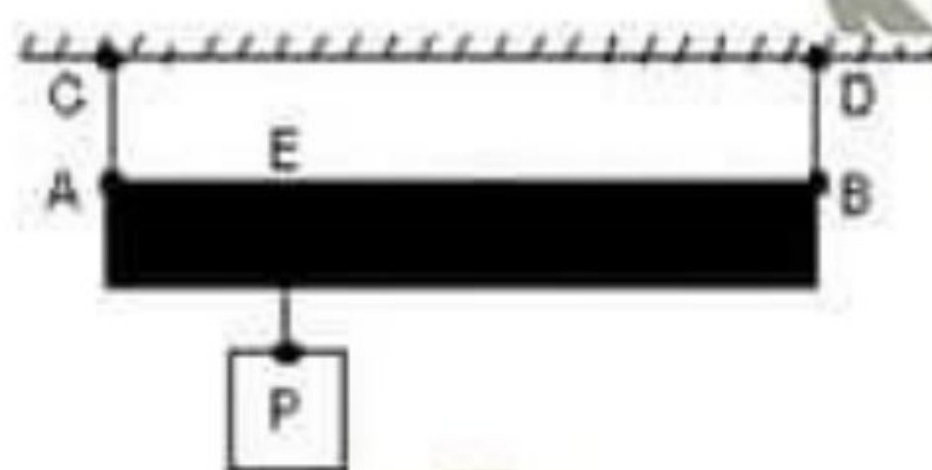
14) A 2.0-kg mass swings at the end of a light string (length = 3.0 m). Its speed at the lowest point on its circular path is 6.0 m/s. What is its kinetic energy at an instant when the string makes an angle of 50° with the vertical?
a. 21 J
b. 15 J
c. 28 J
d. 36 J
e. 23 J

9) A rod is pivoted about its center. A 5-N force is applied 4 m from the pivot and another 5-N force is applied 2 m from the pivot, as shown. The magnitude of the total torque about the pivot is:



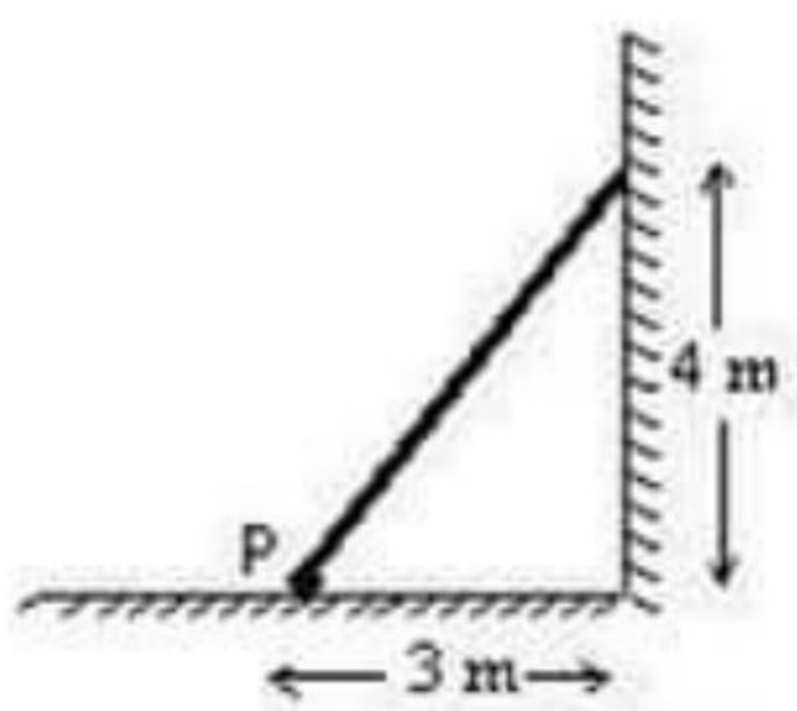
A) 0 N·m
B) 5.0 N·m
C) 8.7 N·m
D) 15 N·m
E) 26 N·m

10) A uniform rod AB is 1.2 m long and weighs 16 N. It is suspended by strings AC and BD as shown. A block P weighing 96 N is attached at E, 0.30 m from A. The magnitude of the tension force in the string BD is:



A) 8.0 N
B) 24 N
C) 32 N
D) 48 N
E) 80 N

11) An 80-N uniform rod leans against a frictionless wall as shown. The torque (about point P) applied to the rod by the wall is:



A) 40 N·m
B) 60 N·m
C) 120 N·m
D) 160 N·m
E) 240 N·m

15) The same force F is applied horizontally to bodies 1, 2, 3 and 4, of masses m, $2m$, $3m$ and $4m$, initially at rest and on a frictionless surface, until each body has traveled distance d. The correct listing of the magnitudes of the velocities of the bodies, v_1, v_2, v_3, and v_4 is

a. $v_4 = \sqrt{\frac{4}{3}}v_3 = \sqrt{\frac{3}{2}}v_2 = 2v_1.$

b. $v_4 = v_2 > v_3 = v_1.$

c. $v_1 = \sqrt{2}v_2 = \sqrt{3}v_3 = 2v_4.$

d. $v_1 = 2v_2 = 3v_3 = 4v_4.$

e. $v_4 = \frac{3}{4}v_3 = \frac{2}{3}v_2 = \frac{1}{2}v_1.$

16) A 3.0-kg block is on a frictionless horizontal surface. The block is at rest when, at $t = 0$, a force (magnitude $P = 2.0$ N) acting at an angle of 22° above the horizontal is applied to the block. At what rate is the force P doing work at $t = 2.0$ s?

a. 2.3 W
b. 2.0 W
c. 1.4 W
d. 1.7 W
e. 1.2 W

17) A 3.0-kg block is on a horizontal surface. The block is at rest when, at $t = 0$, a force (magnitude $P = 12$ N) acting parallel to the surface is applied to the block causing it to accelerate. The coefficient of kinetic friction between the block and the surface is 0.20. At what rate is the force P doing work on the block at $t = 2.0$ s?

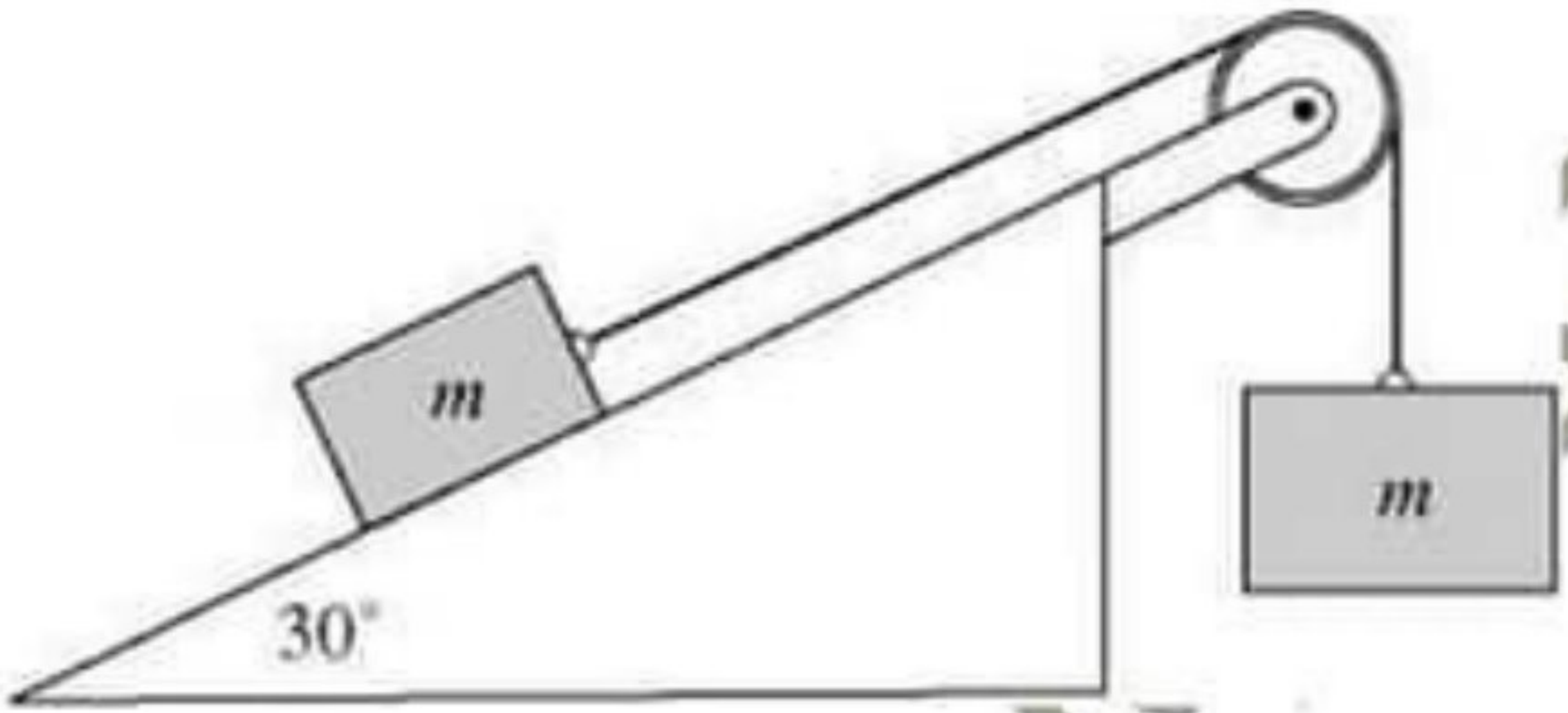
a. 54 W
b. 49 W
c. 44 W
d. 59 W
e. 24 W

18) A crane lifts a 425 kg steel beam vertically a distance of 117 m. How much work does the crane do on the beam if the beam accelerates upward at 1.8 m/s^2 ? Neglect frictional forces.

A) 5.8×10^5 J
B) 3.4×10^5 J
C) 4.0×10^5 J
D) 4.9×10^5 J

19) A 1000.0 kg car is moving at 15 km/h. If a 2000.0 kg truck has 18 times the kinetic energy of the car, how fast is the truck moving?
A) 45 km/h
B) 63 km/h
C) 54 km/h
D) 36 km/h

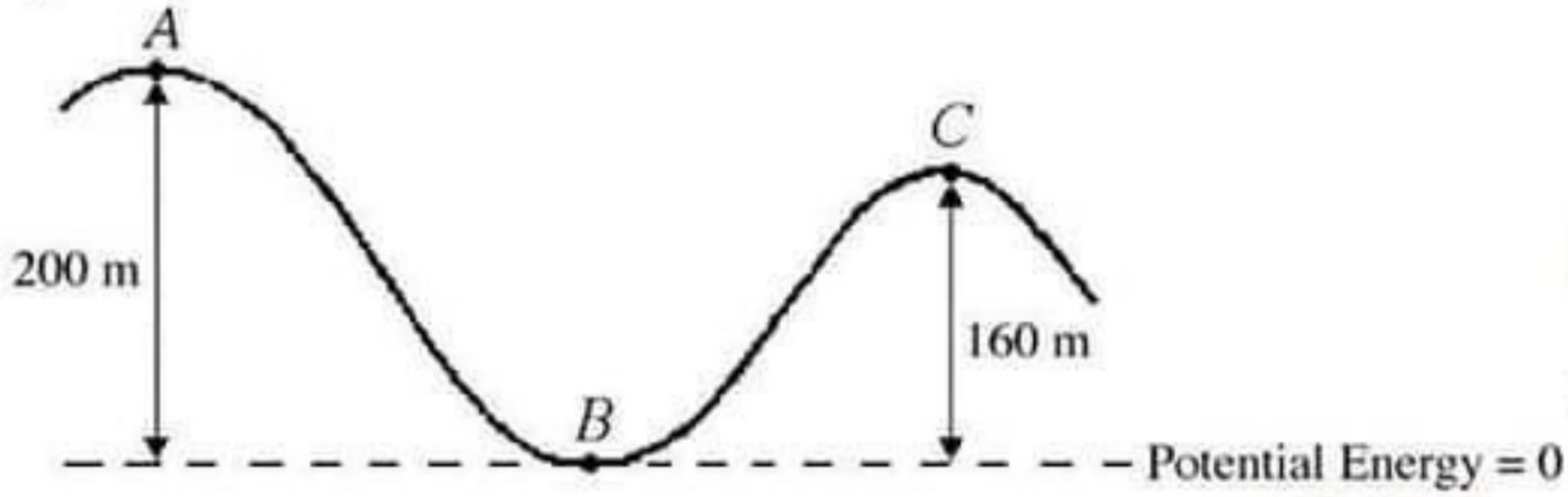
20) In the figure, two boxes, each of mass 24 kg, are at rest and connected as shown. The coefficient of kinetic friction between the inclined surface and the box is 0.31. Find the speed of the boxes just after they have moved 1.6 m. Answer: 1.91 m/s



21) A car needs to generate 75.0 hp in order to maintain a constant velocity of 27.3 m/s on a flat road. What is the magnitude of the total resistive force acting on the car (due to friction, air resistance, etc.)? (1 hp = 746 W)
A) 2.05×10^3 N
B) 2.75 N
C) 1.03×10^3 N
D) 2.87×10^3 N

22) How long will it take a 7.08 hp motor to lift a 250 kg beam directly upward at constant velocity from the ground to a height of 45.0 m? Assume frictional forces are negligible. (1 hp = 746 W)
A) 20.9 s
B) 1.56×10^4 s
C) 2.18×10^4 s
D) 39.7 s

23) A roller coaster of mass 80.0 kg is moving with a speed of 20.0 m/s at position *A* as shown in the figure. The vertical height above ground level at position *A* is 200 m. Neglect friction.

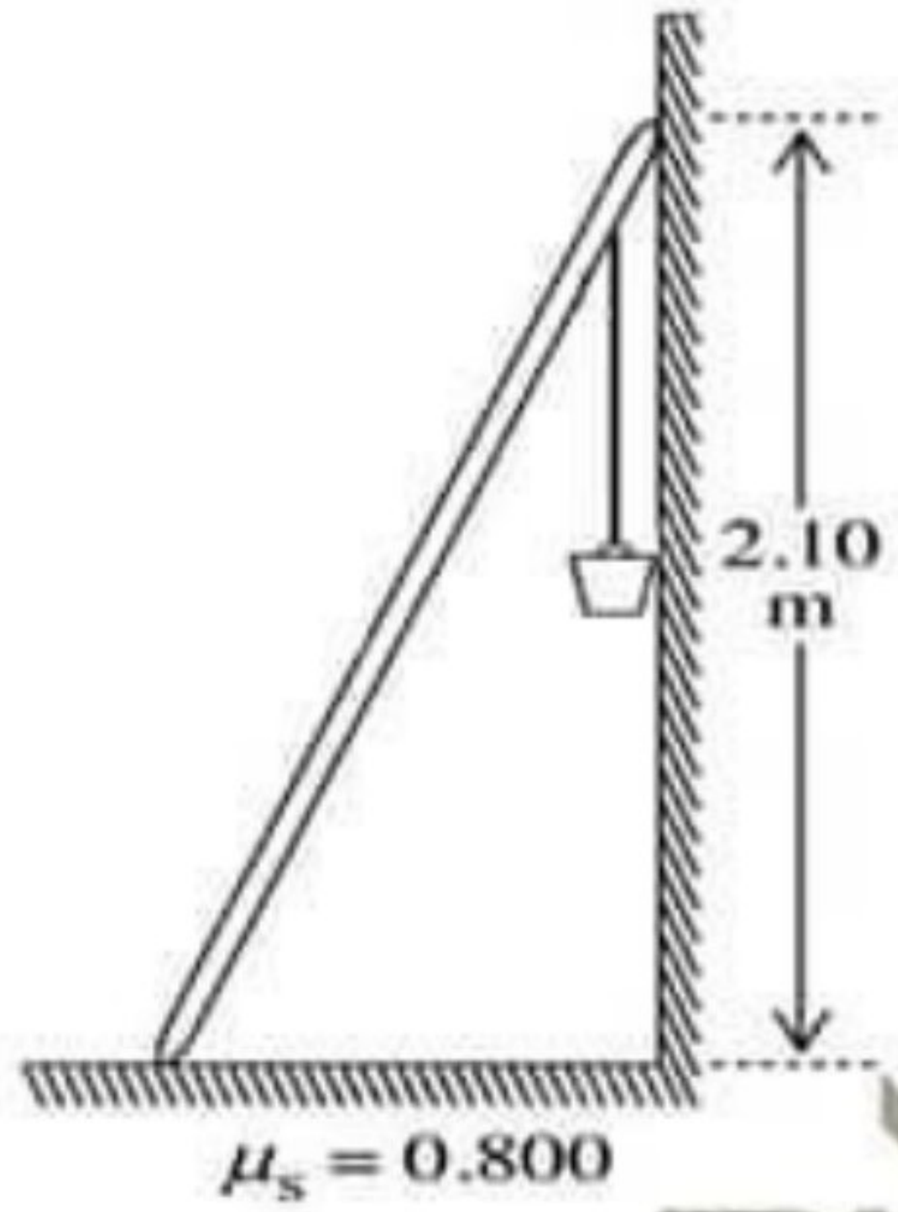


(a) What is the total mechanical energy of the roller coaster at point B?
Answer: 1.73×10^5 J
(b) What is the speed of the roller coaster at point *C*?
Answer: 34.4 m/s

24) In the figure, a block of mass *m* is moving along the horizontal frictionless surface with a speed of 5.70 m/s. If the slope is 11.0° and the coefficient of kinetic friction between the block and the incline is 0.260, how far does the block travel up the incline?

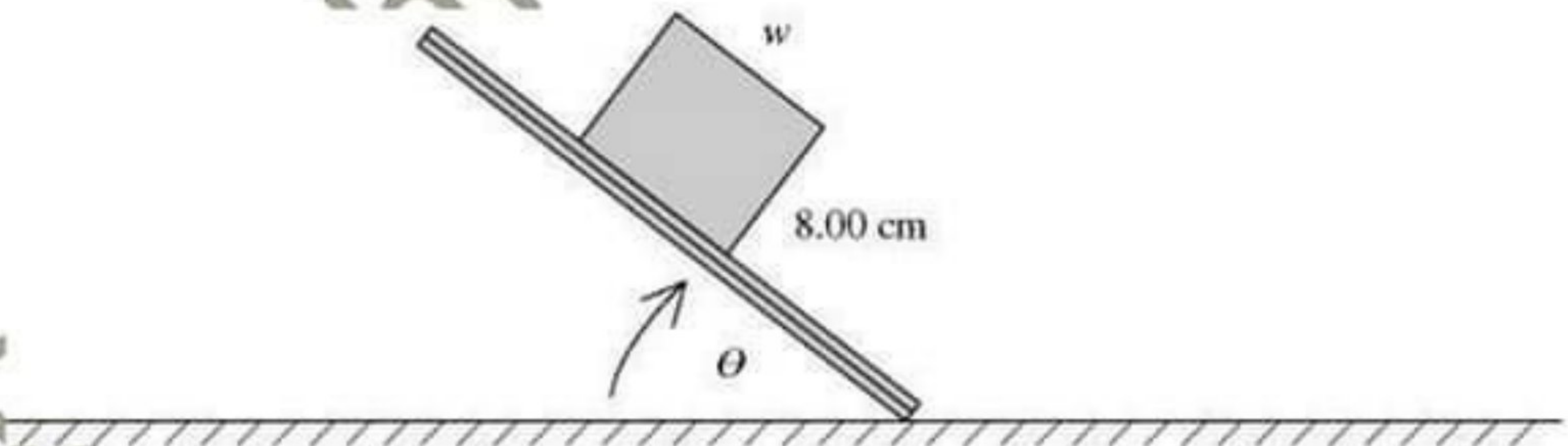
Answer: 3.72 m

25) A 10.0-kg uniform ladder that is 2.50 m long is placed against a smooth vertical wall and reaches to a height of 2.10 m, as shown in the figure. The base of the ladder rests on a rough horizontal floor whose coefficient of static friction with the ladder is 0.800. An 80.0-kg bucket of concrete is suspended from the top rung of the ladder, right next to the wall, as shown in the figure. What is the magnitude of the friction force that the floor exerts on the ladder?



A) 538 N
B) 706 N
C) 1290 N
D) 833 N
E) 601 N

26) A solid uniform brick is placed on a sheet of wood. When one end of the sheet is raised (see figure), you observe that the maximum that the angle θ can be without tipping over the brick is 49.6°. There is enough friction to prevent the brick from sliding. What is the width w of the brick?



A) 5.18 cm
B) 6.09 cm
C) 6.81 cm
D) 9.40 cm
E) 10.5 cm

Physics Department | Physics 0342105
The University of Jordan | Practical Final Exam

Information:
R = 8.314 J/mole.K; k_B=1.38×10^{-23} J/K; g = 9.8 m/s^2. ρ_{water} = 1000.0 kg/m^3 and P_{atm} = 1.013 × 10^5 Pa.
1u = 1.66 x 10^{-27} kg. N_A = 6.02 x 10^{23} molecules/mole. Note: Some Results Are Rounded.

1) A patient is administered (^{131}I). How long will it take for the observed radioactivity in her body to decrease to one-fourth its original magnitude? Given that (^{131}I) has half-life ($T_{1/2}$) of 8.1 days

A) 8.1 days B) 360 days C) 376.2 days D) 16.2 days E) 7.75 days

---

3) A submarine deep below the surface of the sea is at a gauge pressure of 40 atm. The air inside the submarine is at normal atmospheric pressure. The *net* force (in N) on a flat hull plate 2m by 6m is:

A) 4.86 x 10^2 B) 4.86 C) 4.86 x 10^7 D) 4.92 E) 4.92 x 10^7

---

4) The linear expansion coefficient for *Al* is α = 2.2×10^{-5} K^{-1}. What is the increase in volume of a block of 1 m^3 of *Al* if the temperature of the block is raised by 10 ºC?

A) 220 cm^3 B) 440 cm^3 C) 22 cm^3 D) 660 cm^3 E) 66 cm^3

---

5) What volume fraction of a cube of density (ρ = 0.50 g/cm^3) would sink under the surface of a liquid of density (ρ_o = 1.0 g/cm^3)?

A) 0.80 B) 0.67 C) 0.33 D) 0.50 E) 0.20

---

6) A 63-kg researcher absorbs 2.6 × 10^8 neutrons in a work day. The energy of each neutron is 6.5 MeV. The quality factor (QF) for fast neutrons is 10. The biologically equivalent dosage of the radiation, in mrem (mrem = 10^{-3} rem), is closest to (Note: 1 rad = 0.01 J/kg and 1ev = 1.6 x 10^{-19} J)

A) 43 B) 1.3 C) 2.7 D) 13 E) 4.3

---

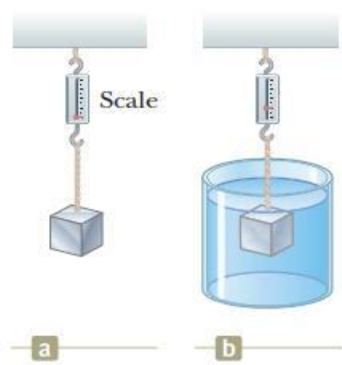
7) A man pulls a box weighting 40 N a distance of 10 m across the floor at constant speed. How much work (in J) does he do if the coefficient of kinetic friction is 0.20?

A) 80 B) -40 C) 0.0 D) 40 E) -80

---

8) The gravitational force exerted on a solid object, in air, is 4.0 N (Figure a). When the object is suspended from a spring scale and submerged in water, the scale reads 2.0 N (Figure b). Find the density of the object (in kg/m^3). Assume density of water ρ = 1000.0 kg/m^3.

A) 4000 B) 2000 C) 5000
D) 1000 E) 1500



9) When a man stands, his brain is 0.5 m above his heart. If he bends so that his brain is 0.4 m below his heart, by how much does the blood pressure in his brain change? (Assume density of blood is 1059.5 kg/m^3.)

A) 13.3 kP B) 4.0 kP C) 13.1 kP D) 9.3 kP E) 16.6 kP

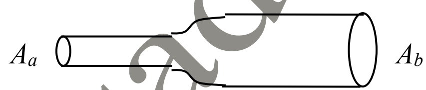
---

10) If both gases H_2 and CO_2 are at the same temperature. Then the ratio of the *rms* velocities of H_2 and CO_2, [V_{rms} (H_2)/ V_{rms} (CO_2)] is: (Given that the molecular mass of H_2 = 2.016 u and for CO_2 = 44.009 u)

A) 21.8 B) 0.21 C) 4.0 D) 0.05 E) 4.67

---

11) Water flows (streamline, nonviscous) from point *a* to point *b* in the horizontal section shown in the figure. Which of the following statements is correct regarding the velocity *v*, pressure *P*, and flow rate *Q* at the two ends of the section?



A) $v_a < v_b$. B) $P_a > P_b$ C) $P_a < P_b$.
D) $P_a = P_b$. E) $Q_a > Q_b$ (Q is the flow rate).

---

12) ^{60}Co beta decays with half life of 5.27 years (1.66 x10^8 sec) into ^{60}Ni, which then promptly emits gamma rays. These gamma rays are widely used in treating cancer. What is the mass (in gram) of a 1000-Ci cobalt source? (Given that one mole of ^{60}Co has a mass of 60 g)

A) 0.118 B) 0.441 C) 0.882
D) 0.245 E) 0.0147

---

13) If an object was thrown vertically from the ground level with initial speed 25 m/s and return to the same ground level after 5.1 seconds. What is the average velocity (in m/s) of the object when reaching the ground?

A) 12 B) 24 C) 6 D) 0 E) -12

---

14) The maximum permissible workday dose for occupational exposure to radiation is 26 mrem. A 63 kg laboratory technician absorbs 2.1 mJ of 0.7 MeV gamma rays in a work day. The quality factor (QF) for gamma rays is 1.0. The ratio of the equivalent dosage received by the technician to the maximum permissible equivalent dosage is closest to: (mrem = 10^{-3} rem, 1rad = 0.01 J/kg and 1ev = 1.6 x 10^{-19} J)

A) 0.18 B) 0.14 C) 0.17 D) 0.13 E) 0.15

---

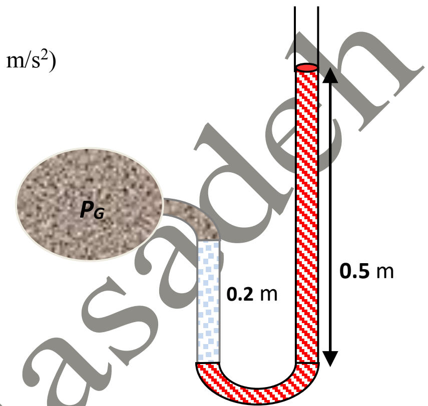
15) A radioactive source emits 2.4 MeV neutrons at the rate of 9200 neutrons per second. The number of atoms in the source is 4.0 x 10^9. The activity of the source, in nCi, is closest to: Hint (nCi = 10^{-9} Ci) and (1Ci = 3.70 x 10^{10} decays/sec.)

A) 2500 B) 92 C) 920 D) 25 E) 250

---

16) The level of the fluid with density ρ_s = 1000 kg/m^3
in the left arm of the manometer is 0.2 m above
the manometer fluid of density ρ_f = 800 kg/m^3
in the right arm. Which of the following relations is true? (Use ; g = 10 m/s^2)

A. $P_G = P_{atm}$.
B. P_G is 2000 Pa higher than P_{atm}.
C. P_G is 2000 Pa lower than P_{atm}.
D. P_G is 4000 Pa higher than P_{atm}.
E. P_G is 6000 Pa higher than P_{atm}



---

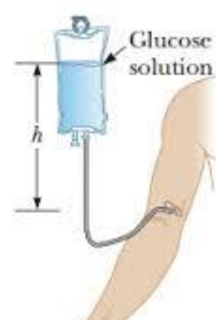
17) The radioactive nuclide ^{60}Co is widely used in medical applications. It undergoes beta decay, and the energy of the decay process is 2.82 MeV per decay event. The half-life of this nucleus is 272 days. Suppose that a patient is given a dose of 6.9 microCurie of ^{60}Co. If all of this material decayed while in the patient's body, what would be the total energy (in J) deposited there? Hint: (1Ci = 3.70 x 10^{10} decays/sec.) and 1ev = 1.6 x 10^{-19} J.

A) 3.9 B) 11.0 C) 14.0 D) 8.63 × 101^{12} E) 4.15 × 10^6

---

18) A collapsible plastic bag contains glucose. If the average gauge pressure in the vein is 1.33 x 10^3 Pa, what must be the minimum height h (in m) of the bag in order to infuse glucose into the vein? Assume density of the solution is equal 1.02 ρ_{water}.

A) 0.133 B) 0.113 C) 0.150 D) 0.752 E) 0.333



19. Oxygenation of the deep waters in a sea occurs in early winter due to:

a. Diffusion of air molecules through water.
b. Water mixing resulting from the decrease in density of water at lower as the temp decreases.
c. Water mixing resulting from the increase in density of water at lower as the temp decreases.
d. The lower density of ice relative to water.
e. Water mixing resulting from turbulence and the see waves in early winter.

---

20. One mole of an ideal gas has a temperature of 25°C. If the volume is held constant and the pressure is doubled, the final temperature (in °C) will be

a. 174 b. 323 c. 50 d. 596 e. 25

---

21. If water is to be pumped into a water tank at the top of a 10 m high building, what should the water pressure at the base of the building be if the speed of water is constant through the water pipe? (1.013 bar = 1 atm, $g = 9.8\ m/s^2$)

a. 1.0 bars b. 2.0 bars c. 0.5 bars d. 3.0 bars e. 0.3 bars

---

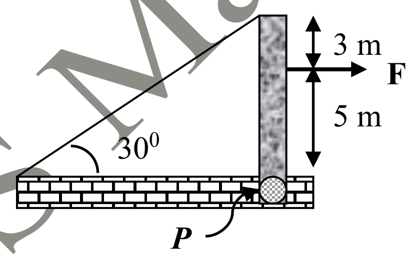
22. The temperature of an object is 80 ºF. What is its absolute temperature on the Kelvin scale?

a. 300 K. b. 335 K. c. 359 K. d. 475 K. e. 400 K.

---

23. A uniform 100 N beam is held in a vertical position by a pin (***P***) at its lower end and a cable at its upper end. A horizontal force of magnitude **F** = 75 N acts as shown in the figure. What is the tension in the cable?

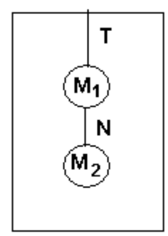
a. 47 N b. 69 N
c. 61 N d. 94 N
e. 54 N



---

24. If two objects M_1, M_2 ($M_1 = M_2$) are connected by a light inextensible cord which is attached to the ceiling of an elevator that is accelerating upward at $2\ m/s^2$, the ratio T/N

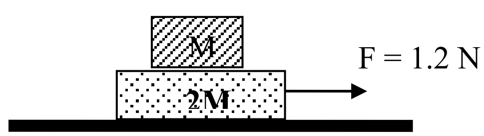
a. 5/3 b. 2 c. 1 d. 3/2 e. ½



---

25. The frictional force between mass 2M and the surface is zero, and the frictional force between masses M and 2M causes both masses to move together when the F = 1.2 N is applied to 2M. If M = 1 kg, what is the frictional force exerted by the large block on the small block?

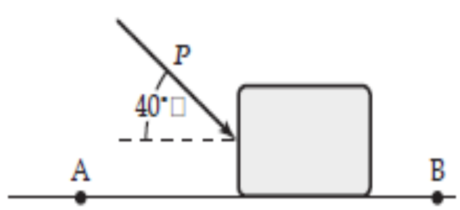
a. 0.4 N to the lef b. 0.8 N to the right
c. 0.4 N to the right d. 0.8 to the left
e. 1.2 to the right



---

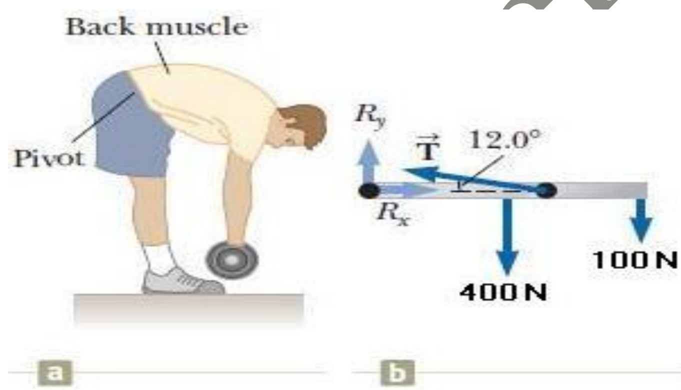
26. A block slides on a rough horizontal surface from point A to point B. A force (P = 2.0 N) acts on the block between A and B, as shown. Points A and B are 1.5 m apart. If the kinetic energies of the block at A and B are 5.0 J and 4.0 J, respectively, how much work is done on the block by the force of friction as the block moves from A to B?

a. –3.3 J b. +1.3 J c. +3.3 J
d. –1.3 J e. +4.6 J



27) Consider the model shown in Figure (b) for a person bending forward to lift a 100-N object. The spine and upper body are represented as a uniform horizontal rod of weight 400 N and length L, pivoted at the base of the spine. The erector spinal muscle, attached at a point 2L/3 a way from the pivot, maintains the position of the back. The angle between the spine and this muscle is 12 degrees. The tension T (in N) in the back muscle is:

A) 460 B) 2117 C) 0
D) 722 E) 2164



28) The horizontal component of the force R (≡R_x) exerted by the pivot (sacrum) along the spine (in N)?

A) 2117 B) 450 C) 0
D) 2164 E) 1667