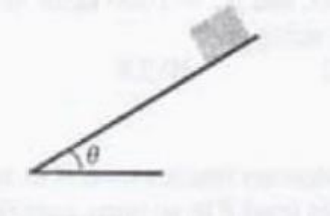
PHYSICS 105

Done by Dima Alrafaiah

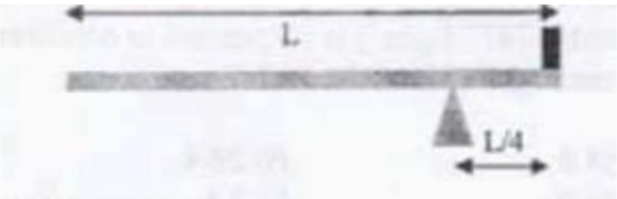
1. A stone is released from rest at a height h above the ground's surface. Just before it hits the ground its kinetic energy is 200 J. Ignoring air resistance, the change in the potential energy of this stone is (in J) is:
   A. 200
   B. 0
   C. -200
   D. 100
   E. -100

2. The figure shows a box of mass M= 4.0Kg , which slides down a rough inclined plane that makes an angle Ø= 30 with the horizontal. If the object starts from rest and the coefficient of kinetics friction is M_K = 0.2 , find the speed of the box (in m/s) when it has moved 3.0 m down the inclined plane.
   A. 4.4
   B. 6.3
   C. 7.1
   D. 3.1
   E. 5.3

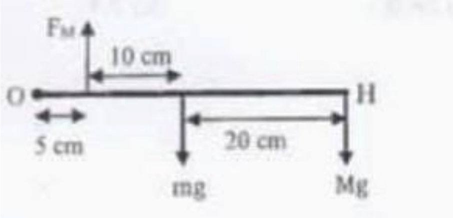


3. A ball is thrown vertically upwards with an initial speed v_1. When it has reached a height of one-fifth of its maximum height, its speed is 16.0 m/s upwards. The initial speed v_1 of the ball (in m/s) is: (ignore air resistance)
   A. 39.2
   B. 25.1
   C. 27.7
   D. 17.9
   E. 20.6

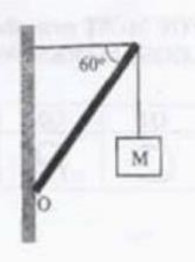
4. A 40Kg box is placed at the end of a uniform board of length L and mass M. the pivot is placed a distance L/4 from the end of the board as shown. If the board is in static equilibrium, then the weight of the board (in N) is:
   A. 200
   B. 392
   C. 120
   D. 196
   E. 784



5. The figure represents a forearm of mass m in a horizontal position as shown. The elbow joint, O, is 5 cm from the force exerted by the biceps muscle, F_M . when a mass M is held in the hand at the position H, the forearm is in static equilibrium. If $F_M = 185$ N , and M = 2.0 Kg, then the mass m (in Kg) is:
   - A. 1.9
   - B. 2.1
   - C. 0.5
   - D. 1.1
   - E. 1.6

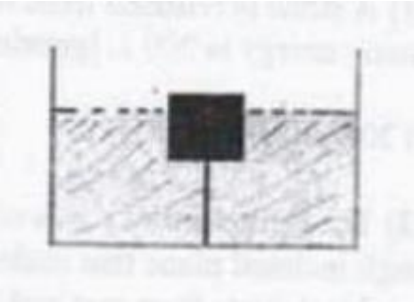


6. A 25.0 Kg uniform beam is attached to the wall by a hinge at point O. it is held in static equilibrium by connecting it to a 1.5 m horizontal rope which is tied to the wall. A mass M=18.0Kg is suspended in equilibrium from the beam using another vertical rope as shown. The magnitude of the horizontal component of the hinge force (in N) that acts on the beam at point O is:
   - A. 172.6
   - B. 297.9
   - C. 99.6
   - D. 122.1
   - E. 23.5

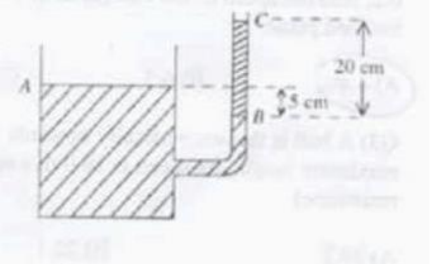


7. Consider a plastic cube of side length 20 cm and density of 0.5 grams/cm^3 . if you push the cube until it is completely submerged under water (of density of 1.0 grams/cm^3), and continue to push the cube deeper below the water surface, which of the following statements is correct?
   - A. The weight of the cube is greater than the buoyant force acting on it.
   - B. If you remove your force that acts on the cube, it will always move down and will never move up.
   - C. The buoyant force acting on the cube becomes large as the cube moves deeper below the water surface .
   - D. The buoyant force acting on the cube remains constant as the cube moves deeper below the water surface.
   - E. The buoyant force that acts on the cube when its fully under water depends on the density of the cube.

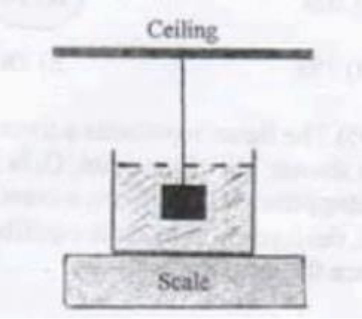
8. The figure shows a box with exactly 0.8 of its volume submerged in water. If the volume of the box is 0.001 m^3 , and $p_o = 0.2\ p_w$, where p_o is the density of the box, and $p_w = 1000$ Kg/m^3 is the density of the water, then the tension (in N) in the string is:
   - A. 0.2
   - B. 7.8
   - C. 0
   - D. 9.8
   - E. 5.9



9. Mercury reaches level A in an open, wide, vertical container and reaches level B in an open, narrow, vertical tube. The wide container and the narrow tube are connecter through a hole of inner radius 32.00 mm, as shown. Level A is 5.0 cm higher then level B . the mercury supports a 20.0 cm high column of unknown liquid, between levels B and C. the density (in Kg/m³) of the unknown liquid is : (density of mercury is 13600 Kg/m³)
   A. 54400
   B. 3400
   C. 13600
   D. 10200
   E. 6800



10. A 1.00-Kg beaker containing 2.00Kg of oil (density=916 Kg/m³) rests on a scale. A 3.00-Kg block of iron (density=7870 Kg/m³) is suspended in equilibrium from a rope and is completely submerged in the oil. What is reading (in N) of the scale?
   A. 58.8
   B. 29.4
   C. 32.8
   D. 26.0
   E. 3.4



Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
C	A	D	B	E	A	D	E	B	C

Answer Key 2nd Exam

$\boxed{1}$ Recall lecture 7 - page 10:

the total mechanical energy E is conserved : $\Delta K = +200\,J \rightarrow$

$\Delta U = -200\,J.$

$\boxed{2}$ Recall lecture 8 - page 6 OR lecture 7 - page 6:

We can tackle the problem using the work-energy approach, and it's equivalent approach; Newton's 2nd law:

Work-Energy approach
"scalar approach"

$$W_{F_{applied}} + W_{f_k} = \Delta K + \Delta U$$

$$-\mu_k mg\cos\theta\, d = \frac{mv^2}{2} - mgd\sin\theta$$

$$v = \left[2gd(\sin\theta - \mu_k\cos\theta)\right]^{1/2}$$

Newton's 2nd law approach
"vector approach"

$$\Sigma\vec{F} = m\vec{a}$$

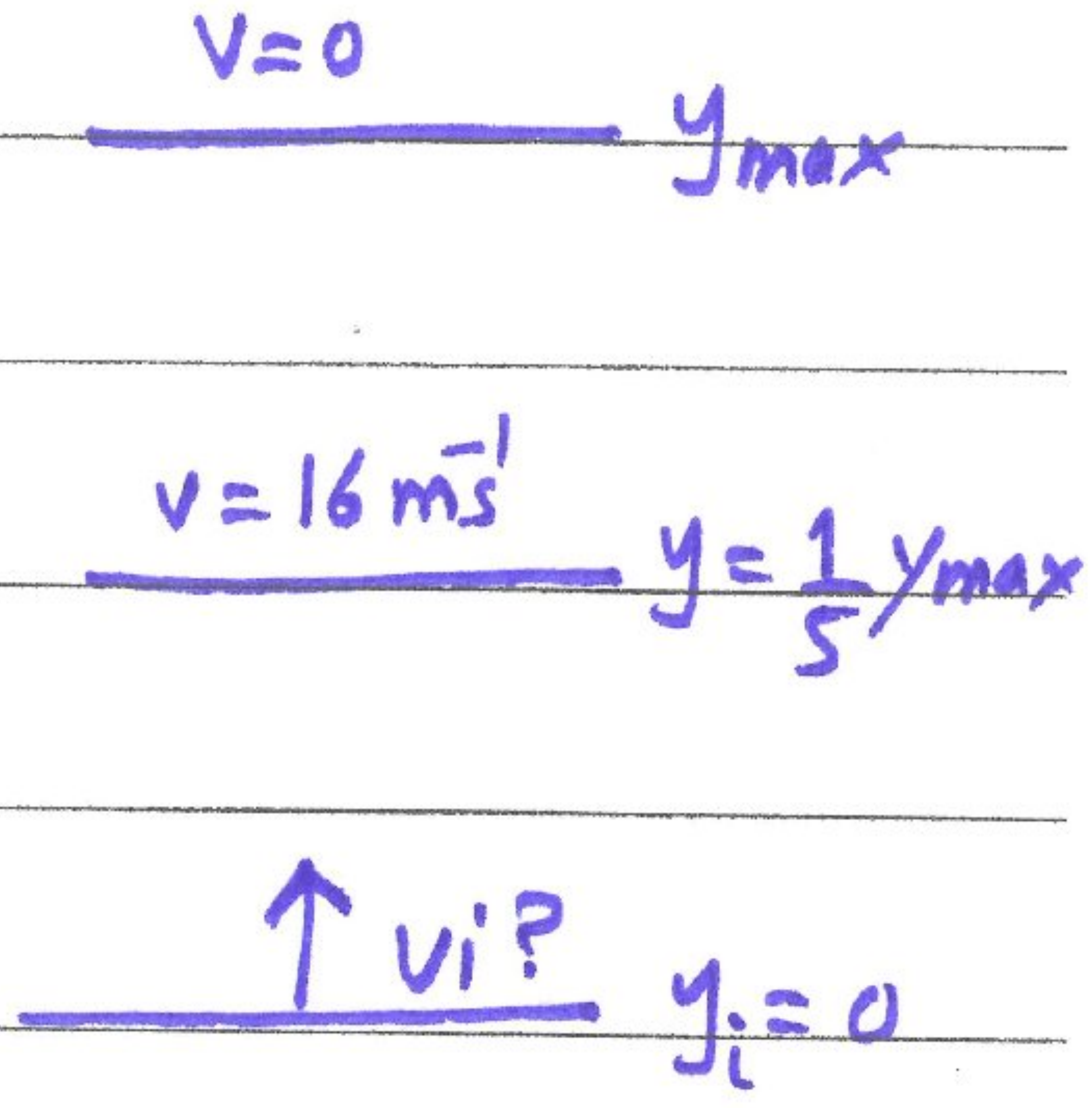
$$mg\sin\theta - \mu_k mg\cos\theta = ma$$

$$a = g(\sin\theta - \mu_k\cos\theta)$$

as a is constant, then

$$v^2 = 0 + 2ad\,.$$

$\boxed{3}$ As in the previous problem, you have two degrees of freedom on how to solve this one! Generally speaking, there is an advantage for the work-energy method over the force's approach (vector analysis).



1) $y_i = 0,\ y_f = y_{max} \Rightarrow$

$$\frac{mv_i^2}{2} = mgy_{max} \rightarrow \underbrace{v_i^2 = 2gy_{max}}$$

2) $y_i = 0,\ y_f = 1/5\ y_{max} \Rightarrow$

$$\frac{mv_i^2}{2} = \frac{mv^2}{2} + mg\ y_{max}/5$$

$$v_i^2 = v^2 + \frac{1}{5} * \underbrace{2gy_{max}}$$

$$\therefore v_i^2 = v^2 + \frac{v_i^2}{5} \rightarrow v_i = \sqrt{\frac{5}{4}}\, v$$

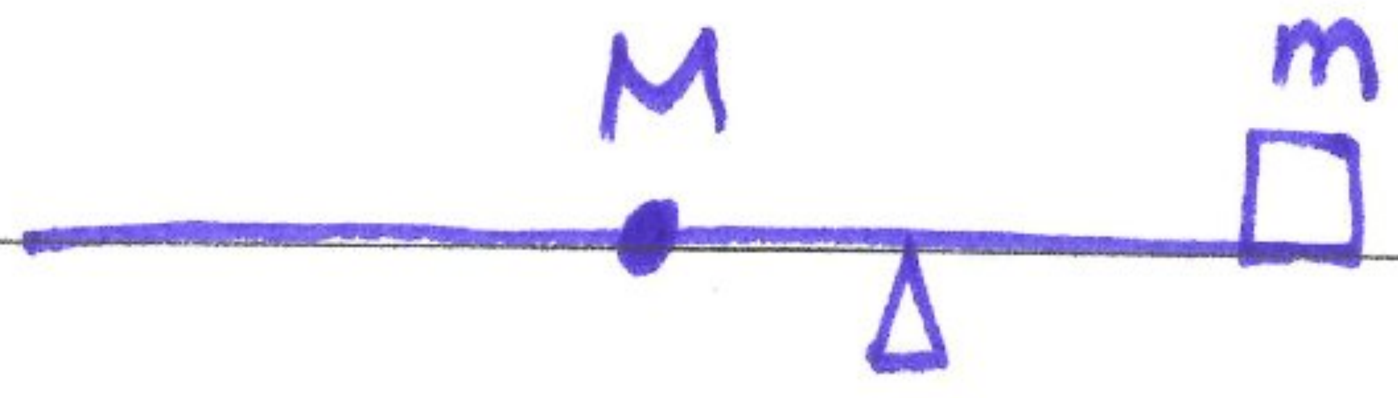
⇒ Force approach :→ freely falling object:-

recall lecture 3 - page 5:

$$t_{peak} = \frac{v_i}{g} \rightarrow y_{max} = \frac{v_i^2}{2g} \rightarrow v^2 = v_i^2 - 2g * \frac{1}{5} y_{max} \rightarrow v_i = \sqrt{\frac{5}{4}}\, v.$$

$\boxed{4}$ A clever selection of a pivot point is often the key to a quick solution. The "natural" selection in this problem is at the board's pivot itself.

One reads right off that



$$mg\frac{L}{4} = W\frac{L}{4}, \text{ where } W = Mg$$

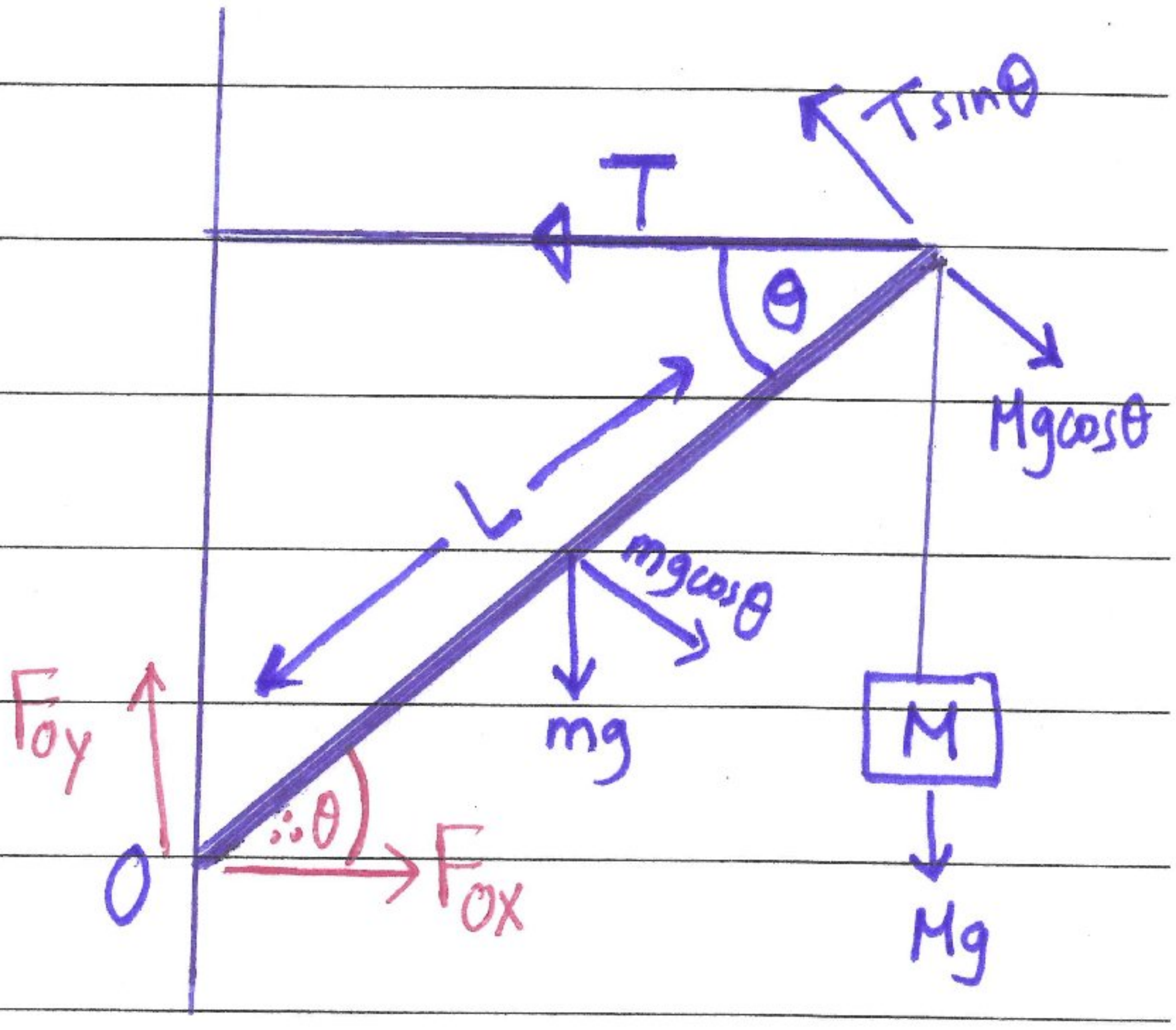
$$\Rightarrow W = mg.$$

$\boxed{5}$ When an unknown force is present in a problem; the joint force in our case, one can select the point where the force acts as the pivot point — O in our case. Then, the joint force will not enter into the torque equation because it has a lever arm of length zero.

Recall Lecture 10 - page 3 & lecture 11 - page 1.

$F_M * 0.05 = mg * 0.15 + Mg * 0.35$ and solve for m.

$\boxed{6}$



We know right off what Fox and Foy are:

$F_{ox} = T$ — ①

$F_{oy} = (m+M)g$ — ②

Both masses, m and M, are given, thus Foy is known.

Technically, the problem is about finding T.

The torque of about O reads:-

$(T\sin\theta)(L) = (Mg\cos\theta)(L) + (mg\cos\theta)(L/2)$.

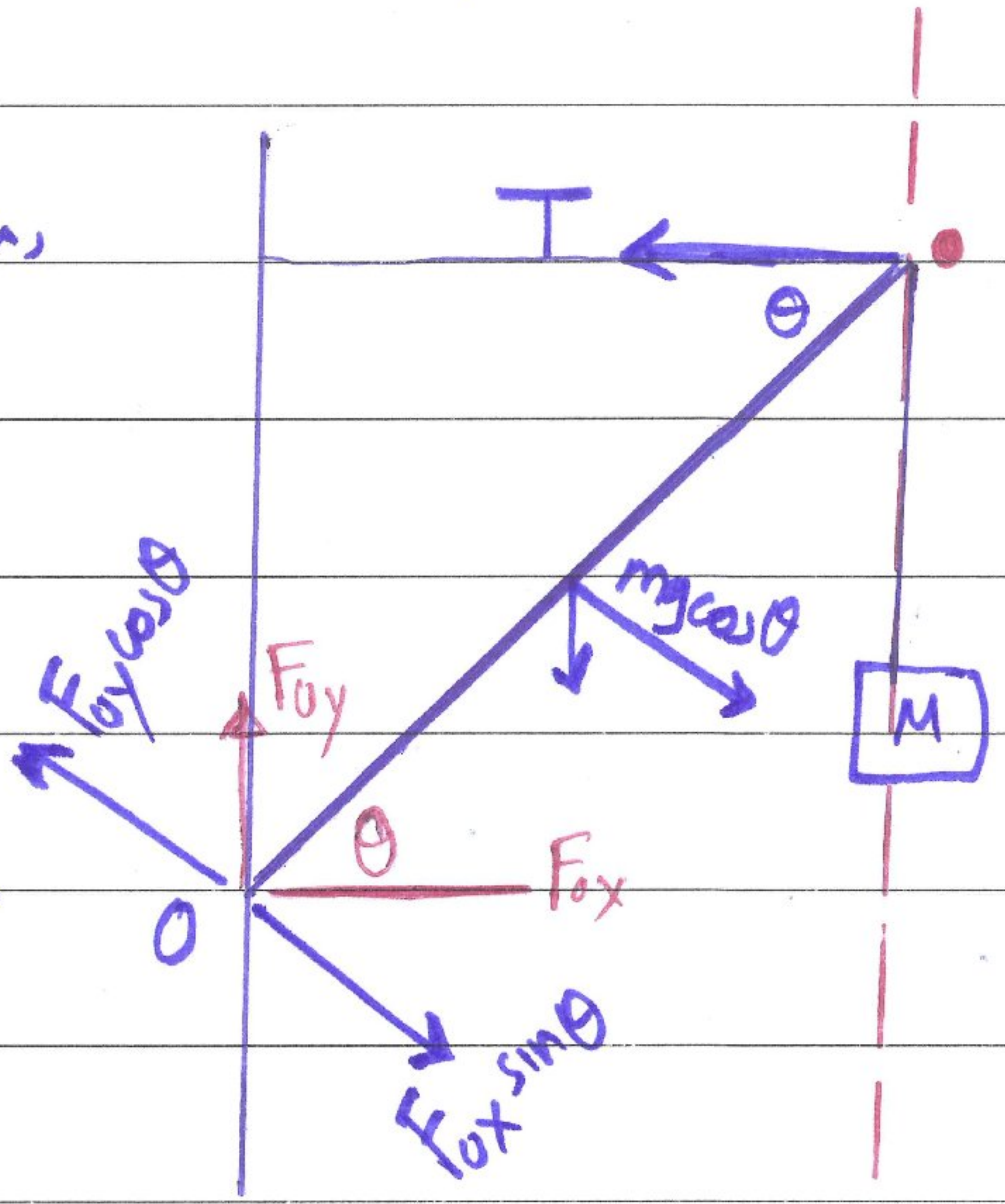
Hmm.... this explains why L is not given in the stem of the question: $T = (\frac{m}{2} + M)g * (\cot\theta)$

⇒ For the numerical values given in the question, one finds $F_{oy} = 421.4\,N$, $F_{ox} = T = 172.6\,N.$

⇒ The magnitude of the hinge force $= \sqrt{(F_{ox})^2 + (F_{oy})^2}$.

⇒ Notice that the length of the horizontal rope (1.5m) is irrelevant to our calculations!

⇒ Let's validate our calculations by choosing the point ● as a pivot point.



$$(mg\cos\theta)\frac{L}{2} + (F_{ox}\sin\theta)L = (F_{oy}\cos\theta)L$$

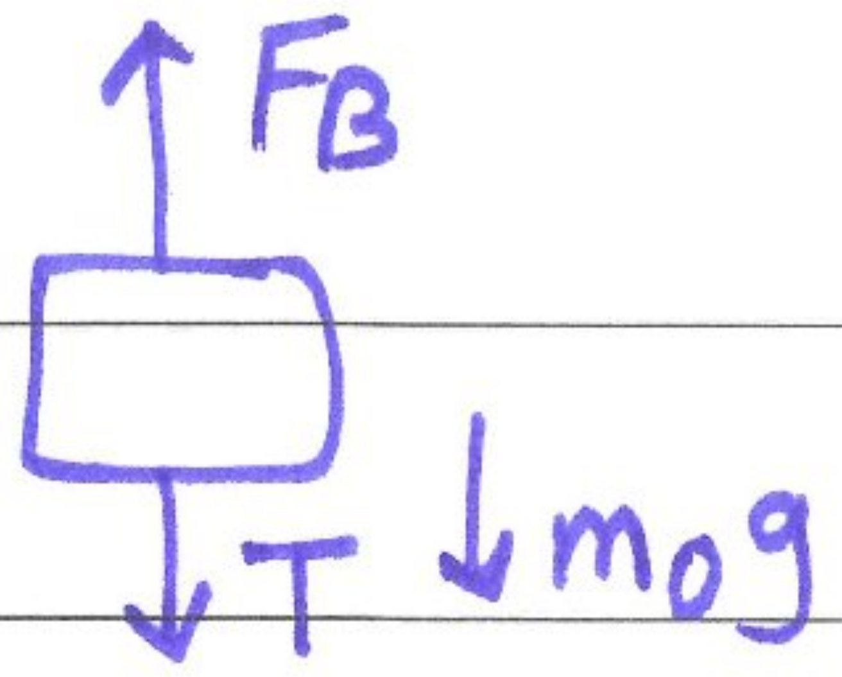
$$\Rightarrow F_{ox} = \left(F_{oy} - \frac{mg}{2}\right) * (\cot\theta).$$

$\boxed{7}$ Recall exercise D - lecture 14 - page 23.

$F_B = m_f g = \rho_f * V_f * g$, for totally submerged object $V_f = V_0$

$\therefore F_B = \rho_f * g * V_0 =$ constant.

- You should rationalize why the other options are incorrect.



$\boxed{8}$ Let m_0 = mass of the object,

m_W = " " water, then

$F_B = T + m_0 g \rightarrow T = m_W g - m_0 g = (m_W - m_0) g.$

$T = [\rho_W * (0.8 V_0) - \rho_0 * V_0] g$, $\rho_0 = (0.2) * \rho_W \Rightarrow$

$T = \rho_W * V_0 * (0.6) * g$, $\rho_W * V_0 = 1$

$\therefore T = (0.6) g.$

$\boxed{9}$ Recall assignment *3 - problems 20 & 24.

$P_B = P_A + \rho_{Hg} g * 0.05$ —— (1)

$P_B = P_C + \rho_f g * 0.20$ —— (2)

$P_A = P_C = P_{atm}$

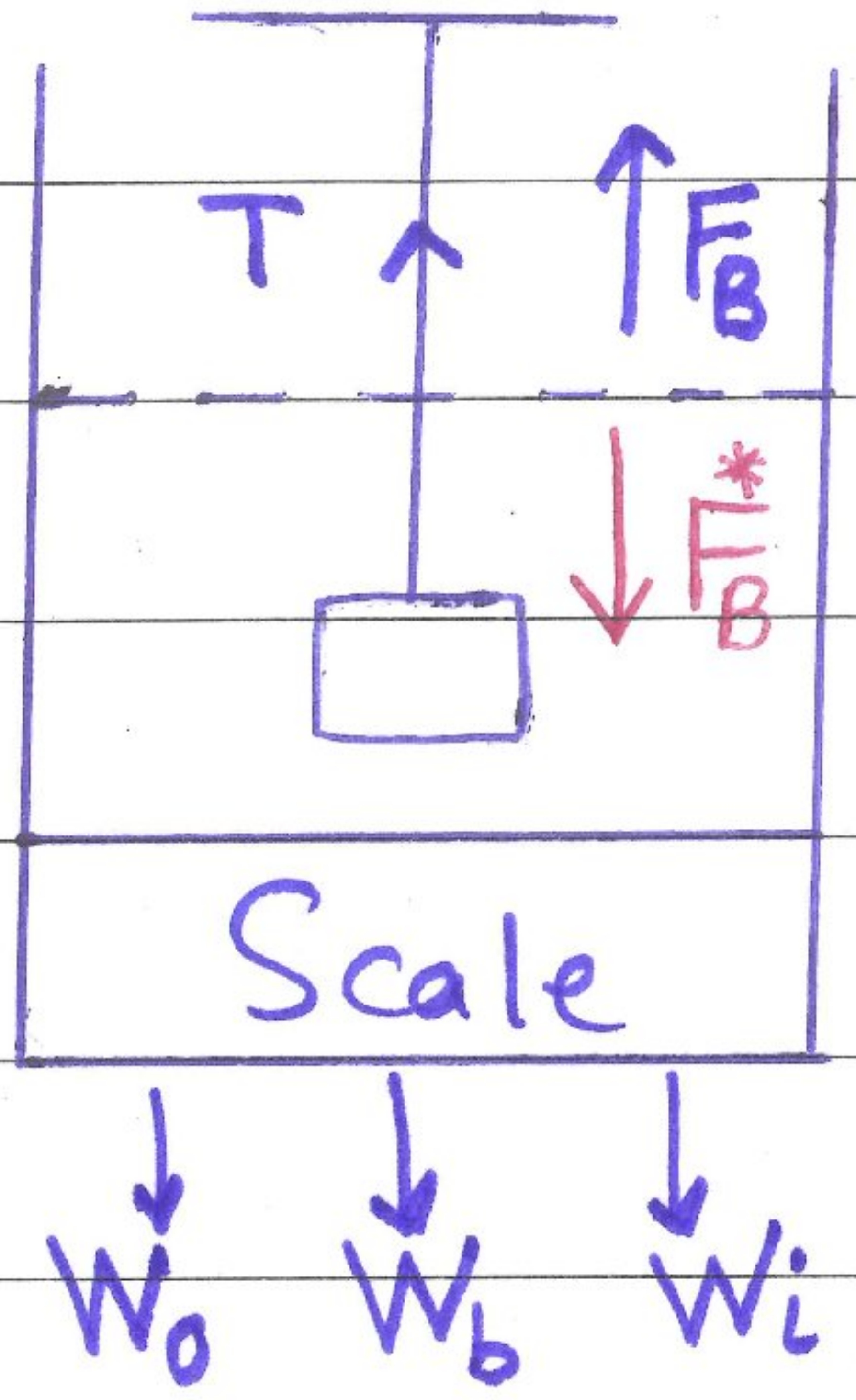
The left-hand sides of the two equations are equal, thus,

$P_A + \rho_{Hg} g * 0.05 = P_C + \rho_f g * 0.20 \rightarrow$ solve for ρ_f.

$\rho_f = \left(\frac{0.05}{0.20}\right) \rho_{Hg} = \frac{1}{4} * \rho_{Hg}.$

- By making an educated guess, one can safely eliminate choice A and choice C, and increase the probability of getting the correct answer.

$\boxed{10}$



- Let W_o = weight of oil
  W_b = weight of beaker
  W_i = weight of iron
- The weight of iron is supported by the tension in the rope and does not affect the reading on the scale.

Recall of (2) - lecture 14 - page 27 : $T = W_i - F_B$: the reading of T "apparent" is less than the "real" weight.

- If the oil exerts an upward buoyant force on the iron block, by Newton's 3rd law the block exerts a downward force F_B^* on the oil that is equal in magnitude.
- Thus the reading on the scale can be determined by considering the forces acting on the oil, W_o and F_B^*, the weight of the beaker, and the upward force from the scale, which sum to zero because the whole system is in equilibrium.

$$\therefore F_{scale} = W_o + W_b + F_B^* .$$
$$= 3g + \left(\frac{\rho_o}{\rho_i}\right) W_i$$

$$F_B^* = \rho_o V_i g = \rho_o \left[\frac{m_i}{\rho_i}\right] g$$
$$= \left(\frac{\rho_o}{\rho_i}\right) W_i$$

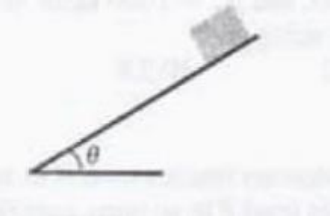
6/6

Physics 105 second exam 2021

Done by Dima Alrafaiah

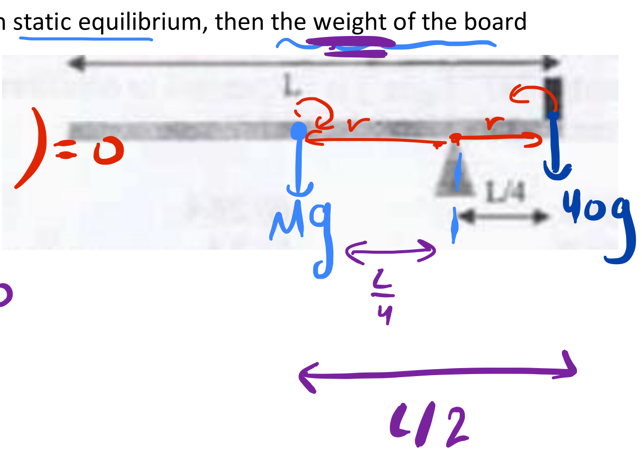
1. A stone is released from rest at a height h above the ground's surface. Just before it hits the ground its kinetic energy is 200 J. Ignoring air resistance, the change in the potential energy of this stone is (in J) is:
   A. 200
   B. 0
   C. -200
   D. 100
   E. -100

2. The figure shows a box of mass M= 4.0Kg , which slides down a rough inclined plane that makes an angle Ø= 30 with the horizontal. If the object starts from rest and the coefficient of kinetics friction is M_K = 0.2 , find the speed of the box (in m/s) when it has moved 3.0 m down the inclined plane.
   A. 4.4
   B. 6.3
   C. 7.1
   D. 3.1
   E. 5.3



3. A ball is thrown vertically upwards with an initial speed v_1. When it has reached a height of one-fifth of its maximum height, its speed is 16.0 m/s upwards. The initial speed v_1 of the ball (in m/s) is: (ignore air resistance)
   A. 39.2
   B. 25.1
   C. 27.7
   D. 17.9
   E. 20.6

4. A 40Kg box is placed at the end of a uniform board of length L and mass M. the pivot is placed a distance L/4 from the end of the board as shown. If the board is in static equilibrium, then the weight of the board (in N) is:
   A. 200
   [✓ B.] 392
   C. 120
   D. 196
   E. 784



$40\cancel{g}(\frac{\cancel{L}}{4}) - M\cancel{g}(\frac{L}{4}) = 0$

$40(\frac{1}{4}) - M(\frac{1}{4}) = 0$

$M = 40 kg$

$Mg = 40 \times 9.81 = 392.4N$

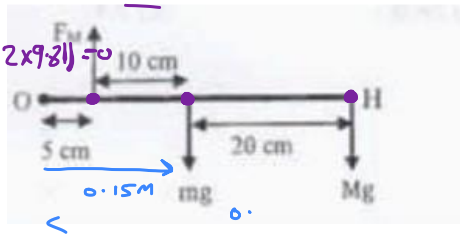
5. The figure represents a forearm of mass m in a horizontal position as shown. The elbow joint, O, is 5 cm from the force exerted by the biceps muscle, F_M. when a mass M is held in the hand at the position H, the forearm is in static equilibrium. If F_M = 185 N , and M = 2.0 Kg, then the mass m (in Kg) is:

A. 1.9
B. 2.1
C. 0.5
D. 1.1
[✓ E.] 1.6

$\tau = 0$ | $-0.05(185) + 0.15\,(m \times 9.81) + 0.35(2\times 9.81) = 0$

$F = 0$ |

$m = 1.62$



6. A 25.0 Kg uniform beam is attached to the wall by a hinge at point O. it is held in static equilibrium by connecting it to a 1.5 m horizontal rope which is tied to the wall. A mass M=18.0Kg is suspended in equilibrium from the beam using another vertical rope as shown. The magnitude of the horizontal component of the hinge force (in N) that acts on the beam at point O is:

[✓ A.] 172.6
B. 297.9
C. 99.6
D. 122.1
E. 23.5

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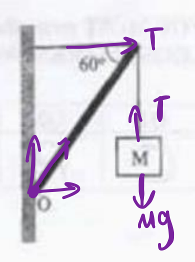


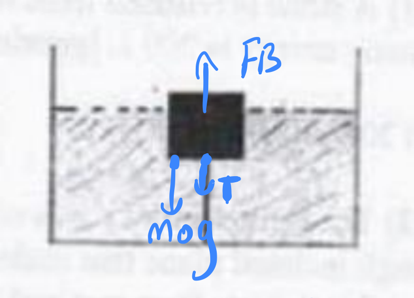
7. Consider a plastic cube of side length 20 cm and density of 0.5 grams/cm³ . if you push the cube until it is completely submerged under water (of density of 1.0 grams/cm³), and continue to push the cube deeper below the water surface, which of the following statements is correct?

A. The weight of the cube is greater than the buoyant force acting on it. X
B. If you remove your force that acts on the cube, it will always move down and will never move up X X X $\rho_f > \rho_o$
C. The buoyant force acting on the cube becomes large as the cube moves deeper below the water surface .
[✓ D.] The buoyant force acting on the cube remains constant as the cube moves deeper below the water surface. ✓
E. The buoyant force that acts on the cube when its fully under water depends on the density of the cube. X X of the fluid

8. The figure shows a box with exactly 0.8 of its volume submerged in water. If the volume of the box is 0.001 m³ , and p_o= 0.2 p_w, where p_o is the density of the box, and p_w =1000 Kg/m³ is the density of the water, then the tension (in N) in the string is:

A. 0.2
B. 7.8
C. 0
D. 9.8
[✓ E.] 5.9

$V_s = 0.8\,V_o$
$V_o = 0.001$
$\rho_o = 0.2\,\rho_w$



$F_B = T + m_o g$

$m_f g = T + m_o g$

$\rho_w V_s * g = T + \rho_o * V_o * g$

$1000 * 0.8 * 0.001 * 9.81 = T + 0.2(1000) * 0.001 * 9.81$

$\boxed{T = 5.886}$

9. Mercury reaches level A in an open, wide, vertical container and reaches level B in an open, narrow, vertical tube. The wide container and the narrow tube are connecter through a hole of inner radius 32.00 mm, as shown. Level A is 5.0 cm higher then level B . the mercury supports a 20.0 cm high column of unknown liquid, between levels B and C. the density (in Kg/m^3) of the unknown liquid is : (density of mercury is 13600 Kg/m^3)

A. 54400

[✓ B. 3400]

C. 13600

D. 10200

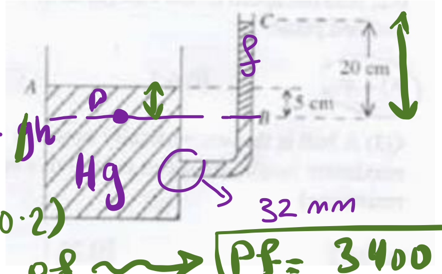
E. 6800

$$P_D = P_B$$

$$\cancel{P_{atm}} + P_{Hg}\cancel{g}h = \cancel{P_{atm}} + P_f\cancel{g}h$$

$$P_{Hg}(0.05) = P_f(0.2)$$

$$\frac{13600 * 0.05}{0.2} = P_f \rightsquigarrow \boxed{P_f = 3400}$$



10. A 1.00-Kg beaker containing 2.00Kg of oil (density=916 Kg/m^3) rests on a scale. A 3.00-Kg block of iron (density=7870 Kg/m^3) is suspended in equilibrium from a rope and is completely submerged in the oil. What is reading (in N) of the scale?

A. 58.8

B. 29.4

[✓ C. 32.8]

D. 26.0

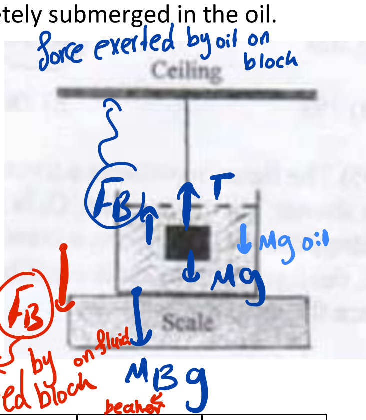
E. 3.4

we have to determine forces acting on the oil so we can obtain reading of the scale

$$F_{scale} = Mg_{oil} + Mg_{Beaker} + F_B$$

$$= (2*9.81) + (1*9.81) + 916\left[\frac{3}{7870}\right]*9.81$$

$$= \boxed{32.855}$$

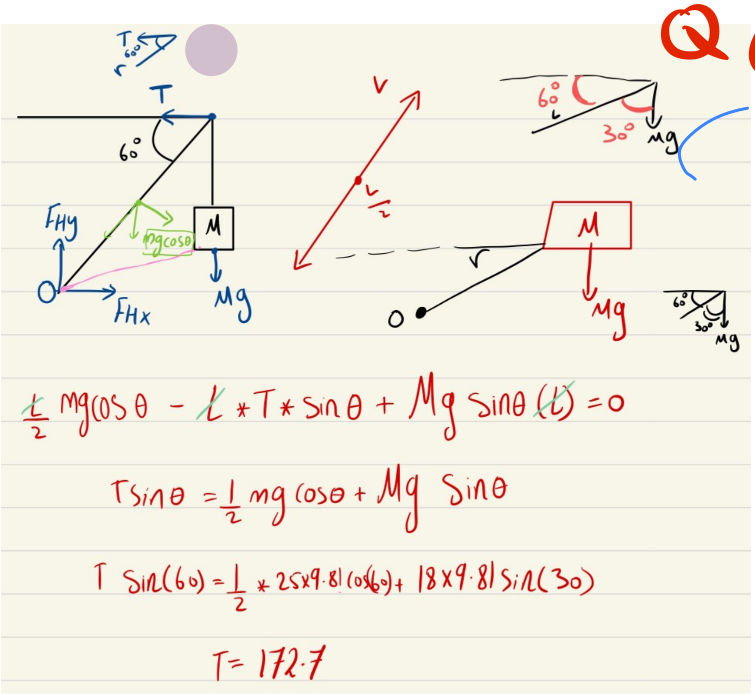


Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
C	A	D	B	E	A	D	E	B	C

$$F_B = \rho_f V_{iron}\, g$$

$$\rho_f \left[\frac{M_{iron}}{\rho_{iron}}\right] g$$

Q 6



$$\frac{\cancel{L}}{2} Mg\cos\theta - \cancel{L} * T * \sin\theta + Mg\sin\theta(\cancel{L}) = 0$$

$$T\sin\theta = \frac{1}{2} mg\cos\theta + Mg\sin\theta$$

$$T\sin(60) = \frac{1}{2} * 25\times9.81\cos(60) + 18\times9.81\sin(30)$$

$$T = 172.7$$

THE UNIVERSITY OF JORDAN **PHYSICS DEPARTMENT**

PHYSICS 105 (2nd EXAM)

Student's Name (Arabic):………………………………………… Registration #……………….

Lecturer's Name:……………………………………………………… Section # ……………………

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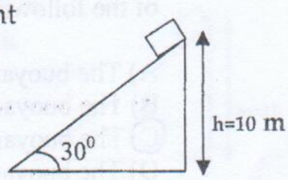
g = 9.8 m/s2, 1 atm = 1.013×10^5 Pa, $\rho_{water} = 1000$ kg/m^3

Q1) An object of mass 4 kg slides down a rough 30° inclined plane at constant velocity. The value of the coefficient of kinetic friction μ_k between the block and the inclined plane is:

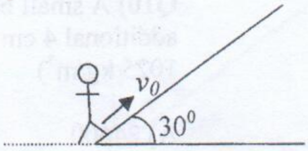


A) 0 [✓ B) 0.58] C) 1.73 D) 0.87 E) 0.5

Q2) Two cars of masses M_a and $M_b = 2M_a$ have the same kinetic energy. If the speed of mass M_b is V then the speed of mass M_a is:

A) V B) $2V$ [✓ C) $\sqrt{2}V$] D) $\frac{1}{\sqrt{2}}V$ E) $\frac{1}{2}V$

Q3) A skier starts with an initial speed $v_0 = 10$ m/s at the bottom of a rough steady upward 30^0 inclined plane as shown. The skier travels a distance of 6 m along the plane before coming to rest. The value of the coefficient of kinetic friction is:

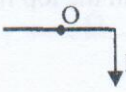


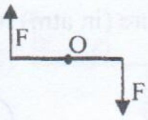
A) 0.17 B) 1.55 C) 0.70 [✓ D) 0.40] E) 0.91

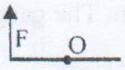
Q4) A 70-kg athlete in basic training climbs a 10-m vertical rope at a constant speed of 1.2 m/s. His power output (in W) is:

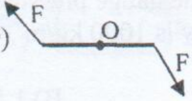
[✓ A) 823] B) 85.8 C) 840 D) 686 E) 0

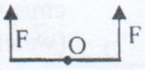
Q5) The figure shows a uniform beam fixed at its midpoint O. The beam can only rotate about an axis perpendicular to the page and passes through point O. Which of the following graphs represents static equilibrium?

A) 

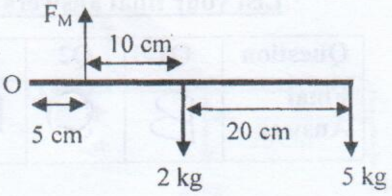
B) 

C) 

D) 

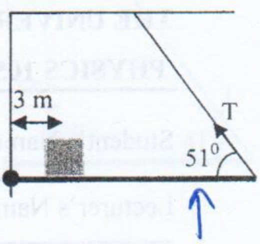
[✓ E)] 

Q6) 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 arm horizontal as in the figure. Assume that the mass of forearm and hand together is 2.0 kg.



A) 803 B) 50 C) 105
D) 201 [✓ E) 402]

Q7) The figure shows a uniform, horizontal beam (length = 10 m, mass = 25 kg) that is pivoted at the wall at point O, with its far end supported by a cable that makes an angle of 51° with the horizontal. If a load (mass = 60 kg) is placed 3.0 m from the pivot. Determine the horizontal component of the hinge force (in N) acting at point O.



A) 298 B) 189 C) 264 [✓ D) 242] E) 150

Q8) A block of iron is completely immersed in water and is sinking below the water surface. Which of the following statements is correct?

A) The buoyant force acting on it increases as the block sinks.
B) The buoyant force acting on it decreases as the block sinks.
[✓ C) The buoyant force acting on it is constant as the block sinks.]
D) The buoyant force does not depend on the density of the water.
E) All the above statements are wrong.

Q9) A balloon is filled with 100 m^3 of helium gas ($\rho_{He} = 0.179$ kg/m^3, $\rho_{air} = 1.29$ kg/m^3). The weight (in N) of a load that can be lifted using this balloon is: (ignore the mass of the skin of the balloon and the buoyant force on the load)

[✓ A) 1089] B) 11 C) 111 D) 1880 E) 1000

Q10) A small boat is 4m wide and 6 m long. When a load is placed on the boat, the boat sinks an additional 4 cm in the river water. What is the weight (in N) of the load? (density of sea water is 1025 kg/m^3)

A) 24600 [✓ B) 9643] C) 1025 D) 24108 E) 940

Q11) The cross-sectional area of the aorta is 2 cm^2 and blood flows through it at 40 cm/s. The mass flow rate (in grams/s) of blood through the aorta is: (Assume density of blood to be 1059 kg/m^3)

A) 0.1 B) 100 [✓ C) 84.7] D) 8470 E) 1059

Q12) 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: (water density is 1000 kg/m^3) ≡

A) 0 B) 1.54 C) 2.65 [✓ D) 1.65] E) 3.2

List your final answers in this table. Only the answer in this table will be graded

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Final Answer	B	C	D	A	E	E	D	C	A	B	C	D

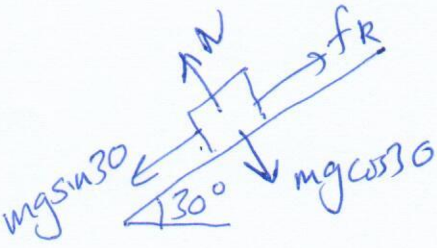
Physics for Medical Students
(0342105)/Second Exam Solutions

April/26/2018

Q1] $+\swarrow$ $mg\sin30 - f_k = ma$

$mg\sin30 - \mu_k(mg\cos30) = 0$

$\therefore\ \mu_k = \tan30^\circ$



Q2] $K_a = K_b \Rightarrow \frac{1}{2}M_aV_a^2 = \frac{1}{2}M_bV_b^2$

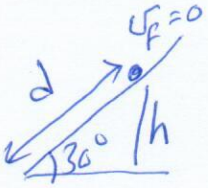
$\therefore\ M_aV_a^2 = (2M_a)V^2 \Rightarrow V_a^2 = 2V^2 \Rightarrow V_a = \sqrt{2}\,V$

Q3] $W_{nc} = \Delta K + \Delta U$

$f_k(d)\cos180^\circ = (0 - \frac{1}{2}m(v_0)^2) + mgh$

$-\mu_k(\cancel{m}g\cos30)(d) = -\frac{1}{2}\cancel{m}v_0^2 + \cancel{m}g(d\sin30)$

$\therefore\ \mu_k = \dfrac{gd\sin30 - v_0^2/2}{-gd\cos30} = 0.40$



Q4] $\bar{P} = \dfrac{\text{total work done}}{\text{time taken}} = \dfrac{(mg)(h)}{t} = mg\left(\dfrac{h}{t}\right) = mgv \simeq 823$ W

Q5] The only graph for which $\Sigma\tau = 0$ and Σ forces $= 0$ is Ⓔ

Q6] $+\circlearrowleft O$ $F_M(0.05) - 2g(0.15) - 5g(0.35) = 0$

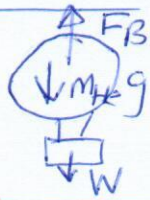
$F_M = \dfrac{2g(0.15) + 5g(0.35)}{0.05} \approx 402$ N.

Q7] $\overset{+}{\circlearrowleft}$ $(T\sin 51)(10) - 25g(5) - 60g(3) = 0$

$$T = \frac{g(25\times5 + 60\times3)}{10\sin 51} \simeq 384$$

$$T\cos 51 = H_x = 242$$

Q8] Since the block is <u>completely</u> imersed in water
⇒ the buoyant force acting on it is constant.
Remember $F_B = \rho_F V g$, as it sinks
the volume of displaced water is constant $= V$
which is the same as the volume of the block.



Q9] $\uparrow^+$ $F_B - m_{He}g = W \Rightarrow (\rho_{air}Vg - \rho_{He}Vg) = W$

$W = (\rho_{air} - \rho_{He})Vg = (1.29 - 0.179)(100)g$

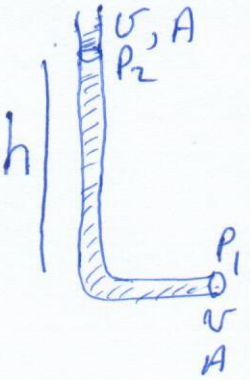
Q10] W_{load} = weight of displaced fluid

$$= \rho_w V g = (1025)\overbrace{(4\times6\times0.04)}^{\text{volume of disp. fluid}}\times9.8$$

$$\simeq 9643\text{ N}.$$

Q11] mass flow rate $= \rho\dfrac{\Delta V}{\Delta t} = \rho A v = 1059\times2\times10^{-4}\times0.4$
$\simeq 84.7$ gram/s.

Q12] $A_1v_1 = A_2v_2$ since area is constant
$\Rightarrow v_1 = v_2 = 0.6$ m/s.



$$P_1 + \rho g y_1 + \tfrac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \tfrac{1}{2}\rho v_2^2$$

$v_1 = v_2$,

$$P_1 + \rho g(y_1 - y_2) = P_2$$

$$P_1 - P_{atm} + \rho g(y_1 - y_2) = P_2 - P_{atm}$$

$$P_{1g} + \rho g(0-16) = P_{2g} \Rightarrow P_{2g} = 3.2 + \frac{1000\times9.8(-16)}{1.013\times10^5}$$

$$P_{2g} \simeq 1.65\text{ atm}$$

The University of Jordan
Faculty of Science
Department of Physics

Physics 105 - Second Exam

Name (In Arabic):
Student Number:
Instructor:
Section:

Constants: $g = 9.8\ m/s^2$, $1\ atm = 1.013\times10^5$ Pa, $\rho_{water} = 1.0\times 10^3\ kg/m^3$

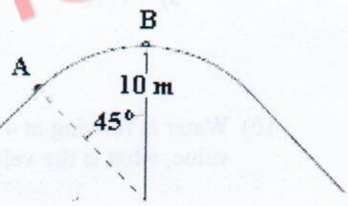
1) A 5.0-kg object is pulled along a horizontal surface at a constant speed by a 15-N force acting 20° above the horizontal. How much work is done by this force as the object moves 6.0 m?

a) 85 J b) 82 J c) 74 J d) 78 J e) 43 J

2) When a ball rises vertically to a height h and returns to its original point of projection, the work done by the gravitational force is

a) +mgh b) −mgh c) 0 d) −2mgh e) +2mgh

3) A skier weighing 0.70 kN goes over a frictionless circular hill as shown. If the skier's speed at point A is 9.2 m/s, what is his speed at the top of the hill (point B)?



a) 3.1 m/s b) 5.2 m/s c) 6.5 m/s d) 4.1 m/s e) 6.2 m/s

4) An all-terrain vehicle of 2000 kg mass moves up a 15.0° slope a distance of 48 m at a constant velocity in 8 sec. The rate of change of gravitational potential energy with time is

a) 30.4 kW b) 5.25 kW c) 24.8 kW d) 118 kW e) 439 kW

5) Find the pressure in atmospheres in the water at the base of a dam if the water in the reservoir is 200 meters deep.

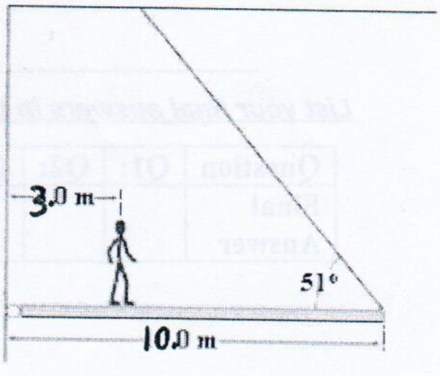
a) 194 b) 24.7 c) 29.4 d) 20.4 e) 75

6) A balloon is filled with 200 m^3 of helium. How large a mass can the balloon lift while moving upward at constant speed? The density of helium 0.179 kg/m^3 and of air is 1.29 kg/m^3. Consider the mass of the skin of the balloon to be negligible. (ignore the buoyant force on the load)

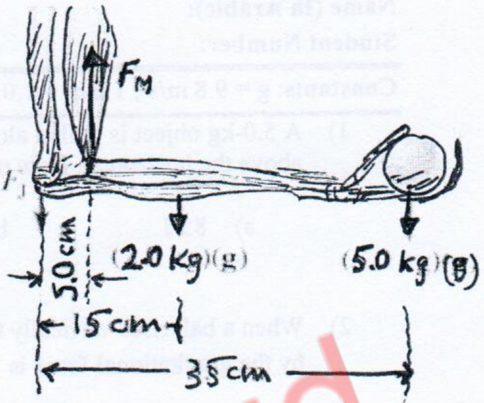
a) 115 kg b) 315 kg c) 222 kg d) 415 kg e) 37 kg

7) The figure shows a uniform, horizontal beam (length = 10 m, mass = 25 kg) that is pivoted at the wall, 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 tension in the cable?

a) 0.83 kN b) 0.30 kN c) 0.42 kN
d) 3.0 kN e) 0.38 kN



8) How much force (F_M) must the biceps muscle exert when a 5.0-kg mass is held in the hand with the arm horizontal as in the figure. Assume that the mass of forearm and hand together is 2.0 kg and their CG is as shown.



a) 800 N b) 400 N c) 100 N
d) 200 N e) 50 N

9) What fraction of an iceberg is submerged if ρ_{ice} = 917 kg/m^3 and ρ_{sea} = 1.03× 10^3 kg/m^3?

a) 77% b) 89% c) 91% d) 93% e) 95%

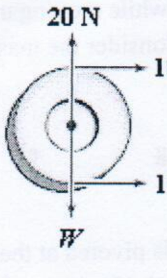
10) Water is flowing at 4.0 m/s in a circular pipe. If the diameter of the pipe decreases to 1/2 its former value, what is the velocity of the water downstream?

a) 1.0 m/s b) 2.0 m/s c) 4.0 m/s d) 8.0 m/s e) 16 m/s

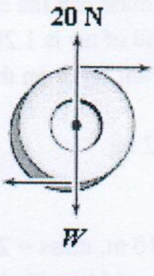
11) Water pressurized to 3.5 × 10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and velocity of the water after the contraction?

a) 4.5 × 10^5 Pa, 1.5 m/s b) 3.0 × 10^5 Pa, 10 m/s c) 3.0 × 10^5 Pa, 15 m/s
d) 2.5 × 10^5 Pa, 15 m/s e) 5.5 × 10^5 Pa, 1.5 m/s

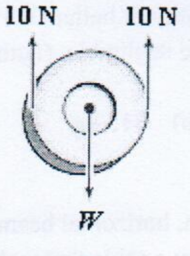
12) The diagrams below show forces applied to a wheel that weighs 20 N. The symbol *W* stands for the weight. In which diagram(s) is (are) the wheel in static equilibrium? (the wheel is **NOT** pivoted)



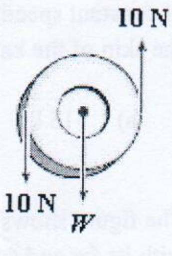
A



B



C



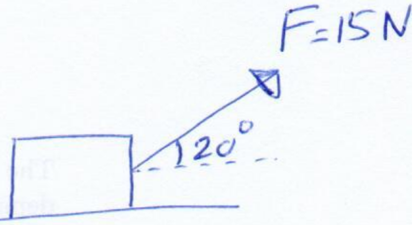
D

a) A b) B c) C d) D e) B and C

List your final answers in this table. Only the answer in this table will be graded..

Question	Q1:	Q2:	Q3:	Q4:	Q5:	Q6:	Q7:	Q8:	Q9:	Q10:	Q11:	Q12:
Final Answer												

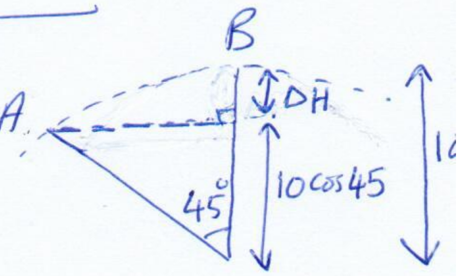
Physics for Medical and Dentistry students
Second Eam [redacted]
Solutions



Q1] $W_F = (F\cos 20)(6)$

$\simeq 85$ J.

Q2] Vertical displacement $=0 \Rightarrow W_g = 0$.



Q3] No friction $\Rightarrow \Delta K + \Delta U = 0$

$\frac{1}{2}m(v_B^2 - v_A^2) + mg\Delta H = 0$

$\Delta H = 10 - 10\cos 45 = 2.93$ m

$\frac{1}{2}v_B^2 = \frac{1}{2}(9.2)^2 - g\Delta H$

$v_B = \left[(9.2)^2 - 2g\Delta H\right]^{1/2} \simeq 5.2$ m/s

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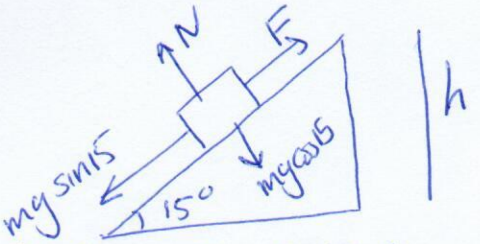


Q4] $P = Fv$

constant velocity $\Rightarrow F = mg\sin 15$

$P = (mg\sin 15)\underbrace{\left(\frac{48}{8}\right)}_{v} = (2000 \times 9.8\sin 15)(6) = 30.4\,kW$

Note as speed is constant all the work is converted into potential energy.

Alternatively $\Delta U = mgh = 2000 \times 9.8 \times (48\sin 15)$

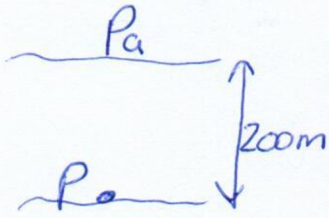
$P = \frac{\Delta U}{\Delta t} = \frac{\Delta U}{8} = 30.4\,kW$.

5] $P = P_a + \rho g h$

$= 1\,atm + \frac{1000 \times 9.8 \times 200}{1.013 \times 10^5}\,atm$

$= 1\,atm + 19.35$

$= 20.4\,atm$



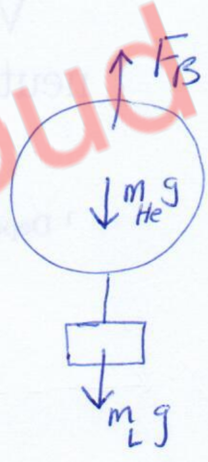
6] constant speed $\Rightarrow$ Dynamic equilibrium

$\Rightarrow \sum \vec{F} = 0$

$\overset{+}{\uparrow}\quad F_B - m_{He}\,g - m_L\,g = 0$

$\rho_{air} V \cancel{g} - \rho_{He} V \cancel{g} = m_L \cancel{g}$

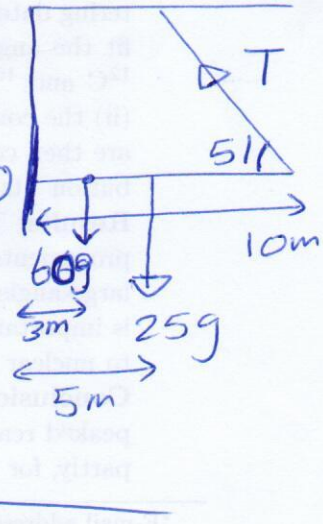
$(\rho_{air} - \rho_{He}) V = m_L = 222\,kg$



7] $+\circlearrowleft_O\ (T\sin 51)(10) - 60g(3) - 25g(5) = 0$

$T = \frac{180g + 125g}{10\sin 51}$

$\simeq 0.38\,kN$



Velocity-dependent optical potential for [illegible]eutron elastic sc[illegible] 1p-shell nuclei

[illegible] N. Ghabat, M. I. Jaghoub *

1 Department of Physics, University of Jordan, P. O. 11942, Amman, Jordan

[illegible]

[illegible]stract

Background: The conventional optical model is quite successful in describing the nucleon elastic scattering data from medium and heavy nuclei. However, its success in describing the light 1p-shell nuclei is rather limited. The velocity-dependent [illegible] resulted in a significant improvement in describing the [illegible] angular distributions for light nuclei in the low energy region. Purpose: To extend the formalism of the velocity-dependent potential to higher energies, and to [illegible] in describing neutron elastic scattering data from light [illegible] fit the angular distribution data for neutron elastic scattering from ^{12}C and ^{16}O using (i) the velocity-dependent optical potential and (ii) the conventional optical potential. The [illegible] of the two models are then compared. At low energies, we compare our results for [illegible] with the fits of other works that exist in the literature. [illegible] The velocity-dependent potential resulted in a significant improvement in describing the angular distributions particularly in the large angle scattering region and for certain energy ranges. This model is important where the experimental data show structural effects due to nuclear surface deformations, which are important in light nuclei. Conclusions: The velocity-dependent potential gives rise to surface-peaked real terms in the optical model. Such terms account, at least partly, for the structural effects seen in the angular distribution data.

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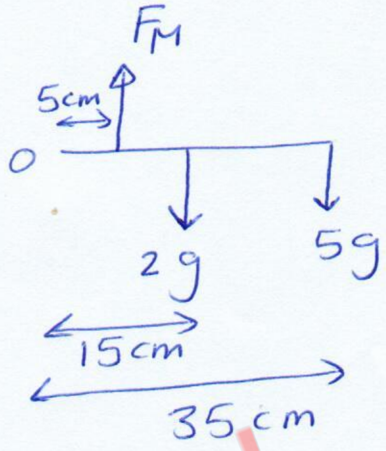
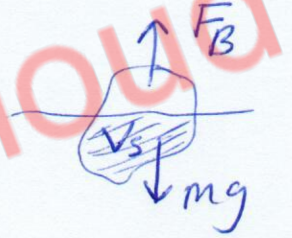
8] $\overset{+}{\circlearrowleft}_{O}$ $F_M(0.05) - 2g(0.15) - 5g(0.35) = 0$



$$F_M = \frac{0.3g + 1.75g}{0.05}$$

$F_M \sim 400$ N.

9] $F_B = mg$ static equilibrium



$\rho_w V_s \cancel{g} = \rho V \cancel{g}$

$$\frac{V_s}{V} = \frac{\rho}{\rho_w} = \frac{917}{1030} \sim 0.89$$

$\Rightarrow$ % submerged volume = 89%

10] $A_1 v_1 = A_2 v_2$

$\cancel{\pi}\left(\frac{D_1}{2}\right)^2(4) = \cancel{\pi}\left(\frac{D_2}{2}\right)^2 v_2$

$v_2 = \left(\frac{D_1}{D_2}\right)^2(4) = \left(\frac{D_1}{\frac{D_1}{2}}\right)^2(4) = 4\times4 = 16$ m/s

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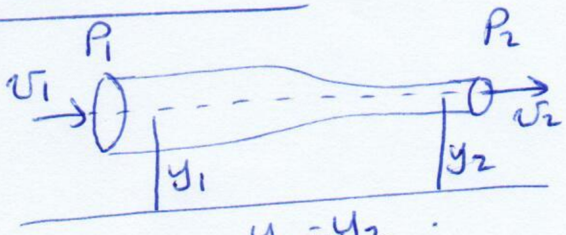
11] $P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$



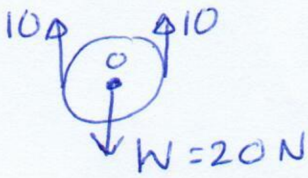
$y_1 = y_2$.

$A_1 v_1 = A_2 v_2$

$A_1(5) = \frac{A_1}{3} v_2 \Rightarrow v_2 = 15$ m/s.

$\Rightarrow P_1 + \frac{1}{2}\rho(v_1^2 - v_2^2) = P_2 \Rightarrow P_2 = 2.5\times10^5$ Pa.

Q12] static equilibrium $\Rightarrow \sum\vec{F} = 0,\ \sum\vec{\tau} = 0$
only diagram that satisfies both conditions
is



$\overset{+}{\circlearrowleft}$ $\sum\vec{\tau} = 0$

$\sum\vec{F} = 0$

THE UNIVERSITY OF JORDAN PHYSICS DEPARTMENT

PHYSICS 105 (2nd EXAM)

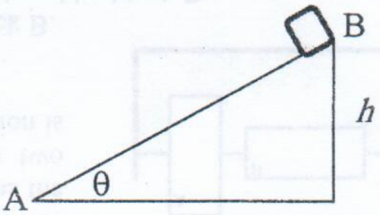
Student's Name (Arabic):…………………………………… Registration #:………………………… Sec #……

*Useful Information: $R = 8.314$ J/mole.K; $k_B=1.38\times10^{-23}$ J/K; $N_A= 6.02 \times 10^{23}$ molecules/mole; $g = 9.8$ m/s^2 ; $\rho_{water} = 1000.0$ kg/m^3 , $\rho_{mercury} = 13600.0$ kg/m^3 and $P_{atm} = 1.013 \times 10^5$ Pa.

1. Two balls, A and B, of masses $2m$ and m, respectively, are raised to the same height h and then back to the initial point. The total work done by the gravitational force on B is:

[✓ A) the same as the work done on A.] B) one quarter the work done on A.
C) one half the work done on A. D) twice the work done on A.
E) four times the work done on A.

2. An object of mass 2 kg starts sliding from rest at the top of a rough inclined plane of height h =10 m, as shown in the figure,. If the speed of the object at the bottom of the inclined plane is 10 m/s, how much work (in J) is done by the force of friction?

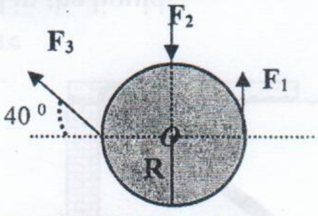


A) +96 [✓ B) -96]
C) 0 D) -192 E) +192

3. Power P is required to lift a body a distance d at a constant speed v. The power required to lift the body a distance $2d$ at constant speed $6v$ is: (ignore air resistance)

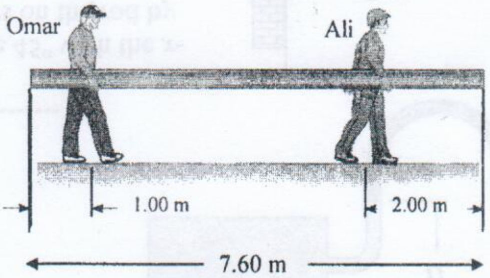
A) P B) $2P$ C) $3P$ [✓ D) $6P$] E) $3P/2$

4. If F_1= 15 N, F_2 = 22 N, F_3 = 9 N, the magnitude of the net torque around point O (in N.m) applied to the wheel of radius R= 0.80 m is:



[✓ A) 7.4] B) 5.2 C) 4.6
D) 2.9 E) 1.5

5. A uniform beam of length 7.60 m and weight 3.50×10^2 N is carried by two workers, Omar and Ali, as shown in the figure. The force that Omar exerts on the beam (in N) is:

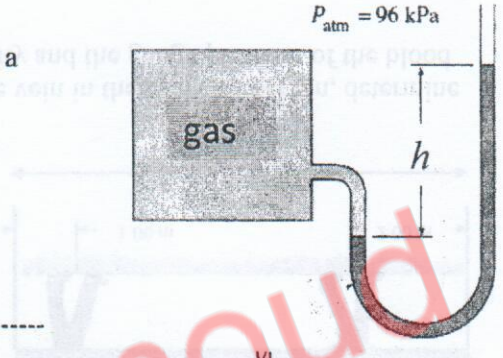


A) 176 [✓ B) 137] C) 96
D) 470 E) 320

6. If a vertical tube open to the atmosphere is connected to the vein in the arm of a person, determine how high the blood will rise in the tube (in m). Take the density and the gauge pressure of the blood to be 1050 kg/m^3 and 110 mmHg, respectively.

A) 0.76 B) 1.00 [✓ C) 1.42] D) 1.55 E) 0.07

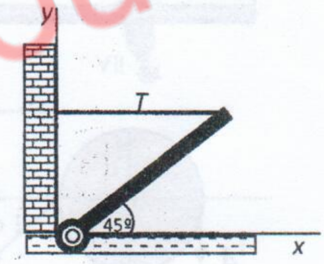
7. A manometer is used to measure the pressure of a gas in a tank. The fluid used has a specific gravity of 0.85, and the manometer column height is $h = 35$ cm, as shown in the figure. If the atmospheric pressure is 96 kPa, the absolute pressure within the tank (in kPa) is:



A) 50.2 B) 70.1 [✓ C) 98.9]
D) 120.9 E) 100.6

---

8. In the figure, the weight of the rod $W = 431$ N, and its length L = 8 m. The rod is at equilibrium making an angle 45° with the x-axis. The vertical component of the reaction force that acts on the rod by the hinge (in N)?



A) 352 N B) 500 N
C) 707 N D) 100 N [✓ E) 431]

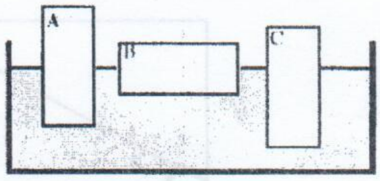
---

9. Two balls of the same radius but densities $\rho_1 = 2\rho_L$ and $\rho_2 = 4\rho_L$ are placed in a liquid of density ρ_L. What is the ratio $\left(\frac{\text{the weight of ball 1 in the liquid}}{\text{the weight of ball 2 in the liquid}}\right)$?

A) 2/3 B) 1/2 C) 3/4 D) 4/3 [✓ E) 1/3]

---

10. Three blocks labeled A, B, and C are floating in water as shown in the figure. Blocks A and B have the same mass and volume. Block C has the same volume, but is submerged to a greater depth than the other two blocks. Which one of the following statements concerning this situation is **false**?



A) The density of block A is less than that of block C.
B) The buoyant force acting on block A is equal to that acting on block B.
[✓ C) The volume of water displaced by block A is greater than that displaced by block B.]
D) The buoyant force acting on block C is greater than that acting on block B.
E) The volume of water displaced by block C is greater than that displaced by block B.

---

11. Air flowing horizontally with a speed v over the flat roof of a building reduces the pressure on the roof by an amount ΔP. What is the pressure reduction if the speed of the air is $3v$? Assume that the air was still initially.

A) 0 B) 4ΔP [✓ C) 9ΔP] D) ΔP/9 E) ΔP/4

---

12. 2 Liters/s of water enter a pipe of radius 1 cm. The speed of the water inside the pipe (in m/s) is:

[✓ A) 6.37] B) 3.71 C) 0.28 D) 8.46 E) 12.7

List your final answers in this table. Only the answer in this table will be graded.

Question	**Q1:**	**Q2:**	**Q3:**	**Q4:**	**Q5:**	**Q6:**	**Q7:**	**Q8:**	**Q9:**	**Q10:**	**Q11:**	**Q12:**
Final Answer	A	B	D	A	B	C	C	E	E	C	C	A

Physics (105)
Second Exam Solutions

ا.د. محمود الجاغوب

Q1] Vertical displacement $= 0 \Rightarrow$ <u>total</u> work done on each ball $= 0$.

Q2] $\Delta K + \Delta U = W_{nc}$

$\therefore W_{nc} = \frac{1}{2}(2)(100-0) - 2g(10) = -96\ J$

Q3] in each case $F = mg$ since $a = 0$ as the speed is constant.

$P = Fv$

$P' = F(6v) = 6Fv = 6P$

Q4] $+\circlearrowleft O$ $\tau = F_1(0.8) - F_3 \sin 40\ (0.8)$

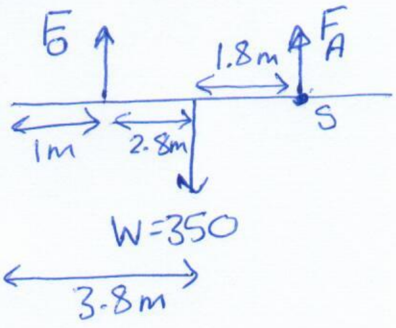
$= 0.8(F_1 - F_3 \sin 40) \simeq 7.4\ N.m$

(Note: F_2 does no torque about O as its line of action passes through point O).

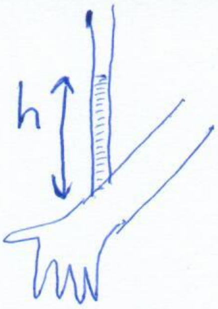
Q5] $\circlearrowleft S$ $350(1.8) - F_0(4.6) = 0$

$\therefore F_0 \simeq 137\ N.$

$F_{omar} \nearrow F_0$



Q6] $$P_{blood} = \rho_{blood}\, g h + P_{atm}$$



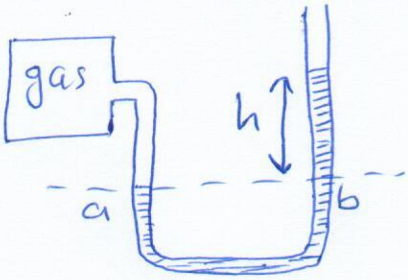
$$\underbrace{P_{blood} - P_{atm}} = \rho_{blood}\, g h$$

$$P^{gage}_{blood} = \rho_{blood}\, g h$$

$$\Rightarrow h = \frac{P^{gauge}_{blood}}{\rho_{blood}\, g} = \frac{110 \ mmHg \times \left(\frac{1.013\times10^{5} \ Pa}{760 \ mmHg}\right)}{1050 \frac{kg}{m^3} \times 9.8 \frac{m}{s^2}}$$

$$h = 1.42 \ m$$

Q7] $$P_a = P_b$$

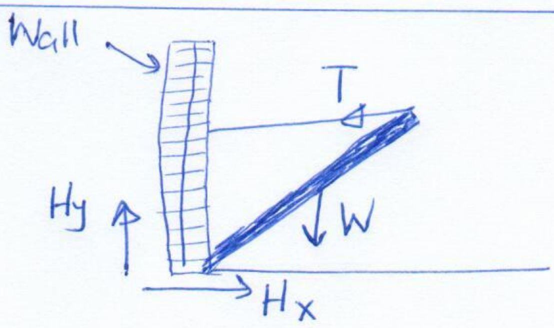


$$P_{gas} = \rho_F\, g h + P_{atm}$$

$$= (0.85\times1000)(9.8)(0.35) + 96\times10^{3}$$

$$= 98.9\times10^{3} \ Pa = 98.9 \ kPa .$$

Q8] Hy and Hx are the vertical and horizontal components of the reaction force.

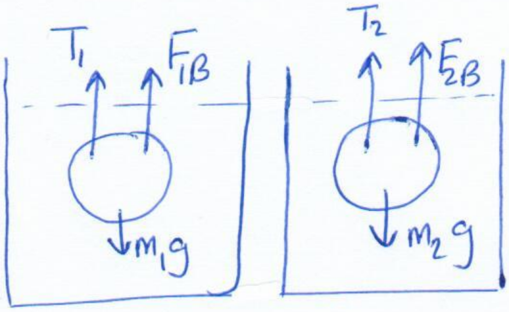


$$\sum F_y = 0 \Rightarrow \overset{+}{\uparrow} \quad H_y - W = 0$$

$$H_y = W = 431 \ Newtons.$$

Q9] Two balls have the same radius ⇒ they have the same <u>volume</u>. (V)

$\rho_1 = 2\rho_L$, $\rho_2 = 4\rho_L$ ⇒ both are totally submerged under liquid.



T_1 : weight of ball 1

T_2 : weight of ball 2

$$T_1 + F_{1B} = m_1 g \Rightarrow T_1 = m_1 g - F_{1B}$$
$$= \rho_1 V g - \rho_L V g$$
$$= 2\rho_L V g - \rho_L V g = \rho_L V g$$

Similarly

$$T_2 + F_{2B} = m_2 g \Rightarrow T_2 = m_2 g - F_{2B}$$
$$= \rho_2 V g - \rho_L V g$$
$$= 4\rho_L V g - \rho_L V g = 3\rho_L V g$$

$$\Rightarrow \frac{T_1}{T_2} = \frac{\rho_L V g}{3\rho_L V g} = \frac{1}{3}.$$

Q10] A and B have same mass and volume ⇒ $\rho_A = \rho_B = \rho$

C is submerged more than A and B ⇒ $\rho_C > \rho$

Since bolck A and block B have the same mass and volume (same density) ⇒ they must displace the same volume of the liquid.

Q11]

$\underline{P_1 \,, v_1^{air} = 0}$ $\underline{P_1' \,, v_1^{air} = v}_{roof}$

use Bernoulli's equation

$P_1 + 0 = P_1' + \frac{1}{2}\rho v^2$ (note height is the same

$\therefore P_1 - P_1' = \Delta P = \frac{1}{2}\rho v^2$

Now, $v \rightarrow 3v$

$P_2 + 0 = P_2' + \frac{1}{2}\rho(3v)^2 = P_2' + 9 \times \frac{1}{2}\rho v^2$

$\therefore P_2 - P_2' = 9\left(\frac{1}{2}\rho v^2\right) = 9\Delta P$

12]

$Av \equiv$ volume flow rate

$\therefore \pi(1\times10^{-2})^2 v = \underbrace{2\times10^{-3}}_{\text{volume in } m^3}$

$\Rightarrow v \simeq 6.37$ m/s

THE UNIVERSITY OF JORDAN **PHYSICS DEPARTMENT**

PHYSICS 105 (2nd EXAM) [redacted]

Student's Name (Arabic):………………………………………… Registration #……………….

Lecturer's Name:……………………………………………………… Section # ……………………..

$g = 9.8\ m/s^2 \cdot \rho_{water} = 1000\,kg/m^3$, $P_0 = 1.013 \times 10^5$ Pa, $\rho_{blood} = 1050\,kg/m^3$

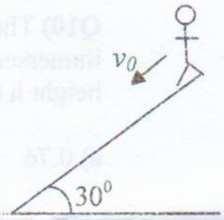
Q1) A boy lifts a 4 kg mass vertically upwards a distance of 2m at constant speed. The work (in J) done by the boy is

[✓ a) 78.4] b) 19.6 c) 39.2 d) -19.2 e) -78.4

Q2) A stone is thrown vertically upwards. Ignoring air resistance, which of the following statements is correct?

a) The sum of the kinetic and potential energies is zero.
b) As the stone rises the potential energy decreases.
c) As the stone descends the kinetic energy decreases.
[✓ d) The total mechanical energy is conserved.]
e) The change in the potential energy equals the change in the kinetic energy.

Q3) A skier slides down a 30^0 inclined path as shown in the figure. He starts with an initial velocity of 6 m/s and slides down the hill a distance of 20 m. If the coefficient of kinetic friction between the ice and his skies is 0.15, determine his speed (in m/s) at the bottom of the hill.



a) 15.7 b) 17.2 c) 16.8 [✓ d) 13.5] e) 8.2

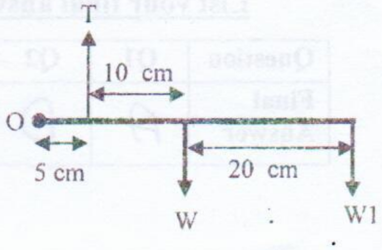
Q4) The average power output of a 60 – kg running athlete is 400 W. The work (in k J) that he does in 5 minutes is:

a) 60.0 [✓ b) 120] c) 0 d) 1.5 e) 90

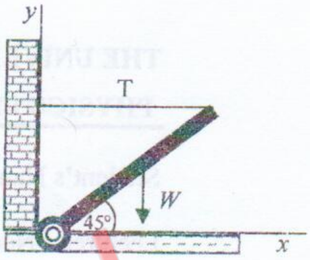
Q5) The figure shows a see – saw of length L = 6 m pivoted in the middle at point O. A 20 – kg boy sits at point A and a 30 kg boy sits at point B. How far from point O (in m) should a 15 kg child sit so that the see –saw is in static equilibrium?

a) 2 to the right of O [✓ b) 2 to the left of O] c) 1.3 to the left of O
d) 1.3 to the right of O e) at point O

Q6) The figure shows the forearm modeled as a beam kept horizontally in static equilibrium by the tension T exerted by the biceps muscle. The arm rotates about point O at the **elbow joint**. The weight of the forearm is W = 12 N. If the forearm carries a weight W1 = 15 N, calculate the tension T (in N) in the biceps muscle to keep the forearm in static equilibrium in a horizontal position.



a) 34 b) 106 c) 20
d) 12 [✓ e) 141]



Q7) In the figure, the weight of the uniform beam $W = 500$ N, and its length $l = 8$ m. A massless cable holds the beam in static equilibrium at an angle of 45° with the x-axis. The **horizontal** component of the hinge force (in N) acting at the joint (point O) is:

[✓ a) 250]   b) 352   [✓ c) 250]

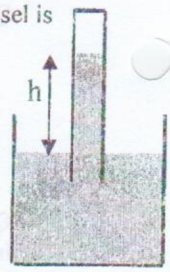
d) 500   e) 707

Q8) A 60 – kg man just floats in water with all of his body below the water surface. What is his volume (in m^3) ?

a) 1.2   [✓ b) 0.08]   [✓ c) 0.06]   d) 0.6   e) 1.0

Q9) A blood vessel of radius r splits into three vessels, each of radius $r/4$. If the velocity in the larger vessel is v, then the velocity in each of the smaller vessels is

a) $3v/16$ b) $v/3$ c) $9v/4$ [✓ d) $16v/3$]   e) v



Q10) The figure shows a long **evacuated** tube with its open lower end immersed in water. The water tank is open to the atmosphere. The maximum height h (in m) the water can rise in the evacuated tube is:

a) 0.76   [✓ b) 10.3]   c) 9.1   d) 3   e) 6.6

Q11) A 6.0 cm radius horizontal pipe gradually narrows down to 5.0 cm. If $P_1 = 30$ kPa and $V_2 = 6$ m/s, then the value of the pressure P_2 (in kPa) is:

a) 39.3   b) 63.5   [✓ c) 20.7]

d) 209.6   e) 24.2

Q12) An object of density ρ is placed in a fluid of density ρ_F. Assume the only forces acting on the object are its weight and the buoyant force. Which of the following statements is correct?

a) The buoyant force depends on the density of the object.

[✓ b)] The buoyant force is due to the increase in the fluid pressure with depth below the fluid surface.

c) If $\rho_F > \rho$, the object sinks.

d) If $\rho_F < \rho$, the object floats.

e) None of the above is correct.

List your final answers in this table. Only the answer in this table will be graded

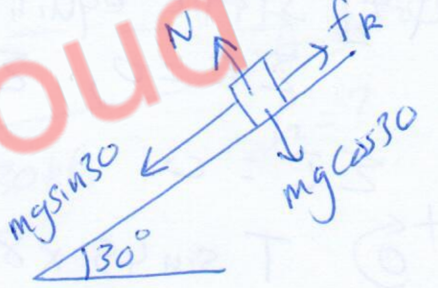
Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Final Answer	A	D	D	B	B	E	C	C	D	B	C	B

A

Physics (105)/2^{nd} exam
Nov. 29 /2016

Q1] $W_{ext} = \Delta U \Rightarrow W_{boy} = \Delta U = mgh = 4\times 9.8\times 2 = 78.4\ J$ ⓐ

Q2] The total mechanical energy is conserved. ⓓ



Q3] #mg is a conservative force

#N isanon-conservative force but does NO work.

f_k is a non-conservative force and does negative work.

distance moved down the incline

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

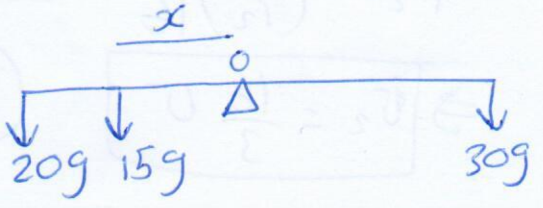
$$\frac{1}{2}m(v_f^2 - v_i^2) - mgd\sin30 = (f_k)(d)\cos180^\circ$$

$$\frac{1}{2}\cancel{m}(v_f^2 - v_i^2) - \cancel{m}gd\times\frac{1}{2} = -\mu_k(\cancel{m}g\cos30)(d)$$

$$v_f^2 = v_i^2 + gd - \mu_k gd\sqrt{3} \Rightarrow v \simeq 13.5\ m/s$$ ⓓ

Remember $\cos30 = \frac{\sqrt{3}}{2}$

Q4] $\bar{P} = \frac{W}{t} \Rightarrow W = \bar{P}t = 400\times5\times60 = 120{,}000$
$= 120\ kJ$ $\boxed{b}$



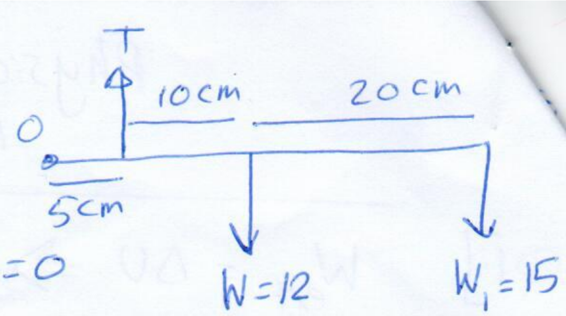
Q5] 15 kg child should sit on the same side as the lighter boy i.e on the left hand side of 'O'

$+\circlearrowleft_O$ $20\cancel{g}(3) + 15\cancel{g}x - 30\cancel{g}(3) = 0$

$\Rightarrow x = 2\ m$ (to the left of O) ⓑ

Q6] static equilibrium

$\Rightarrow \sum \tau = 0$

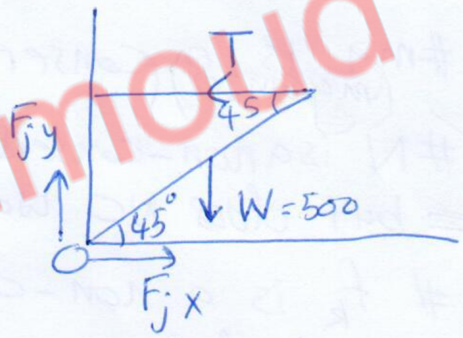


$+\circlearrowleft_{O} \quad T(0.05) - 12(0.15) - 15(0.35) = 0$

$\Rightarrow T = 141 \text{ N} .$ $\boxed{e}$

Q7] static equilibrium $\Rightarrow$

$\sum \tau = 0, \quad \sum \vec{F} = 0$



$\sum \tau = 0$

$+\circlearrowleft_{O} \quad T \sin 45 \times 8 - W \sin 45 \times 4 = 0$

$\therefore T = \frac{4W}{8} = \frac{W}{2} = 250 \text{ N}.$

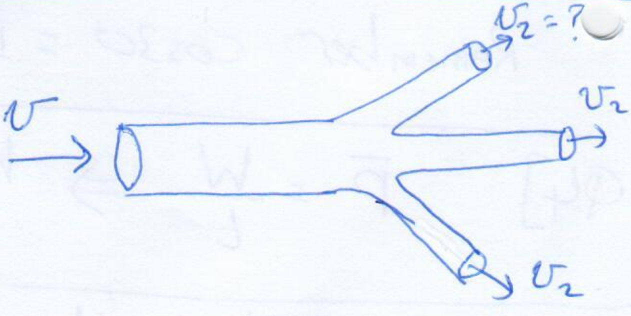
$\sum F_x = 0$

$\rightarrow + \quad F_{jx} - T = 0 \Rightarrow F_{jx} = 250 \text{ N}.$ (c)

Q8] $F_B = mg$

$\rho_F V \cancel{g} = m\cancel{g} \Rightarrow V = \frac{m}{\rho_F} = \frac{8\cancel{0}}{100\cancel{0}} = 0.08 \text{ m}^3$

Q9] $A_1 v_1 = 3 A_2 v_2$



$\cancel{\pi} r_1^2 v = 3 \cancel{\pi} r_2^2 v_2$

$r^2 v = 3 \frac{r^2}{16} v_2$

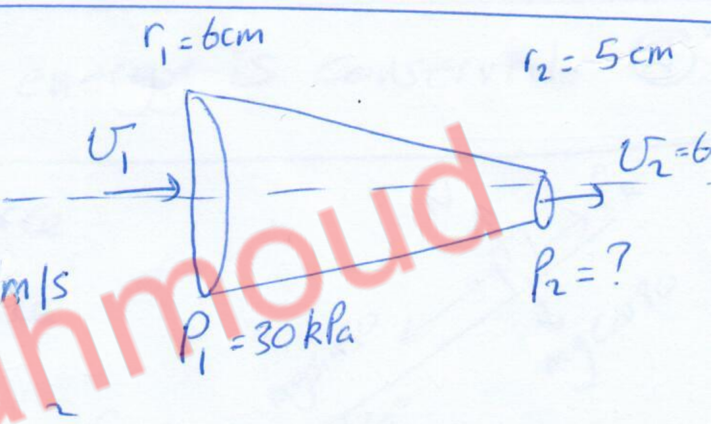
$\Rightarrow \boxed{v_2 = \frac{16}{3} v}$ (d)

10] $P_{water} = P_0$ ← atmospheric pressure

$$\rho_w g h = 1.013\times10^5 \Rightarrow h = \frac{1.013\times10^5}{(9.8)\times10^3} = 10.3 \text{ m}$$

$\boxed{B}$

Q11] $A_1 v_1 = A_2 v_2$



$$\cancel{\pi}(0.06)^2 v_1 = \cancel{\pi}(0.05)^2 v_2$$

$$v_1 = \left(\frac{0.05}{0.06}\right)^2 (6) \simeq 4.167 \text{ m/s}$$

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

[remember $mgh_1 = mgh_2$ since pipe is horizontal

$$P_2 = P_1 + \frac{1}{2}\rho(v_1^2 - v_2^2) = 30\times10^3 + \frac{1}{2}\times1000(v_1^2 - v_2^2)$$

$$= 20.7 \text{ kPa}$$ Ⓒ

---

q12] Ⓑ

Problem 1: Minimum Gauge Pressure for Water Pumping

Question: What is the minimum gauge pressure needed to pump water to a faucet 38 m high?

Options:

A. 37.3 kPa

B. 38.0 kPa

C. 400 kPa

D. 370 kPa

Answer: D. 370 kPa

Explanation: The gauge pressure P needed can be calculated using the formula:

$$P = \rho \cdot g \cdot h$$

Where:

- $\rho = 1000\,\mathrm{kg/m^3}$ (density of water)
- $g = 9.81\,\mathrm{m/s^2}$ (acceleration due to gravity)
- $h = 38\,\mathrm{m}$

  So,

$$P = 1000 \cdot 9.81 \cdot 38 \approx 373,080\,\mathrm{Pa} \text{ or } 373.08\,\mathrm{kPa}$$

Problem 2: Buoyancy in Water

Question: If you have a piece of wood in one hand and a piece of iron in the other, both with the same volume, which will experience greater buoyancy when submerged in water?

Options:

A. the iron

B. the wood

C. both will experience the same

D. both will experience zero buoyancy

Answer: C. both will experience the same

Explanation: The buoyant force experienced by an object is equal to the weight of the water displaced, which depends only on the volume submerged. Since both pieces have the same volume, they experience the same buoyant force.

Problem 3: Center of Mass Calculation

Question: A board with two scales has a height of 180 cm. If $F_1 = 425\,\mathrm{N}$ and $F_2 = 375\,\mathrm{N}$, calculate the center of mass from the feet. (Assume F_2 is under the feet.)

Options:

A. 90 cm

B. 105 cm

C. 115 cm

D. 180 cm

Answer: B. 105 cm

Explanation: The center of mass (CM) can be calculated using the formula:

$$CM = \frac{F_1 \cdot d_1 + F_2 \cdot d_2}{F_1 + F_2}$$

Where d_1 and d_2 are the distances of F_1 and F_2 from a reference point (feet). With the given forces and heights, you can find the exact location.

Problem 4: Diameter of a Wire

Question: A wire can stretch 5 mm with a tensile force of 800 N and has an initial length of 2 m. Calculate the diameter of the wire given the elastic constant $E = 2 \times 10^{11}$.

Options:

A. 5 mm

B. 6 mm

C. 7 mm

D. 8 mm

Answer: A. 5 mm

Explanation: Use Young's modulus formula:

$$E = \frac{F/A}{\Delta L/L_0}$$

Calculate the area A using the diameter and then derive the diameter.

Problem 5: Torque on a Rectangle

Question: A rectangle 1 m wide and 2 m long has two forces acting on it, $F_1 = 12\,\mathrm{N}$ and $F_2 = 14\,\mathrm{N}$ (with F_1 counterclockwise along the width and F_2 along the length). Calculate the net torque.

Options:

A. (+5 N·m)

B. (-5 N·m)

C. (+9 N·m)

D. (-9 N·m)

Answer: A. (+5 N·m)

Explanation: Calculate individual torques and find the net torque considering directions.

Problem 6: Horizontal Component of Hinge Force

Question: A beam with a mass of 20 kg and a box of mass 45 kg is placed 0.4L from the left end. The beam is suspended at the right end at an angle of 30°. Calculate the horizontal component of the hinge force.

Options:

A. 400 N

B. 475 N

C. 500 N

D. 450 N

Answer: B. 475 N

Explanation: Use equilibrium equations to solve for the horizontal component of the hinge force.

Problem 7: Density of a Sphere

Question: A sphere has a volume of $1.25 \times 10^{-3}\,\mathrm{m}^3$ and weighs 96 N in water. What is its density?

Options:

A. 76.8 kg/m³

B. 85.4 kg/m³

C. 80 kg/m³

D. 90 kg/m³

Answer: C. 80 kg/m³

Explanation: Density can be calculated by dividing the weight in water by the volume.

Problem 8: Pressure Difference Calculation

Question: If the velocity of water v_1 is 6 m/s and the second velocity is $A/2$, calculate $P_1 - P_2$.

Options:

A. 54000 Pa

B. 48000 Pa

C. 50000 Pa

D. 56000 Pa

Answer: A. 54000 Pa

Explanation: Use Bernoulli's principle to find the pressure difference based on the velocities.

Problem 9: Center of Mass of the Human Leg

Question: The human leg consists of three uniform pieces with masses of 1.5 kg, 4 kg, and 8 kg for the feet, lower leg, and upper leg, respectively. Calculate the center of mass from the sole of the feet.

Options:

A. 45 cm

B. 47.7 cm

C. 50 cm

D. 55 cm

Answer: B. 47.7 cm

Explanation: Use the center of mass formula, incorporating the distances from the sole of the feet.

Problem 10: Force Exerted by Muscle

Question: An arm with a mass of 8.4 kg is holding a 1.8 kg ball. If the center of mass of the arm is 15 cm from the elbow and the ball is 33 cm away, calculate the force exerted by the muscle located 4 cm from the elbow.

Options:

A. 120 N

B. 100 N

C. 140 N

D. 160 N

Answer: C. 140 N

Explanation: Use torque equilibrium to find the muscle force.

Problem 11: Mass from Stretching

Question: A steel wire with a diameter of 2.3 mm stretches by 0.03% when a mass is suspended from it. Given Young's modulus is 2×10^{11}, how much is the mass?

Options:

A. 25 kg

B. 34 kg

C. 32 kg

D. 36 kg

E. 42 kg

Answer: D. 36 kg

Explanation: Use the formula for Young's modulus and rearrange to find the mass.

Problem 12: Bernoulli's Equation

Question: Bernoulli's Equation is used to describe which of the following?

Options:

A. conservation of mass

B. conservation of energy

C. conservation of volume

D. mass balancing

Answer: B. conservation of energy

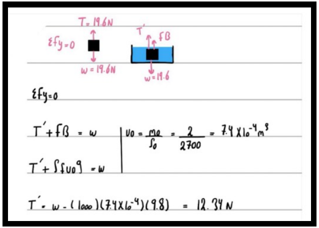
Explanation: Bernoulli's equation relates pressure, velocity, and height, embodying the conservation of energy principle in fluid dynamics.

Problem : An Aluminum Block Suspended in Water

Question: An aluminum block with a mass of 2 kg and a density of 2.7 kg/m³ is suspended after being submerged in water. Its weight before submersion is 19.6 N. Calculate the tension T in the supporting string when submerged.

Given:

- Weight of aluminum $W = 19.6\,\mathrm{N}$
- Density of aluminum $\rho = 2.7\,\mathrm{kg/m^3}$
- Volume $V = \frac{m}{\rho} = \frac{2\,\mathrm{kg}}{2.7\,\mathrm{kg/m^3}} \approx 0.74\,\mathrm{m^3}$
- Buoyant force $F_B = \rho_{water} \cdot g \cdot V$ (where $\rho_{water} = 1000\,\mathrm{kg/m^3}$)



$\Sigma f_y = 0$

$T' + f_B = w$ | $V_0 = \frac{m_a}{\rho_a} = \frac{2}{2700} = 7.4 \times 10^{-4}\,m^3$

$T' + \rho_f V_0 g = w$

$T' = w - (1000)(7.4 \times 10^{-4})(9.8) = 12.34\,N$

Options: A. 5 N

B. 12.34 N

C. 19.6 N

D. 7.34 N

Answer: B. 12.34 N

Explanation: The buoyant force F_B is equal to the weight of the water displaced.

$$F_B = \rho_{water} \cdot g \cdot V = 1000 \cdot 9.81 \cdot 0.74 \approx 7253\,\mathrm{N}$$

Then, applying $E_{fy} = 0$:

$$T + F_B - W = 0 \Rightarrow T = W - F_B = 19.6 - 7.25 \approx 12.34\,\mathrm{N}$$

Problem : Center of Mass of a Person on a Beam

Question: A uniform beam is 10 m long and has a mass of 20 kg. A person with a mass of 60 kg stands at the end of the beam. How far is the center of mass of the (person + beam system) from the person?

Options: A. 2.5 m
B. 5 m
C. 10 m
D. 7.5 m

Answer: C. 10 m
Explanation: The center of mass of the system can be calculated using the formula:

$$CM = \frac{m_1 \cdot d_1 + m_2 \cdot d_2}{m_1 + m_2}$$

Where:

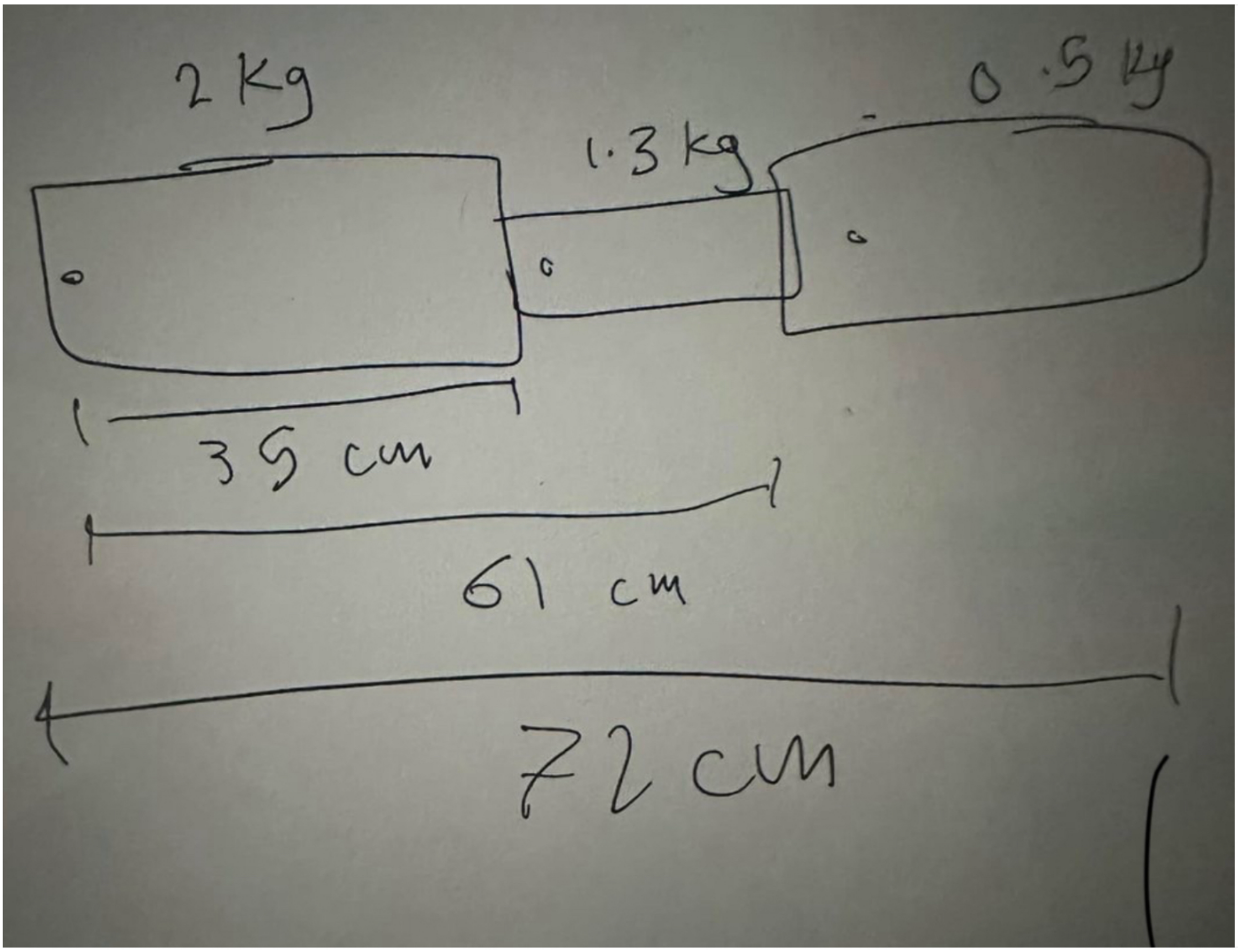
- $m_1 = 20\,\mathrm{kg}$ (mass of the beam)
- $m_2 = 60\,\mathrm{kg}$ (mass of the person)
- $d_1 = 5\,\mathrm{m}$ (center of the beam)
- $d_2 = 10\,\mathrm{m}$ (end of the beam)

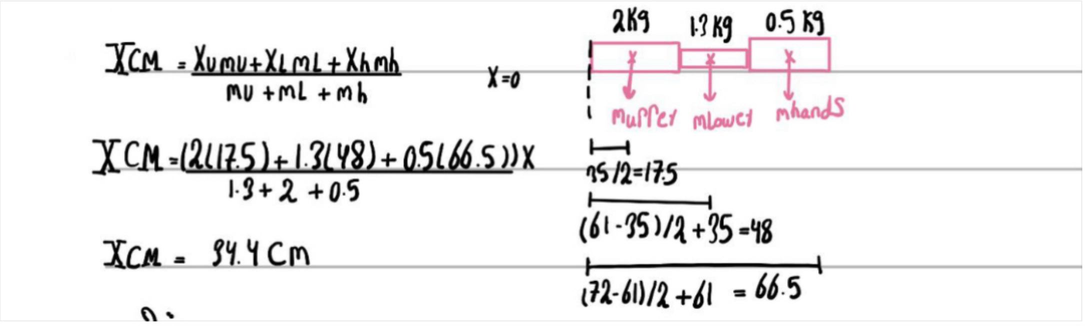
Plugging in the values:

$$CM = \frac{(20 \cdot 5) + (60 \cdot 10)}{20 + 60} = \frac{100 + 600}{80} = \frac{700}{80} = 8.75\,\mathrm{m}$$

From the person standing at the end of the beam (10 m), the distance to the center of mass is $10\,\mathrm{m} - 8.75\,\mathrm{m} = 1.25\,\mathrm{m}$.

-this is the model of a human arm that is 72 cm long and I have 3 dots on it (Shoulder joint / elbow / wrist) ,, The rotation axis is from the left , Calculate the Central of mass..





$$X_{CM} = \frac{X_u m_u + X_L m_L + X_h m_h}{m_u + m_L + m_h}$$

X=0

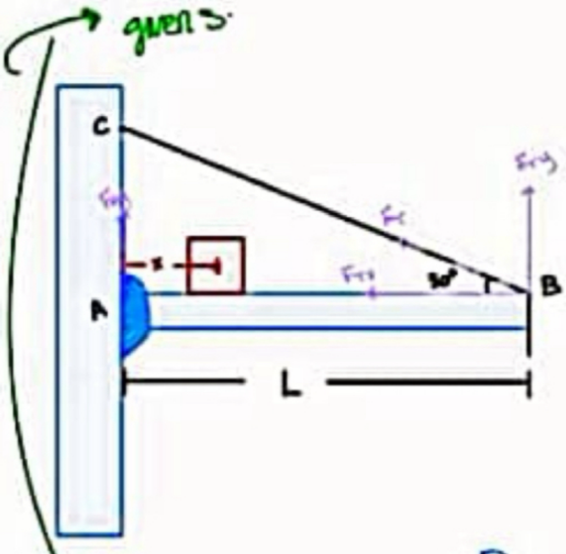
$$X_{CM} = \frac{(2(17.5) + 1.3(48) + 0.5(66.5))}{1.3 + 2 + 0.5} X$$

$$X_{CM} = 34.4 \text{ Cm}$$

35/2=17.5

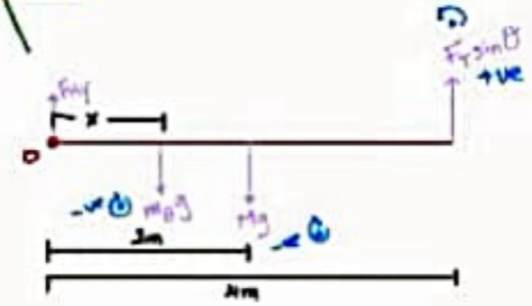
(61-35)/2+35=48

(72-61)/2+61 = 66.5



Givens:

AB = 4m
weight of Beam = 200N
Weight of Box = 300N
FT in cord CB = 500N
$\theta = 30°$
Find x = ?



solutions:-

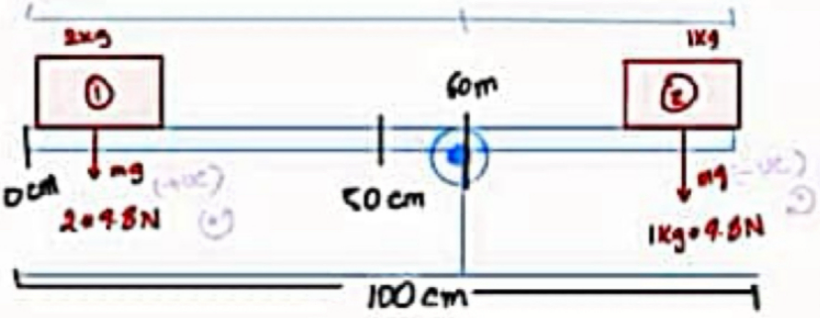
→ Tnet = 0

$(F_T \sin\theta * 4) - (300 * x) - (200 * 2) = 0$

$\frac{(500 * \sin(30) * 4) - (200 * 2)}{300} = x$

$x = 2$

* Not sure of ans. but generally this question idea *



Given:-

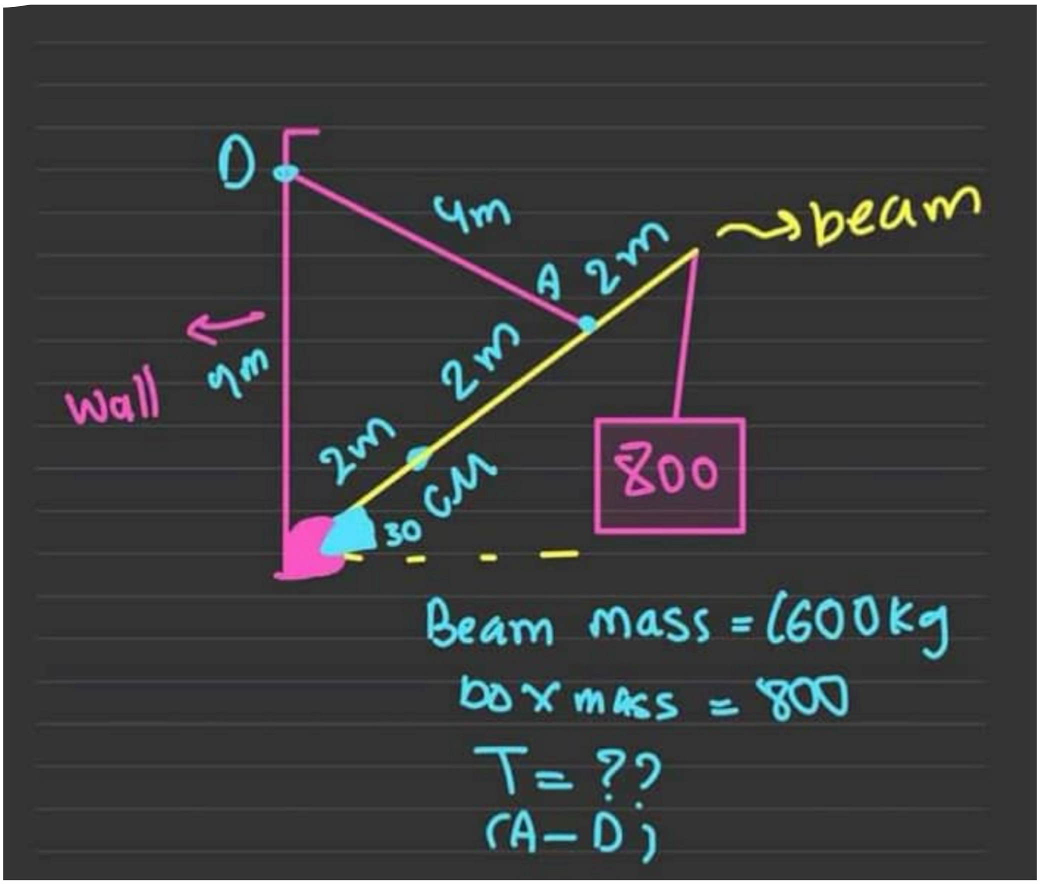
$M_1 = 2kg$ $M_2 = 1kg$
Pivot at 60cm.
Neglect mass of board.
Tnet = ?

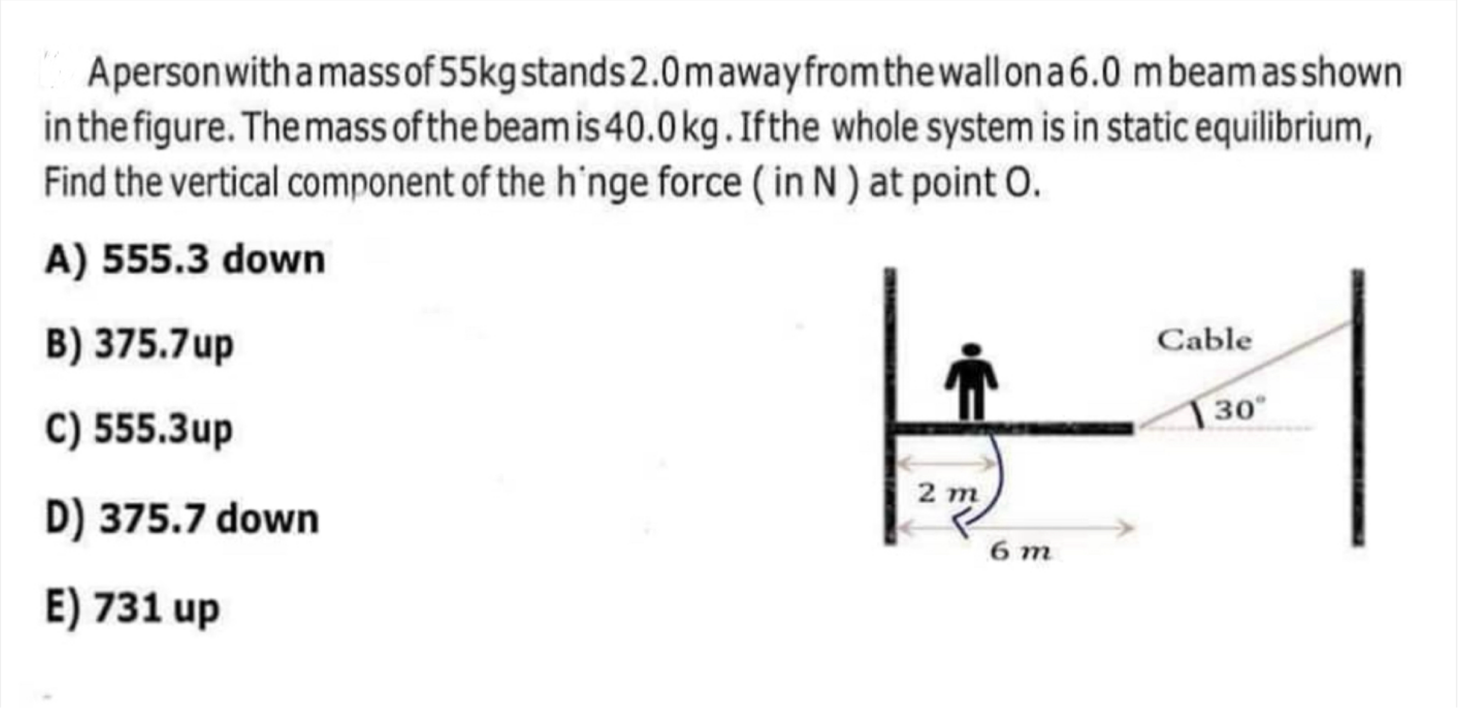
Solution:-

→ $T_{net} = (r * m_2 g) - (r * m_1 g)$

$= (60 * 10^{-2})(2 * 9.8) - (40 \times 10^{-2})(1 * 9.8)$

$= 7.84m \approx 8m.$





A person with a mass of 55kg stands 2.0 m away from the wall on a 6.0 m beam as shown in the figure. The mass of the beam is 40.0 kg. If the whole system is in static equilibrium, Find the vertical component of the hinge force (in N) at point O.

A) 555.3 down

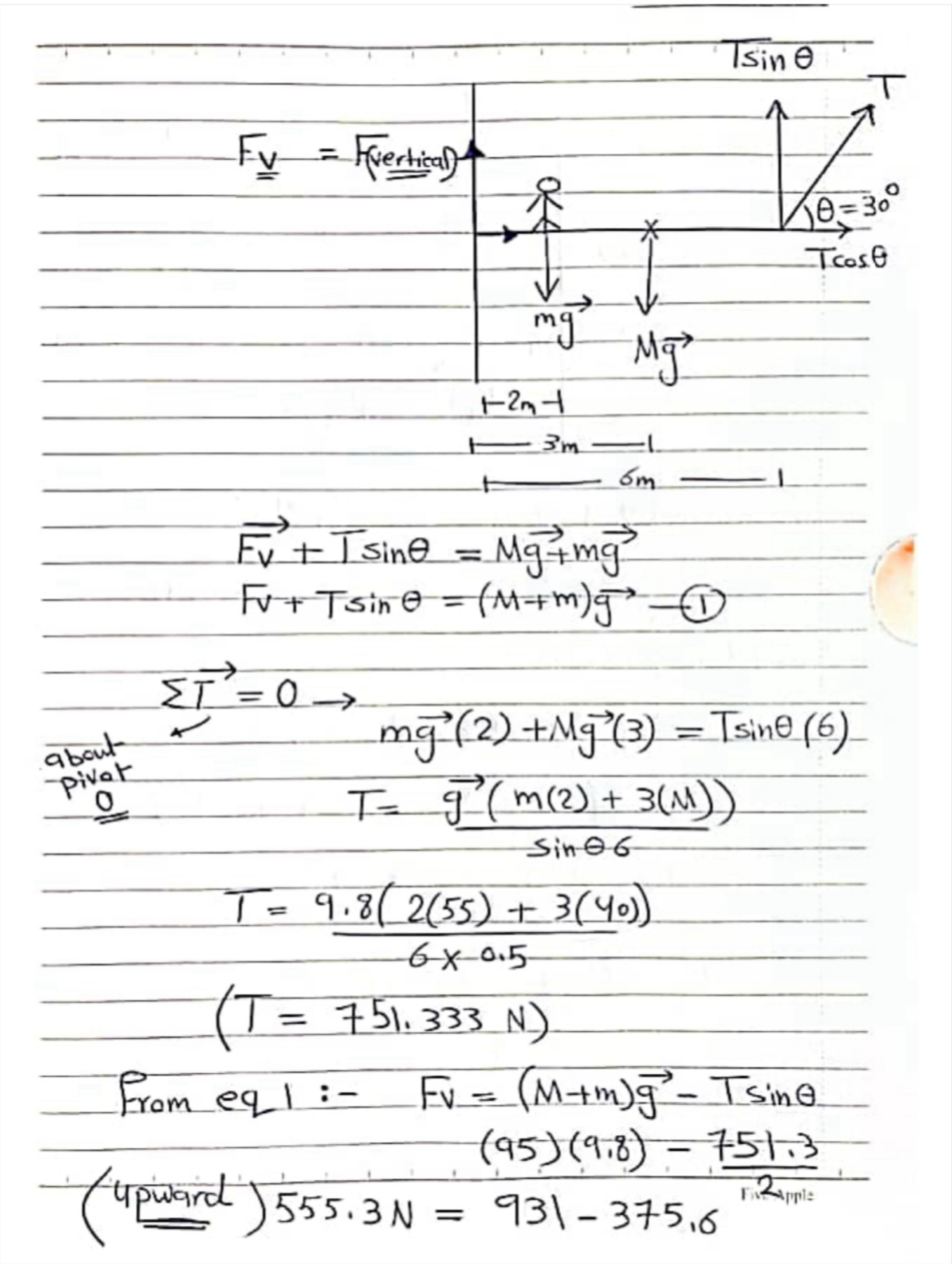
B) 375.7up

C) 555.3up

D) 375.7 down

E) 731 up

Ans :



$$\vec{F_V} + T\sin\theta = M\vec{g} + m\vec{g}$$

$$F_V + T\sin\theta = (M+m)\vec{g} \text{ — ①}$$

$$\sum \vec{T} = 0 \rightarrow$$

about pivot $\underline{\underline{O}}$

$$m\vec{g}(2) + M\vec{g}(3) = T\sin\theta\,(6)$$

$$T = \frac{\vec{g}(m(2) + 3(M))}{\sin\theta\, 6}$$

$$T = \frac{9.8(2(55) + 3(40))}{6 \times 0.5}$$

$$(T = 751.333 \text{ N})$$

From eq 1 :- $F_V = (M+m)\vec{g} - T\sin\theta$

$$(95)(9.8) - \frac{751.3}{2}$$

$(\underline{\underline{\text{upward}}})\ 555.3\text{ N} = 931 - 375.6$

Question: If the radius of an artery decreases from 0.95 cm to 0.5 cm, how much must the heart pressure increase in order to maintain the same flow Q?

Answer:

Using Poiseuille's law:

$$Q = \frac{\pi r^4 (P_1 - P_2)}{8 \eta L}$$

1. **Initial radius** $r_1 = 0.95$ cm
2. **Final radius** $r_2 = 0.5$ cm

The flow rate must remain constant. The relationship between the pressure difference and the radius can be expressed as:

$$\frac{Q}{P} \propto r^4$$

Let P_1 be the initial pressure and P_2 be the new pressure required to maintain flow. Setting up the ratios:

$$\frac{P_1 - P_2}{P_1} = \left(\frac{r_2}{r_1} \right)^4$$

Calculating:

$$\left(\frac{0.5}{0.95} \right)^4 \approx 0.24$$

This indicates the pressure must increase significantly to maintain the same flow. The exact value of the pressure increase depends on the initial pressure P_1.