THE UNIVERSITY OF JORDAN **PHYSICS DEPARTMENT**

PHYSICS 105 (First Exam) **First Semester (October. 30th, 2017)**

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

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

***CONSIDER (ACCELERATION DUE TO GRAVITY) g = 9.8 m/s²**

Q1) The position of an object (in m) is given as a function of time (in s) as $x(t) = (3.0)t + (2.0)t^2$. What is the average velocity of the object (in m/s) between $t = 0.0$ s and $t = 3.0$ s?

A) 7.0 B) 13 C) 27 D) 9.0 E) 3.0

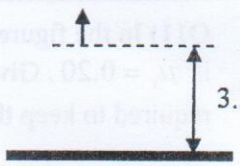
Q2) A stone is thrown vertically upwards reaches a highest point and returns to the ground. When the stone is at the top of its path, its acceleration

A) changes direction from upwards to downwards.
B) is zero.
C) is directed upwards.
D) is directed downwards.
E) none of the above.

Q3) A car starting from rest travels a distance of 20.0 m with an acceleration of 2.0 m/s². The car then slows to a stop uniformly in 5.00 seconds. The distance traveled by the car during the whole time period (in m) is:

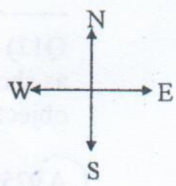
A) 36.8 B) 42.4 C) 50.1 D) 58.3 E) 64.7

Q4) A ball is thrown vertically upwards with a speed of 12 m/s. If the ball starts at an initial height of 3.5 m, how long (in s) the ball is in the air?



A) 3.3 B) 1.5 C) 6.6
D) 2.7 E) 0.41

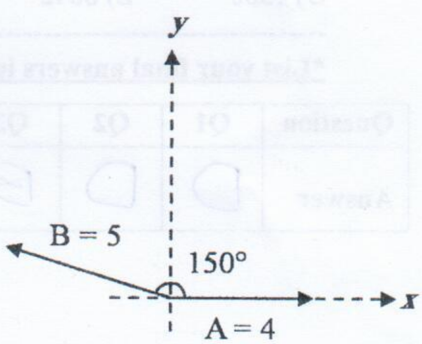
Q5) A car starts from the origin and drives 2.2 km south, then 3.1 km in a direction 53° north of east. What is the car's final position relative to the origin?



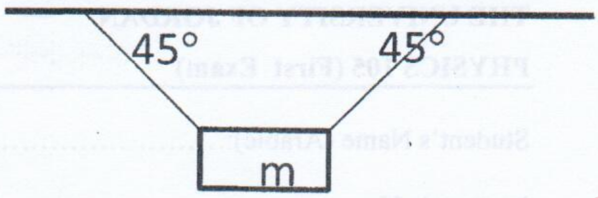
A) 1.9 km east
B) 3.1 km east and 1.2 km south
C) 1.9 km east and 1.3 km north
D) 1.9 km east and 2.5 km north
E) 1.9 km east and 0.3 km north

Q6) Vectors **A** and **B** are represented as shown in the figure. What is the angle of their resultant with respect to the positive x-axis?

A) −77° B) −82° C) 283°
D) 103° E) 98°

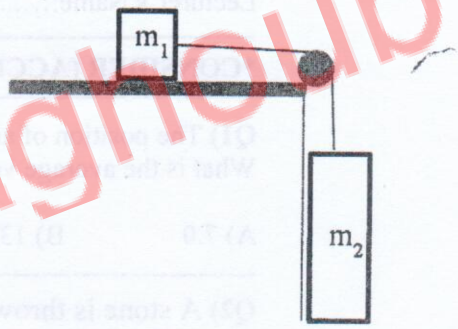


Q7) A box of mass M = 50 kg is suspended by two massless cables as shown below. Find the tension in the cable on the left.



A) 740
B) zero
C) 346
D) 520
E) 75

Q8) Two blocks are connected by a massless string which runs over a massless pulley as shown in the figure. The coefficient of kinetic friction between the mass m_1 and the horizontal surface is $\mu_k = 0.40$ and $m_1 = 3.0$ kg, $m_2 = 9.0$ kg. The acceleration of the system (in m/s^2) is:

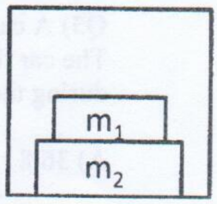


A) 6.4
B) 32
C) 9.8
D) 4.9
E) 140

Q9) A block of mass 0.52 kg is sliding on a rough horizontal surface. If the block has an initial speed of 60 m/s, and slides a distance of 2200 m before coming to rest, the work done by friction (in J) is:

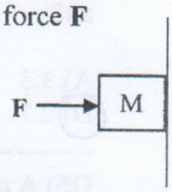
A) −36
B) −14
C) −936
D) − 414
E) −122

Q10) Two blocks of mass $m_1 = 3.0$ kg and mass $m_2 = 14$ kg are sitting on the floor of a container as shown. If the container is accelerating downward at 3.5 m/s^2, the magnitude of the force of block 1 on block 2 (in N) is:



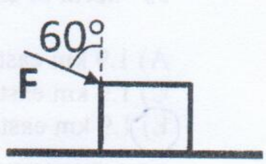
A) 19
B) 29
C) 49
D) 35
E) 54

Q11) In the figure shown, the coefficient of static friction between the mass M and the vertical wall is $\mu_s = 0.20$. Given that M = 4.0 kg, determine the minimum value of the horizontal force **F** required to keep the mass M stationary.



A) 98
B) 20
C) 196
D) 47
E) 0.0

Q12) A force F of 50 N is applied to a box of mass 5 kg moving on the floor as shown in the diagram. How much work (in J) is done by this force as the object moves 60 m?



A) 2598
B) 5196
C) 3000
D) 1500
E) 8042

***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
Answer	D	D	B	D	E	E	C	A	C	A	C	A

Physics (0342105)/First Exam
30th OCT /2017
Sample Solutions / Prof. Mahmoud Jaghoub

Q1] $\bar{v}_{0-3} = \dfrac{x_f - x_i}{t_f - t_i} = \dfrac{x(3) - x(0)}{3 - 0} = \dfrac{27 - 0}{3} = 9 \text{ m/s}$

Q2] D) acceleration is directed downwards.

Note: Gravitational acceleration is always towards the center of the earth (downwards) independent of the direction of motion.

Q3] $\Delta x_1 = 20$ m, $a = 2$ m/s^2 in first phase of motion, $v_{1i} = 0$

$\Delta x_2 = ?$ in second phase of motion, $t = 5$ s.

Note: we have two different phases of motion.

phase 1: $v_{1f}^2 - v_{1i}^2 = 2a\,\Delta x_1 \Rightarrow v_{1f} = \sqrt{2\times2\times20} = 4\sqrt{5}$ m/s

phase 2: $\Delta x_2 = \frac{1}{2}(v_{2i} + v_{2f})\,t$

Note: $v_{2i} = v_{1f} = 4\sqrt{5}$ m/s, $v_{2f} = 0$

$\Rightarrow \Delta x_2 = \frac{1}{2}(4\sqrt{5} + 0)(5) \simeq 22.4$ m

$\Rightarrow$ Total displacement $\Delta x = \Delta x_1 + \Delta x_2 = 20 + 22.4 = 42.4$ m

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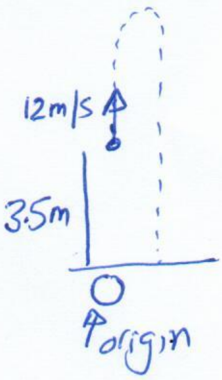
Q4] $\overset{+}{\uparrow}$ $\boxed{a = -g}$



$y_f - y_i = v_i t - \frac{1}{2} g t^2$

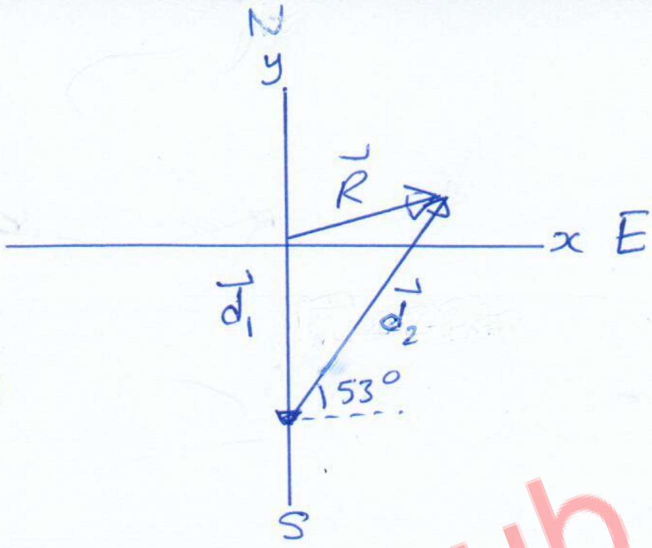
$0 - 3.5 = 12t - 4.9t^2$

$4.9t^2 - 12t - 3.5 = 0$

$t = \dfrac{12 \pm \sqrt{(-12)^2 - 4(4.9)(-3.5)}}{2(4.9)}$

$t \simeq 2.7$ s.

Q5] Resolve both displacements into components.



$d_{1x} = 0$, $d_{1y} = -2.2$ km (North)

$d_{2x} = 3.1\cos 53^\circ \simeq 1.9$ km (East)

$d_{2y} = 3.1\sin 53^\circ \simeq 2.5$ km (North)

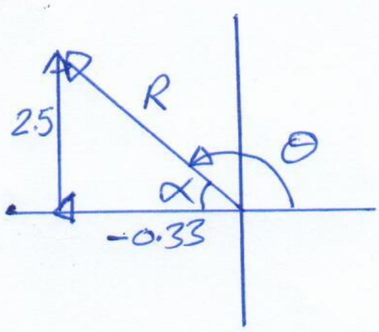
$\therefore \vec{R} = \vec{d}_1 + \vec{d}_2$

$R_x = 1.9$ km (East)

$R_y = 0.3$ km (North)

Q6] $\vec{R} = \vec{A} + \vec{B}$

$R_x = A_x + B_x$, $R_y = A_y + B_y$



$A_x = 4$, $A_y = 0$

$B_x = 5\cos 150^\circ = -5\cos 30^\circ = -2.5\sqrt{3}$

$B_y = 5\sin 150^\circ = 5\sin 30^\circ = 2.5$

$\Rightarrow R_x = 4 - 2.5\sqrt{3} \simeq -0.33$

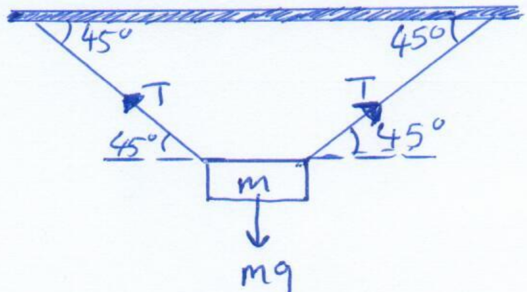
$R_y = 2.5$

$\tan\alpha = \left|\frac{2.5}{-0.33}\right| = \frac{2.5}{0.33}$

$\therefore \alpha \simeq 82.4^\circ$

$\Rightarrow \theta = 180^\circ - \alpha \approx 98^\circ$

Q7] since angles are equal
$\Rightarrow$ tensions are equal in magnitude.



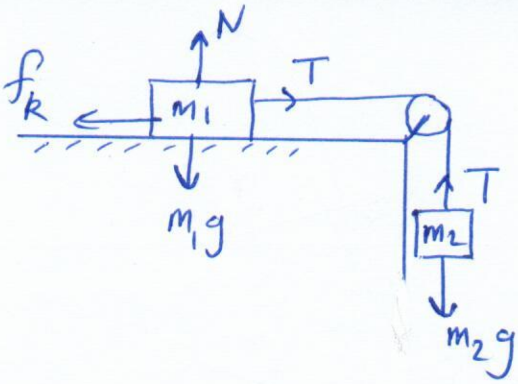
Resolve horizontally and vertically

$T\sin 45 + T\sin 45 = mg$

$2T\sin 45 = mg$

$T = \frac{mg}{2\sin 45} \simeq 346$ Newton.

Q8]



For m_2: $\downarrow +$ $m_2 g - T = m_2 a$ — (1)

for m_1: $\rightarrow +$ $T - f_k = m_1 a$ — (2)

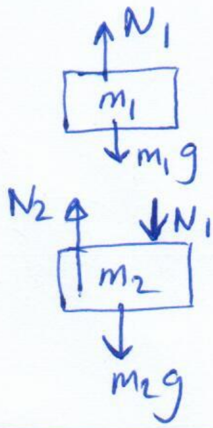
(1)+(2) $\Rightarrow$ $m_2 g - f_k = (m_1 + m_2) a$

$m_2 g - \mu_k (m_1 g) = (m_1 + m_2) a$

$$a = \frac{m_2 g - \mu_k (m_1 g)}{m_1 + m_2} \simeq 6.4 \ m/s^2$$

Q9] $W_{Total} = \Delta K = \frac{1}{2}(0.52)(0 - (60)^2) = -936 \ J$.

Q10] $m_1 = 3kg$, $m_2 = 14 \ kg$



For m_1:

$\downarrow +$ $m_1 g - N_1 = m_1 a$

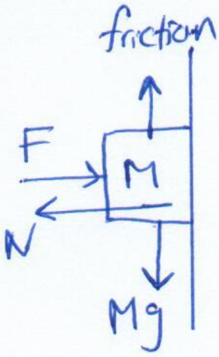
$N_1 = m_1 g - m_1 a = m_1 (g - a) \simeq 18.9$ Newton

$\simeq 19$ Newton

Q11] maximum possible value of friction is $f_{s,max}$

for block to remain stationary $\Rightarrow$

Mg must NOT exceed $f_{s,max}$.



$\therefore f_{s,max} \geq Mg$ for block to remain stationary

$\mu_s N \geq Mg \Rightarrow \mu_s (F) \geq Mg$

$\therefore F \geq \frac{Mg}{\mu_s} \Rightarrow F \geq \frac{4 \times 9.8}{0.2} \Rightarrow F_{min} = 196$ Newton

Q12] $W = (F \sin 60)(60)$

$\approx 2598 \ J$.