Kuwait University Physics Department

Physics 121

Midterm I Exam
Summer Semester (2023-2024)

June 29, 2024
Time: 08:00 – 09:30

Student's Name: ……..……..…… Serial No: ……

Student's Number: ….…… Section No: ……

Instructors: Drs. Alotaibi, Afrousheh, Alsmadi, Hadipour,

Important Instructions to the Students:

1. Answer all questions and problems.
2. Full mark = 23 points
3. No solution = no points.
4. **Use SI units.**
5. Take g = 9.8 m/s^2.
6. Mobiles are **strictly prohibited** during the exam.
7. Programmable calculators, which can store equations, are not allowed.
8. **Cheating incidents will be processed according to the university rules.**

For use by Instructors only

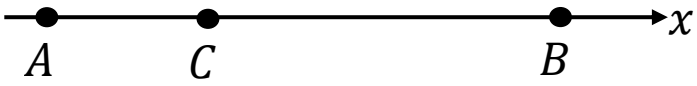
#	P1	P2	P3	P4	P5	P6	Total
Pts	4	4	4	4	3	4	23

GOOD LUCK

P1. A motorist travels for 3.0 h at 80 km/h from point A to point B and waits for 30 minutes. Then, he travels for 2.0 h at 100 km/h from point B to point C.

a) Find the average speed for the trip. (2 points)
b) What is the average velocity for the trip? (2 points)

$d_1 = t_1 \times v_1 = 240\ km$
$d_2 = t_2 \times v_2 = 200\ km$



$t_{total} = t_1 + t_2 + 0.5 = 5.5\ hour$

$$\bar{S} = \frac{total\ distance}{total\ time} = \frac{d_1 + d_2}{t_{total}} = \frac{240 + 200}{5.5} = 80\ \ km/h$$

$$\bar{v} = \frac{displacement}{total\ time} = \frac{\Delta x}{t_{total}} = \frac{40}{5.5} = 7.3\ \ km/h$$

P2. A car that is initially moving at 7.50 m/s begins to accelerate forward uniformly at 0.55 m/s^2.

a) Find the time needed for the car to move 3.5 km after beginning to accelerate. (2 points)
b) How fast is the car moving just as it has traveled 3.5 km? (2 points)

$(a)\ x - x_0 = v_0 t + \frac{1}{2} a t^2 \rightarrow 3500 = 7.5\ t + \frac{1}{2}(0.55) t^2 \rightarrow$
$t = 100\ sec.$

$(b)\ \ v_f = v_0 + a\ t \rightarrow v_f = 7.5 + 0.55 \times 100 \rightarrow$
$v_f = 62.5\ m/s$

P3. A stone released from rest from the top of a cliff reaches the ground in 3.8 seconds.

a) Find the height of the cliff. (2 points)

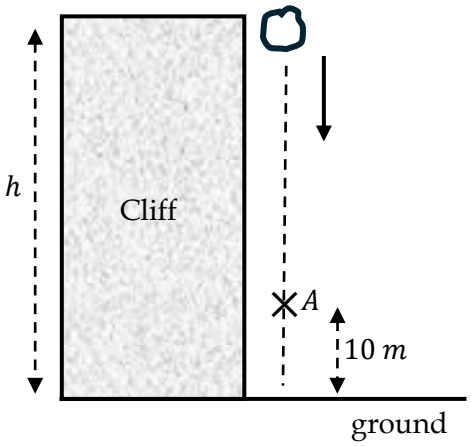
b) Calculate the velocity of the stone 10 meters above the ground, at point A. (2 points)

$(a)\ \ y = y_0 + v_0 t + \frac{1}{2} g t^2 \rightarrow 0 = h + 0 + \frac{1}{2}(-9.8)(3.8)^2 \rightarrow$

$h = 70.75\ m$

$(b)\ \ v^2 = v_0^2 + 2g\Delta y \rightarrow v^2 = 0 + 2(-9.8)(10 - 70.75) \rightarrow$

$v = \pm 34.5\ m/s \rightarrow v = -34.5\ m/s$



P4: A car travels 30 km at 60° north of west. It then travels 40 km to the east.

a) Find the magnitude of its total displacement. (3 points)

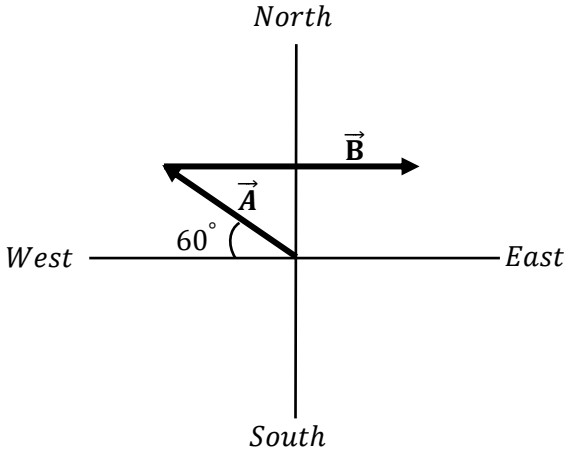
b) Find the angle of its displacement with respect to the east. (1 point)

$D_x = A_x + B_x = -(30 \times cos60^\circ) + (40) = +25\ km$

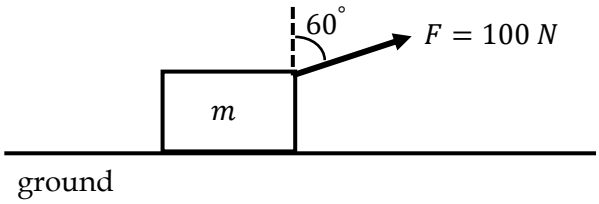
$D_y = A_y = +(30 \times sin60^\circ) = +26\ km$

$D_{total} = \sqrt{D_x^2 + D_y^2} = \sqrt{(25)^2 + (26)^2} = 36.1\ km$

$\theta = tan^{-1}\frac{D_y}{D_x} = tan^{-1}\left(\frac{26}{25}\right) \rightarrow \theta = 46.1^\circ$



P5. A box of mass $4\ kg$ is at rest on the ground. The box is then pulled by a force $F = 100\ N$ as shown. Ignore friction. How long does it take for the box to reach a speed of 43 m/s? (3 points)



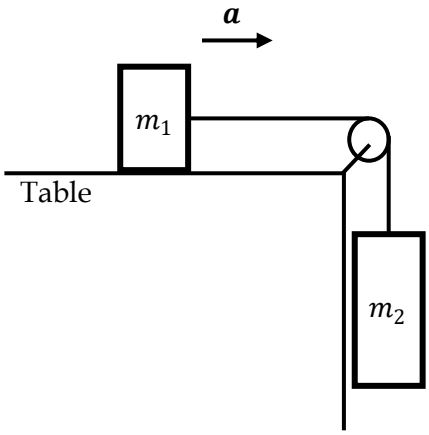
$F_x = F \times sin60^\circ = 100 \times (0.86) = 86\ N$

$F_x = ma_x \rightarrow a_x = \frac{F_x}{m} = \frac{86}{4} = 21.5\ m/s^2$

$v = v_0 + at \rightarrow 43 = 0 + 21.5 \times t \rightarrow t = 2\ sec$

P6. Two blocks of mass $m_1 = 4\ kg$ and m_2 are connected by a massless cord over a frictionless pulley. They are moving with the acceleration of magnitude $a = 1.8\ m/s^2$. The coefficient of kinetic friction between block m_1 and table is $\mu_k = 0.2$.

a) Find the tension in the cord. (2 points)
b) Find the mass m_2. (2 points)



$F_{fr} = \mu_k \times F_N = \mu_k \times m_1 \times g = 7.8\ N$

$T - F_{fr} = m_1 a \rightarrow T = F_{fr} + m_1 a = 15\ N$

$T - m_2 g = m_2(-a) \rightarrow m_2 = \frac{T}{g - a}$

$m_2 = 1.88\ kg$