Kuwait University Physics Department

جامعة الكويت
KUWAIT UNIVERSITY

Physics 121

First Midterm Exam
Summer Semester (2025-2026)

June 27, 2026
Time: 12:00 – 13:30

Student's Name: ……...Serial Number: ……

Student's Number: …… Section: ……

Instructors: Drs. Al-Refai, Alotaibi, Burahmah, Hadipour, Kokkalis

Important:

1. Answer all questions and problems (No solution = no points).
2. Full mark = 26 points as arranged in the table below.
3. **Give your final answer in the correct units.**
4. Assume g = 9.8 m/s^2.
5. Mobiles are **strictly prohibited** during the exam.
6. Programmable calculators, which can store equations, are not allowed.
7. **Cheating incidents will be processed according to the university rules.**

For use by instructors

Grades:

#	P1	P2	P3	P4	P5	P6	P7	Total
Pts	4	4	4	4	3	4	3	26

GOOD LUCK

P1. A car is moving at $54\ \text{km/h}$ when the driver sees a red traffic light and applies the brakes. The car decelerates uniformly at a rate of $3.0\ \text{m/s}^2$ until it stops.

a) Determine the time it takes for a car to stop. **(2 points)**

b) Find the distance travelled by the car after braking. **(2 points)**

$$v_0 = \frac{54}{3.6} = 15\ \frac{\text{m}}{\text{s}} \qquad v = 0 \qquad a = -3.0\ \frac{\text{m}}{\text{s}^2}$$

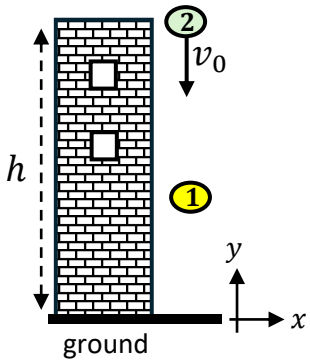
$$v = v_0 + at \rightarrow$$

$$t = 5\ \text{s}$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2 \rightarrow$$

$$x = 0 + 15 \times 5 + \frac{1}{2} \times (-3) \times 5^2 = 37.5\ \text{m}$$

P2. Stone number 1 is dropped from a tower of height $h = 44.1$ m above the ground. Stone number 2 is thrown vertically down from the same height 1.0 s after the first one is dropped. Both the stones strike the ground at the same time. What is the initial velocity of the second stone? Ignore air resistance. **(4 points)**



Stone 1:

$$y = y_0 + \frac{1}{2}gt_1^2 \rightarrow t_1 = 3\ \text{s}$$

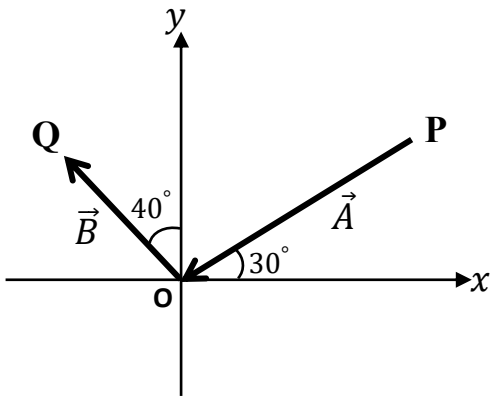
Stone 2:

$$t_2 = 3 - 1 = 2\ \text{s}$$

$$y = y_0 + v_0 t_2 + \frac{1}{2}gt_2^2$$

$$v_0 = 12.3\ \frac{\text{m}}{\text{s}}$$

P3. A student is walking from point **P** to point **Q** by following paths $A = 500$ m and $B = 300$ m in 20 minutes, as shown in the figure. What is the magnitude of the average velocity of the student for the whole trip? **(4 points)**



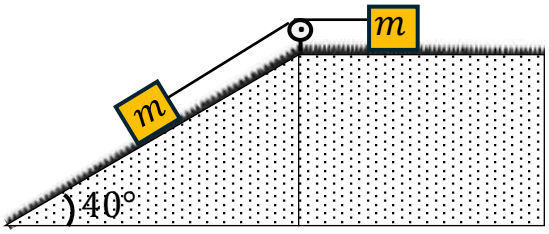
$$D_x = A_x + B_x = -Acos30° - Bsin40° = -625.8 \text{ m}$$

$$D_y = A_y + B_y = -Asin30° + Bcos40° = -20.2 \text{ m}$$

$$D = \sqrt{D_x^2 + D_y^2} = 626.1 \text{ m}$$

$$v = \frac{D}{t} = \frac{626.1}{20 \times 60} = 0.52 \ \frac{\text{m}}{\text{s}}$$

P4. Two identical blocks are placed on rough horizontal and inclined surfaces while connected by a massless rope and pulley, as shown in the figure. Find the minimum static coefficient of friction μ_s so that the blocks remain at rest. **(4 points)**



$$T = \mu_s mg$$

$$T = mgsin40° - \mu_s mgcos40°$$

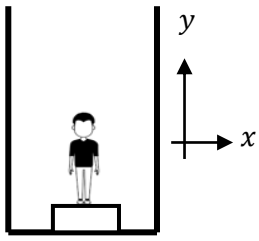
$$\mu_s mg = mgsin40° - \mu_s mgcos40° \rightarrow$$

$$\mu_s = \frac{sin40°}{1 + cos40°} = 0.36$$

P5. An 80 kg person stands on a scale in an elevator. Shortly before the elevator stops, the scale reads 65 kg.

a) Calculate the acceleration (magnitude and direction) of the elevator. **(2 points)**

b) What is the direction of the elevator's motion? **(1 point)**



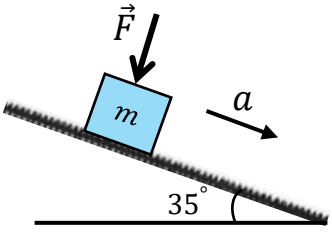
$$F_N - mg = ma$$

$$a = \frac{F_N - mg}{m} = \frac{g \times (65 - 80)}{80} = -1.8 \text{ m/s}^2$$

Upward .

$(v_0 > v = 0 \ \& \ a = downward \rightarrow elevator\ must\ be\ moving\ upward)$

P6. A force of magnitude $F = 20$ N applied on a box of mass $m = 8$ kg, which is sliding down a rough inclined surface, as shown. The coefficient of kinetic friction is $\mu_k = 0.2$. Find the acceleration of box. **(4 points)**



$$F_N = mgcos35^\circ + F \rightarrow F_N = 84.2 \text{ N}$$

$$F_{fr} = \mu_k \times F_N = (0.2) \times (84.2) = 16.8 \text{ N}$$

$$mgsin35^\circ - F_{fr} = ma$$

$$a = 3.5 \text{ m/s}^2$$

P7. The normal force on the driver is half of his weight when his car passes over the top of a hill, as shown in the figure. The radius of the curvature of the hill is 118 m. Find the speed of the car. **(3 points)**

$$\sum F_R = \frac{mv^2}{R} \rightarrow mg - F_N = \frac{mv^2}{R}$$

$$mg - 0.5 \times mg = \frac{mv^2}{R} \rightarrow v = \sqrt{0.5 \times Rg}$$

$$v = 24\ \frac{\text{m}}{\text{s}}$$