Kuwait University Physics Department

Physics 101

Summer Semester

First Midterm Exam

Saturday, June 27, 2026

9:00 AM – 10:30 AM

Student's Name: …… Serial Number: ……

Student's Number: ……Section: ……

Choose your Instructor's Name:

Instructors: Drs. Al Dosari, Al Jassar, Al Qattan, Al Smadi, Askar, Salameh, Zaman

For Instructors' use only

Grades:

#	SP1	SP2	SP3	SP4	SP5	LP1	LP2	MC	Total
Pts	2	2	2	2	2	3	3	4	20

Important:

1. Answer all questions and problems (No solution = no points).
2. Full mark = 20 points as arranged in the above table.
3. **Give your final answer in the correct units.**
4. Assume g = 10 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.**

GOOD LUCK

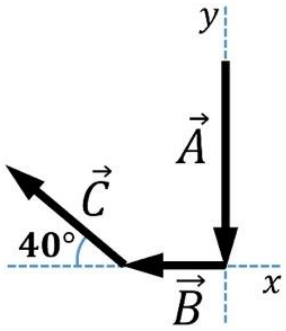
Part I: Short Problems (2 points each)

SP1. Three displacement vectors with magnitudes $|\vec{A}| = 4\ m$, $|\vec{B}| = 2\ m$, and $|\vec{C}| = 3\ m$ are shown in the figure. Find the **magnitude** of the resultant vector $|\vec{R}|$, where $\vec{R} = \vec{A} + \vec{B} + \vec{C}$.

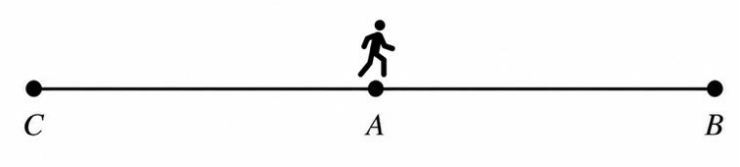
$$\vec{R} = (-2 - 3\cos 40)\hat{\imath} + (-4 + 3\sin 40)\hat{\jmath}\ m$$

$$\vec{R} = (-4.3)\hat{\imath} + (-2.1)\hat{\jmath}\ m$$

$$|\vec{R}| = 4.8\ m$$



SP2. An engineer walks along a straight road. She starts at point A, walks to point B, then turns around to reach point C. The distance between points A and C is 6 m, and the distance between points B and C is 14 m. The entire motion takes 20 s. Find the **average speed (in $\boldsymbol{m/s}$)** for the entire trip.



$$s_{av} = \frac{D}{t}$$

$$s_{av} = \frac{(14 - 6) + 14\ m}{20\ s}$$

$$s_{av} = 1.1\ m/s$$

SP3. A particle moves along the x-axis. Its velocity is given by $\boldsymbol{v_x(t) = 0.9t^2 - 8}$, where $\boldsymbol{v_x}$ is in m/s and t is in s. Find the **average acceleration (in $\boldsymbol{m/s^2}$)** of the particle during the period from $\boldsymbol{t = 1\ s}$ to $\boldsymbol{t = 5\ s}$.

$$v_x(1) = 0.9(1)^2 - 8 = -7.1\ m/s$$

$$v_x(5) = 0.9(5)^2 - 8 = 14.5\ m/s$$

$$a_{av-x} = \frac{\Delta v_x}{\Delta t} = \frac{14.5 - -7.1}{5 - 1} = 5.4\ m/s^2$$

or

$$a_x(t) = 1.8t$$

$$a_{av-x} = \frac{a_x(1) + a_x(5)}{2} = \frac{1.8 + 9}{2} = 5.4\ m/s^2$$

SP4. A particle moves in the ***xy*-plane** with a constant acceleration of $(2\hat{\imath} - 3\hat{\jmath})\ m/s^2$. The particle starts from the **origin**. After 2 seconds, its position is $12\hat{\imath}\ m$. Find the **initial speed (in m/s)** of the particle.

$$\Delta\vec{r} = \overrightarrow{v_0}t + \frac{1}{2}\vec{a}t^2$$

$$12\hat{\imath} = \overrightarrow{v_0}(2) + \frac{1}{2}(2\hat{\imath} - 3\hat{\jmath})(2)^2$$

$$6\hat{\imath} = \overrightarrow{v_0} + 2\hat{\imath} - 3\hat{\jmath}$$

$$\overrightarrow{v_0} = 4\hat{\imath} + 3\hat{\jmath}$$

$$|\overrightarrow{v_0}| = \sqrt{(4)^2 + (3)^2} = 5\ m/s$$

SP5. A player throws the ball **vertically upward** with an initial speed of $30\ m/s$. How long (in $seconds$) will it take the ball to reach **half the maximum height** on its way down (point C)?

$$v_f^2 = v_i^2 - 2gy_{max}$$

$$0 = 30^2 - 2(10)y_{max}$$

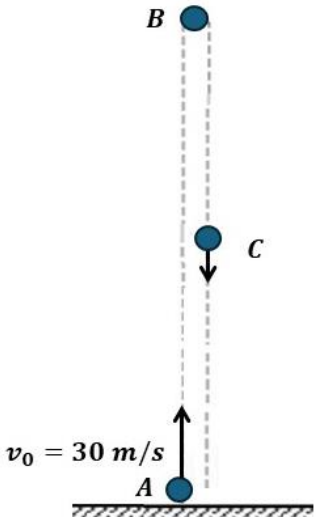
$$y_{max} = 45\ m$$

$$\Delta y = v_i t - \frac{1}{2}gt^2$$

$$\frac{45}{2} = 30t - \frac{1}{2}(10)t^2$$

$t = 0.88\ s$ or $t = 5.1\ s$

on its way down $\Longrightarrow t = 5.1\ s$



Part II: Long Problems (3 points each)

LP1. Given two vectors, $\vec{A} = 2\hat{\imath} - 3\hat{\jmath} - \hat{k}$ and $\vec{B} = \hat{\jmath} - 3\hat{k}$.

a) Find $\vec{A} \cdot \vec{B}$

$$\vec{A} \cdot \vec{B} = A_x B_x + A_x B_x + A_x B_x = -3+3=0$$

b) Find the angle between $\vec{A}$ and $\vec{B}$

$$\phi = 90^0$$

c) Find $\vec{A} \times \vec{B}$

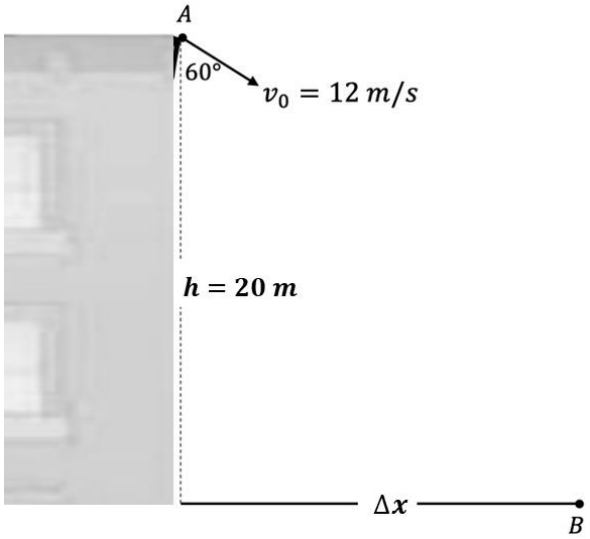
$$\vec{A} \times \vec{B} = \left(2\hat{\imath} - 3\hat{\jmath} - \hat{k}\right) \times \left(\hat{\jmath} - 3\hat{k}\right) = 10\hat{\imath} + 6\hat{\jmath} + 2\hat{k}$$

d) The angle between $\vec{B}$ and the negative x-axis is

(*) equal to 90° * less than 90° * greater than 90°

LP2. A stone is thrown from the edge of a $20\ m$ high building (point A) with an initial speed of $12\ m/s$ and an angle of $60°$ with the vertical, as shown. The stone strikes the ground at point B. Ignoring air resistance, find

a) the time of flight from point A to point B.



$$v_{xi} = 12\cos(30^o) = 10.4\ m/s$$

$$v_{yi} = -12\sin(30^o) = -6\ m/s$$

$$\Delta y = v_{yi}t - \frac{1}{2}gt^2$$

$$-20 = -6t - 5t^2$$

$$t = 1.49\ s$$

b) the horizontal distance (Δx) reached by the stone as it strikes the ground.

$$\Delta x = v_{xi}t = 10.4(1.49) \approx 15.5\ m$$

c) the velocity of the stone just before it hits the ground **in unit vector notation**.

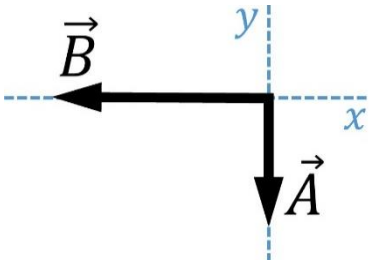
$$v_{x_f} = v_{x_i} = 10.4\ m/s$$

$$v_{y_f} = v_{y_i} - gt = -6 - (10)(1.49) \approx -20.9\ m/s$$

$$\vec{v}_f = (10.4\hat{\imath} - 20.9\hat{\jmath})\ m/s$$

Part III: Questions (Choose the correct answer, one point each)

Q1. Vectors $\vec{A}$ and $\vec{B}$ are shown in the figure. The value of $\hat{k} \cdot (\vec{A} \times \vec{B})$ is



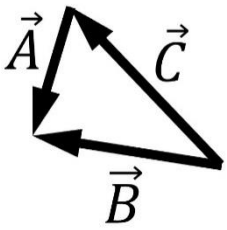
(*) $-AB$

* AB

* 0

* $AB\,\hat{k}$

Q2. Which of the following relations describes the vector $\vec{A}$ in the figure?



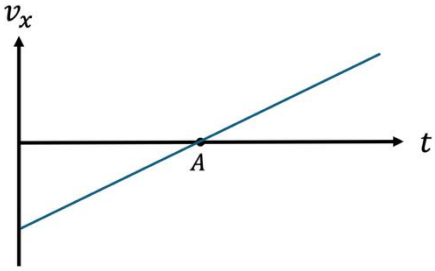
* $\vec{A} = \vec{B} + \vec{C}$

(*) $\vec{A} = \vec{B} - \vec{C}$

* $\vec{A} = -\vec{B} + \vec{C}$

* $\vec{A} = -\vec{B} - \vec{C}$

Q3. The figure describes the velocity of an object moving along the $x - axis$ as a function of time. One of the following statements is **always true** at point A.



* The acceleration reaches its minimum value.
* The acceleration reaches its maximum value.
* The object reaches its starting position.

(*) The object changes its direction.

Q4. In **uniform circular motion**, which one of the following statements is correct?

* The velocity is constant

(*) The speed is constant

* The centripetal acceleration is constant in direction
* The magnitude of the centripetal acceleration is not constant