Kuwait University Physics Department

Physics 101

Fall Semester

First Midterm Exam

Saturday, November 27, 2021

9:00 AM – 10:30 AM

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

Student's Number: ….…… Section: ……

Choose your Instructor's Name:

Dr. Ahmed Al-Jassar	Dr. Belal Salameh
Dr. Hala Al-Jassar	Dr. Nasser Demir
Dr. Tareq Al Refai	Dr. Ruqayyah Askar
Dr. Abdul Khaleq	Dr. Bedoor Alkurtass

For Instructors use only

Grades:

#	SP1	[illegible]	[illegible]	SP4	SP5	LP1	LP2	Q1	Q2	Q3	Q4	Total
Pts	2	2	[illegible]	2	2	3	3	1	1	1	1	20

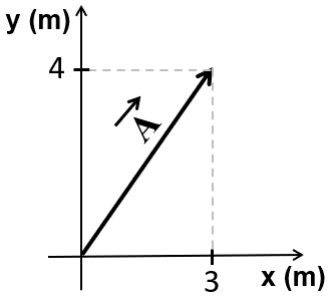
Important:

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. Vector $\vec{A}$ is shown in the figure, while the components of vector $\vec{B}$ along the x, y and z axes are $(4m, 2m, 4m)$, respectively. Find the angle between $\vec{A}$ and $\vec{B}$.

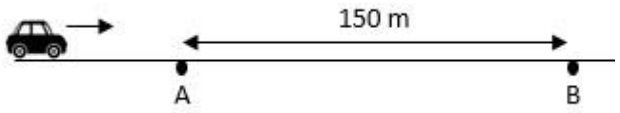


$$\vec{A}.\vec{B} = AB\cos\varphi$$

$$(3i + 4j).\left(4i + 2j + 4\hat{k}\right) = 5(6)\cos\theta$$

$$12 + 8 = 30\cos\varphi \;\Rightarrow\; \varphi = 48.2°$$

SP2. A car is traveling with a constant speed of $5\,m/s$ along a straight road. At point A the car starts accelerating with a constant rate of $2\,m/s^2$ to reach point B. What is the car's speed (in km/h) at point B?



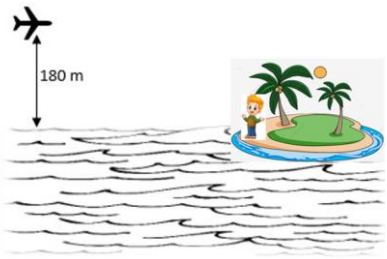
$$v_B^2 = v_A^2 + 2a\Delta x$$

$$v_B^2 = 25 + 2(2)(150) = 625$$

$$v_B = \sqrt{625} = 25\,m/s$$

$$\Rightarrow\; v_B = 25(3.6) = 90\;km/h$$

SP3. An airplane is moving horizontally at 40 m/s. The plane is $180\,m$ above sea level. You drop a food basket to your brother on an island. How many seconds does it take the basket to land on the island?



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

$$-180 = o - 5t^2$$

$$t^2 = 36 \;\Rightarrow t = 6\,s$$

SP4. A stone is thrown 36.9° above the horizontal with a speed of 20 m/s from the roof of a building. The stone lands 48 m from the base of the building as shown. What is the height of the building?

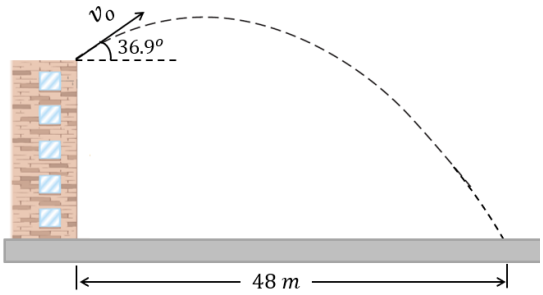
$$\Delta x = v_o \cos\theta\, t$$

$$48 = 20\,(0.8)t \quad \Rightarrow \quad t = 3s$$

$$\Delta y = v_o \sin\theta\,(t) - \frac{1}{2}gt^2$$

$$\Delta y = 20\,(0.6)(3) - 5(3)^2$$

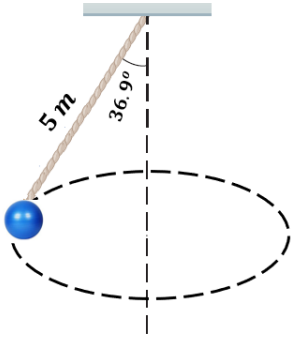
$$= -9\,m \qquad \Rightarrow h = 9\,m$$



SP5. A ball of mass 2 kg is attached to the end of a rope of length 5m. The rope is attached to the ceiling as shown in the figure. The ball is forced to rotate in a horizontal circle with a constant speed of 2 m/s. Find the magnitude of the acceleration of the ball.

$$R = l\sin(36.9^o) = 3\,m$$

$$a_R = \frac{v^2}{R} = \frac{2^2}{3} = 1.33\,m/s^2$$

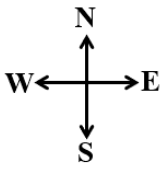


Part II: Long Problems (3 points each)

LP1. You walk for 17 minutes (800 m north, 400 m east then 500 m south).

a) What is your average speed (in m/s)?

$$S_{av} = \frac{d}{t} = \frac{1700}{17 \times 60} = 1.67\, m/s$$



b) What is the magnitude of your average velocity (in m/s)??

$$|\vec{v}_{av}| = \left|\frac{400\hat{\imath}+300\hat{\jmath}}{17\times60}\right| = \frac{500}{17\times60} = 0.49\ m/s$$

c) What is the direction of your average velocity?

$$\theta = \tan^{-1}\left(\frac{300}{400}\right) = 36.9°$$

$36.9°\ north\ of\ east$

LP2. A cat is running in a field, its position vector as a function of time is given by:

$$\vec{r} = (4t - t^2)\hat{\imath} + 3\hat{\jmath}$$

Where $\vec{r}$ is measured in meters and t is in seconds.

a) What is the cat's initial position vector?

$$\vec{r}(0\ s) = 3\hat{\jmath}\ \ m$$

b) What is the cat's initial velocity vector?

$$\vec{v} = \frac{d\vec{r}}{dt} = (4 - 2t)\hat{\imath} \ \Rightarrow\ \vec{v}(0\ s) = 4\hat{\imath}\ m/s$$

c) At what position does the cat momentarily stop?
How far is this position from the initial position?

$$\vec{v} = (4 - 2t)\hat{\imath} = \ 0 \ \Rightarrow\ t = 2\ s$$
$$\vec{r}(2\ s) = (4\hat{\imath} + 3\hat{\jmath})m$$
$$\Delta\vec{r} = \ \vec{r}(2\ s) - \ \vec{r}(0\ s)$$
$$\Delta\vec{r} = 4\hat{\imath}\ m$$
$$d = 4\ m$$

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

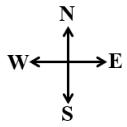
Q1. If $\vec{A} = \hat{\imath} + \hat{\jmath}$, then the unit vector of vector $\vec{A}$ is

* $\hat{k}$ * $\hat{\imath} + \hat{\jmath}$ (*) $\frac{\hat{\imath} + \hat{\jmath}}{\sqrt{2}}$ * $\frac{\hat{\imath} + \hat{\jmath}}{2}$

Q2. A car is moving along a straight line in a direction 30° north of east and slowing down, the direction of its acceleration is

* 30° north of west * 30° east of north

(*) 30° south of west * 30° south of east



Q3. If a ball is kicked from the ground with initial velocity $\vec{v} = (4\hat{\imath} + 3\hat{\jmath})\ m/s$, then its speed at the highest point in its path is

$*\ zero$ $*\ 3m/s$ (*) $4m/s$ $*\ 5m/s$

Q4. Ali is moving toward the east with a speed of $3m/s$ while Bader is moving toward the west with a speed of $2m/s$, then the velocity of Ali with respect to Bader is

$*\ 1m/s\ east$ $*\ 1m/s\ west$ (*) $5m/s\ east$ $*\ 5m/s\ west$