Kuwait University **Physics Department**

Physics 101
First Mid-term Examination

October 27, 2002

Name: .... Student No. .....

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For use by Instructors only

Prob.	1	2	3	4	5	6	7	8	9	Total
Marks										

1. Answer all the questions.
2. The solution should be given explicitly for each problem.
3. No solution = no grade.
4. Check the correct answer for each question.
5. Take g = 10 m/s^2.

1-A car moving in a straight road with constant acceleration of 4 m/s2 covers a distance between two points A and B , 48 m apart , in 8 seconds. Find its final velocity (in m/s) at point B.

a) 19 b)14 c) 24 (d) 22 e) 32 f) Other

$\Delta x = 48\,m$, $a = 4\,m/s^2$, $t = 8\,s$, v?

$\Delta x = vt - \frac{1}{2}at^2$

$48 = v(8) - \frac{1}{2}(4)(8)^2$

$v = 22\ m/s$

$v = v_0 + at$

$v_0 = v - at$

$\Delta X = v_0 t + \frac{1}{2}at^2$

$= (v - at)t + \frac{1}{2}at^2$

$= vt - at^2 + \frac{1}{2}at^2$

2- The position x (in m) of a particle moving along the x-axis varies with time t (in seconds) according to the equation $x = t^3 - 27\,t$. find the acceleration in (m/s^2) when the particle reaches its maximum x- coordinate.

a) 72 (b)18 c) 54 d) 22 e) 92 f) Other

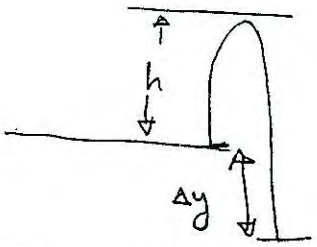
$x = t^3 - 27t$

$v = 3t^2 - 27 = 0 \Rightarrow t^2 = \frac{27}{3} = 9$

$t = 3\,s$

$a = 6t \Rightarrow a = 6(3) = 18\ m/s^2$

3-A stone is thrown vertically upward from the edge of a cliff with speed of 15 m/s. It reaches the grounds 4 seconds later. Find the value of $(d - |\Delta y|)$, in m , where d is the total distance traveled by the stone and $|\Delta y|$ is magnitude of its displacement.



a) 32 b)12.5 c) 26.5 (d) 22.5 e) 10.2 f) Other

$v_0 = 15\ m/s$, $t = 4\,s$

$d - |\Delta y| = 2h$ ($h \equiv$ height above initial position)

$v^2 = v_0^2 - 2gh \Rightarrow 0 = (15)^2 - 2(10)h$

$h = 11.25\ m$

$d - |\Delta y| = 2(11.25) = 22.5\ m$

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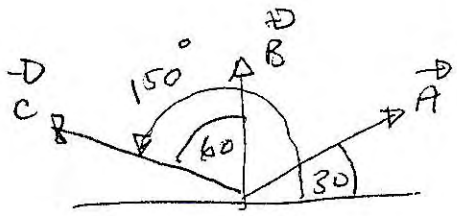


4- A= 4.0 , B= 2.0, C = 5.0 and
E = A - B +C
Find the angle (in degrees) that the vector
E makes with respect to the positive x- axis
a) 55 b)71 c) 109 d) 118 e) 145 f) Other

$A_x = 4\cos 30 = 3.46$, $A_y = 4\sin 30 = 2$

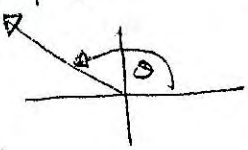
$B_x = 0$ $\quad B_y = 2$

$C_x = 5\cos 150 = -4.33$ $\quad C_y = 5\sin 150 = 2.5$

$E_x = A_x - B_x - C_x \Rightarrow E_x = 3.46 - 0 - 4.33 = -0.87$

$E_y = A_y - B_y - C_y \Rightarrow E_y = 2 - 2 + 2.5 = 2.5$

$\theta = \tan^{-1}\frac{2.5}{0.87} = -71 + 180 = 109°$



5- If $\mathbf{A} = 3.0\,\mathbf{i} + 4.0\,\mathbf{j} + 6.0\,\mathbf{k}$ and $\mathbf{B} = 2.0\,\mathbf{i} + 5.0\,\mathbf{j} - 3.0\,\mathbf{k}$
find $\mathbf{A} \cdot (\mathbf{A} + \mathbf{B})$
a) 69 b) $-42\,\mathbf{i} + 21\,\mathbf{j} + 7\,\mathbf{k}$ c) 49 d) $-42\,\mathbf{i} + 16\,\mathbf{k}$
e)18 f) Other

$\vec{C} = \vec{A} + \vec{B} = 5\hat{i} + 9\hat{j} + 3\hat{k}$

$\vec{A} = 3\hat{i} + 4\hat{j} + 6\hat{k}$

$\vec{A} \cdot \vec{C} = A_x C_x + A_y C_y + A_z C_z$

$= 3(5) + 4(9) + 6(3) = 69$

$B = \sqrt{(2)^2 + (1)^2 + (0.67)^2} = 2.3$

6- Let $\mathbf{C} = \mathbf{A} \times \mathbf{B}$ where $\mathbf{C} = 4.0\,\mathbf{i} - 6.0\,\mathbf{j} - 8.0\,\mathbf{k}$, $\mathbf{A} = 2.0\,\mathbf{i} - 3.0\,\mathbf{j} + 6.0\,\mathbf{k}$
and $B_x = 2\,B_y$
Find the magnitude of the vector B
a) 4.3 b)6.0 c) 2.3 d) 5.4 e) 18 f) Other

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & 6 \\ B_x & B_y & B_z \end{vmatrix} = (-3B_z - 6B_y)\hat{i} - (2B_z - 6B_x)\hat{j} + (2B_y + 3B_x)\hat{k}$$

$2B_y + 3B_x = C_z \Rightarrow B_x + 3B_x = -8 \Rightarrow B_x = -2$

$\therefore B_y = \frac{1}{2}B_x = -1$ $\quad -3B_z - 6(-1) = 4 \Rightarrow B_z = 0.67$

so

7- A particle moves from the point (2,5) to the point (4,3) in 2.0 seconds. If its initial velocity is $v_0 = 2.0\,\mathbf{i} - \mathbf{j}$, find the magnitude of its acceleration. (in m/s^2)

(a) 1 b)2 c) 3 d) 4 e) 0 f) Other

$$\Delta\vec{r} = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$$

$$\Delta x\,\hat{i} + \Delta y\,\hat{j} = (2\hat{i} - \hat{j})2 + \frac{1}{2}\vec{a}(2)^2$$

$$(4-2)\hat{i} + (3-5)\hat{j} = 4\hat{i} - 2\hat{j} + 2\vec{a}$$

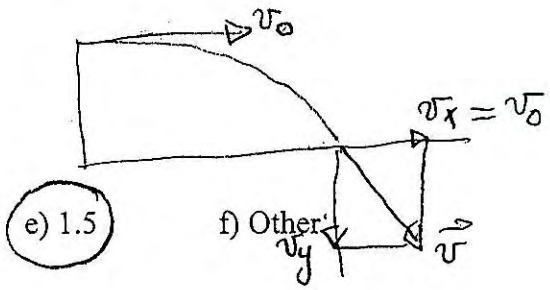
$$2\vec{a} = -2\hat{i}$$

$$\vec{a} = -\hat{i}$$

$$a = 1$$

8- A projectile is thrown horizontally with a speed of 20 m/s from the top of a cliff. It strikes the ground with a speed of 25 m/s. Find the time (in seconds)during which the projectile is in the air.

a) 2.2 b)3.2 c) 4.5 d) 5.0 e) 1.5 f) Other



$v_x = 20$ m/s $\quad v = 25$ m/s

$$v^2 = v_x^2 + v_y^2$$

$$(25)^2 = (20)^2 + v_y^2 \Rightarrow v_y = -15 \text{ m/s}$$

$$v_y = v_{oy} - gt \Rightarrow -15 = 0 - 10t \Rightarrow t = 1.5\,s$$

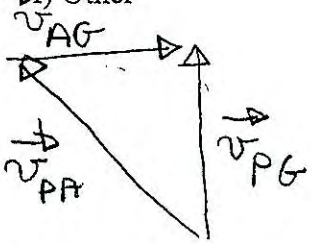
9- The pilot of an airplane (P) flies due north relative to the ground (G) in an air blowing relative to the ground at 35 km/h toward the east. If the speed of the airplane relative to air (A) is 70 km/h, find the speed (in km/h) of the airplane relative to the ground .

a) 75 b)61 c) 25 d) 81 e) 44 f) Other

$v_{PA} = 70$ km/h

$v_{AG} = 35$ km/h

$$\vec{v}_{PG} = \vec{v}_{PA} + \vec{v}_{AG}$$



$$v_{PG} = \sqrt{v_{PA}^2 - v_{AG}^2}$$

$$= \sqrt{(70)^2 - (35)^2} = 60.6 = 61$$

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