Kuwait University

Physics Department
Physics 101

Exam I
Summer 2016
Sunday, June 12, 2016
8:30 p.m. – 10:00 p.m.

Student's Name: ..... Key .....

Student's Number: .....
Section number: .....

Choose your Instructor's Name:

Prof. Yacob Makdisi
Dr. Abdul Khaliq Smadi
Dr. Belal Salama
Dr. Fatma Al-Dossari
Dr. Tareq Alrefae

#	Q1	Q2	Q3	Q4	Q5	SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10	Total
Pts	1	1	1	1	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	20

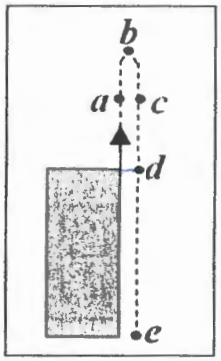
Important:
1. Answer all questions and problems.
2. Each question is assigned 1 point.
3. Each short problem is assigned 1.5 points.
4. No solution = no points.
5. Assume $g = 10\ m/s^2$.
6. Mobiles and pagers are not allowed during the exam.
7. Programmable calculators, which can store equations, are not allowed.

GOOD LUCK *

Select the correct answer for each of the following questions (1 point each)

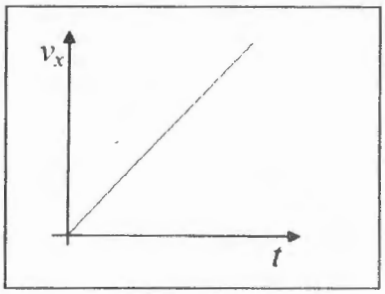
1. A ball is thrown upward from the top of a building as shown. The ball's displacement is zero at the position:

(a) a
(b) b
(c) c
(d) d
(e) e



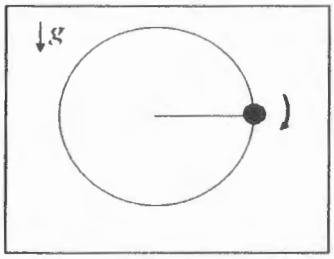
2. The velocity of a particle moving along the x axis as a function of time is described in the shown graph. What can be said about the particle's displacement and acceleration $(\Delta x, a_x)$?

(a) (+,+)
(b) (+,0)
(c) (0,+)
(d) (+,-)
(e) (-,+)



3. A ball swings in a vertical circle with a varying speed. At the shown position, the direction of the ball's total acceleration is

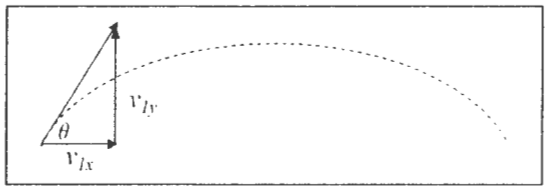
(a) ↓
(b) →
(c) ←
(d) ↗
(e) ↙



4. A box is moving to the right with a decreasing acceleration. At time t_1, the acceleration becomes constant. If at all times the acceleration of the box is positive, then the velocity:

(a) decreases until t_1, then becomes constant
(b) increases until time t_1 then becomes constant.
(c) increases at all times.
(d) decreases until t_1, then becomes zero.
(e) increases until t_1, then becomes zero.

5. The speed of a projectile at the maximum height is $\frac{v_{1y}}{4}$. The angle of projection θ in degrees is



$\theta = \tan^{-1}\left(\frac{v_{1y}}{v_{1x}}\right)$

(a) 27
(b) 56
(c) 63
(d) 76
(e) Undeterminable

Solve the following short problems. Show your work. No solution = no points (1.5 points each)

1. It takes time t for a ball to be dropped from a height of h to reach the ground. How long does it take the ball (in terms of t) to reach the ground if it is dropped from a height of $3h$.

.5pt $h = \frac{1}{2} g t^2$

.5pt $3h = \frac{1}{2} g t'^2 \Rightarrow t' = \sqrt{3}\, t$ (0.5 pt)

Answer: $\sqrt{3}\, t$

2. A car covers a distance of 40 m in 8.5 s while uniformly slowing down to a final speed of 2.80 m/s. Find the car's acceleration (in m/s^2).

$\Delta x = -40\text{ m}$, $v_1 = -2.8\ \frac{m}{s}$, $t = 8.5\text{ s}$

1.5pt $\Delta x = v_1 t + \frac{1}{2} a t^2$

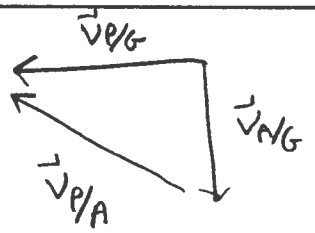
.5pt $\frac{2}{t^2}(\Delta x - v_1 t) = a$

pt $\frac{2}{(8.5)^2}(-40 - -2.8(8.5)) = -0.45\ \frac{m}{s^2}$

Answer: $-0.45\ m/s^2$

3. The pilot of an airplane wishes to fly due west in a wind blowing at 50 km/h toward the south. If the speed of the airplane in the absence of a wind is 200 km/h, find the speed of the airplane relative to ground (in km/h).

(0.5pt) $\vec{V}_{P/G} = \vec{V}_{P/A} + \vec{V}_{A/G}$



(0.5 pt)

5pt $\Rightarrow |\vec{V}_{P/G}| = \sqrt{200^2 - 50^2}$

$= 194 \frac{km}{h}$

Answer: 194 km/hr

4. A man walks at a constant speed of 5 m/s along a straight line from point *A* to point *B*, then back from point *B* to point *A* at a constant speed of 3 m/s. Find the man's average speed (in m/s) over the entire trip.

5pt avg speed = $\frac{\text{dist}}{\text{time}}$

$5 \frac{m}{s} = v_1$ ——→ t_1

$3 \frac{m}{s} = v_2$ ←—— t_2

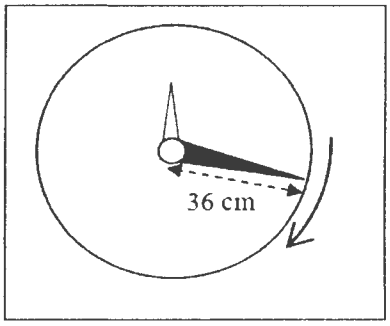
$v_1 t = v_2 t$

(0.5pt) $= \frac{2 v_1 t_1}{t_1 + t_2}$

$\Rightarrow$ (0.5pt) $= \frac{2 v_1}{1 + \frac{t_2}{t_1}} = 3.75 \frac{m}{s}$

Answer: 3.75 m/s

5. The minute arm of a clock is 36 cm in length. Find the average speed of the tip of the arm.



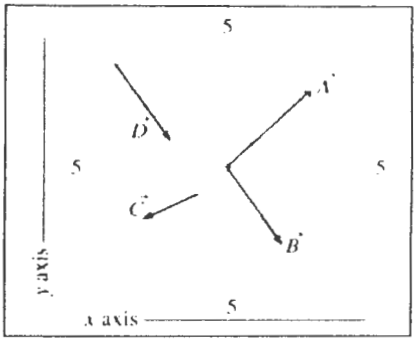
pt $v = \frac{2\pi R}{T}$

(5pt) $= \frac{2\pi\, 0.36 m}{3600 s}$

(5pt) $= 0.63 \times 10^{-3} \frac{m}{s}$

Answer: 0.63 mm/s

6. For the shown figure, find the magnitude of the vector $\vec{A}+\vec{B}+\vec{C}+\vec{D}$



(1pt) $\vec{R} = (A_x + B_x + C_x + D_x)\,\hat{i} + (A_y + B_y + C_y + D_y)\,\hat{j}$

(.5pt) $= 5\,\hat{i} - 4\,\hat{j}$

(1pt) $|\vec{R}| = 6.4$

Answer: 6.4 units

7. A particle is moving in a straight line according to the function $x = 50\,t - 5\,t^2$, where x is in meters and t is in seconds. Find the average speed of the particle during the time interval $t_1 = 0$ to $t_2 = 6$ seconds.

(1pt) $v = \frac{dx}{dt} = 50 - 10t = 0 \Rightarrow t = 5\ s$

(1pt) $x(t = 5\ s.) = 125\ m$

(1pt) $x(t = 6\ s.) = 120\ m$

$\Rightarrow 125\ m - 120\ m = 5\ m$

$\Rightarrow 125\ m + 5\ m = 130\ m$

(1pt) avg speed $= \frac{\text{dist}}{\text{time}} = \frac{130\ m}{6\ s} = 21.7\ m/s$

Answer: 21.7 m/s

8. At $t = 0$, a particle leaves the origin with a velocity of $6\,\hat{j}$ m/s. The acceleration of the particle is constant, and is equal to $\vec{a} = (2\hat{i} - 3\hat{j})$ m/s^2. When the particle reaches its maximum y coordinate, find the particle's speed (in m/s).

$\vec{v}_1 = (0\,\hat{i} + 6\,\hat{j})\ m/s$

(1pt) $\frac{dy}{dt} = v_{2y} = v_{1y} + a_y t$

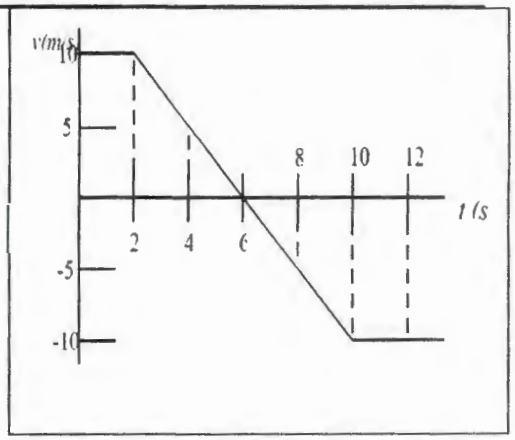
(1pt) $-\frac{v_{1y}}{a_y} = t = 2\ s.$

Answer: 4 m/s

(0.5pt) $v_{2x} = v_{1x} + a_x t = 4\ m/s$

(1pt) speed $= \sqrt{v_x^2 + v_y^2}_{\,0} = v_x$

9. The figure shows the velocity graph of a particle moving along the x-axis. Find the magnitude of the average velocity (in m/s) of the particle during the first 10 seconds.



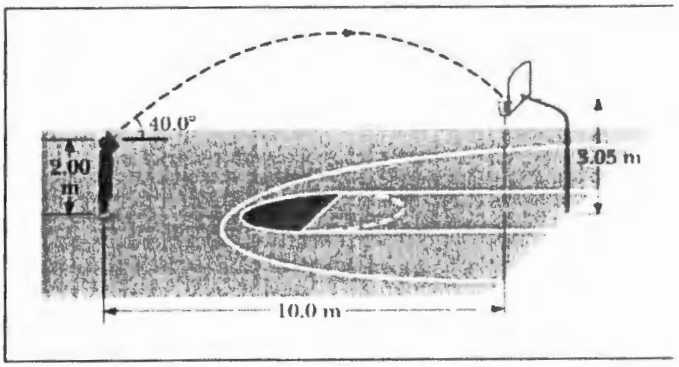
pt $\left[2(10)+\frac{1}{2}4(10)-\frac{1}{2}4(10)\right]$ m

$\frac{}{10\ s.}$

5pt) = 2 m/s

Answer: 2 m/s

10. At what speed (m/s) must the player shoot the ball, such that it goes right through the hoop (basket).



pt $\begin{cases} \Delta x = v_1 \cos\theta\, t \\ \frac{\Delta x}{t\cos\theta} = v_1 \end{cases}$

5pt $\begin{cases} \Delta y = v_1 \sin\theta\, t + \frac{1}{2} g t^2 \\ \Delta y = \Delta x \tan\theta + \frac{1}{2} g t^2 \\ \sqrt{\frac{2}{g}(\Delta y - \Delta x \tan\theta)} = \sqrt{\frac{2}{-10}(1.05 - 10\tan 40)} \\ = 1.21\ s. = t \end{cases}$

pt) $\Rightarrow v_1 = 10.79$ m/s

Answer: 10.79 m/s