Kuwait University **Physics Department**

Physics 101
First Examination

July 8, 2004

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

Instructors:

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For use by Instructors only

Prob.	1	2	3	4	5	6	7	8	9	10	Total
Marks											

1. Answer all the questions.
2. The solution should be given explicitly for each problem.
3. No solution = no points.
4. Check the correct answer for each question.
5. Take g = 10 m/s^2, cos 37 = 0.8 sin 37 = 0.6
6. Mobile phone and pagers are not allowed.

1. The position of a particle varies with time according to the equation $x = 4 - 4t + 2t^2$ m where t is in seconds. Find the average velocity of the particle between t = 0 and t = 2s.

a) 4 m/s b) 2 m/s **c) 0** d) –2 m/s e) –4 m/s

$x(0) = 4\ m$ & $x(2) = 4 - 4(2) + 2(2)^2 = 4\ m$

$\bar{V} = \frac{4-4}{2-0} = 0$

2. For the same particle of example (1) where $x = 4 - 4t + 2t^2$ m, find the average speed from t = 0 and t = 2s.

a) 4 m/s **b) 2 m/s** c) 0 d) –2 m/s e) –4m/s

$\frac{dx}{dt} = -4 + 4t = 0 \Rightarrow t = 1\ s$

$x(0) = 4\ m$ $x(1) = 4 - 4 + 2 = 2\ m$

$x(2) = 4 - 8 + 8 = 4\ m$

average speed $= \frac{\text{Total distance}}{\text{time}} = \frac{2+2}{2} = 2\ m/s$

3. The angle between the two vectors $\vec{A} = 3\vec{i} + 4\vec{j}$ and $\vec{B} = 4\vec{i} + 3\vec{j}$ is:

a) 0° **b) 16°** c) 37° d) 53° e) 90°

$\cos\theta = \frac{\vec{A}\cdot\vec{B}}{|A||B|} = \frac{12+12}{(5)(5)} = \frac{24}{25} \Rightarrow \theta = 16^\circ$

Or $\theta_A = \tan^{-1}\left(\frac{4}{3}\right) = 53^\circ$ $\theta_B = \tan^{-1}\left(\frac{3}{4}\right) = 37^\circ \Rightarrow \Delta\theta = 16^\circ$

4. A particle started from origin with velocity $6\vec{i}$ m/s and moves with acceleration $-3\vec{i} - 2\vec{j}$ m/s^2. When the particle reaches its maximum positive x coordinate what is the speed of the particle?

a) 0 b) –2 m/s **c) 4 m/s** d) 2 m/s e) -4 m/s

$V_x = V_{x0} + a_x t \Rightarrow 0 = 6 + (-3)t \Rightarrow t = 2\ s$

$V_y = V_{y0} + a_y t \Rightarrow V_y = 0 - 2(2) = -4\ m/s$

speed = 4 m/s

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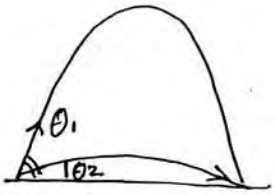
5. Particle A is projected from the ground level with speed of 50 m/s at a certain angle θ_1. Six seconds later another particle B is projected from the same point with the same speed but at angle θ_2, The two particles meet when they hit the ground at a horizontal distance of 160 m from the projection point and at the same ground level. What is θ_2?

a) 20° b) 30° c) 40° d) 50° e) 60° f) 70°



$$R = \frac{V_0^2 \sin 2\theta}{g}$$

$$160 = \frac{(50)^2 \sin 2\theta}{10} \Rightarrow \sin 2\theta = \frac{(160)(10)}{(50)^2}$$

$$2\theta = 40^\circ \qquad \theta = \frac{40}{2} = 20^\circ$$

This is (θ_2) because it take the least time.

6. What would the period of rotation of Earth (number of hours per day) have to be for an object on the equator to have a centripetal acceleration of a magnitude of 9.8 m/s^2 ($R_e = 6.4 \times 10^6$ m) ?

a) 5.1 h b) 24 h c) 2.2 h d) 8 h e) 1.4 h

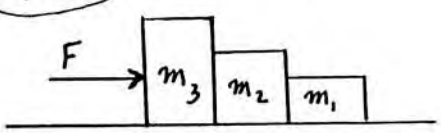
$$a_r = \frac{V^2}{R} \Rightarrow 9.8 = \frac{V^2}{6.4 \times 10^6} \Rightarrow V = 7.9 \times 10^3 \text{ m/s}$$

$$T = \frac{2\pi R}{V} = \frac{2\pi (6.4 \times 10^6)}{7.9 \times 10^3} = 5.07 \times 10^3 \text{ s}$$

$$T = \frac{5.07 \times 10^3}{3600} = (1.4 \text{ h})$$

7. Three masses in contact as shown in figure m_1 = 8 kg, m_2 = 12 kg, m_3 = 20 kg. A force of 160 N acts on m_3 horizontally. What is the net force on m_2?

a) 12 N b) 16 N c) 24 N d) 32 N e) 48 N



$$F - P_1 = m_3 a$$
$$P_1 - P_2 = m_2 a$$
$$P_2 = m_3 a$$

$$F = Ma$$

$$a = \frac{160}{40} = 4 \text{ m/s}^2$$

$$\Sigma F = 12(4) = (48 \text{ N})$$

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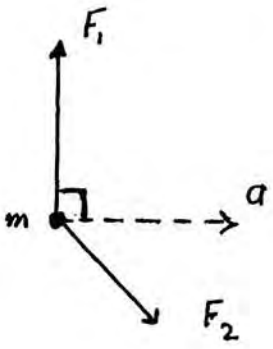
8. A particle of mass 1 kg is acted upon by two forces F_1 and F_2 as shown in figure. As a result the particle moves with acceleration of 3 m/s^2 in the direction shown in figure. If F_1 = 4 N, the magnitude of the force F_2 is :

a) 3 N b) 4 N **c) 5 N** d) 6 N e) 7 N



$F_{2x} = m\,a = (1)(3) = 3\ N$

$F_{2y} = F_1 = 4\ N$

$F_2 = \sqrt{F_{2x}^2 + F_{2y}^2} = \sqrt{3^2 + 4^2} = 5\ N$

9. A plane (P) flies horizontally with speed of 100 m/s. A package (c) is released from the plane. Find the velocity (in m/s) of the package relative to the plane after 2 s.

a) $100\vec{i}$ b) $20\ \vec{j}$ **c) $-20\vec{j}$** d) $100\vec{i} + 20\vec{j}$ e) $100\vec{i} - 20\vec{j}$

$\vec{V}_{pg} = 100\,\vec{i}$

$\vec{V}_{cg} = 100\,\vec{i} - 20\,\vec{j}$

$\vec{V}_{cp} = \vec{V}_{cg} + \vec{V}_{gp} = (100\,\vec{i} - 20\,\vec{j}) - (100\,\vec{i})$

$= -20\,\vec{j}$

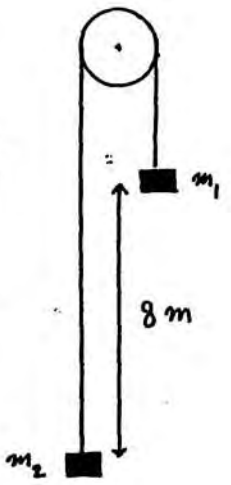
For $V_y = V_{y_0} - gt$

$= 0 - 10(2)$

$= -20\ m/s$

10. In Atwood machine the particles m_1 = 12 kg and m_2 = 8 kg are arranged (as shown in figure) with distance 8 m apart from each other. How long does m_1 take to meet particle m_2 when the system is released from rest.?

a) 4 s **b) 2 s** c) 1.4 s d) 2.8 s e) 3.6 s



$m_1 g - T = m_1 a$

$T - m_2 g = m_2 a$

$\Rightarrow m_1 g - m_2 g = (m_1 + m_2) a$

$a = \frac{m_1 - m_2}{m_1 + m_2} g = \frac{12 - 8}{12 + 8}(10) = 2\ m/s^2$

$y = V_{y_0} t + \frac{1}{2} a t^2$

$4 = 0 + \frac{1}{2}(2) t^2$

$t = 2\ s$

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