Physics Department
Physics 101

III

First Midterm Exam
Summer 2010
Thursday, July 8th, 2010
6:00 p.m. – 7:30 p.m.

Student's Name: ……..……..……..……..……..……

Model Answer

Student's Number: ……..……..……..……..……..……

Choose your Instructor's Name:

Dr. Adnan Al-Yaseen	Dr. Abdulnasser Burezq
Dr. Abdul-Mohsen Ali	Dr. Fatma Al-Dossari
Dr. Tareq Alrefae	Dr. Ashraf Zaher

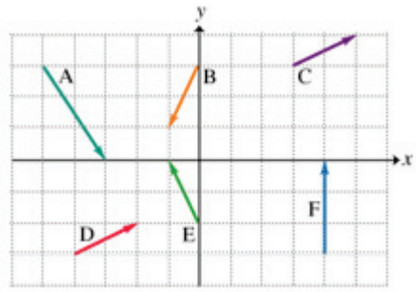
Grades:

#	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	Total
Points																

Important:
1. Answer all questions and problems.
2. Each question/problem will be assigned 1 point.
3. No solution = no points.
4. Check the correct answer for each question/problem.
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

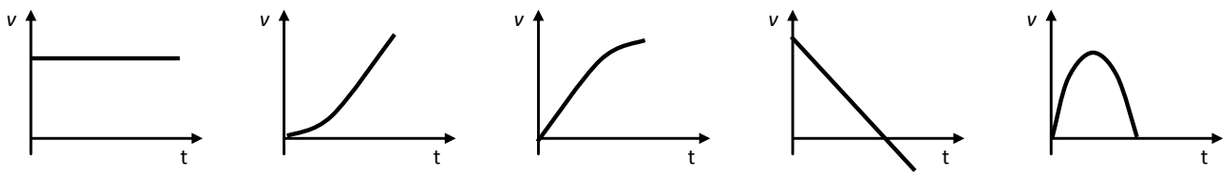
1. Which two vectors, when subtracted, will have the largest magnitude?



(a) A and F
(b) A and E
(c) D and B
(d) C and D
(e) E and F

Only pairs (A & F) and (A & E) should be considered to yield that (A - F) is the correct answer!

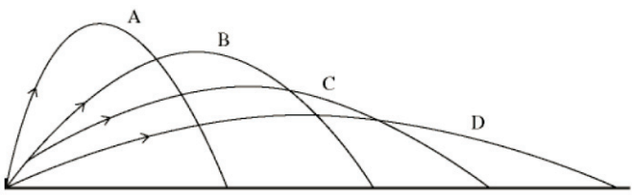
2. An object is thrown vertically up in the air. Which of the five following graphs correctly represents its velocity?



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

Velocity should start +, goes to zero, then becomes -ve

3. Shown in the figure are the trajectories of four projectiles. Each was fired with the same speed. Which was in the air the longest time?



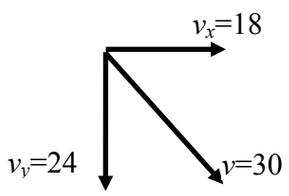
(a) Projectile A
(b) Projectile B
(c) Projectile C
(d) Projectile D
(e) All were in the air for the same time

$$\Delta y = 0 \Rightarrow t = \frac{v \sin\theta}{g} \Rightarrow t_{\max} = \frac{v \sin\theta_{\max}}{g}$$

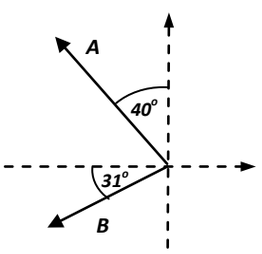
4. When a ball is thrown horizontally out of a window at a speed of 18 m/s, it hits the ground at a speed of 30 m/s. If a ball were dropped out the same window, what would be its speed when it hits the ground?

(a) 0
(b) 12 m/s
(c) 18 m/s
(d) 24 m/s
(e) 30 m/s

$$v_y = \sqrt{v^2 - v_x^2} = \sqrt{30^2 - 18^2} = 24$$



5. Two vectors $\vec{A}$ and $\vec{B}$ are shown. The magnitudes of vector $\vec{A}$ is 16 units, and $\vec{B}$ is 7 units. The magnitude of vector $\vec{C} = \vec{B} - \vec{A}$ is closest to:



(a) 15.50
(b) 17.48
(c) 16.43
(d) 9.00
(e) 9.53

$$\vec{C} = (-7\cos 31^\circ \hat{i} - 7\sin 31^\circ \hat{j}) - (-16\sin 40^\circ \hat{i} + 16\cos 40^\circ \hat{j})$$
$$= (-7\cos 31^\circ + 16\sin 40^\circ)\hat{i} + (-7\sin 31^\circ - 16\cos 40^\circ)\hat{j}$$
$$= +4.28\,\hat{i} - 15.86\,\hat{j} \Rightarrow |C| = 16.43$$

6. The angle between vector $\vec{A} = +2\hat{i} - 2\hat{j} - 3\hat{k}$ and the *y*-axis, in degrees, is closest to:

(a) 61
(b) 29
(c) 119
(d) 151
(e) 90

$$\theta = \cos^{-1}\left(\frac{\vec{A}.\hat{j}}{A}\right) = \cos^{-1}\left(\frac{-2}{\sqrt{2^2+2^2+3^2}}\right) = \cos^{-1}(-0.485) \cong 119^\circ$$

7. For the vector $\vec{C} = -3\hat{i} - 2\hat{j} - 3\hat{k}$, the *vector* product $\vec{C} \times \hat{j}$ equals:

(a) $+3\hat{i} + 2\hat{j} - 3\hat{k}$
(b) $+3\hat{i} - 3\hat{k}$
(c) $+3\hat{i} + 3\hat{k}$
(d) $-3\hat{i} + 3\hat{k}$
(e) $-3\hat{i} - 2\hat{j} + 3\hat{k}$

$$\vec{C} \times \hat{j} = -3(\hat{i} \times \hat{j}) - 2(\hat{j} \times \hat{j}) - 3(\hat{k} \times \hat{j}) = -3\hat{k} + 3\hat{i}$$

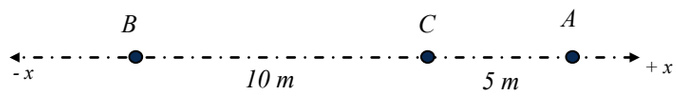
8. Two objects ***A*** and ***B*** start moving from point of origin. Object ***A*** moves 13 m east and then 13 m north. Object ***B*** moves 16 m west and then 11 m north. Find the *scalar product* of their net displacements from the origin.

(a) 65
(b) -208
(c) 143
(d) -65
(e) 338

$$\vec{A} \cdot \vec{B} = (13\hat{i} + 13\hat{j}) \cdot (-16\hat{i} + 11\hat{j}) = (13 * -16) + (13 * 11) = -65$$

9. A cat runs along a straight line from point ***A*** to point ***B*** *then* to point ***C***, as distances are shown in the figure. The time to run from ***A*** to ***B*** is 20 s, and the time from ***B*** to ***C*** is 8 s. The average speed of the cat between points *A* and *C* is closest to:

(a) 0.893 m/s
(b) -0.179 m/s
(c) 0.179 m/s
(d) 0.536 m/s
(e) -0.893 m/s

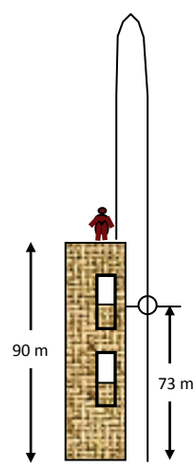


$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{15+10}{20+8} = 0.893\ \text{m/s}$$

10. A ball is projected upward at time t = 0 s, from a point on a roof 90 m above the ground. The ball rises, then falls and strikes the ground. The initial velocity of the ball is 82.4 m/s. The velocity of the ball when it is 73 m above the ground is closest to:

(a) -51 m/s
(b) -101 m/s
(c) -68 m/s
(d) -84 m/s
(e) -34 m/s

$$v^2 = v_0^2 - 2g(y - y_0) = (82.4)^2 - 2 * 10 * (73 - 90)$$
$$= 7129.76 \Rightarrow v = -84.44\ \text{m/s}$$



11. On the earth, when a 0.250-kg stone is thrown vertically upward, it returns back 8 s later. On planet X, under the same circumstances, the stone returns back in 16 s. In both cases, the stone is thrown with the same initial velocity and it feels negligible air resistance. The acceleration due to gravity on planet X (in terms of g) is closest to:

(a) $g/2$
(b) $g/\sqrt{2}$
(c) $2g$
(d) $g\sqrt{2}$
(e) $g/4$

$$y - y_0 = 0 = v_0 t - 0.5at^2 \Rightarrow a = \frac{2v_0}{t} \Rightarrow \frac{a_2}{a_1} = \frac{t_1}{t_2}$$
$$\frac{a_2}{g} = \frac{8}{16} \Rightarrow a_2 = g/2$$

12. An object is moving in a straight line with constant acceleration. Initially it is travelling at 16m/s. three seconds later it is travelling at 10m/s. How far does it move during this time?

(a) 26 m
(b) 30 m
(c) 39 m
(d) 48 m
(e) 55 m

$$x - x_0 = \frac{t}{2}(v + v_0) = \frac{3}{2}(10 + 16) = 39\text{ m}$$
$$x - x_0 = \frac{t}{2}(v + v_0) = \frac{3}{2}(10 + 16) = 39\text{ m}$$

13. An object rotates in a circle of radius of 500 m and takes 1.5 minutes for each revolution around the axis. The acceleration of this object is:

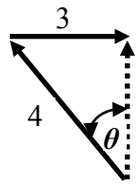
(a) 0.388 m/s²
(b) 0.776 m/s²
(c) 219.3 m/s²
(d) 34.91 m/s²
(e) 2.437 m/s²

$$a_{rad} = \frac{4\pi^2 R}{T^2} = \frac{4\pi^2 * 500}{(1.5 * 60)^2} = 2.44\text{ m/s}^2$$

14. A swimmer is able to swim through still water at 4 km/h. She wishes to swim from point A, to port B due north, a distance of 50 km. A river current flows from west to east at 3 km/h. In what direction should she swim to make the crossing along a straight line between the two points?

(a) 37° east of north
(b) 41° west of north
(c) 49° west of north
(d) 37° west of north
(e) 41° east of north

$$\theta = \sin^{-1}(3/4) \cong 49^\circ = 49^\circ \text{ W of N}$$



15. A helicopter accelerates vertically upward from the ground from rest at 2 m/s². Three s after the helicopter leaves, a bag is dropped from the helicopter. What is the speed of the bag just before it hits the ground? (The helicopter is moving when the bag is dropped.)

(a) 2.00 m/s
(b) 4.67 m/s
(c) 6.00 m/s
(d) 12.5 m/s
(e) 14.7 m/s

$$v_0 = 0 + 2 * 3 = 6\text{ m/s and } y_0 = 0 + 0 + 0.5 * 2 * (3)^2 = 9\text{ m}$$
$$v^2 = v_0^2 - 2g(y - y_0) = 6^2 - 2 * 10 * (0 - 9) = 216 \Rightarrow v \cong 14.7\text{ m/s}$$