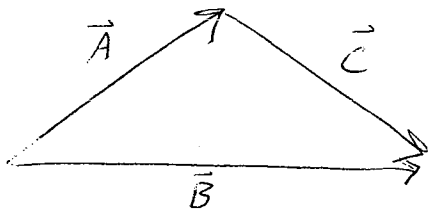
solutions

Physics 2414
Midterm #1 – Spring 2012

Version A

Multiple choice (6 points each)

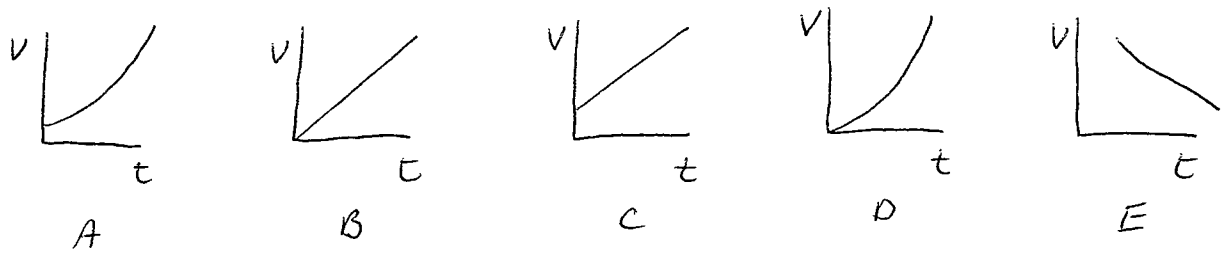


1) Which of the following vector equations correctly describes the relationship among the vectors shown in the figure for Vectors **A**, **B** and **C**?

A) **A+B+C=0**
B) **A-B+C=0**
C) **A-B-C=0**
D) **A+B-C=0**
E) None of the above vector equations is correct

$\vec{A} + \vec{C} = \vec{B}$

$\vec{A} - \vec{B} + \vec{C} = 0$



2) A car accelerates uniformly from a velocity of 10 km/h to 30 km/h in one minute. Which velocity vs time graph best describes the motion of the car?

A) A
B) B
C) C
D) D
E) E

constant acceleration so constant positive slope

at $t=0$ $v=10$ km/h so y-intercept not 0

3) An object starts from rest and undergoes uniform acceleration. During the first second it travels 5.0m. How far will it travel during the third second?

A) 5.0 m
B) 15 m
C) 25 m
D) 35 m
E) 45 m

During 1st second $V_0 = 0$ $x = x_0 + v_0 t + \frac{1}{2} a t^2$

$x = \frac{1}{2} a t^2$ $5m = \frac{1}{2} a (1s)^2$ $a = 10 m/s^2$

from 2s-3s

$V = a(2s) = (10 m/s^2)(2s) = 20 m/s$

$x = x_0 + v_0 t + \frac{1}{2} a t^2 = (20 m/s)(1s) + \frac{1}{2}(10 m/s^2)(1s)^2$

$= 20m + 5m = 25m$

4) A variable y is found to behave as $y=5x^5$. x is measured to be 2.2 ± 0.3 m. What is the uncertainty on y?

A) 136 m^5
B) 682 m^5
C) 257 m^5
D) 176 m^5
E) 356 m^5

$y = 5 \cdot (2.2)^5 = 257.68 m^5$

% unc on $x = \frac{0.3m}{2.2m} = .136$

so % unc on $y = 5 \cdot .136 = 0.68$

so unc on $y = 257.68 \cdot 0.68 = 176 m^5$

5) An airplane travels at 300 mi/h south for 2.00 hours and then at 250 mi/h north for 750 miles. What is the average speed of the entire trip?

A) 260 mi/h
B) 270 mi/h
C) 275 mi/h
D) 280 mi/h
E) 285 mi/h

$speed = \frac{total\ distance}{total\ time}$

$= \frac{600mi + 750mi}{2h + 3h}$

$\frac{1350mi}{5h} = 270 mi/h$

South: time = 2h, distance = 600 mi

North: distance = 750 mi, time = 3h

6) A car starting from rest moves with constant acceleration of 2.0 m/s^2 for 10 s, then travels with constant speed for another 10 s, and then finally slows to a stop with constant acceleration of -2.0 m/s^2. How far does it travel?

A) 200 m
B) 300 m
C) 350 m
D) 400 m
E) 500 m

1) $x = x_0 + v_0 t + \frac{1}{2} a t^2 = \frac{1}{2}(2 m/s^2)(10s)^2 = 100m$

$v = at = 2.0 m/s^2 \cdot 10s = 20 m/s$

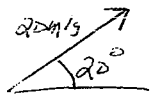
2) $x = vt = 20 m/s \cdot 10s = 200m$

3) $0 = v_0^2 + 2a\Delta x = (20 m/s)^2 - 2(2 m/s^2)(\Delta x) = 0 \Rightarrow \frac{400}{4} = 100m$

total distance = 100m + 200m + 100m = 400m

7) A ball is thrown with a velocity of 20 m/s at an angle of 20° above the horizontal. What is the horizontal component of its instantaneous velocity at the exact top of its trajectory?

A) 18.8 m/s
B) 6.8 m/s
C) 20 m/s
D) zero
E) 16.6 m/s



$V_x = 20 m/s \cos 20° = 18.8 m/s$

V_x never changes so always 18.8 m/s

8) Ignoring air resistance, the horizontal component of a projectiles velocity and acceleration:

Velocity	Acceleration
(A) remains constant	is zero
B) continously increases	continuously increases
C) continuously decreases	continuously decreases
D) remains constant	non-zero constant
E) continuously increases	non-zero constant

9) When a football in a field goal attempt reaches its maximum height, how does its speed compare to its initial speed?

initial speed $\vec{V} = \vec{V}_x + \vec{V}_y$

at maximum height $V_y = 0$

so less

A) It is zero
(B) It is less than its initial speed
C) It is equal to its initial speed
D) It is greater than its initial speed
E) Cannot be determine with the given information

10 A girl throws a rock horizontally, with a velocity of 10 m/s, from a bridge. It falls 20 m to the water below. How far does the rock travel horizontally before striking the water?

time for rock to hit water

$y = y_0 + V_{0y}t + \frac{1}{2}at^2 \Rightarrow 20\,m = \frac{1}{2}gt^2 \quad t = \sqrt{\frac{2 \cdot 20\,m}{9.8\,m/s^2}} = 2\,s$

$X = V_{0x}t = 10\,m/s \cdot 2s = 20m$

A) 14 m
B) 16 m
C) 17 m
D) 18 m
(E) 20 m

11) You and your friend have built radio controlled model cars. You line your cars up to race in a straight-line drag race. Your car can accelerate from rest at twice the rate as your friend's car. How much longer will it take your friend's car to reach the finish line than your car?

$x = x_0 + V_0 t + \frac{1}{2}at^2$

Both cars travel same distance $\quad a_2 = 2a_1$

$x = \frac{1}{2}a_1(t_1)^2 = \frac{1}{2}a_2(t_2)^2 = \frac{1}{2}(2a_1)(t_2)^2$

$t_1^2 = 2t_2^2 \quad t_1 = \sqrt{2}\,t_2$

(A) $\sqrt{2}$ times longer.
B) 2 times longer.
C) $2\sqrt{2}$ times longer.
D) 4 times longer.
E) More information is needed to answer this question.

12) Two rocks are dropped into two different deep wells. The first one takes four times as long to hit bottom as the second one. Ignore air resistance. How much deeper is the first well than the second?

$y = y_0 + V_{0y}t + \frac{1}{2}at^2$

$y = \frac{1}{2}gt^2$

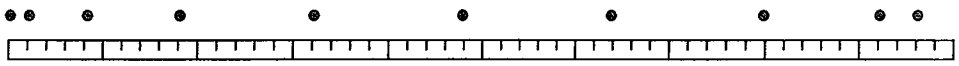
if t 4x longer

$y' = \frac{1}{2}g(4t)^2 = 16 \cdot \frac{1}{2}gt^2$

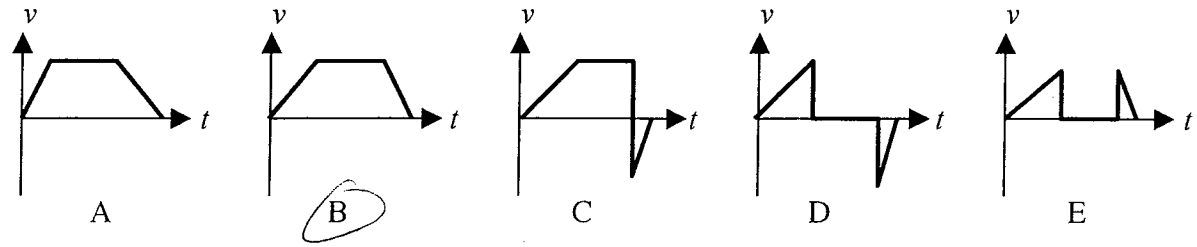
$= 16y$

A) 2 times as deep
C) 4 times as deep
(E) 16 times as deep
B) 6 times as deep
D) 2*g times as deep

13) The diagram below shows a motion diagram for an object moving to the right. Each position is separated by equal time intervals. The first position occurs just after the object starts to move and the last position occurs just before the object comes to rest.



Which of the following graphs best represents the object's velocity as a function of time?



14) To be dimensionally consistent, velocity [m/s], force [kg m/s^2], mass [kg], and length [m] must be related as follows:

a. Velocity squared ~ force length/mass
b. Velocity squared ~ force mass/length
c. Velocity squared ~ mass length/force
d. Velocity squared ~ force mass/length^2
e. Velocity squared ~ mass /force

$\frac{kg\,m}{s^2} \cdot \frac{m}{kg} = \frac{m^2}{s^2} = v^2$

15) Can an object's velocity change direction when its acceleration is constant?

A. No, this is not possible because it is always speeding up.
B. No, this is not possible because it is always speeding up or always slowing down, but it can never turn around.
C. Yes, this is possible, and a rock thrown straight up is an example.
D. Yes, this is possible, and a car that starts from rest, speeds up, slows to a stop, and then backs up is an example.
E. none of the above.

16) You drop a bowling ball from the top of a tall building. One second later, you drop a ping-pong ball from the same point. Neglecting air resistance, what can we say about the motion of the two balls?

A) The bowling ball will hit the ground more than one second before the ping-pong ball.
B) The bowling ball and the ping-pong ball will hit the ground at the same time.
C) The bowling ball will hit the ground exactly one second before the ping-pong ball.
D) The difference in their speeds will continually increase by 9.8 m/s every second.
E) The distance between the bowling ball and the-ping pong ball will remain the same until at least one of them hits the ground.