Physics 1200
Quiz 1, Spring 2013, Form: A

Name: Key
Date: _____

You must include units with all quantities (that have units). You must show your work or explain your reasoning in words for all questions including multiple-choice questions. An answer with no calculation or explanation will not receive full credit.

1. A displacement vector is shown in Figure 1.

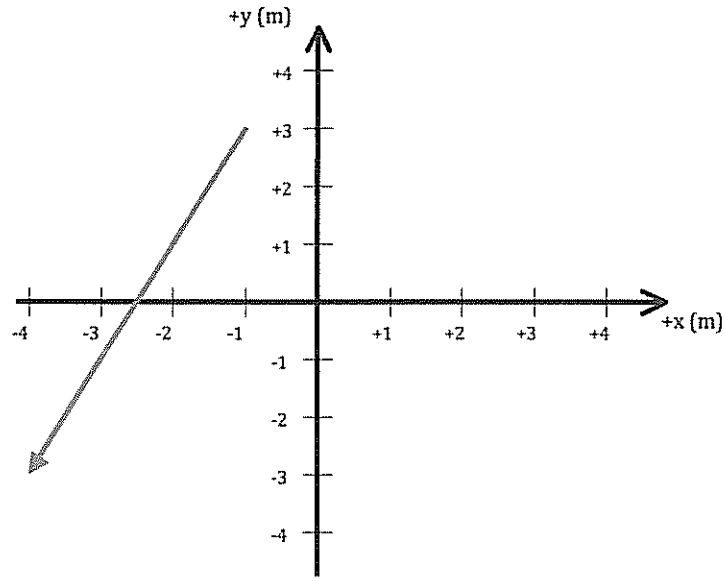

Figure 1: A displacement vector.

(a) What are the coordinates of the tail of the vector? $x = -1m$, $y = 3m$ or $(-1, 3)m$

(b) What are the coordinates of the head of the vector? $x = -4m$, $y = -3m$ or $(-4, -3)m$

(c) Write the vector (in component form).

head − tail = $(-3, -6)m$

2. An object was at (4, 2, 1) m and is displaced (−1, 3, 2) m. What is its (new) position after it moved?

new position = old pos. + displacement
= $(4, 2, 1)m + (-1, 3, 2)m$
= $(3, 5, 3)m$

3. (a) An object has a speed 2 m/s in the $-y$ direction. What is its velocity (vector)?

$\vec{V} = 2(0, -1, 0) = (0, -2, 0)\frac{m}{s}$

(b) An object has a speed of 5 m/s in the $+x$ direction. What is its velocity (vector)?

$\vec{V} = 5(1, 0, 0) = (5, 0, 0)\frac{m}{s}$

4. An object has a velocity $\vec{v} = (-2,\ 4,\ 0)$ m/s.

(a) Sketch this vector.

(b) What is the magnitude of its velocity (i.e. speed)?

$|\vec{v}| = \sqrt{2^2+4^2} = \sqrt{20} = 4.5\ \frac{m}{s}$

(c) What is its direction (i.e. its unit vector)?

$\hat{v} = \frac{\vec{v}}{|\vec{v}|} = \frac{(-2,4,0)}{\sqrt{20}} = (-0.45,\ 0.89,\ 0)$

(d) The object is traveling:

i. to the left — v_x is neg.
ii. to the right
iii. neither of the above

(e) The object is traveling:

i. upward — v_y is pos.
ii. downward
iii. neither of the above

(f) The object is traveling:

i. outward
ii. inward
iii. neither of the above — $v_z = 0$

(g) What is $-\vec{v}$? (Express it in component form.)

$-\vec{v} = -(-2,4,0) = (2,-4,0)\ \frac{m}{s}$

(h) Sketch $-\vec{v}$.

note that $-\vec{v}$ is opposite $\vec{v}$.

5. At $t = 0$, a ball is at the position $(-6, 9, 0)$ m and has a velocity $\vec{v} = (2, -3, 0)$ m/s. What is its position at the following clock readings: $t = 2$ s, $t = 4$ s, and $t = 6$ s? Show your calculations and write your answers in the table.

t (s)	position (m)
0	$(-6,9,0)$
2	$(-2,3,0)$
4	$(2,-3,0)$
6	$(6,-9,0)$

new pos = old pos + $\vec{v}\,\Delta t$

$t=2$: $= (-6,9,0) + (2,-3,0)(2s)$
$= (-2,3,0)\,m$

$t=4$: $= (-2,3,0)\,m + (2,-3,0)(2)$
$= (2,-3,0)\,m$

$t=6$: $= (2,-3,0)\,m + (2,-3,0)(2)$
$= (6,-9,0)\,m$

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Game

Here is a VPython program of a ball that rolls across a level track with uniform motion (It is similar to the one you wrote in class but with two lines missing at the locations of the comment # characters.) Suppose that position is in meters, time is in seconds, and velocity is in m/s.

```
1  from visual import *
2
3  track=box(pos=vector(0,-0.075,0), size=(3,0.05,0.1), color=color.white)
4
5  ball=sphere(pos=vector(1.5,0,0), radius=0.05, color=color.cyan)
6
7  ball.v=0.6*vector(-1,0,0)
8
9  dt=0.01
10 t=0
11
12 while 1:
13     rate(100)
14 #
15 #
```

Questions

1. What is the length of the track? 3m (see size attribute)
2. Is the ball's initial position at the right side of the track, at the left side of the track or somewhere in the middle? x=0 is in the middle of the 3m track so x=1.5m is on the right side.
3. What is the speed of the ball? (Remember, speed is the magnitude of velocity. Thus, speed is not a vector.) $0.6\frac{m}{s}$ since ball.v = 0.6*vector(-1,0,0)
4. Is the velocity of the ball to the left or to the right? (Or, is it zero?) since ball.v.x is neg.
5. On line 14, you want to update the position the ball after a time step *dt*. Write the appropriate line of code.

```
ball.pos = ball.pos + ball.v*dt
```

6. On line 15, you want to update the clock reading *t* by an amount *dt*. Write the appropriate line of code.

```
t = t + dt
```

6. The x-position as a function of time for an object is shown in Figure 2. What is the x-velocity of the object?

v_x = slope

$= \frac{\Delta x}{\Delta t}$

$= \frac{1.5-(-1)\,m}{5-0\,s}$

$= \frac{2.5\,m}{5\,s}$

$= \boxed{0.5\,\frac{m}{s}}$

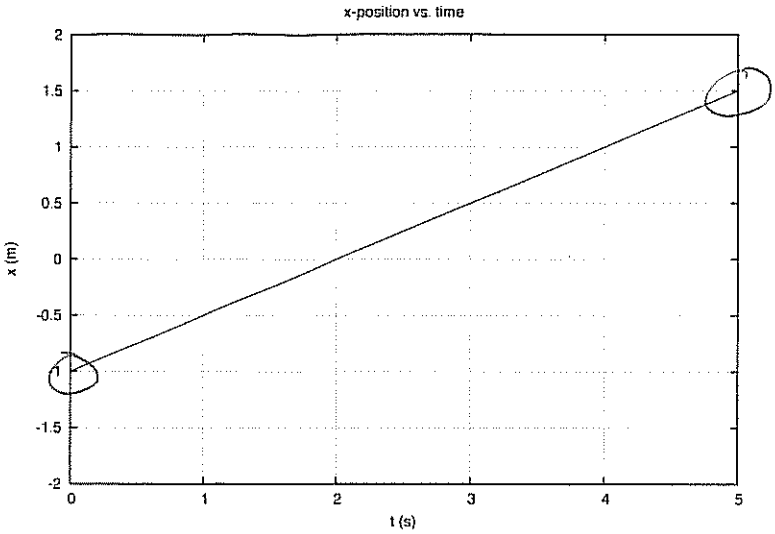
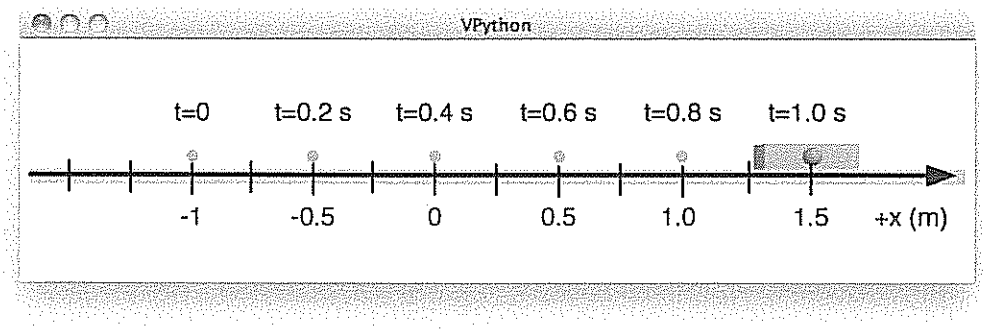


Figure 2: A x(t) graph.

7. An object travels to the right. Its position at certain clock readings is shown below.



(a) What is the object's x-velocity? $v_x = \frac{\Delta x}{\Delta t} = \frac{-0.5-(-1)}{0.2-0} = \frac{0.5\,m}{0.25} = \boxed{2.5\,\frac{m}{s}}$

(b) What is the object's x-position at $t = 0.5$ s?

halfway between $x=0$ and $x=0.5$ so $\boxed{x = 0.25\,m}$ at $t = 0.5\,s$

(c) What is the object's x-position at $t = 5.0$ s?

$x_f = x_i + v_x \Delta t$ choose $t_i = 0$ and $\Delta t = 5s$.

$= -1m + \left(2.5\,\frac{m}{s}\right)(5s)$

$= -1m + 12.5\,m$

$= \boxed{11.5\,m}$