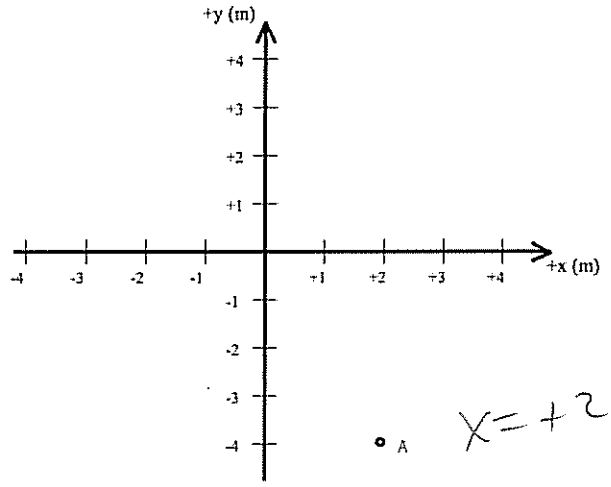
Physics 1200
Quiz 1, Spring 2012, Form: A

Name: Key
Date: _____

You must include units with all quantities (that have units).

1. An object is located at point A shown in Figure 1. What are the (x,y) coordinates of the object?

(5)



$x = +2$ m, $y = -4$ m

$(2, -4)$ m

Figure 1: Point A on a coordinate system.

2. In VPython, you create the original box shown in Figure 2 and you decide to change it to make the new box shown. Which property of the box should you change: length, width, or height?

(5)

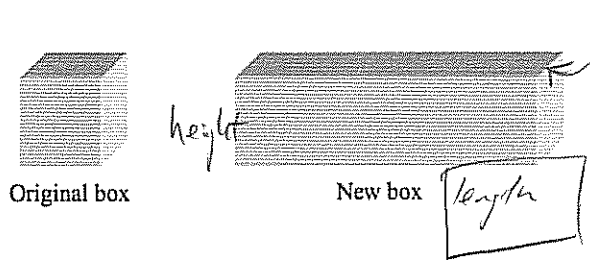


Figure 2: Point A on a coordinate system.

(40)

3. An object has a velocity $\vec{v} = (3, -1, 0)$ m/s.
   (a) Sketch this vector. → down and to the left.
   (b) What is $-\vec{v}$?
   (c) Sketch $-\vec{v}$.
   (d) What is the magnitude of the object's velocity (i.e. speed)?

(a) →

(b) $-\vec{v} = -1(3, -1, 0)\frac{m}{s} = (-3, +1, 0)\frac{m}{s}$

(c) ← opposite $\vec{v}$.

(d) $|\vec{v}| = \sqrt{3^2 + 1^2} = \sqrt{10} = 3.16\ \frac{m}{s}$

4. A vector is shown in Figure 3.

(10)

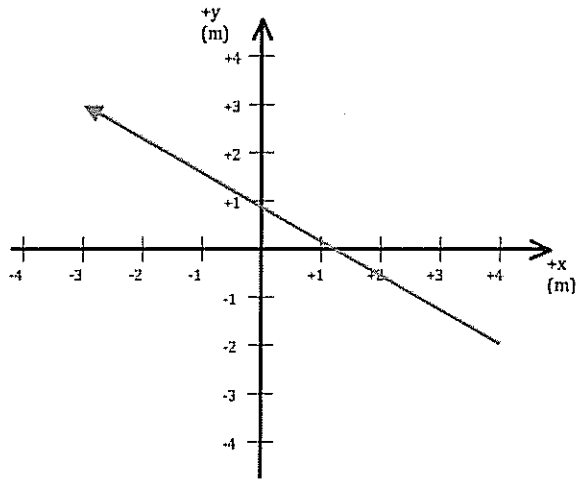


Figure 3: A vector.

(a) What are the coordinates of the tail of the vector? $(4, -2)$ m

(b) What are the coordinates of the head of the vector? $(-3, 3)$ m

(c) What are the components of the vector? $(-7, 5)$ m

5. The y-position as a function of time for an object is shown in Figure 4.

(10)

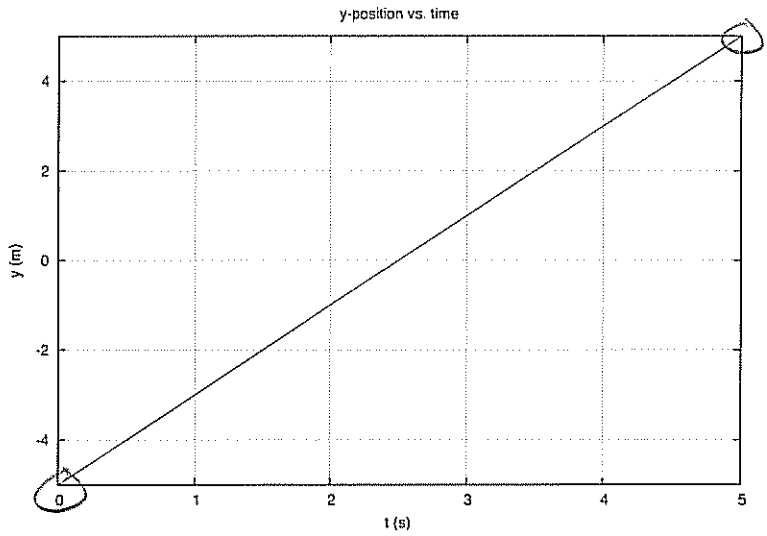


Figure 4: A y(t) graph.

$\text{slope} = \frac{\text{rise}}{\text{run}}$

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

$= \boxed{2\,\frac{m}{s}}$

What is the y-velocity of the object?

$v_y = \text{slope} = \boxed{2\,\frac{m}{s}}$

(10)

6. A bullet has a speed of 2 m/s in the $-x$ direction. What is its velocity vector? $\vec{v} = (-2, 0, 0)\ \frac{m}{s}$

7. A ball is at the position $(-10, -5, 0)$ m and has a velocity $\vec{v} = (1, 2, 0)$ m/s. What is its position at the following clock readings: $t = 2$ s, $t = 4$ s, $t = 6$ s, $t = 8$ s, $t = 10$ s? Show your calculations and write your answers in the table.

Δt between clock readings is 2 sec.

displacement $= \vec{v}(\Delta t)$

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

$= (2, 4, 0)$ m

(10)

t (s)	position (m)
0	$(-10, -5, 0)$
2	$(-8, -1, 0)$
4	$(-6, +3, 0)$
6	$(-4, 7, 0)$
8	$(-2, 11, 0)$
10	$(0, 15, 0)$

t=0: $(-10, -5, 0)$

t=2: pos = pos + disp.
$= (-10, -5, 0)\ m + (2, 4, 0) = (-8, -1, 0)\ m$

t=4: pos $= (-8, -1, 0)\ m + (2, 4, 0) = (-6, +3, 0)\ m$

t=6: pos $= (-6, +3, 0)\ m + (2, 4, 0) = (-4, 7, 0)\ m$

t=8: pos $= (-2, 11, 0)\ m$

t=10: pos $= (0, 15, 0)\ m$

8. A ball is at $(1, 2, 0)$ m and has a radius of 0.05 m. A bullet is at $(1.04, 1.97, 0)$ and has a radius of 0.01 m. What is the distance between the ball and the bullet and did they collide?

distance $= \sqrt{0.04^2 + 0.03^2}$

$= 0.05$ m

vector from ball to bullet is

$(1.04, 1.97, 0) - (1, 2, 0)$

$= (0.04, -.03, 0)$ m

(10)

Yes, they collided because $0.05m < (0.05m + 0.01m)$

9. A shooter in a VPython program is at the top of the screen moving in the $-x$ direction with a speed of 2 m/s with respect to the scene (i.e. window). It fires a bullet downward that has a velocity of 4 m/s in the $-y$ direction relative to the shooter. What should be the velocity of the bullet relative to the scene in order for the physics to be correct?

Home frame – scene
other frame – shooter
object – bullet

(10)

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

$\vec{v}' = \vec{v} - \vec{\beta}$

$\vec{v} = ?$

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

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

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

bullet moves like this.

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Game

Here is a VPython program of a shooter that shoots balls. (It is exactly like the one you wrote in class but with a few lines missing at the locations of the comment # characters.)

```
1  from visual import *
2
3  def collisionSpheres(sphere1, sphere2):
4      dist=mag(sphere1.pos-sphere2.pos)
5      if(dist<sphere1.radius+sphere2.radius):
6          return True
7      else:
8          return False
9
10 scene.range=5
11 scene.autoscale=False
12
13 ball1=sphere(pos=(-5,3,0), radius=0.2, color=color.magenta)
14 ball2=sphere(pos=(-5,1,0), radius=0.2, color=color.cyan)
15 ball3=sphere(pos=(-5,-1,0), radius=0.2, color=color.yellow)
16 ball4=sphere(pos=(-5,-3,0), radius=0.2, color=color.orange)
17
18 ball1.v=0.5*vector(1,0,0)
19 ball2.v=1*vector(1,0,0)
20 ball3.v=1.5*vector(1,0,0)
21 ball4.v=2*vector(1,0,0)
22
23 ballsList = [ball1, ball2, ball3, ball4]
24
25 shooter=box(pos=(-4.5,-4.5,0), width=1, height=1, length=1, color=color.red)
26 shooter.v=2*vector(1,0,0)
27
28 bulletsList=[]
29
30 t=0
31 dt=0.01
32
33 while 1:
34     rate(100)
35     for thisball in ballsList:
36         thisball.pos=thisball.pos+thisball.v*dt
37         if thisball.pos.x>5:
38             thisball.v=-1*thisball.v
39         elif thisball.pos.x<-5:
40             thisball.v=-1*thisball.v
41
42     if scene.kb.keys:
43             k = scene.kb.getkey()
```

```
44              if k == "right":
45                  shooter.v=2*vector(1,0,0)
46              elif k == "left":
47                  shooter.v=2*vector(-1,0,0)
48              elif k==" ":
49                  bullet=sphere(pos=shooter.pos, radius=0.1, color=color.white)
50                  bullet.v=5*vector(0,1,0)
51                  bulletsList.append(bullet)
52              else:
53                  shooter.v=vector(0,0,0)
54      shooter.pos = shooter.pos + shooter.v*dt
55  # write a conditional statement that checks the position of the shooter
56  #
57  #
58  #
59
60      for thisbullet in bulletsList:
61  # this line should update the position of thisbullet
62          for thisball in ballsList:
63              if collisionSpheres(thisbullet, thisball):
64                  thisball.pos=vector(0,-10,0)
65                  thisball.v=vector(0,0,0)
66
67  # this line should update the clock reading t
```

Questions

1. For line 67, write one line of code that updates the clock reading, t. (5)

   ```
   t = t + dt
   ```

2. For line 61, write one line of code that updates the position of *thisbullet* which is the variable name for a bullet item in the `bulletsList`. (5)

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

3. For lines 55-58, write a conditional statement in four lines that checks the shooter's position. If the shooter's position is greater than the right side of the screen, it changes the shooter's position back to the left side of the screen. If the shooter's position is less than the left side of the screen, it changes the shooter's position to the right side of the screen. (10)

   ```
   if shooter.pos.x > 5:
       shooter.pos.x = -5
   elif shooter.pos < -5:
       shooter.pos.x = 5
   ```