

Physics 2A, Mechanics -- Fall 2006    Instructor: B. Grinstein  
Quiz # 1

INSTRUCTIONS: Fill, tear and return the bottom strip of the front page with your scantron. Keep the top portion of the front page and the rest of the quiz. Use a pencil #2 to fill your scantron. Write your code number and bubble it in under "EXAM NUMBER". Bubble in the quiz form (see letter A--H at bottom of page) in your scantron under "TEST FORM"

$$\begin{array}{r} 34 \\ + 6 \times 1.2465 \\ \hline 41.479 \end{array}$$

- 1) What is  $34 + (6) \times (1.2465)$  written with the correct number of significant figures? Assume the factor "(6)" is exactly known.

~~A) 41.5~~

~~B) 41~~

C) 41.479

D)  $4 \times 10^1$

~~E) 41.48~~

- 2) What is the sum  $(3.46 \times 10^4) + (23.5 \times 10^3)$  expressed in scientific notation?

A)  $27.0 \times 10^3$

B)  $2.89 \times 10^3$

C)  $3.48 \times 10^4$

D)  $27.0 \times 10^4$

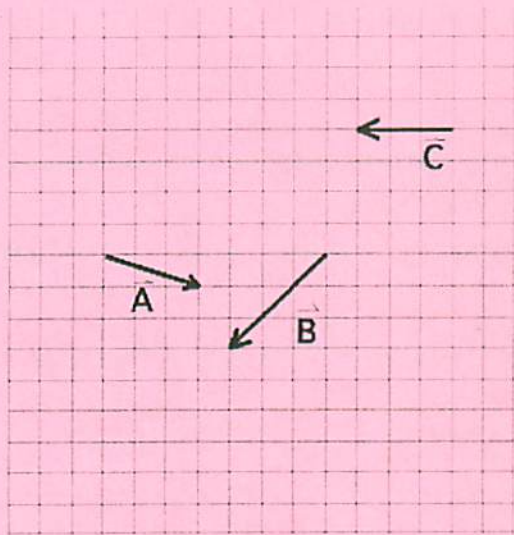
E)  $5.81 \times 10^4$

$$3.46 \times 10^4 \quad 2.35 \times 10^4$$

$$5.81$$

- 3) The vectors  $\vec{A}$ ,  $\vec{B}$ , and  $\vec{C}$  are shown. The vector sum of these three vectors is  $\vec{S} = \vec{A} + \vec{B} + \vec{C}$ .

What is the value of  $S_x$ , the x-component of  $\vec{S}$ ?



$$\begin{aligned} A &= \langle 3, -1 \rangle \\ B &= \langle -3, -3 \rangle \\ C &= \langle -3, 0 \rangle \end{aligned}$$

- A) -3      B) +3      C) +2      D) -2      E) -4

- 4) The components of vectors  $\vec{A}$  and  $\vec{B}$  are given as follows:

$$A_x = +7.4 \quad B_x = -2.9$$

$$A_y = -6 \quad B_y = -3.4$$

$$\vec{A} = \langle 7.4, -6 \rangle \quad \vec{B} = \langle -2.9, -3.4 \rangle$$

$$\vec{B} - \vec{A} = \langle -10.3, 2.6 \rangle$$

The magnitude of the vector difference  $\vec{B} - \vec{A}$ , is closest to:

- A) 11      B) 5.1      C) 10      D) 5.2      E) 110

- 5) Quantity a, b, c, and d are quantities with physical dimensions. They are related by the equation  $d = Kabc$ , where K is a dimensionless quantity. What is a dimensionless combination of the dimensional quantities above?

- A)  $1/abc$       B)  $dabc$       C)  $abc$       D)  $da/bc$       E)  $d/(abc)$

K

6) A person on a diet loses 1.1 kg in a week. How many micrograms/second ( $\mu\text{g/s}$ ) are lost?

A)  $4.4 \times 10^4 \mu\text{g/s}$

B)  $1.1 \times 10^5 \mu\text{g/s}$

C)  $1.8 \times 10^3 \mu\text{g/s}$

D)  $30 \mu\text{g/s}$

7) In a certain system of units, 37 stretches equal 1 meter, a snatch is 67 seconds, and a bander is 27 kilograms. How many bander-stretches per snatch squared are there in 80 Newtons, where 1 Newton equals  $1 \text{ kg}\cdot\text{m/s}^2$

A)  $1.8 \times 10^1$

B)  $2.0 \times 10^{-6}$

C)  $3.6 \times 10^8$

D)  $4.9 \times 10^5$

E)  $7.4 \times 10^3$

*Handwritten work for Q7:*  

$$\frac{80 \text{ kg}\cdot\text{m}}{\text{s}^2} \cdot \frac{37 \text{ stretches}}{\text{meter}} \cdot \frac{\text{bander}}{27 \text{ kg}} \cdot \frac{\text{s}^2}{67^2 \text{ snatch}^2}$$

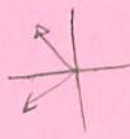
$$\frac{80 \text{ kg}\cdot\text{m}}{\text{s}^2} \cdot \frac{37 \text{ stretches}}{\text{m}} \cdot \frac{\text{bander}}{27 \text{ kg}} \cdot \frac{67^2 \text{ s}^2}{\text{snatch}^2}$$

8) The components of vectors  $\vec{B}$  and  $\vec{C}$  are given as follows:

$B_x = -8.1$     $C_x = -6.3$     $\vec{B} = \langle -8.1, -4.7 \rangle$   
 $B_y = -4.7$     $C_y = +5.4$     $\vec{C} = \langle -6.3, 5.4 \rangle$

The angle (less than 180 degrees) between vectors  $\vec{B}$  and  $\vec{C}$ , in degrees, is closest to:

- A) 10                      B) 71                      C) 170                      D) 109                      E) 81

*Handwritten work for Q8:*  
  

$$\cos\theta = \frac{\vec{B} \cdot \vec{C}}{|\vec{B}| |\vec{C}|}$$

$$\cos\theta = \frac{(51.03 + (-25.38))}{65.61}$$

$$\cos\theta = \frac{25.75}{65.61}$$

$$\theta = 68.3^\circ$$

*Dot product calculation:*  

$$\begin{array}{r} 8.1 \\ 8.1 \\ \hline 64.8 \\ 5.4 \\ \hline 48.6 \\ \hline 113.4 \end{array}$$

*Magnitudes calculation:*  

$$\begin{array}{r} 8.1 \\ 8.1 \\ \hline 64.8 \\ 4.7 \\ 4.7 \\ \hline 21.6 \\ \hline 86.4 \end{array}$$

$$\begin{array}{r} 6.3 \\ 6.3 \\ \hline 39.6 \\ 5.4 \\ 5.4 \\ \hline 29.16 \\ \hline 68.76 \end{array}$$

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- 1) Which of the following situations is impossible?
- A) An object has constant non-zero acceleration and changing velocity.
  - B) An object has constant non-zero velocity and changing acceleration.
  - C) An object has velocity directed east and acceleration directed west.
  - D) An object has zero velocity but non-zero acceleration.
  - E) An object has velocity directed east and acceleration directed east.
- 2) An object has a velocity directed to the right, and an acceleration directed to the left. Which statement is true?
- A) The position of the object is increasing to the left with time, and its speed is increasing.
  - B) The position of the object is increasing to the right with time, and its speed is decreasing.
  - C) The position of the object is not changing in time.
  - D) The position of the object is increasing to the right with time, and its speed is increasing.

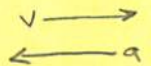
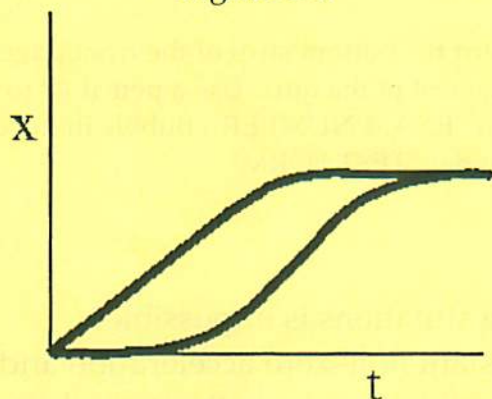


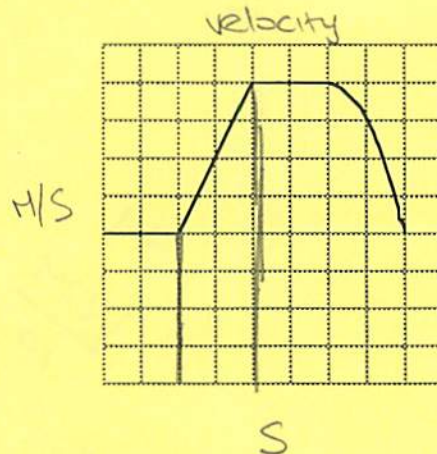
Figure 2.1



- 3) Shown in Figure 2.1 is a schematic graph of position versus time for two moving objects. Which of the following best describes what is depicted here?
- A) A speeder races past a parked police car. A moment later the police car starts and takes off in pursuit with high acceleration and siren screaming. He ends up giving the violator a speeding ticket.
  - ~~B) Leading the Indianapolis 500, with two laps to go, Bobby Rahal throws a wheel bearing and pulls in for a pit stop as Tom Sneva zooms by and goes on to win.~~
  - ~~C) A ball is thrown into the air and a moment later a second ball is thrown, but with a higher velocity than the first.~~
  - D) While accelerating in an attempt to pass, Mario Andretti plows into the back of a speeding A.J. Foyt on the back straightaway at the Indy 500.
  - ~~E) A rock and a crumpled piece of paper are dropped from rest at  $t = 0$  in the presence of air (i.e. friction is present).~~



- 4) A graph of **velocity** as a function of time is shown below. The vertical axis has velocity measured in meters per second (each square is 1 m/s) and the horizontal axis is time in units of seconds (each square is 1 s). During which time interval could the object be possibly moving with non-zero constant acceleration?



- A) 4.1 s to 5.9 s  
 B) 6.1 s to 7.9 s  
 C) 0.1 s to 1.9 s  
 D) 2.1 s to 3.9 s  
 E) There is no interval that is consistent with constant non-zero acceleration.

Handwritten notes and calculations:

$$\frac{50 \text{ mi}}{\text{h}} \cdot \frac{1 \text{ h}}{60 \text{ min}} = \frac{50}{60} \frac{\text{mi}}{\text{min}}$$

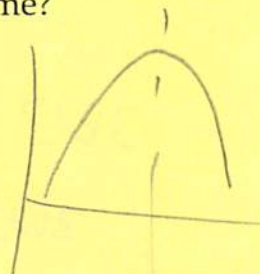
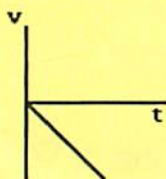
5250  
 50  
 73

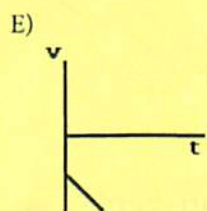
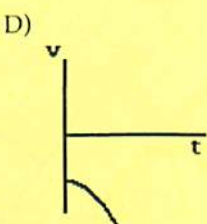
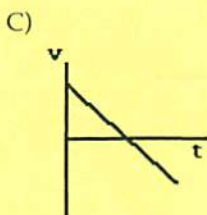
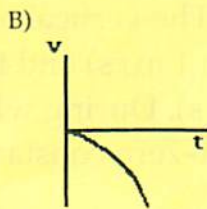
- 5) Human reaction times are worsened by alcohol. How much farther would a drunk driver's car travel before he hits the brakes than a sober driver's car? Assume both cars are initially traveling at 50.0 mi/h, the sober driver takes .33 s and the drunk driver takes 1.0 s to hit the brakes in a crisis.

- A) 59 ft                      B) 34 ft                      C) 49 ft                      D) 54 ft

- 6) A child standing on a bridge throws a rock straight up. The rock leaves the child's hand at  $t = 0$ . Which of the graphs shown here best represents the velocity of the stone as a function of time?

A)





$v_{avg} = \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$   
 $x = bt^3 - ct^2$   
 $v = 3bt^2 - 2ct$   
 $\frac{dv}{dt} = 6bt - 2c$

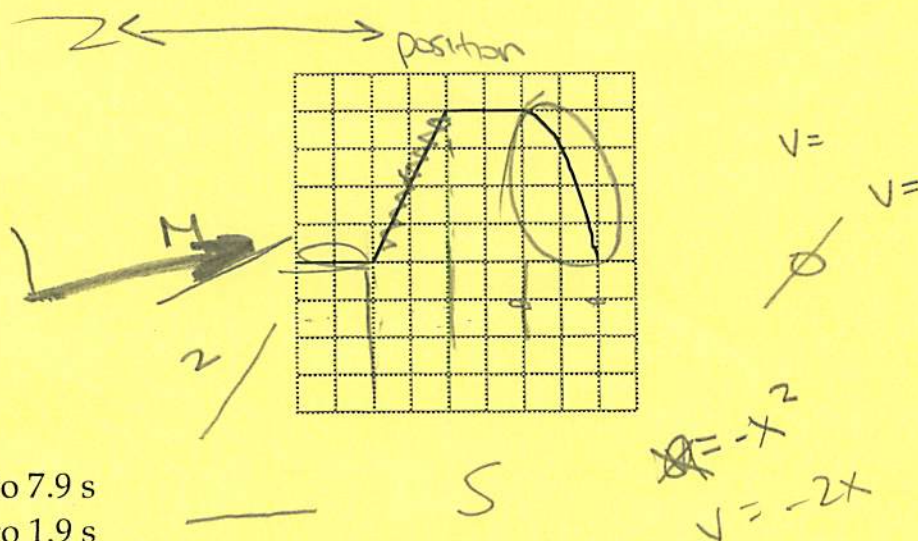
- 7) At what time (other than  $t = 0$ ) is the instantaneous velocity equal to the average velocity? Assume  $b = 4.2 \text{ m/s}^3$  and  $C = 1.8 \text{ m/s}^2$ .
- A) 0.26 s                      B) 0.21 s                      C) 0.15 s                      D) 0.19 s

$v = 3bt^2 - 2ct = 12.1t^2 - 3.6t$   
 $\frac{dv}{dt} = 6bt - 2c$   
 $3bt^2 - 2ct = 6bt - 2c$



$3bt^2 - 2ct = 6bt - 2c$   
 $3bt^2 - 2ct - 6bt + 2c = 0$

- 8) A graph of **position** as a function of time is shown below. The vertical axis has position measured in meters (each square is 1 m) and the horizontal axis is time in units of seconds (each square is 1 s). During which time interval could the object be possibly moving with non-zero constant acceleration?



- A) 6.1 s to 7.9 s  
 B) 0.1 s to 1.9 s  
 C) 4.1 s to 5.9 s  
 D) 2.1 s to 3.9 s  
 E) There is no interval that is consistent with constant non-zero acceleration.

- 9) At the same moment, one rock is dropped and one is thrown downward with an initial velocity of 17 m/s from the top of a 300 m building. How much earlier does the thrown rock strike the ground?

- A) 1.5 s  
 B) 1.4 s  
 C) 1.1 s  
 D) They land at exactly the same time.

$$0 = 300 + 0 + \frac{1}{2}(a)t^2$$

$$0 = 300 - 17t + \frac{1}{2}(a)t^2$$

$$\frac{17m}{s} \cdot \frac{300}{300}$$

$$\frac{5}{17m} \cdot \frac{300m}{300s}$$

$$\boxed{175}$$

page-5

$$0 = 300 + 0 + \frac{1}{2}at^2$$

$$0 = 300 + 17t + \frac{1}{2}at^2$$

$$300 = \frac{1}{2}at^2$$

$$\sqrt{\frac{600}{a}} = t$$

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1) What conditions are sufficient for the path of an object to be curved?

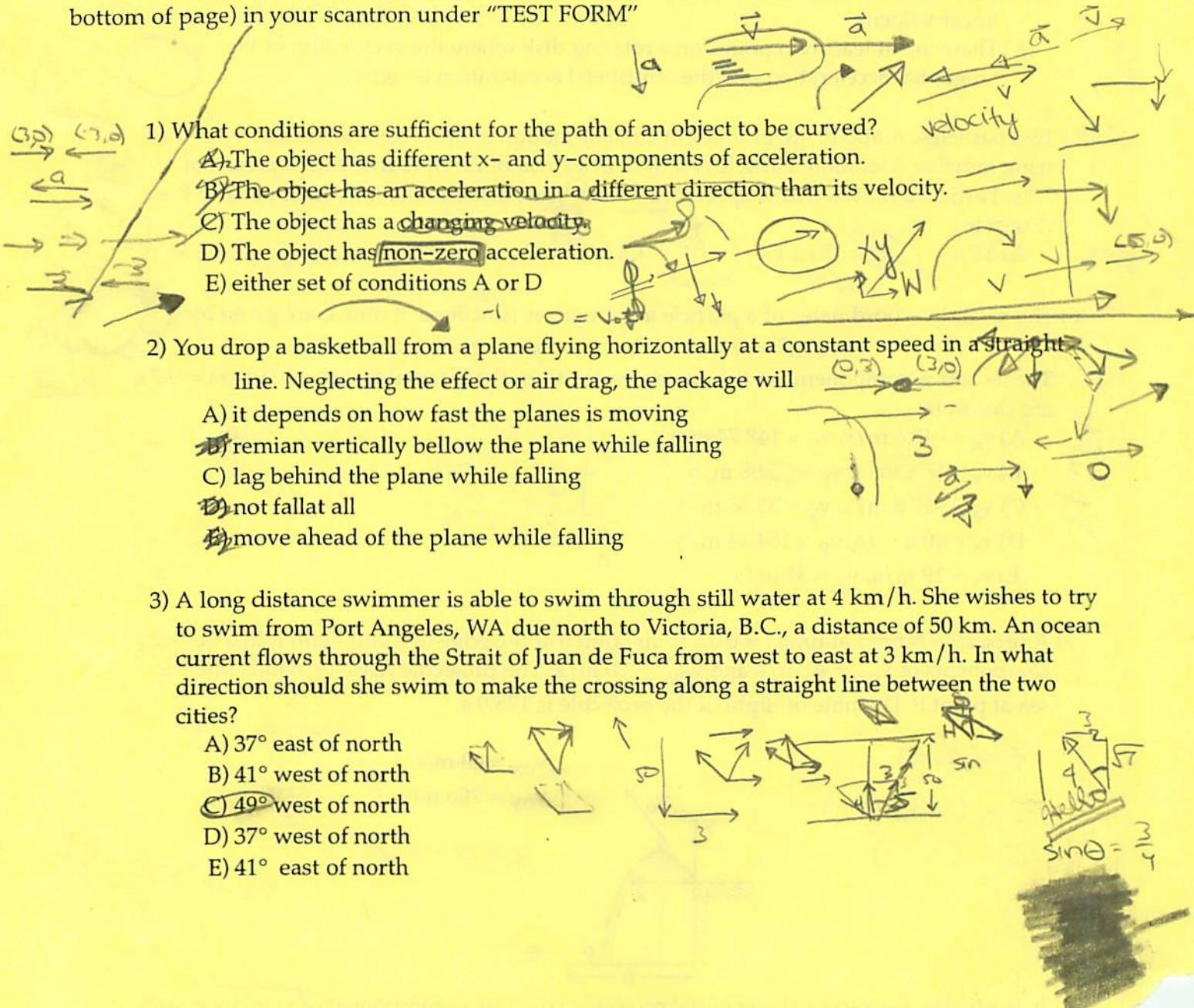
- A) The object has different x- and y-components of acceleration.
- B) The object has an acceleration in a different direction than its velocity.
- C) The object has a changing velocity.
- D) The object has non-zero acceleration.
- E) either set of conditions A or D

2) You drop a basketball from a plane flying horizontally at a constant speed in a straight line. Neglecting the effect of air drag, the package will

- A) it depends on how fast the plane is moving
- B) remain vertically below the plane while falling
- C) lag behind the plane while falling
- D) not fall at all
- E) move ahead of the plane while falling

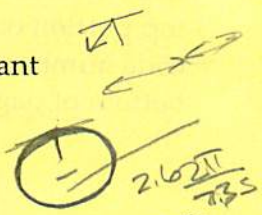
3) A long distance swimmer is able to swim through still water at 4 km/h. She wishes to try to swim from Port Angeles, WA due north to Victoria, B.C., a distance of 50 km. An ocean current flows through the Strait of Juan de Fuca from west to east at 3 km/h. In what direction should she swim to make the crossing along a straight line between the two cities?

- 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



4) Which of the following is an accurate statement?

- A) All points on a rotating disk have the same angular velocity.
- B) All points on a rotating disk experience the same radial acceleration.
- C) All points on a rotating disk have the same linear speed.
- D) All points on a car tire have zero acceleration if the car is moving with constant linear velocity.
- E) There are at least two points on a rotating disk where the vector sum of the tangential acceleration and the centripetal acceleration is zero.



5) Two particles, A and B, are in uniform circular motion about a common center with the same radial acceleration. Particle A moves in a circle of 2.6 m radius with a period of 7.3 s. Particle B moves with a speed of 1.0 m/s. The period of the motion of particle B is closest to:

- A) 3.7 s
- B) 3.1 s
- C) 3.5 s
- D) 2.8 s
- E) 3.3 s



6) The x- and y-coordinates of a particle in motion, as functions of time t, are given by:

$$x(t) = 4t^2 - 5t + 6 \quad y(t) = 2t^3 - 3t^2 - 12t - 9$$

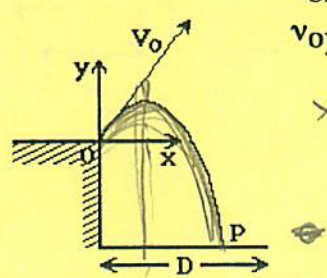
The x- and y-components of the average velocity, in the interval from t = 0.0 s to t = 5.7 s, are closest to:

- A)  $v_x = -40.6$  m/s,  $v_y = 148.74$  m/s
- B)  $v_x = 17.8$  m/s,  $v_y = 35.88$  m/s
- C)  $v_x = -17.8$  m/s,  $v_y = 35.88$  m/s
- D)  $v_x = 40.6$  m/s,  $v_y = 154.44$  m/s
- E)  $v_x = 19$  m/s,  $v_y = 34$  m/s

	0	5.7
x	6	107.46
y	-9	195.52

7) A projectile is fired at time t = 0.0s, from point 0 at the edge of a cliff, with initial velocity components of  $v_{0x} = 40$  m/s and  $v_{0y} = 700$  m/s. The projectile rises, then falls into the sea at point P. The time of flight of the projectile is 175.0 s.

$\vec{r} = (0, 0)$   
 $\vec{v} = (40, 700)$   
 $\vec{a} = (0, g)$



$v_{0x} = 40$  m/s  
 $v_{0y} = 700$  m/s  
 $x = 0 + 40t$

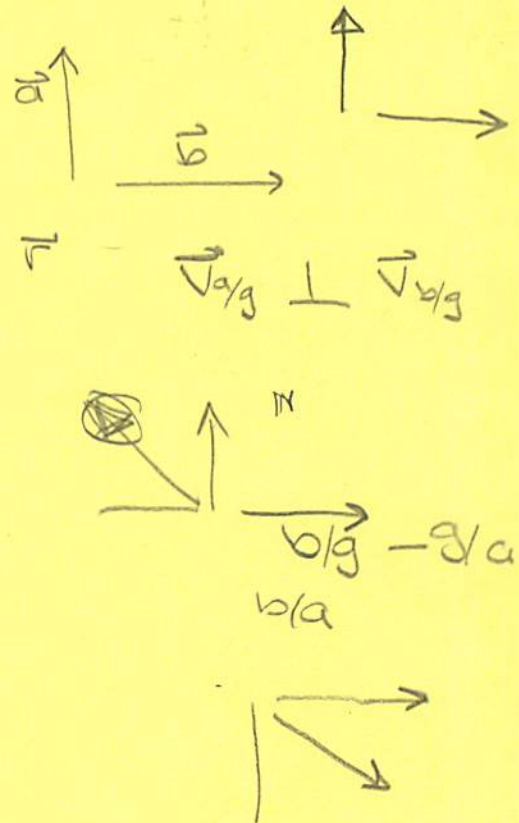
$560 = +$   
 $560 = 700 - gt$   
 $t = 14.3$

In the figure, the x-coordinate of the projectile when its y-component of velocity equals 560 m/s is closest to:

- A) 520 m
- B) 600 m
- C) 540 m
- D) 570 m
- E) 490 m

8) The velocity of object A and object B relative to the ground are perpendicular to each other. Which statement is true regarding the magnitude of the relative velocity of object A to object B?

- A) The magnitude of the relative velocity of A to B is equal to sum of the speeds of A and B relative to the ground.
- B) The magnitude of the relative velocity of A to B is greater than the speed of either A or B relative to the ground.
- C) The magnitude of the relative velocity of A to B is equal to difference of the speeds of A and B relative to the ground.
- ~~D) The magnitude of the relative velocity of A to B is less than the speed of either A or B relative to the ground.~~
- E) The magnitude of the relative velocity of A to B is equal to average of the speed of A and B relative to the ground.

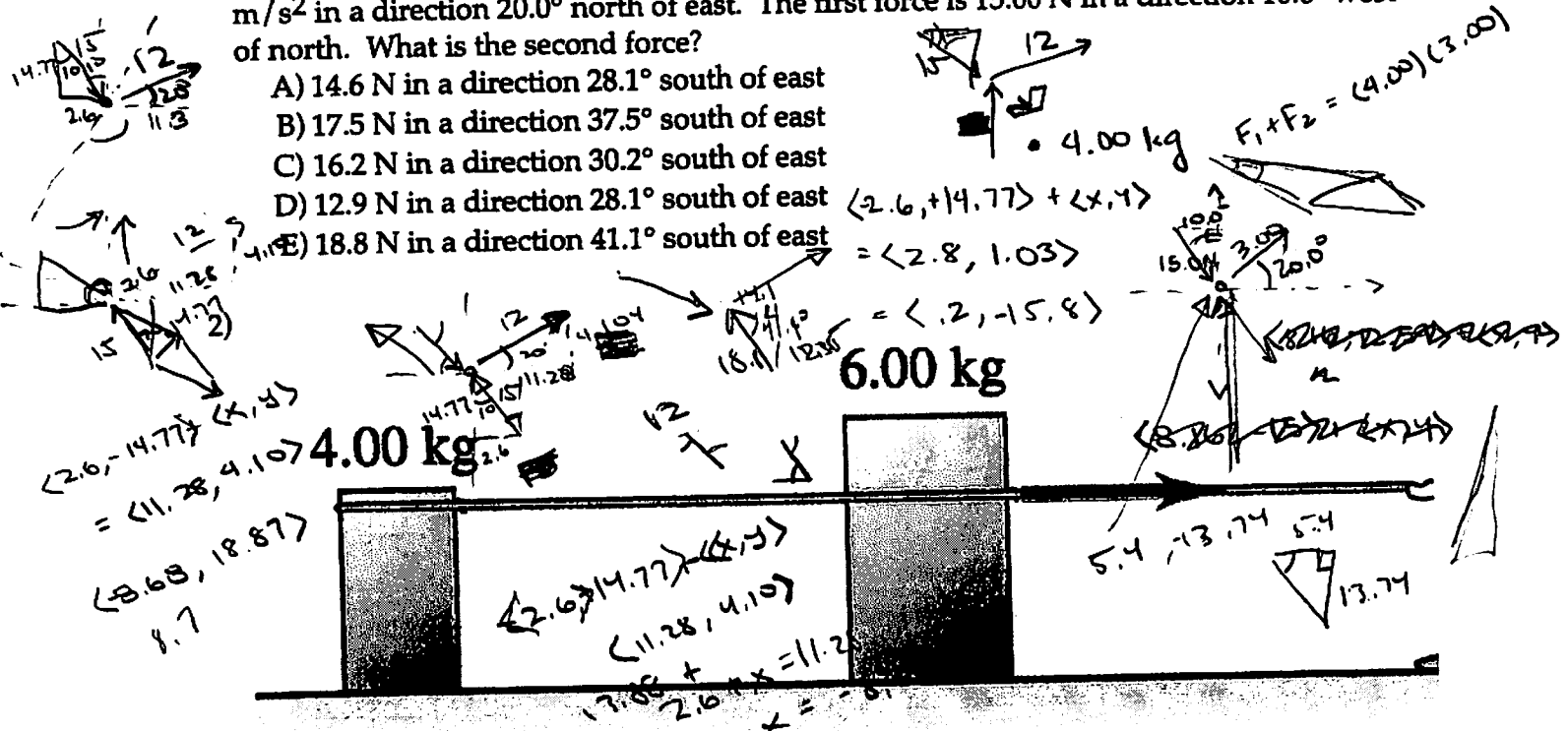


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1) Two forces act on a 4.00-kg object in a manner that the object has an acceleration  $3.00 \text{ m/s}^2$  in a direction  $20.0^\circ$  north of east. The first force is  $15.00 \text{ N}$  in a direction  $10.0^\circ$  west of north. What is the second force?

- A)  $14.6 \text{ N}$  in a direction  $28.1^\circ$  south of east
- B)  $17.5 \text{ N}$  in a direction  $37.5^\circ$  south of east
- C)  $16.2 \text{ N}$  in a direction  $30.2^\circ$  south of east
- D)  $12.9 \text{ N}$  in a direction  $28.1^\circ$  south of east
- E)  $18.8 \text{ N}$  in a direction  $41.1^\circ$  south of east



A person pulls on a 6.00-kg crate, which in turn is connected to a 4.00-kg crate by a light rope. The light rope remains taut. Compared to the 6.00-kg crate, the lighter 4.00-kg crate:

- A) is subjected to the same net force and has a smaller acceleration
- B) is subjected to the same net force and has the same acceleration
- C) is subjected to a smaller net force and has the same acceleration
- D) is subjected to a smaller net force and has a smaller acceleration
- E) none of the above

8.3

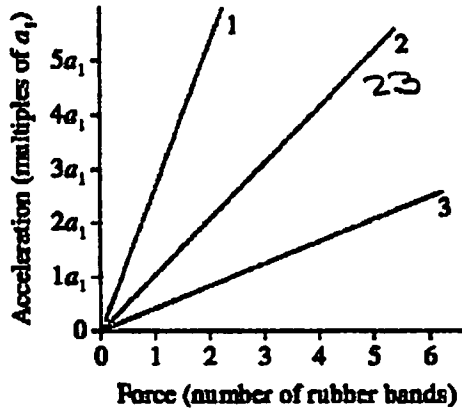
$w = mg$

- 3) A block is on a frictionless table, on earth. The block accelerates at  $8.4 \text{ m/s}^2$  when a  $70 \text{ N}$  horizontal force is applied to it. The block and table are set up on the moon. The acceleration due to gravity at the surface of the moon is  $1.62 \text{ m/s}^2$ . A horizontal force of  $35 \text{ N}$  is applied to the block when it is on the moon. The acceleration imparted to the block is closest to:

- A)  $4.6 \text{ m/s}^2$     B)  $4.2 \text{ m/s}^2$     C)  $5.5 \text{ m/s}^2$     D)  $3.8 \text{ m/s}^2$     E)  $5.0 \text{ m/s}^2$

- 4) The figure shows an acceleration-versus-force graph for three objects pulled by rubber bands. The mass of object 2 is  $23 \text{ kg}$ . What are the masses of objects 1 and 3?

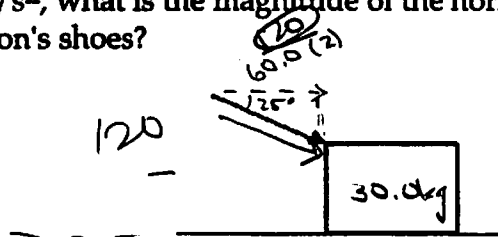
$T = -kx$   
 $F = MA$



$70 \rightarrow$   
 $\downarrow w$   $\odot$   
 $70 + 9.8 = M(8.4)$

- A)  $46 \text{ kg}$  and  $12 \text{ kg}$     B)  $58 \text{ kg}$  and  $12 \text{ kg}$   
C)  $9.2 \text{ kg}$  and  $46 \text{ kg}$     D)  $9.2 \text{ kg}$  and  $58 \text{ kg}$

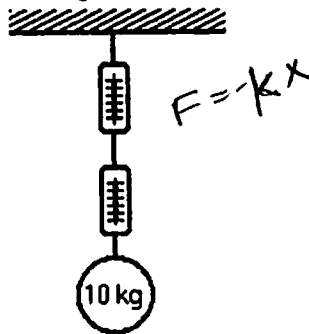
- 5) A  $60.0\text{-kg}$  person moves a  $30.0\text{-kg}$  box by pushing on it in a direction  $25.0^\circ$  below horizontal as shown in the diagram. There is no friction between the box and the floor, but there is friction between the person's shoes and the floor. If the box and the person accelerate at  $2.00 \text{ m/s}^2$ , what is the magnitude of the horizontal frictional force of the floor on the person's shoes?



$(60.0)(2.00) + (30.0)(2.00)$

- A)  $589 \text{ N}$     B)  $180 \text{ N}$     C)  $120 \text{ N}$     D)  $60.0 \text{ N}$     E)  $240 \text{ N}$

Figure 4.1



6) In Figure 4.1, a 10 kg mass is suspended from two spring scales, each of which has negligible weight. Thus

~~A) The lower scale will read zero, the top scale will read 10 kg.~~

~~B) Each scale will read 5 kg.~~

~~C) The top scale will read zero, the lower scale will read 10 kg.~~

D) Each scale will show a reading between one and 10 kg, such that the sum of the two is 10 kg. However, exact readings cannot be determined without more information.

E) None of these is true.

$$T_1 + T_2 = 10$$

$$T = 10(9.8)$$

$$T = 98 \text{ N}$$