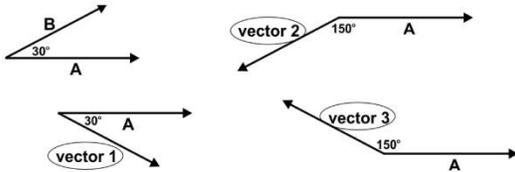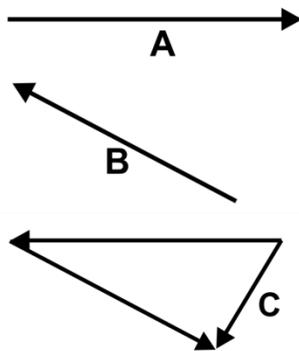1. Vector B is at a 30 degree angle from vector A. Which vector is "-B": vector 1, 2, or 3?
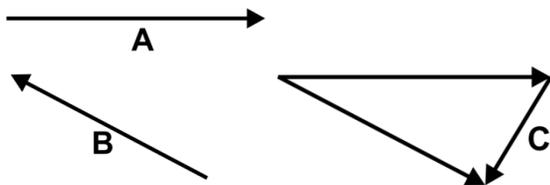

(A) vector 1
(B) vector 2
(C) vector 3

2. What is vector C?

(A) A + B
(B) A - B
(C) -A + B
(D) -A - B

3. What is vector C?

(A) A - B
(B) B + A
(C) -B -A
(D) -A + B

4. A camper needs to walk 4.2 kilometers due north but misreads his compass and walks 4.2 kilometers 40 degrees south of due east.

How far and in what direction will he now have to walk to get to his original destination?

(A) 7.6km 24.7º NW
(B) 6.9km 24.7º NW
(C) 6.1km 27.4º NW
(D) 6.7km 27.4º NW
(E) 6.5 km 27.4º NW

5. What single vector (magnitude and direction) summarizes these four force vectors?

Sin 53º = 0.80   Sin 37º = 0.60
Cos 53º = 0.60   Cos 37º = 0.80
Tan 53º = 1.33   Tan 37º = 0.75
Sin 0º = 0   Cos 0º = 1.0
Sin 90º = 1.0   Cos 90º = 0

(A) 4.0 N
(B) square root of 10.0 N
(C) square root of 4.0 N
(D) 6.2 N
(E) 5.4 N

6. A cannonball is aimed 37 degrees into the air and fired at 100 feet per second. How high does it go, how far does it go horizontally, and what is its speed and direction at impact with the ground?

	Vertical Distance	Horizontal Distance	Impact Speed	Direction
(A)	58.75 ft	150 ft	$75 \frac{ft}{sec}$	45º
(B)	52.25 ft	200 ft	$85 \frac{ft}{sec}$	40º
(C)	66.50 ft	300 ft	$120 \frac{ft}{sec}$	38º
(D)	61.75 ft	315 ft	$105 \frac{ft}{sec}$	41º
(E)	56.25 ft	300 ft	$100 \frac{ft}{sec}$	37º

7. A marble starts out from a stationary position and travels a distance of 5.72 meters over a period of 2.60 seconds. What is its peak velocity and what is its average velocity?

	Peak Velocity	Average Velocity
(A)	$5.72 \frac{m}{sec}$	$4.4 \frac{m}{sec}$
(B)	$5.72 \frac{m}{sec}$	$4.4 \frac{m}{sec}$
(C)	$4.4 \frac{m}{sec}$	$2.2 \frac{m}{sec}$
(D)	$5.2 \frac{m}{sec}$	$4.4 \frac{m}{sec}$
(E)	$5.2 \frac{m}{sec}$	$2.6 \frac{m}{sec}$

8. A marble is rolled off the edge of a 1.0 meter high table with a horizontal velocity of 5.0 meters per second, while another identical marble is dropped from the edge of the table. How long before each marble strikes the floor, and how far away from the table does the rolling marble land? How fast is each marble moving at impact?

	Time to Reach the Floor	Distance From Table	Velocity at Impact
(A)	0.38 sec	1.95 meters	$6.1 \frac{m}{sec}$
(B)	0.40 sec	2.05 meters	$6.3 \frac{m}{sec}$
(C)	0.42 sec	2.15 meters	$6.5 \frac{m}{sec}$
(D)	0.44 sec	2.25 meters	$6.7 \frac{m}{sec}$
(E)	0.46 sec	2.45 meters	$6.9 \frac{m}{sec}$

9. At what angle should an artillery cannon be aimed to maximize the trajectory of the cannonball sitting at ground level?

(A) 35 degrees
(B) 45 degrees
(C) 60 degrees
(D) 70 degrees
(E) 75 degrees

10. A pilot flying at 250 meters has no way of knowing how far she is from the island. She does have a viewfinder, though, which tells her the number of degrees the island is below the horizontal.

If she is flying at 100 km per hour, at what angle below the horizontal should she drop her supplies?

(A) 52.4°
(B) 53.5°
(C) 54.1°
(D) 55.8°
(E) 56.9°

11. Here is a 100 lb box suspended from the ceiling. When the box comes to rest, angle a is 37 degrees, and angle b 60 degrees. How strong a rope is needed to suspend the box from the ceiling? That is, how much tension would this rope need to withstand to ensure that it was strong enough to keep the box suspended?

(A) 50.3 lbs
(B) 59.6 lbs
(C) 67.8 lbs
(D) 76.3 lbs
(E) 80.5 lbs

12. Suppose a ball is thrown upward at a speed of 14.7 meters per second from this 100 meter high roller coaster. How high will the ball ascend, how long before it reaches the ground, and what is its speed at impact with the ground?

	Peak Height	Time to Hit Ground	Speed at Impact
(A)	10.5m	6.3sec	42.4m/sec
(B)	10.5m	5.8sec	46.0m/sec
(C)	11.0m	5.8sec	41.3m/sec
(D)	11.0m	6.3sec	46.6m/sec
(E)	11.0m	4.3sec	42.4m/sec

13. A rock is thrown downward off a 100 meter building with a velocity of $10.0 \frac{m}{sec}$. What is the rock's speed at impact and how long did it take for the rock to strike the ground?

(A) 41.3 m/s, 3.2 sec
(B) 42.3 m/s, 3.3 sec
(C) 43.3 m/s, 3.4 sec
(D) 44.3 m/s, 3.5 sec
(E) 45.3 m/s, 3.6 sec

14. How many g's of acceleration does a pilot traveling at 480 miles per hour experience when making a sharp turn with a radius of 1900 feet?

(A) 8g
(B) 9g
(C) 10g
(D) 11g
(E) 12g

15. Which of the following statements is true?

1. The tangential velocity of a ball being spun in a circle is the circumference divided by the time it takes to travel the circumference

2. Centripetal acceleration is directed toward the center of rotation, while centrifugal acceleration is directed outward along the radial axis away from the center of rotation

3. To get an object to move in a circle, the acceleration vector has to be perpendicular to the tangential velocity vector.

4. An asteroid rotating in a circle around the sun would travel along a tangential vector if the sun's gravity suddenly stopped.

5. When the radius of rotation and the centripetal acceleration of the ball are multiplied together, they equal the tangential velocity squared.

(A) 1, 2
(B) 1, 2, 3
(C) 1, 3, 5
(D) 1, 2, 4, 5
(E) 1, 2, 3, 4, 5

16. When the tangential velocity vector and the acceleration vector are at 90 degrees, the object moves in a circle.

When the angle between the tangential velocity vector and the acceleration vector is more than 90 degrees, _____.

(A) The motion remains circular but with a larger radius.
(B) The motion remains circular but with a smaller radius.
(C) The motion becomes tangential.
(D) The motion becomes parabolic.
(E) The motion becomes inverted.

17. Which statements about a pendulum
are true?
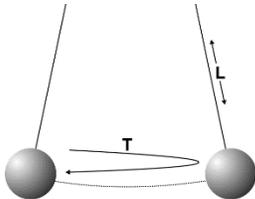
1. The longer the pendulum string, the
longer the pendulum bob takes to swing
back and forth.

2. The shorter the pendulum string, the
longer the pendulum bob takes to swing
back and forth.

3. The heavier a pendulum bob is, the
longer the pendulum bob takes to swing
back and forth.
4. The lighter a pendulum bob is, the longer
the pendulum bob takes to swing back and
forth.

5. The longer the distance that the
pendulum bob swings through, the longer
the pendulum bob takes to swing back and
forth.

(A) 1
(B) 1, 3
(C) 2, 3
(D) 2, 4
(E) 1, 3, 5