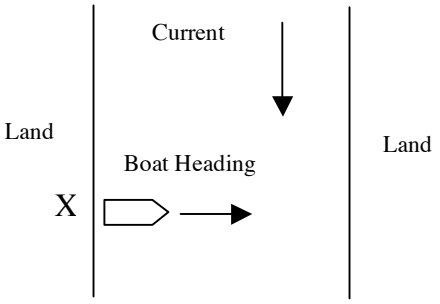
Unit 1: Vectors

Multiple Choice Portion

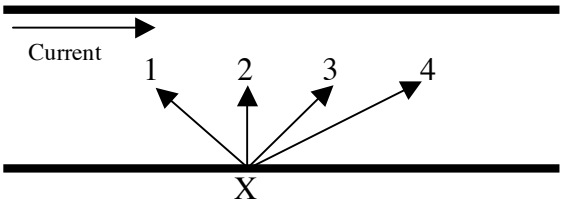
1. A boat which can travel at a speed of 7.9 m/s in still water heads directly across a stream in the direction shown in the diagram above. The water is flowing at 3.2 m/s. What is the resulting speed of the boat relative to point X?



   a. 11.1 m/s
   b. 8.5 m/s
   c. 7.2 m/s
   d. 4.7 m/s

2. If a car travels due west for 5.0 km and then directly north for 6.0 km, how far, along a straight line is the car from its starting position?
   a. 1.0 km
   b. 3.3 km
   c. 7.8 km
   d. 11 km

3. A plane heads north with an airspeed of 420 km/h. However; relative to the ground, it travels in a direction of 7.0 ^{o} west of north. If the wind's direction is towards the northwest (45.0^{o} west of north), what is the wind's speed?
   a. 51 km/h
   b. 65 km/h
   c. 72 km/h
   d. 83 km/h



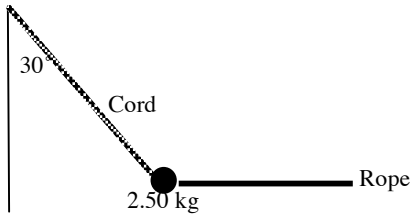
4. A motorboat at point X must cross a river flowing as shown in the above diagram. If the boat travels fixed speed relative to the water, in which direction should the boat head in order to reach the other side in the least amount of time?
   a. 1
   b. 2
   c. 3
   d. 4

5. If a person travels 12.5 m north and then 7.8 m east, what is the magnitude of his displacement from the starting point?
   a. 4.7 m
   b. 9.8 m
   c. 14.7 m
   d. 20.3 m

6. If a skier coast down a slope at an angle of 24 ^{o} below the horizontal, what is her acceleration if the force of friction is negligible?
   a. 24 m/s^2
   b. 9.0 m/s^2
   c. 4.4 m/s^2
   d. 4.0 m/s^2

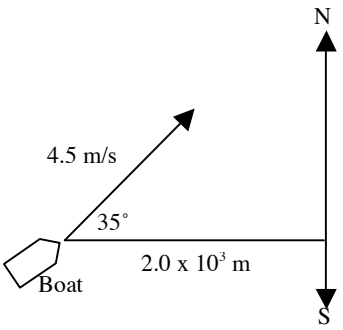
7. An airplane with an airspeed of 420 km/h is heading due north. If there is a wind blowing due east with a speed of 120 km/h, what is the direction of the plane relative to the ground?
   a. 16 ^{o} east of north
   b. 16 ^{o} east of south
   c. 74 ^{o} east of north
   d. 74 ^{o} east of south

8. A football player is tackled; he is acted upon by three horizontal forces: 145 N north, 96 N south and 64 N east. What is the magnitude of the equilibrant of these three forces?
   a. 113 N
   b. 185 N
   c. 81 N
   d. 15 N



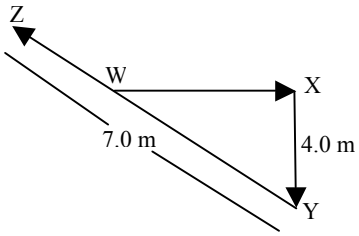
9. A rope pulls horizontally on a 2.50 kg pendulum bob and holds the pendulum at an angle of 30.0 ^{o} from the vertical as shown in the diagram above. What is the tension in the pendulum cord?
   a. 14.1 N
   b. 21.2 N
   c. 28.3 N
   d. 49.0 N

10. Which of the following is property of all vector quantities?
    a. time
    b. energy
    c. distance
    d. direction



11. In the above diagram, the boat has a speed of 4.5 m/s in still water. How long will it take the boat to reach the N/S longitudinal line?
    a. 440 s
    b. 540 s
    c. 630 s
    d. 770 s

12. A man move from W to X to Y to Z as shown in the diagram below. What is the magnitude of his final displacement from W?

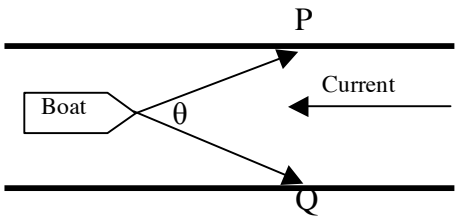


    a. 2.0 m
    b. 8.6 m
    c. 12 m
    d. 9.0 m

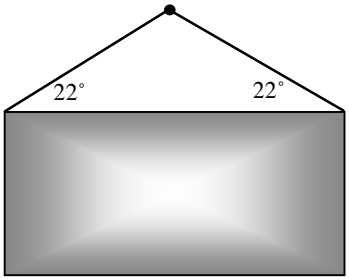
13. A car travels 10.0 km due east and then 12.0 km in a direction 45 ^{o} north of west. What is the magnitude of the car's displacement?
    a. 6.6 km
    b. 8.6 km
    c. 15.6 km
    d. 22.0 km

14. A car changes its velocity from 55 km/h due north to 55 km/h due east. What is the direction of the change in its velocity
    a. 45 ^{o} north of east
    b. 45 ^{o} north of west
    c. 45 ^{o} south of east
    d. 45 ^{o} south of west

15. Two forces act on an object: 125 N due west and 79 N due north. In what direction must the third force act on the object to keep it in equilibrium?
    a. 32 ^{o} north of west
    b. 32 ^{o} south of east
    c. 58 ^{o} north of west
    d. 58 ^{o} south of east



16. The above diagram show a canal boat being held stationary by two ropes anchored at P and Q. For which of the following values of θ will the force of tension in the ropes be least?
    a. 30°
    b. 45°
    c. 60°
    d. 90°

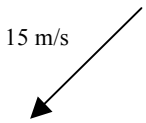


17. A picture on which the force of gravity is 170 N is supported by a wire, as shown in the diagram above. What is the magnitude of the force of tension in the wire?
    a. 85 N
    b. 92 N
    c. 1.7 x 10^2 N
    d. 2.3 x 10^2 N

18. Which one of the following statements best describes vectors?
    a. all vectors have direction only
    b. all vectors have magnitude only
    c. all vectors have both magnitude and direction
    d. all vectors are directed towards the earth's centre

19. An aircraft heading north at 48 m/s encounters a wind blowing towards the east at 27 m/s. What is the aircraft's resultant direction of travel?
    a. 29 ^{o} E of N
    b. 34 ^{o} E of N
    c. 56 ^{o} E of N
    d. 61 ^{o} E of N

20. A vehicle, travelling north at 9.0 m/s changes its velocity to 12 m/s east. Which one of the following best represents its change in velocity?

a.


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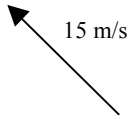

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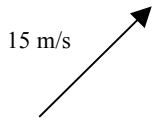

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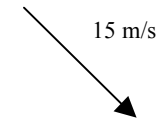
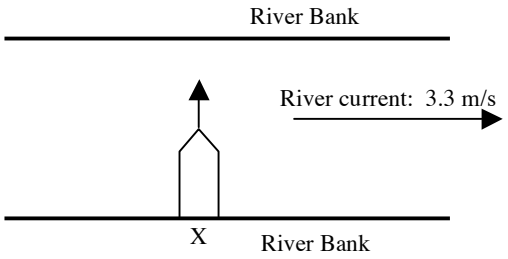


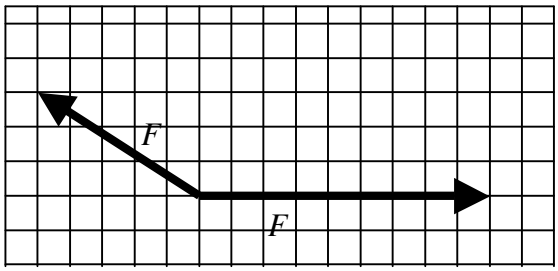
21. As shown in the diagram below, the river flows eastward at 3.3 m/s. A boat can travel at 4.38 m/s relative to still water.



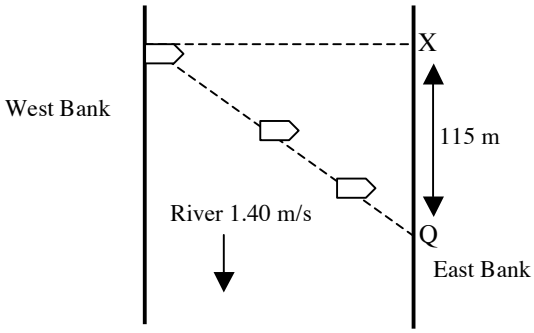
If the boat departs from position X heading due north, in what direction will this boat travel relative to position X?
    a. due north
    b. 35 ^{o} E of N
    c. 43 ^{o} E of N
    d. 47 ^{o} E of N

22. Which one of the following contains two vector quantities?
    a. mass, velocity
    b. time, momentum
    c. force, acceleration
    d. speed, displacement

23. The diagram below shows two forces vectors F_1 and F_2 acting on an object at point P
    What is the magnitude of the resultant force? (Each grid space equal 1 Newton)
    a. 3.0 N
    b. 5.0 N
    c. 7.0 N
    d. 14.3 N



24. A boat departs from point P heading towards point X as shown in the diagram below. Its speed relative to the water is 2.50 m/s. The river is flowing south at 1.40 m/s so that the boat actually touches the east bank at point Q

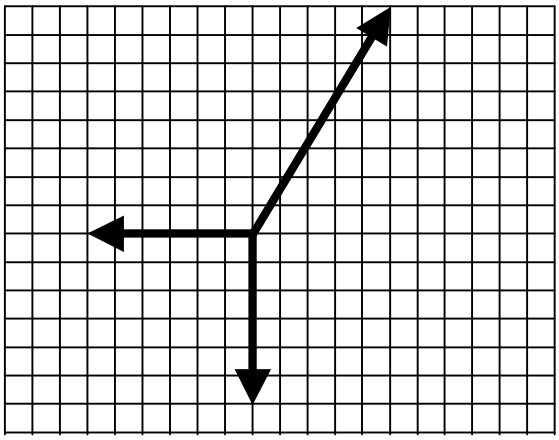


If Q is 115 m downstream from point X, how wide is the river?
    a. 40.0 m
    b. 82.0 m
    c. 2.05 x 10^2 m
    d. 2.35 x 10^2 m

25. A projectile is fired with an initial velocity of 80 m/s at an angle of 37 ^{o} above the horizontal. If air resistance is negligible, how much time elapses before the projectile reaches it maximum height?
    a. 4.9 s
    b. 6.5 s
    c. 8.2 s
    d. 16 s

26. A projectile is fired with an initial velocity of 120 m/s at an angle 30 ^{o} above the horizontal. If air resistance is negligible, how much time elapses before the projectile strikes the ground at the same elevation from which it was fired?
    a. 6.1 s
    b. 11 s
    c. 12 s
    d. 21 s

Use the following graph to answer the question below (each division represents 1.0 N)



27. The above diagram shows three force vectors acting on one point. What is the magnitude of the sum of these force vectors?
    a. 1.6 N
    b. 2.2 N
    c. 17 N
    d. 20 N

28. Which one of the following is not a vector quantity?
    a. work
    b. impulse
    c. velocity
    d. displacement

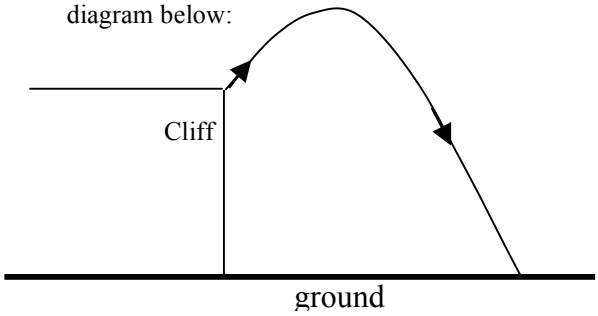
29. Which one of the following is correct for a projectile motion, assuming no air friction?

	Horizontal Speed	**Vertical Acceleration**
a.	constant	constant
b.	constant	changing
c.	changing	constant
d.	changing	changing

30. A rock is falling from building. While the rock is falling, which one of the following remains constant?
    a. speed
    b. velocity
    c. momentum
    d. acceleration

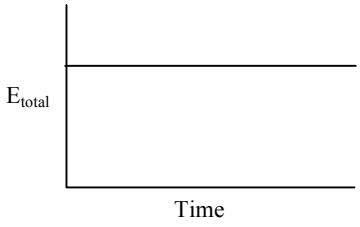
31. Which one of the following is vector quantity?
    a. time
    b. speed
    c. impulse
    d. kinetic energy

32. A projectile is fired from a cliff as shown in the diagram below:

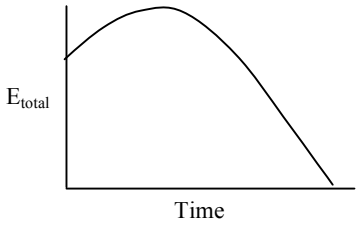


Which one of the following graphs best represents the total energy as a function of time for the projectile while it is in flight? (Ignore friction)

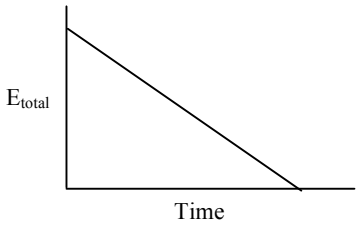
a.



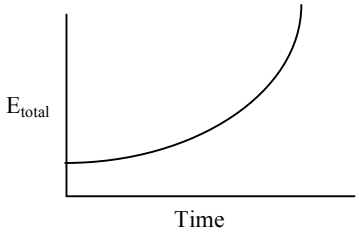
b.



c.

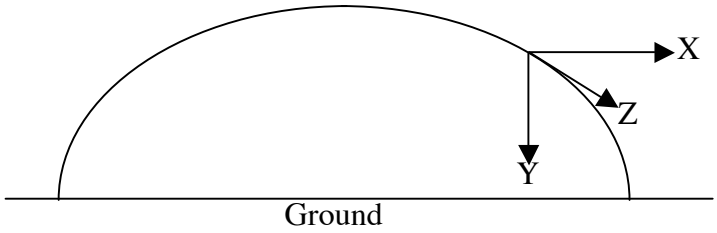


d.



33. A projectile is launched with a velocity of 23 m/s at 57 ^{o} above the horizontal. What is the maximum height reached by the projectile?
    a. 8.0 m
    b. 19 m
    c. 27 m
    d. 64 m

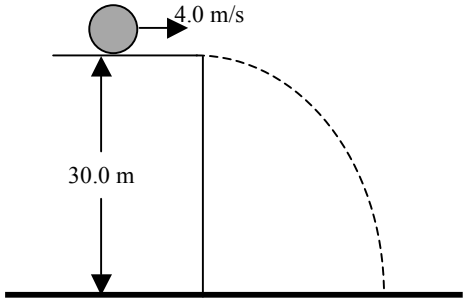
34. The diagram below shows the path of a projectile over level ground.



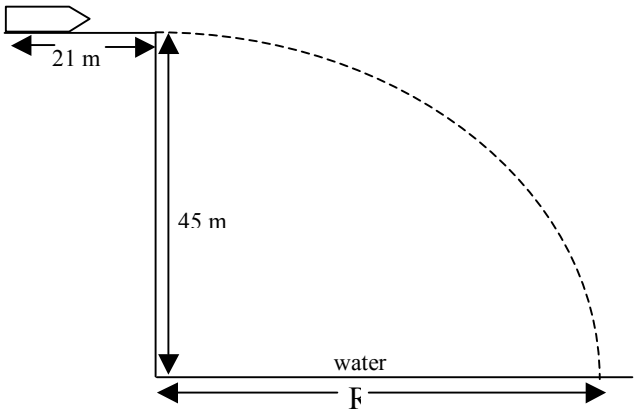
    Which one the following above arrows best represents the direction of the net force on the projectile at point P?
    a. zero (no arrow)
    b. vertical (arrow Y)
    c. horizontal (arrow X)
    d. tangent to the curve (arrow Z)

Written Portion

1. A ball travelling horizontally at 4.0 m/s rolls off a 30.0 m cliff. What will be its velocity (magnitude and direction) as it reaches the ground?



2. A rocket accelerates at 15 m/s^2 from rest for 21 m on a frictionless horizontal surface. The rocket stops firing at the cliff and falls freely from height of 45 m. Calculate R

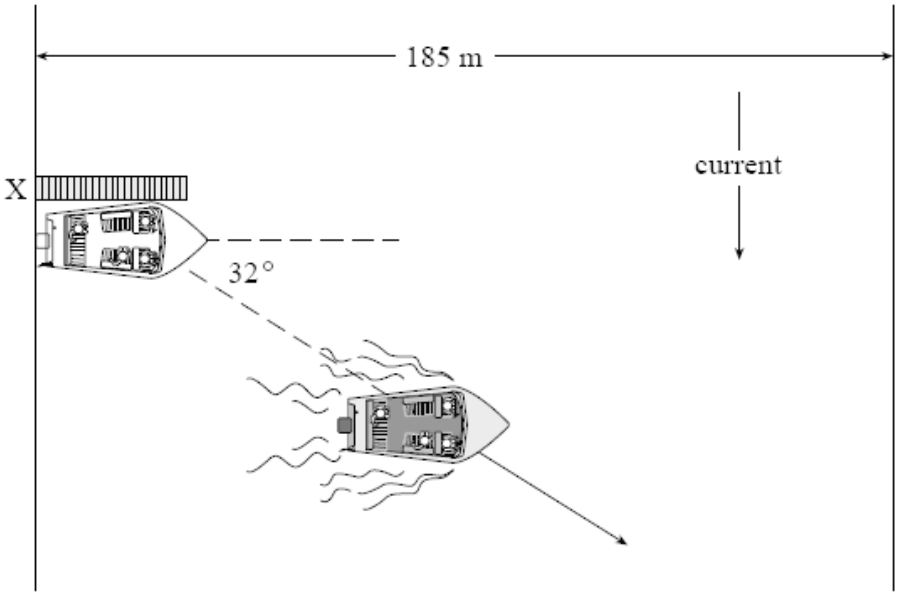


3. A golf ball travels a 1.5 m/s due east for 3.0 s and then travels at 2.0 m/s in a direction of 25 ^{o} north of west for 2.0 s. What is the magnitude of the balls average velocity for the entire 5.0 s?

4. A 1.50 kg projectile is launched at 18.0 m/s from level ground. The launch angle is 26.0° above the horizontal. (Assume negligible friction.)
   a. What is the maximum height reached by this projectile?
   b. How fast will the projectile be travelling when it is at its maximum height?

5. A projectile is launched over level ground at 35 m/s at an angle of 24° above the horizontal (Friction is negligible.)
   a. What is the time of flight of this projectile?
   b. What is the velocity (magnitude and direction) of this projectile 2.5 s after launch?

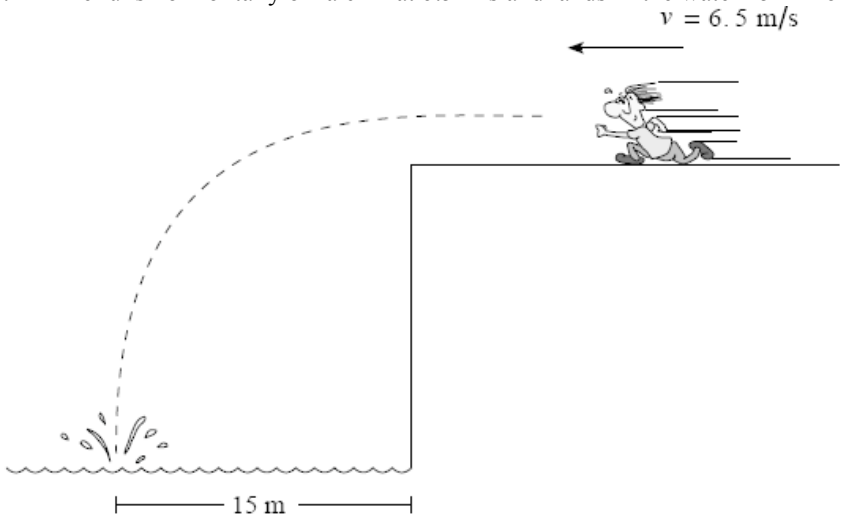
6. A boat which can travel at 5.6 m/s in still water heads due east across a river from a dock at **X**. The boat's resultant path is 32° south of east.



   a. What is the speed of the current?
   b. How long will it take the boat to reach the far shore if the river is 185 m wide?

7. A soccer ball is kicked over level ground with an initial velocity of 18 m/s, 24° above the horizontal.
   a. How long does it take the ball to return to the ground?
   b. What is the range of the ball?

8. Mike runs horizontally off a cliff at 6.5 m s and lands in the water 15 m from the base of the cliff.



   a. How long does it take Mike to hit the water?
   b. How high is the cliff?

9. A projectile is launched over level ground at 85 m/s, 25° above the horizontal. Air resistance may be ignored.
   a. Calculate the range (horizontal distance) of the projectile.
   b. Using principles of physics, comment on the horizontal and vertical components of the projectile's velocity and acceleration during the flight.

Answers:

MC

1. b	11. b	21. b	31. d
2. c	12. a	22. c	32. a
3. d	13. b	23. b	33. b
4. b	14. c	24. c	34. b
5. c	15. b	25. a	
6. d	16. a	26. c	
7. a	17. d	27. b	
8. c	18. c	28. b	
9. c	19. a	29. a	
10. d	20. d	30. d	

Written

1. velocity = 24.6 m/s, 81˚ below the horizontal
2. R = 75 m
3. velocity = 0.38 m/s

4a. height = 3.18 m	b. velocity = 16.2 m/s
5a. time = 2.9 s	b. velocity = 34 m/s 18˚ below the horizontal
6a. velocity = 3.5 m/s	b. time = 33 s
7a. time = 1.49 s	b. range = 25 m
8a. time = 2.3 s	b. height = 26 m
9a. range = 5.6×10^2 m	b. v_h = constant; v_v = constantly changing; $a_h = 0$ m/s^2; $a_v = 9.8$ m/s^2

