**4. Kinematics in 2&3-Dimensions**

1. Velocity is defined as:

A) rate of change of position with time

B) position divided by time

C) rate of change of acceleration with time

D) a speeding up or slowing down

E) change of position

2. Acceleration is defined as:

A) rate of change of position with time

B) speed divided by time

C) rate of change of velocity with time

D) a speeding up or slowing down

E) change of velocity

3. Which of the following is a scalar quantity?

A) Speed

B) Velocity

C) Displacement

D) Acceleration

E) None of these

4. Which of the following is a vector quantity?

A) Mass

B) Density

C) Speed

D) Temperature

E) None of these

5. Which of the following is NOT an example of accelerated motion?

A) Vertical component of projectile motion

B) Circular motion at constant speed

C) A swinging pendulum

D) Earth's motion about sun

E) Horizontal component of projectile motion

6. A particle goes from *x* = –2 m, *y* = 3 m, *z* = 1 m to *x* = 3 m, *y* = –1 m, *z* = 4 m. Its displacement is:

A) (1 m)x + (2 m)z + (5 m)y

B) (5 m)x – (4 m)z + (3 m)y

C) –(5 m)x+ (4 m)z – (3 m)y

D) –(1 m)x **–** (2 m)z – (5 m)y

E) –(5 m)x **–** (2 m)z = (3 m)y

7. A jet plane in straight horizontal flight passes over your head. When it is directly above you, the sound seems to come from a point behind the plane in a direction 30 from the vertical. The speed of the plane is:

A) the same as the speed of sound

B) half the speed of sound

C) three-fifths the speed of sound

D) 0.866 times the speed of sound

E) twice the speed of sound

8. A plane traveling north at 200 m/s turns and then travels south at 200 m/s. The change in its velocity is:

A) zero

B) 200 m/s north

C) 200 m/s south

D) 400 m/s north

E) 400 m/s south

9. Two bodies are falling with negligible air resistance, side by side, above a horizontal plane. If one of the bodies is given an additional horizontal acceleration during its descent, it:

A) strikes the plane at the same time as the other body

B) has the vertical component of its velocity altered

C) has the vertical component of its acceleration altered

D) follows a hyperbolic path 双曲线

E) follows a straight line path along the resultant acceleration vector

10. The velocity of a projectile equals its initial velocity added to:

A) a constant horizontal velocity

B) a constant vertical velocity

C) a constantly increasing horizontal velocity

D) a constantly increasing downward velocity

E) a constant velocity directed at the target

11. A stone thrown from the top of a tall building follows a path that is:

A) circular B) made of two straight line segments

C) hyperbolic 双曲线 D) parabolic 抛物线

E) a straight line

12. Identical guns fire identical bullets horizontally at the same speed from the same height above level planes, one on the Earth and one on the Moon. Which of the following three statements is/are true?

I. The horizontal distance traveled by the bullet is greater for the Moon.

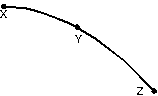
II. The flight time is less for the bullet on the Earth.

III. The velocity of the bullets at impact are the same.

A) III only B) I and II only

C) I and III only D) II and III only

E) I, II, III

 13. A stone is thrown horizontally and follows the path XYZ shown. The direction of the acceleration of the stone at point Y is:

A) ****

B) ****

C)

D)

E)

14. A bullet shot horizontally from a gun:

A) strikes the ground much later than one dropped vertically from the same point at the same instant

B) never strikes the ground

C) strikes the ground at approximately the same time as one dropped vertically from the same point at the same instant

D) travels in a straight line

E) strikes the ground much sooner than one dropped from the same point at the same instant

15. A bomber flying in level flight must release its bomb before it is over the target. Neglecting air resistance, which one of the following is NOT true?

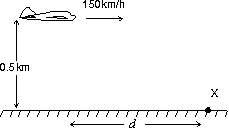
A) The bomber will be over the target when the bomb strikes

B) The acceleration of the bomb is constant

C) The horizontal velocity of the plane equals the vertical velocity of the bomb when it hits the target

D) The bomb travels in a curved path

E) The time of flight of the bomb is independent of the horizontal speed of the plane

 16. The airplane shown is in level flight at an altitude of 0.50 km and a speed of 150 km/h. At what distance *d* should it release a heavy bomb to hit the target X? Take *g* = 10 m/s2.

A) 150 m B) 295 m

C) 417 m D) 2550 m

E) 15,000 m

17. An object is shot from the back of a truck moving at 30 mph on a straight horizontal road. The launcher is aimed upward, perpendicular to the bed of the truck. The object falls:

A) in front of the truck B) behind the truck

C) on the truck D) depends on the initial speed of the object

E) depends on the value of *g*

 18. A stone is thrown horizontally from the top of a 20-m high hill. It strikes the ground at an angle of 45. With what speed was it thrown?

A) 14 m/s B) 20 m/s

C) 28 m/s D) 32 m/s

E) 40 m/s

19. A stone is thrown outward from the top of a 59.4-m high cliff with an upward velocity component of 19.5 m/s. How many seconds will the stone be in the air?

A) 4

B) 5

C) 6

D) 7

E) 8

20. A large cannon is fired over level ground at an angle of 30 above the horizontal. The muzzle velocity is 980 m/s. Neglecting air resistance, the projectile will travel what horizontal distance before striking the ground?

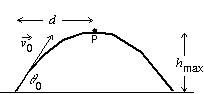
A) 4300 m

B) 8500 m

C) 43,000 m

D) 85,000 m

E) 170,000 m

 21. A projectile has an initial velocity *v*0 at an angle **0 above the horizontal. It reaches the highest point P of its trajectory in a time *T* after launch. The highest point is a vertical distance *h*max and a horizontal distance *d* from the firing point and the speed of the projectile at the highest point is *v*. All of the following statements are true except:

A) *T* = (*v*0 cos **0)/*g*

B) *d* = *v*0*T* cos **0

C) *h*max = (*v*0 sin **0)2/2*g*

D) *v* = *v*0 cos **0

E) the acceleration is *g* (in magnitude)

22. A boy on the edge of a vertical cliff 20 m high throws a stone horizontally outwards with a speed of 20 m/s. It strikes the ground at what horizontal distance from the foot of the cliff? Use *g* = 10 m/s2

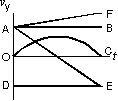
A) 10 m

B) 40 m

C) 50 m

D) 

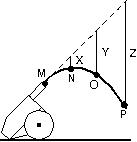
E) none of these

 23. Which of the curves on the graph below best represents the vertical component *vy* versus *t* for a projectile fired at an angle of 45 above the horizontal?

A) OC B) DE

C) AB D) AE

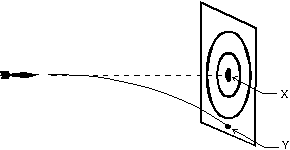
E) AF

 24. A cannon fires a projectile as shown. The dashed line shows the trajectory in the absence of gravity; points MNOP correspond to one second intervals. Using *g* = 10 m/s2, the lengths X,Y,Z are:

A) 5 m, 10 m, 15 m B) 5 m, 20 m, 45 m

C) 10 m, 40 m, 90 m D) 10 m, 20 m, 30 m

E) 0.2 m, 0.8 m, 1.8 m

 25. A dart is thrown horizontally toward X at 20 m/s as shown. It hits Y 0.1 s later. The distance XY is:

A) 2 m B) 1 m

C) 0.5 m D) 0.1 m

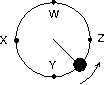
E) 0.05 m

26. A projectile is fired over level ground with an initial velocity that has a vertical component of 20 m/s and a horizontal component of 30 m/s. Using *g* = 10 m/s2, the distance from launching to landing points is:

A) 40 m B) 60 m

C) 80 m D) 120 m

E) 180 m

 27. An object, tied to a string, moves in a circle at constant speed on a horizontal surface as shown. The direction of the displacement of this object, as it travels from W to X is:

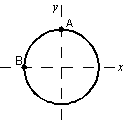
A) ****

B) ****

C) ****

D)

E)

 28. A particle moves with constant speed around the circle shown below. When it is at point A its coordinates are *x* = 0, *y* = 2m and its velocity is (4m/s)3. When it is at point B its velocity and acceleration are:

A) –(4 m/s)zand (8 m/s2)3, respectively

B) (4 m/s)3and –(8 m/s2)3, respectively

C) (4 m/s)z and (8 m/s2)3, respectively

D) (4 m/s)3 and (2 m/s2)z, respectively

E) (4 m/s)z and 0, respectively

29. An airplane makes a gradual 90 turn while flying at a constant speed of 200 m/s. The process takes 20.0 seconds to complete. For this turn the magnitude of the average acceleration of the plane is:

A) zero B) 40 m/s2 C) 20 m/s2

D) 14 m/s2 E) 10 m/s2

30. An airplane is flying north at 500 km/h. It makes a gradual 180 turn at constant speed, changing its direction of travel from north through east to south. The process takes 40 s. The average acceleration of the plane for this turn (in km/hs) is:

A) 12.5 (north) B) 12.5 (east)

C) 12.5 (south) D) 25 (north)

E) 25 (south)

31. An object is moving on a circular path of radius  meters at a constant speed of 4.0 m/s. The time required for one revolution is:

A) 2/2 s B) 2/2 s

C) /2 s D) 2/4 s

E) 2/ s

32. A particle moves at constant speed in a circular path. The instantaneous velocity and instantaneous acceleration vectors are:

A) both tangent to the circular path

B) both perpendicular to the circular path

C) perpendicular to each other

D) opposite to each other

E) none of the above

33. A stone is tied to a string and whirled at constant speed in a horizontal circle. The speed is then doubled without changing the length of the string. Afterward, the magnitude of the acceleration of the stone is:

A) the same

B) twice as great

C) four times as great

D) half as great

E) one-fourth as great

34. Two objects are traveling around different circular orbits with constant speed. They both have the same acceleration but object A is traveling twice as fast as object B. The orbit radius for object A is \_\_\_\_\_\_\_ the orbit radius for object B.

A) one-fourth

B) one-half

C) the same as

D) twice

E) four times

35. A stone is tied to a 0.50 m string and whirled at a constant speed of 4.0 m/s in a vertical circle. Its acceleration in m/s2 at the top of the circle is:

A) 9.8, up B) 9.8, down

C) 8.0, down D) 32, up

E) 32, down

36. A stone is tied to a 0.50 m string and whirled at a constant speed of 4.0 m/s in a vertical circle. The magnitude of its acceleration in m/s2 at the bottom of the circle is:

A) 9.8, up B) 9.8, down

C) 8.0, up D) 32, up

E) 32, down

37. A car rounds a 20-m radius curve at 10 m/s. The magnitude of its acceleration in m/s2 is:

A) 0 B) 0.20

C) 5.0 D) 40

E) 400

38. For a biological sample in a 1.0-m radius centrifuge to have a centripetal acceleration of 25g its speed in m/s must be:

A) 11

B) 16

C) 50

D) 122

E) 245

39. A girl on a merry-go-round moves horizontally in a circle at constant speed. She travels one fourth of a revolution, a distance of 25 m along the circumference of the circle, in 5.0 s. The magnitude of her acceleration is:

A) 0.31 m/s2

B) 1.3 m/s2

C) 1.6 m/s2

D) 3.9 m/s2

E) 6.3 m/s2

40. A stone is tied to the end of a string and is swung with constant speed around a horizontal circle with a radius of 1.5 m. If it makes two complete revolutions each second, its acceleration is:

A) 0.24 m/s2

B) 2.4 m/s2

C) 24 m/s2

D) 240 m/s2

E) 2400 m/s2

41. A Ferris wheel with a radius of 8.0m makes 1 revolution every 10 s. When he is at the top, essentially a diameter above the ground, he releases a ball. How far from the point on the ground directly under the release point does the ball land?

A) 0 B) 1.0 m

C) 8.0 m D) 9.1 m

E) 16 m

42. A boat is able to move through still water at 20 m/s. It makes a round trip to a town 3.0 km downstream. If the river flows at 5 m/s, the time required for this round trip is:

A) 120 s B) 150 s

C) 200 s D) 300 s

E) 320 s

43. A boat is traveling upstream at 14 mph with respect to a river that is flowing at 6 mph (with respect to the ground). A man runs directly across the boat, from one side to the other, at 6 mph (with respect to the boat). The speed of the man with respect to the ground is:

A) 10 mph B) 14 mph

C) 18.5 mph D) 21 mph

E) 26 mph

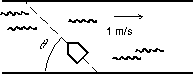
44. A ferry boat is sailing at 12 km 30 W of N with respect to a river that is flowing at 6.0 km/h E. As observed from the shore, the ferry boat is sailing:

A) 30 E of N B) due N

C) 30 W of N D) 45 E of N

E) none of these

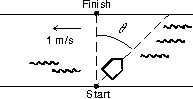
45. A boy wishes to row across a river in the shortest possible time. He can row at 2 m/s in still water and the river is flowing at 1 m/s. At what angle  should he point the bow (front) of his boat?



A) 30 B) 45

C) 60 D) 63

E) 90

 46. A girl wishes to row across a river to a point directly opposite as shown. She can row at 2 m/s in still water and the river is flowing at 1 m/s. At what angle with respect to the line joining the starting and finishing points should she point the bow (front) of her boat?

A) 30 B) 45

C) 60 D) 63

E) 90

47. A motor boat can travel at 10 km/h in still water. A river flows at 5 km/h west. A boater wishes to cross from the south bank to a point directly opposite on the north bank. At what angle must the boat be headed?

A) 27 E of N B) 30 E of N

C) 45 E of N D) 60 E of N

E) depends on the width of the river

48. Two projectiles are in flight at the same time. The acceleration of one relative to the other:

A) is always 9.8 m/s2

B) can be as large as 19.8 m/s2

C) can be horizontal

D) is zero

E) none of these