Conceptual Questions: Vectors and Kinematics

1. Your car can accelerate from 10 m/s to 30 m/s in 2 seconds. The acceleration of the car in g's is (use 10 m/s^2 for acceleration of gravity g)
   a. 1 b. 2 c. 3 d. 64 e. 32

2. A ball is thrown straight upward. When it has reached the highest point in its motion, and is momentarily stopped, its acceleration is
   a. 1 g up b. 1 g down c. zero d. answer depends on weight of ball

3. Your car moves in a circle at a CONSTANT speed of 50 m/s. The acceleration of your car is
   a. 50 m/s^2 b. zero c. need more info to determine acceleration

4. George drives from town A to town B and back to town A in 2 hours. The distance between town A and town B is 60 miles. What is the <u>average velocity</u> for the <u>entire</u> trip?
   a. 0 mph b. 30 mph c. 60mph d. 120mph

5. Which one of the following is not a vector quantity?
   a. acceleration
   b. average speed
   c. displacement
   d. average velocity
   e. instantaneous velocity

6. An object moves with velocity in +x-direction with constant acceleration **a**. After 3 seconds, its acceleration changes to a constant value **-a**. Which of the following statements is true regarding the motion of the object upon this sudden change in acceleration .
   a. Its velocity and displacement become negative.
   b. Its velocity is positive but its displacement is negative.
   c. Its position and velocity decrease.
   d. Its position increases, but its velocity decreases.
   e. Its position and velocity increase.

7. Which one of the following physical quantities is *not* correctly paired with its dimension?

Physical Quantity	*Dimension*
a. Velocity	[L]/[T]
b. Total Distance Traveled	[L]
c. Speed	[L]/[T]
d. Displacement	[L]/[T]
e. Speed x Time	[L]

8. Which one of the following is an accurate statement about an object moving in one dimension.
   a. If velocity and acceleration have opposite signs, the object is slowing down.
   b. If position and velocity have opposite signs, the object is slowing down.
   c. If an object is not moving, it must have zero acceleration at that instant.

d. It is not possible for an object to have both negative velocity and negative acceleration.

9. Two vectors **A** and **B** are added together to form a vector C. The relationship between the magnitudes of the vectors is given by $A^2+B^2=C^2$. Which statement concerning these vectors is true.
   a. **A** and **B** must be at right angles to each other.
   b. **A** and **B** could have any orientation relative to each other.
   c. **A** and **B** must have equal lengths.
   d. **A** and **B** must be parallel.
   e. **A** and **B** could be antiparallel.

10. Which one of the following situations is *impossible*?
    a. An object has velocity directed east and acceleration directed east.
    b. An object has zero velocity but non-zero acceleration.
    c. An object has constant acceleration and changing velocity.
    d. An object has constant velocity and changing acceleration.
    e. An object has velocity directed east and acceleration directed west

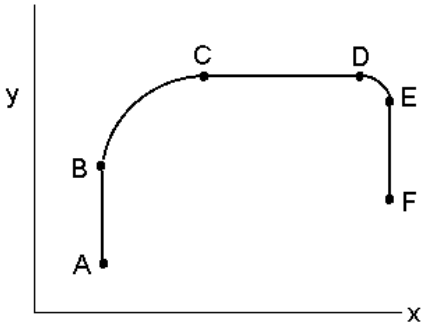
11. In which one of the following does a car have a westward acceleration?
    a. The car travels westward at constant speed.
    b. The car travels eastward and speeds up.
    c. The car travels westward and slows down.
    d. The car starts form rest and moves eastward at constant speed.
    e. The car travels eastward and slows down.

12. If the speed of an object is constant, its acceleration must be zero. This statement is
    a. true
    b. false

13. Two displacement vectors of magnitudes 20 cm and 80 cm are added. Which one of the following is the only possible choice for the magnitude of the resultant?
    a. 0 cm
    b. 28 cm
    c. 82 cm
    d. 114 cm

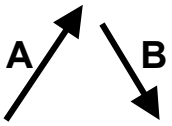
14. The figure below shows the path of a scooter on a flat horizontal surface. It starts at point A and moves at constant speed to point F. During which segment is the acceleration of the scooter greatest?

    a. AB
    b. BC
    c. CD
    d. DE
    e. EF



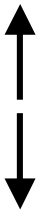
15. What is the difference between vector **A** and vector **B**?

a.



b.

c.



d.

16. Consider a ball thrown at an angle $\theta \neq 90°$ (measured from the horizontal) through the air. Which of the following statements is true regarding the thrown ball?
    a. Its acceleration is negative on the way up and positive on the way down.
    b. The magnitude of its velocity is never zero during its entire flight.
    c. The magnitude of the velocity vector is zero at its maximum height.
    d. Its acceleration is zero at its maximum height.

17. Two objects are fired from separate launchers with an initial velocity of 30m/s. One object is fired at 15 degrees while the other is fired at 75 degrees. The final vertical position of both objects is exactly the same as their initial vertical positions. The following quantities are measured for both objects.

    I. Range II. Time of flight III. Final speed

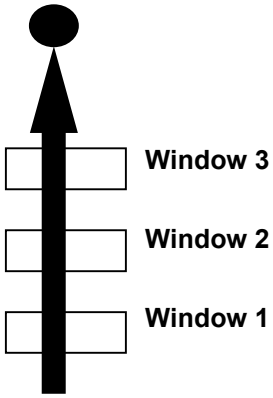
    The results will show that the objects have the same
    a. I
    b. II
    c. I and II
    d. I and III
    e. I, III, and III

18. In uniform circular motion there is no tangential acceleration. This statement is
    a. true
    b. false

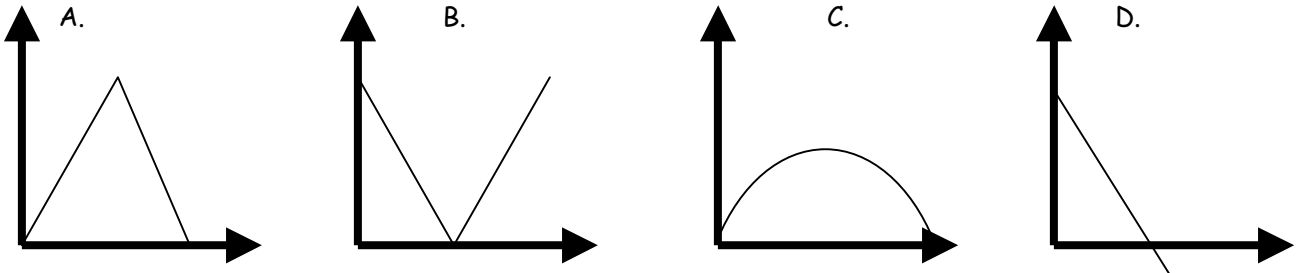
19. A satellite in orbit around the earth is constantly falling toward the center of the earth, with acceleration due to gravity. This statement is
    a. true
    b. false

20. The radial component of an object undergoing circular motion has magnitude v^2/r only if the motion is with constant speed. This statement is
    a. true
    b. false

21. A ball is thrown straight up. It passes three windows that are identical in size. A student measures the average speed of the ball as it passes each window. In which case is the average speed of the ball greatest?
    a. As it passes window 1
    b. As it passes window 2
    c. As it passes window 3
    d. The average speed is the same in all cases



22. A particle traveling in the positive x-direction is subjected to an acceleration in the opposite direction. Which of the following velocity vs. time graphs shown more closely describe the velocity of the particle as a function of time?



23. A motorboat can travel at 8km/hr in still water. A river flows at 4km/hr 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. 23 degrees east of north
    b. 30 degrees east of north
    c. 45 degrees east of north
    d. 60 degrees east of north

24. A particle moves with uniform circular motion. When its position is **r**=2**i**m, its velocity is $-4\sqrt{2}\hat{\boldsymbol{j}}$ m/s. What is its velocity when $\vec{\mathbf{r}} = \sqrt{2}\hat{\boldsymbol{i}} - \sqrt{2}\hat{\boldsymbol{j}}$ m?
    a. (-4**i**-4**j**)m/s
    b. (-32**j**)m/s
    c. (-4**i**+4**j**)m/s
    d. (32**j**)m/s
    e. (-16**i**+16**j**)m/s

25. A particle is undergoing uniform circular motion of radius r=4m. It completes 1 revolution in π seconds. Which of the following best describes its position at any time?
    a. $\vec{r} = 4\cos t\hat{i} + 4\sin t\hat{j}$ m
    b. $\vec{r} = 4\cos 2t\hat{i} + 4\sin 2t\hat{j}$ m
    c. $\vec{r} = 2\sqrt{2}\hat{i} + 2\sqrt{2}\hat{j}$ m
    d. $\vec{r} = 2\sqrt{2}t\hat{i} - 2\sqrt{2}t\hat{j}$ m

26. A particle starts with a velocity v=(-2i)m/s and undergoes an acceleration $\vec{a} = (12t\hat{i} - 4\hat{j})\frac{m}{s^2}$. If its position at t=0 is 5i m, what is the expression that describes its position as a function of time?
    a. $\vec{r} = (12)\hat{i}$ m
    b. $\vec{r} = (t^3 - 2t)\hat{i} - t^2\hat{j}$ m
    c. $\vec{r} = (2t^3 - 2t + 5)\hat{i} - 2t^2\hat{j}$ m
    d. $\vec{r} = (6t^2 + 2t + 5)\hat{i} - 4t\ \hat{j}$ m
    e. $\vec{r} = (12t^2 - 2t - 5)\hat{i} - 2t^2\hat{j}$

27. A car is driven for one lap around a circular racetrack. Its speed around the track was not constant. Which of the following statements is true about the car:
    a. average speed of the car is the displacement divided by the time needed to complete the lap
    b. average velocity of the car is the total distance traveled divided by time needed to complete the lap
    c. average speed of the car is the total distance traveled divided by time needed to complete the lap
    d. average acceleration must be zero
    e. average speed of the car is zeros

28. If an object moves at constant velocity, which of the following increases with time?
    a. average velocity
    b. instantaneous velocity
    c. displacement
    d. direction
    e. acceleration

29. A skydiver jumps out of a helicopter. A few seconds later another skydiver jumps out, so that they fall along the same vertical line. Let's assume for the time being that they are both free falling (no air resistance). One can conclude that the vertical distance between the two skydivers
    a. increases
    b. decreases
    c. stays the same
    d. changes in a chaotic manner

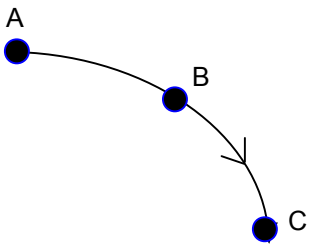
30. An object is thrown such that it follows the path shown below. The direction of the acceleration vector at point B is

a.

b.

c.

d.



31. A car travels at a speed v (km/h) for 20 minutes, then at a speed v/2 for 20 minutes, and finally at a speed v/3 for 10 minutes. What is the average speed for the trip?
A. 4v/5 B. 11v/18 C. 2v/3 D. v/2

32. A car accelerates at -1.0m/s^2 from t=0 to t=2.0s, moves at constant velocity from t=2.0s to t=4.0s, and moves at constant acceleration 0.5 from t=4.0s to 8.0s. Its initial velocity was 3.0 m/s. Plot graphs of position vs. time, velocity vs. time, and acceleration vs. time from t=0 to v=8.0s.