1. When two particles move in the same direction, their relative velocity is
   A. The product of their speeds
   B. The difference of their speeds
   C. The sum of their speeds
   D. Zero (B)

Explanation : For motion in the same direction, relative velocity is the difference between their individual speeds.

2. When two particles move in opposite directions, their relative velocity is
   A. The product of their speeds
   B. The difference of their speeds
   C. The sum of their speeds
   D. Zero (C)

Explanation: In opposite directions, relative velocity equals the sum of their speeds.

3. Differential calculus in physics is mainly used to calculate
   A. Work and energy
   B. Rate of instantaneous change
   C. Heat transfer
   D. Electric current (B)

Explanation: Differential calculus deals with rates of instantaneous change such as velocity and acceleration.

4. If $x=t^2+9-6t$ the velocity of the particle is
   A. $v = t^2 - 6$
   B. $v=2t-6$
   C. $v=2t-9$
   D. $v=t-6$ (B)

Explanation : Differentiating displacement with respect to time gives $v=2t-6$

5. For the equation $x=8+12t-t^3$ the velocity is zero at
   A. t=2
   B. t=3
   C. t=4
   D. t=6 (C)

Explanation: Differentiating gives $v=12-3t^2$, Setting v=0 gives t= 4

6. The acceleration of the particle in Q5 at t=2 is
   A. -6 m/s^2
   B. -12 m/s^2
   C. +6 m/s^2
   D. +12 m/s^2 (B)

Explanation: a=dv/dt=−6t, At t= 2, a= -12 m/s^2

7. Integration in physics is primarily used to calculate
   A. Force only
   B. Instantaneous change
   C. Position, velocity, and work
   D. Density of matter (C)

Explanation: Integration helps find displacement from velocity, velocity from acceleration, and work from force

8. The work done by a restoring force F = – kx between xi, and xf is.
   A. $-\frac{k}{2}(x_f^2-x_i^2)$
   B. k(xf – xi)
   C. – k (xf – xi)
   D. $k(x_f^2-x_i^2)$ (A)

Explanation: Work is the integral of force: W = $\int_{x_i}^{x_f} -kx\,dx = -\frac{k}{2}(x_f^2-x_i^2)$.

9. A particle moves with velocity = $3t\hat{i}+2t\hat{j}+5\hat{k}$. Its position at is t = 2
   A. $8\hat{i}+4\hat{j}+10\hat{k}$
   B. $6\hat{i}+4\hat{j}+5\hat{k}$
   C. $3\hat{i}+2\hat{j}+10\hat{k}$
   D. $12\hat{i}+8\hat{j}+5\hat{k}$ (B)

Explanation: Integrating velocity from 0 to 2 gives displacement $8\hat{i}+4\hat{j}+10\hat{k}$.

10. If $s= 3t^3 + 7t^2 + 14t + 8$ the acceleration at t=1 is
    A. 10 m/s^2
    B. 32 m/s^2
    C. 23 m/s^2
    D. 16 m/s^2 (B)

Explanation : $v=ds/dt =9t^2 + 14t + 14$. Then $a=dv/dt =18t+14$. At t=1, a=32m/s^2.