

**Useful Information:**  $g = 9.8 \text{ m/s}^2$   
Some of the results are rounded.

1. Two cars initially separated by 800 m are moving toward each other with speeds (with respect to the ground) of 15 m/s and 10 m/s. The time (in seconds) they take them to reach each other is:  
a) 25      b) 32      c) 80      d) 53      e) 16
2. Two vectors lying in the  $xz$ -plane are  $\mathbf{A} = 2\mathbf{i} + 3\mathbf{k}$  and  $\mathbf{B} = -\mathbf{i} + 2\mathbf{k}$ . Then  $\mathbf{A} \times \mathbf{B}$  is:  
a)  $\mathbf{j}$       b)  $-9\mathbf{j}$       c)  $7\mathbf{k}$       d)  $-7\mathbf{j}$       e)  $\mathbf{i} + 5\mathbf{k}$
3. If  $\mathbf{A} + \mathbf{B} = 6\mathbf{i} + \mathbf{j}$  and  $\mathbf{A} - \mathbf{B} = -4\mathbf{i} + 7\mathbf{j}$ , then the angle (in degrees) enclosed between the two vectors ( $\mathbf{A}$  and  $\mathbf{B}$ ) is:  
a) 73      b) 107      c) Zero      d) 90      e) 100
4. An object moving on the  $x$ -axis with a constant acceleration increases its  $x$  coordinate by 80 m in a 5.0 s time interval and has a velocity of +20 m/s at the end of this interval. The acceleration (in  $\text{m/s}^2$ ) of the object is:  
a)  $-3.2$       b) 6.4      c) 1.6      d)  $-2.0$       e)  $-6.4$
5. An airplane flies horizontally with a speed of 300 m/s at an altitude of 400 m. Assume that the ground below is level. At what horizontal distance (in km) from a target on the ground must the pilot release a box so as to hit the target?  
a) 3.0      b) 2.4      c) 3.3      d) 2.7      e) 1.7
6. A particle starts from the origin at  $t = 0$  with a velocity of  $(16\mathbf{i} - 12\mathbf{j}) \text{ m/s}$  and moves in the  $xy$  plane with a constant acceleration of  $\mathbf{a} = (3.0\mathbf{i} - 6.0\mathbf{j}) \text{ m/s}^2$ . The speed (in m/s) of the particle at  $t = 2.0 \text{ s}$  is:  
a) 52      b) 39      c) 26      d) 33      e) 43

the incline and up the incline is applied to the block. The magnitude of the acceleration (in  $\text{m/s}^2$ ) of the block is:

- a) 1.1      b) 5.3      c) 2.0      d) 3.9      e) 3.3

10. A 5.0 kg block on a rough horizontal surface is acted on by a force of 25.0 N that makes an angle of  $60.0^\circ$  above the horizontal. The block remains stationary. The coefficient of static friction between the block and the surface is 0.50. The force of static friction (in N) between the block and the surface is:

- a) 0      b) 27.4      c) 13.7      d) 25.0      e) 12.5

11. At an instant when a 4.0 kg object has an acceleration of  $(5\mathbf{i} + 3\mathbf{j}) \text{ m/s}^2$ , one of the two forces acting on the object is known to be  $(12\mathbf{i} + 22\mathbf{j}) \text{ N}$ . The magnitude of the other force (in N) acting on the object is:

- a) 2.0      b) 13      c) 19      d) 1.7      e) 20

12. A 0.40 kg mass attached to the end of a string swings in a vertical circle with a radius of 1.8 m. At an instant when the string makes an angle of 40 degrees below the horizontal, the speed of the mass is 5.0 m/s. The magnitude of the tension (in N) in the string at this instant is:

- a) 9.5      b) 3.0      c) 8.1      d) 4.5      e) 5.7