Physics 53 Exam 1 Dr. Alward September 16, 2009

1. A car traveling at a certain initial speed begins to decelerate, losing speed at the rate of 4 $m/s^2$. During the next six seconds the car travels 240 m. What was the car's initial speed, in m/s?

(a) 18
(b) 32
(c) 40
(d) 52
(e) None of the above

2. At t = 0, an object on the x-axis at x = 11 m is moving to the right at a speed of 9 m/s. At that moment, it begins to accelerate at a rate of 6 $m/s^2$. What will be its speed (in m/s) when it is at x = 20 m?

(a) 9.71
(b) 10.23
(c) 11.71
(d) 13.75
(e) None of the above

3. While accelerating at a constant rate, an automobile's speed is increased from 19 m/s to 37 m/s. During this time period, the car travels 243 m. What will be its speed (in m/s) after five more seconds?

(a) 47.37
(b) 74.54
(c) 59.87
(d) 102.08
(e) None of the above

4. At a certain instant of time, two cars are racing toward each other. The car on the left is moving to the right at a speed of 26 m/s, and the car on the right is moving to the left, toward the other car, at a speed of 42 m/s. At time t = 0 s, the cars are 3100 m apart, and then both cars begin to accelerate. The acceleration of the car on the left is 3 $m/s^2$, while the other car's acceleration is 5 $m/s^2$. How far in meters will the car on the left travel before it collides with the other car?

(a) 1296
(b) 1408
(c) 1315
(d) 1185
(e) None of the above

5. At time t = 0, an object moving at 1.35 m/s begins accelerating along the x-axis according to the equation, $\mathbf{a = 1 + 2t + 3t^2}$, where **a** is in $m/s^2$, and t is in seconds. What distance (in m) does the object travel between t = 0.75 s and t = 0.95 s?

(a) 2.46
(b) 0.71
(c) 1.10
(d) 3.46
(e) None of the above

6. An object's velocity on the x-axis is given by the equation, $\mathbf{v = 20 - 4t + t^4 e^{-0.2t}}$, where **v** is in m/s, and t is in seconds. What will be the object's acceleration in $m/s^2$ at time t = 3.0 s?

(a) 46.38
(b) 10.30
(c) 31.13
(d) 16.92
(e) None of the above

7. An arrow is fired upward at an initial speed of 39.20 m/s. What will be its velocity 0.66 seconds after reaching maximum height?

(a) -1.56
(b) -2.34
(c) -6.47
(d) -4.24
(e) None of the above

8. An object is thrown at speed 25 m/s straight downward from the top of a 30-m tall building. How many seconds does it take the object to strike the ground?

(a) 1.00
(b 1.12
(c) 1.87
(d) 1.93
(e) None of the above

9. An object is moving along the x-axis according to the equation, $\mathbf{x = 3 + 2t + 4t^3}$, where **x** is in m, and t is in seconds. What will be the acceleration (in $m/s^2$) of the object when t = 0.53 seconds?

(a) 7.86
(b) 4.12
(c) 1.34
(d) 12.72
(e) None of the above

10. A group of hikers begin their journey at their campsite, first traveling 500 meters along a heading of 160 degrees, then 400 meters along a heading of 340 degrees. How far in meters are they from the campsite at this point? Assume headings are measured relative to north, rotating clockwise, with north being zero degrees.

(a) 114
(b) 100
(c) 121
(d) 108
(e) None of the above

11. The coordinates of an object moving in a plane are $\mathbf{x = 30t^2}$ and $\mathbf{y = 80t}$, where **x** and **y** are in meters, and **t** is in seconds. What is the speed (in m/s) of the object when t = 2 seconds?

(a) 125
(b) 86
(c) 144
(d) 238
(e) None of the above

12. The components of velocity of an object moving in two dimensions are 40 m/s eastward, and 88 m/s northward. What is the object's approximate heading, in degrees? Assume headings are measured relative to north, rotating *clockwise*, with north being zero degrees.

(a) 66
(b) 24
(c) 294
(d) 336
(e) None of the above

13. The x, y, and z components of a vector **A** are **<-3, -2, 1>**, and the components of a vector **B** are <2, -2, 2>. What is the angle (in degrees) between these two vectors?

(a) 0
(b) 99.03
(c) 104.86
(d) 90.00
(e) None of the above

14. What is the cross product of the two vectors, $\mathbf{A} = 3\mathbf{i} + 2\mathbf{j} + \mathbf{k}$, and $\mathbf{B} = -2\mathbf{i} + 4\mathbf{j}$ ?

(a) $2\mathbf{i} + 6\mathbf{j} - 8\mathbf{k}$
(b) $-6\mathbf{i} - 4\mathbf{j} - 16\mathbf{k}$
(c) $4\mathbf{i} - 2\mathbf{j} - 12\mathbf{k}$
(d) $-6\mathbf{i} - 4\mathbf{j} + 8\mathbf{k}$
(e) None of the above

15. An object's speed changes uniformly from 80 m/s to 190 m/s during a five-second time period. What will be its speed (in m/s) at the end of the sixth second, assuming the acceleration remains the same?

(a) 200
(b) 212
(c) 224
(d) 236
(e) None of the above

16. A rock is thrown with speed 30 m/s from the top of a 50-m tall cliff. The angle of the throw is 20 degrees *above* the horizontal. What will be the speed (in m/s) of the rock when it reaches maximum height?

(a) 35.67
(b) 28.19
(c) 32.45
(d) 47.56
(e) None of the above

17. An airplane is traveling in air whose wind velocity with respect to the ground is 30 m/s, on a heading of 90º, i.e., eastward. The airplane's speed with respect to the air is 220 m/s, and its heading is 0º, i.e., "due north." What is the airplane's speed with respect to the ground, in m/s?

(a) 236
(b) 222
(c) 213
(d) 241
(e) None of the above

18. An object is traveling at a rate of 20 RPM (revolutions per minute) in a circular path at the end of a string of length 0.4 m. What is the centripetal acceleration of the object, in $m/s^2$?

(a) 1.75
(b) 2.34
(c) 3.24
(d) 2.22
(e) None of the above

19. A football is kicked over level ground at initial speed 25 m/s at an angle of 29 degrees above the horizontal. About how far horizontally (in m) will the ball travel before it strikes the ground?

(a) 33
(b) 47
(c) 51
(d) 54
(e) None of the above

20. An artillery cannon is a distance D meters away over level ground from the side of a tall cliff. Projectiles fired from the cannon have a speed of V, in m/s. The projectile must strike a point on the side of the cliff that is at a height H (in meters) above the base of the cliff. Which of the equations below may be solved for the angle θ above the horizontal at which the projectile must be fired, assuming the values of D, V, H, and g are known?

(a) $0 = -H + D \tan \theta - gD^2/(2V^2 \cos^2\theta)$
(b) $H = \frac{1}{2} VD \cos \theta - gD/V\cos \theta$
(c) $\sec \theta = \frac{1}{2} gH/DV$
(d) $0 = H + gD/V^2 \sin \theta$
(e) None of the above