Your Name: _____

PHY203
Final Exam
12/15/08

Solutions

For problems 1 and 2 consider two trains running in the same direction on parallel tracks. Train 1 passes the station at time, t = 0, with a constant speed of 100 m/s.

1. Train 2 passes the station 10 seconds later than train 1 at a constant speed of 120 m/s. Find the time, t (measured from t=0 as above), at which the trains are exactly side-by-side:

a. 5.45 sec.
b. 10.9 sec. $x_1 = 100t$; $x_2 = 120(t-10)$
c. 60 sec. $x_1 = x_2$:$100t = 120t - 1200$
d. 120 sec. $t = 60$ sec.
e. None of the above

2. Train 2 leaves the station 10 seconds later than train 1 at an initial speed of 0 m/s but an acceleration of 20 m/s^2. Find the time, t, at which the trains are exactly side-by-side:

a. 3.8 sec. $x_1 = 100t$; $x_2 = 1/2(20)(t-10)^2$
b. 13.1 sec. $x_1 = x_2$:$100t = 10(t-10)^2$
c. 16.2 sec. $100t = 10(t^2 - 20t + 100)$; t= 26.2 sec.
d. 26.2 sec.
e. 33.0 sec.

For problems 3-5, Let **A** = 4**i** - 9**j**, **B** = 3**i** - 5**j**, **C** = 2**A** – 3**B**

33. Find the magnitude of the vector **A**:

a. -5.0 $A = ((4^2)+ (-9)^2)^{1/2} = 9.8$
b. 5.0
c. -8.1
d. 8.1
e. None of the above

4. Find the angle that vector **B** makes with the positive x-axis (measured from the positive x-axis in a counterclockwise direction):

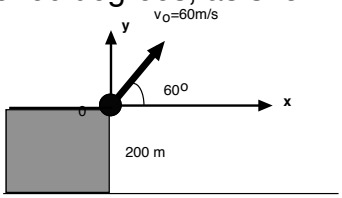
a. 121^o $\theta = -\tan^{-1}(5/3) = 59^o$
b. 239^o $360^o - 59^o = 301^o$
c. 301^o
d. 329^o
e. None of the above

5. Find the magnitude of the vector **C**:

a. 2.1 **C** = 2**A** – 3**B** =2(4**i** - 9**j**)- 3(3**i** - 5**j**) = -**i** - 3**j**
b. 3.2 $C = ((-1^2)+ (-3)^2)^{1/2} = 3.16$
c. 6.3
d. 37.1
e. None of the above

For Questions 6-10:

A missile is shot from a cliff with height 200m and initial speed of 60m/s and an angle of 60 degrees, as shown below. (Use g = 9.81 m/s^2.)



6. What is the initial velocity vector, $\mathbf{v_o}$, in vector notation?

a. (30**i** - 52**j**)m/s $\mathbf{v_O}$ = 60 m/s(cos60° **i** + sin60° m/s **j**) = 30 m/s **i** + 52 m/s **j**
b. (52**i** - 30**j**)m/s
c. (30i + 52j)m/s
d. (52**i** + 30**j**)m/s
e. None of the above

7. Find the time in sec. that it will take for the missile to reach its highest point:

a. 3.06 sec. $0 = 52 \text{ m/s} - (9.81 \text{ m/s}^2)\, t$
b. 5.3 sec. t=5.3s
c. 6.1 sec.
d. 10.6 sec.
e. None of the above

8. Find the y distance above the cliff at which the missile reaches its highest point:

a. 2.65 m $0 = (52 \text{ m/s})^2 - 2(9.81 \text{ m/s}^2)\, H$
b. 45.9 m H = 138 m
c. 138 m
d. 276 m
e. None of the above

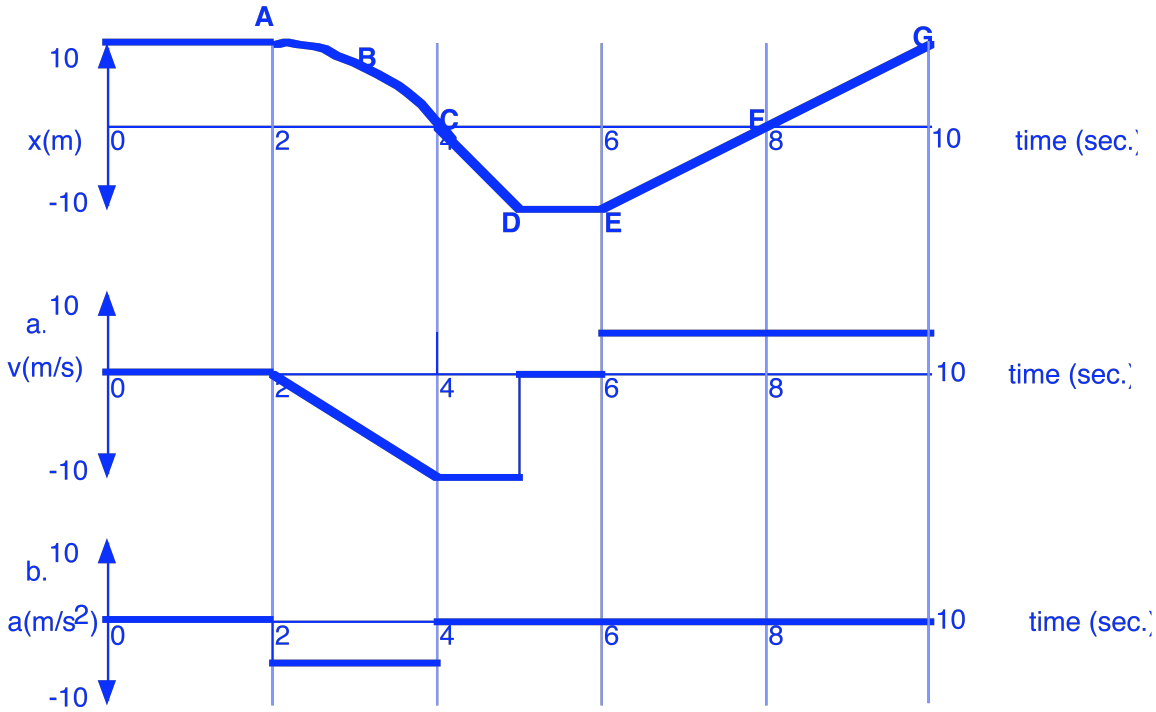
9. Find the time in sec. that it will take for the missile to hit the ground:

a. 3.0 sec. $-200\text{m} = 52 \text{ m/s}\, t + 1/2(-9.81 \text{ m/s}^2)t^2$
b. 8.86 sec. solve quadratic eq.
c. 13.6 sec. t = 13.6s
d. 27.2 sec.
e. None of the above

10. Find the horizontal distance beyond the cliff at which the missile hits the ground:

a. 266 m R = 0 + 30 m/s (13.6 s) = 408 m
b. 408 m
c. 461 m
d. 707 m
e. 816 m

11. For the displacement curve of a car on a 1D track, plot the corresponding curves for velocity, a., and acceleration, b., (the displacement, x, is in straight line segments except for the curve A-B-C, which is a **parabola**). (Note: The acceleration is not constant for the entire graph so constant acceleration equations can *not* be correctly used below.)



c. Calculate the total distance traveled from points C-F.

total distance = 10m + 10 m = 20m

d. Calculate the average speed from points C-F.

average speed = distance/time = 20 m/ 4 s = 5 m/s

e. Calculate the average velocity from points C-F.

$\Delta v_{avg} = (x_2 - x_1)/\Delta t = = (0 - 0)/4s = 0$ m / 4s = 0 m/s

f. Calculate the average acceleration from points B-F.

$\Delta a_{avg} = (v_2 - v_1)/\Delta t = = (5 \text{ m/s} - (-5 \text{ m/s}))/5 \text{ s} = 2 \text{ m/s}^2$