PHY203
Final Exam
Part 1
5/6/10

Solutions

For problems 1-3, Let **A** = 4**j**, **B** = 7**i** - 5**j**, and **C** = 2**A** + 3**B**

1. Find the magnitude of the vector **A** and the angle that vector **A** makes with the positive x-axis (measured in a counterclockwise direction from the positive x-axis):

a. 2.0, 0^o $A = ((4)^2)^{1/2} = 4$
b. 2.0, 90^o $q = 90^o$
c. 4.0, 0^o
d. 4.0, 90^o
e. None of the above

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

a. 4.9, 306^o $B = ((7)^2 + (-5)^2)^{1/2} = 8.6$
b. 4.9, 324^o $q = 360^o - \tan^{-1}(5/7) = 324^o$
c. 8.6, 306^o
d. 8.6, 324^o
e. None of the above

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

a. 19.8 **C** = 2(4**j**)+3(7**i** - 5**j**) = 21**i** - 7**j**
b. 22.1 $C = ((21)^2 + (7)^2)^{1/2} = 22.1$
c. 24.8
d. 32.6
e. None of the above

For problems 4 and 5, on Planet XXX where the acceleration due to gravity is exactly $10 m/s^2$, a soccer ball is kicked from ground level and misses the goal, just clearing the top of the net at the ball's highest point. The height of the top of the net is 1.5 m.

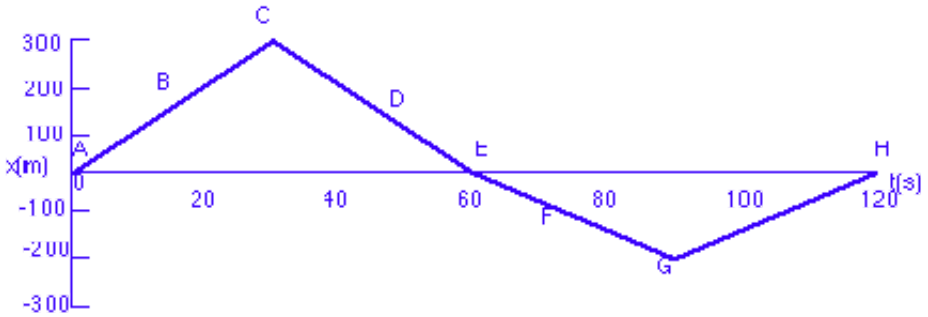
4. Calculate the y-component of the initial velocity.

a. 3.9 m/s $0 = (v_{oy})^2 - 2(10\ m/s^2)(1.5\ m)$
b. 5.48 m/s $v_{oy} = 5.482 m/s$
c. 15 m/s
d. 30 m/s
e. None of the above

5. Calculate the time it takes for the ball to just reach the goal.

a. 0.39 sec. $0 = 5.48\ m/s - (10\ m/s^2)\ t$
b. 0.55 sec. $t = 0.55 s$

c. 1.5 sec.
d. 3.0 sec.
e. None of the above

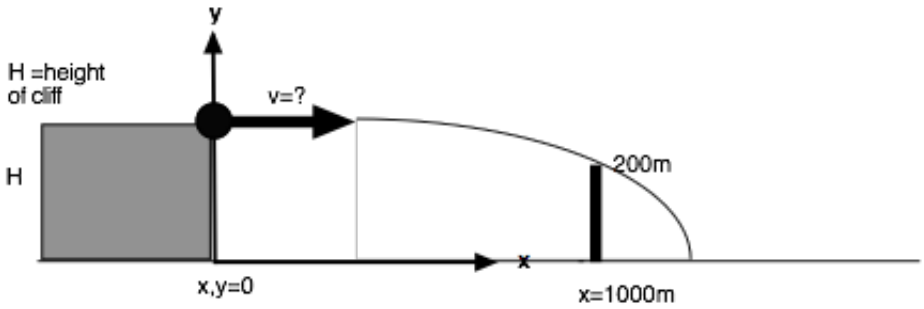


6. For the above graph, find the average speed and average velocity from positions C to E:
a. 10m/s, -10m/s avg. speed=(300m)/(30s)=10m/s
b. 5m/s, -5m/s avg. vel=(0-300m)/(30s)=-10m/s
c. 5m/s, +5m/s
d. 10m/s, +10m/s
e. None of the above

7. For the above graph, find the average speed and average velocity from positions A to H:
a. 8.33m/s, -8.33m/s avg. speed=(300m+300m+200m+200m)/(120s)
b. 0m/s, -8.33m/s =8.33m/s
c. 0m/s, 0m/s avg. vel=(0-0)/(120s)=0
d. 8.33m/s, 0m/s
e. 8.33m/s, +8.33m/s

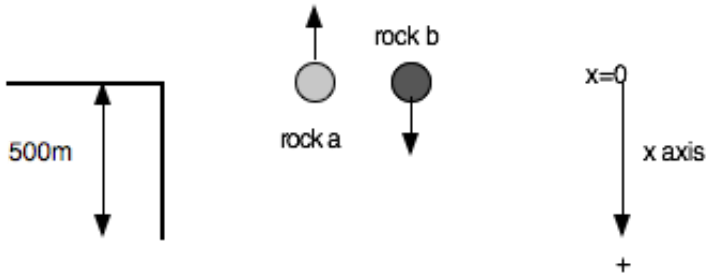
8. For the above graph, find the instantaneous velocity at point B and at point F:
a. 0m/s, -8.33m/s inst. vel=(300-0)/(300s)=10m/s
b. 10m/s, -6.67m/s inst. vel=(-200-0)/(30s)=-6.67m/s
c. 10m/s, 0m/s
d. 15m/s, 0m/s
e. 10m/s, 6.67m/s

For problems 9 and 10, on Planet XXX where the acceleration due to gravity is exactly $10 m/s^2$, a ball is kicked horizontally from the top of a cliff (of height 500m), just clearing the top of a wall (of height 200m) as shown below.



9. Calculate the time it takes for the missile to reach the wall.
a. 5.5 sec. $200= 500 - 0 - 1/2(10)(t)^2$
b. 7.8 sec. $300= 5(t)^2$
c. 8.4 sec.
d. 11.8 sec.
e. 24.5 sec.

10. Calculate the initial speed of the missile.
a. 77.5 m/s 1000 = v(7.8s)
b. 84.7 m/s
c. 119 m/s
d. 128 m/s
e. 182 m/s



11. 2 balls are thrown from a cliff of height 500m. Rock a is thrown straight up at t=0 with an initial speed of 15 m/s; rock b is thrown straight down from the cliff at t=4 sec. at a speed of 30m/s. (Use g=9.81m/s^2) **Show your work**.

a. Using the coordinate system given in the figure, write the equation of motion for rock a.

$x_a = 0 - 15(t) + 1/2(9.81)(t)^2$

b. Using the coordinate system given in the figure, write the equation of motion for rock b.

$x_b = 0 + 30(t-4) + 1/2(9.81)(t-4)^2$

c. Find the time at which the rocks are side-by-side.

$x_a = x_b = -15(t) + 1/2(9.81)(t)^2 = 30(t-4) + 1/2(9.81)(t-4)^2$
$= 30(t-4) + (4.905)(t^2-8t + 16)$
$t = 7.16s$

d. Find the height below the cliff at which the rocks are side-by-side.

$x_b = 30(3.16) + (4.905)(3.16)^2$
$= 143.8m$

e. If rock b were dropped instead of thrown down, find the distance the rock travels in the last second before hitting the ground.

$500m = 1/2(9.81)(t)^2$ $t = 10.1s$
$H' = 1/2(9.81)(t-1)^2 = (4.905)(9.1)^2 = 405.9m$
$500m - 405.9m = 94.1m$