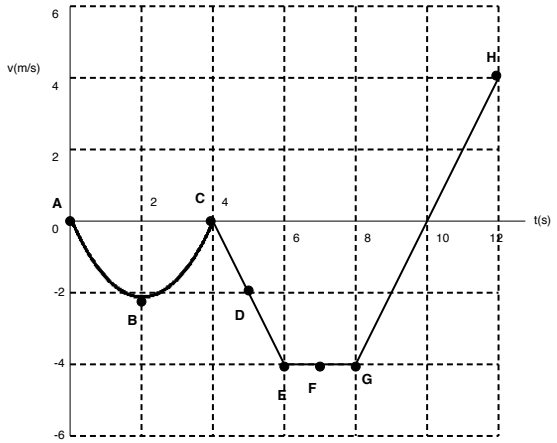
Your Name: _____

PHY203
Exam #1
Chapters 1-5
Fri., 2/27/15

Solutions



1. The plot above depicts the velocity vs. time for the one dimensional motion of a toy car.

a. Consider all the time intervals A-B, B-C, C-D, D-E, E-F, F-G, and G-H. For which time intervals is the acceleration non-constant?

A-B and B-C only **5**

b. Find the instantaneous acceleration (magnitude and sign) at point D.

a_{int} = slope = (-4.00m/s)/(2.00s) = -2.00 m/s^2 **5**

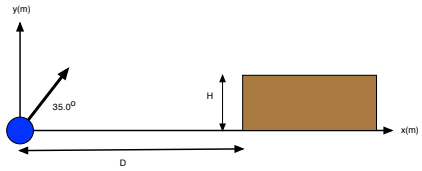
c. Find the instantaneous acceleration (magnitude and sign) at point F.

.

a_{int} = = slope = 0 **5**

d. Find the average acceleration (magnitude and sign) from point B to point G.

$a_{avg} = \Delta v/\Delta t$ = (-4.00m/s – (-2.00m/s)/(6.00s) = -0.333m/s^2 **10**



2. A cannonball is launched from ground level with an initial speed of 155 m/s at an angle of 35.0° with respect to the horizontal.
a. Write the initial velocity in vector notation using the coordinate system in the figure.

v_{xo} = (155 m/s)(cos35.0°) = 127 m/s
v_{yo} = (155 m/s)(sin35.0°) = 88.9 m/s

v = (127 **i** + 88.9 **j**)m/s **10**

b. Find the highest point the cannonball reaches.

$$0 = (88.9)^2 - 2(-9.81)(\Delta y)$$

5

$$\Delta y = 403m$$

c. Find the time it takes the cannonball to reach its highest point.

$$0 = (88.9) - (-9.81)(t)$$

5

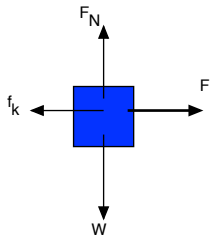
$$t = 9.06s$$

d. Find the time it takes to hit the top of a cliff of height H = 250 m (with the cannonball on the way down).

$$250 = 0 + (88.9)t + \frac{1}{2}(-9.81)t^2$$

Solve quadratic equation

t = 14.6 s (not 3.49 s) **15**



3. Block A (mass of 4.50 kg) is being pushed with a force of magnitude F and is sliding on the top of block B (mass of 7.50 kg) with an acceleration in magnitude of 3.50 m/s^2. Block B is sliding on a frictionless surface. The coefficient of kinetic friction between the blocks is 0.400.

a. Draw a free body diagram of block A on the figure above and to the right. **5**

b. Find the magnitude of the normal force on block A.

F_n=mg=(4.50)(9.81)= 44.1 N **5**

c. Find the magnitude of the normal force on block B (from the floor).

$F_n=(m_A + m_B)g=(12.0)(9.81)= 118N$ **5**

d. Find the magnitude of the frictional force on block A.

$f_k = \mu_k F_n = (0.400)(44.1) = 17.6$ N **5**

e. Find the magnitude of the pushing force F.

$F - f_k = ma$ **10**

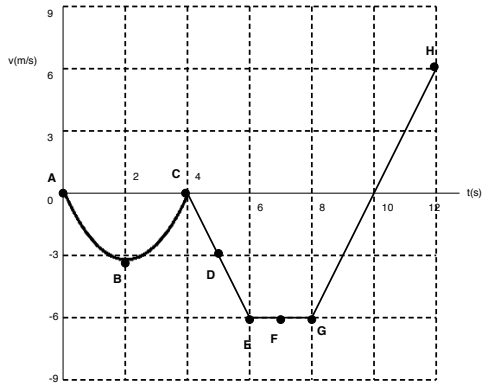
F = 17.6 + (4.50)(3.50) = 33.4 N

f. Find the magnitude of the acceleration of block B.

$f_k = ma$ **10**

a=(17.6)/7.50

a = 2.35 m/s^2



Alt Version

1. The plot above depicts the velocity vs. time for the one dimensional motion of a toy car.

a. Consider all the time intervals A-B, B-C, C-D, D-E, E-F, F-G, and G-H. For which time intervals is the acceleration non-constant?

A-B and B-C only **5**

b. Find the instantaneous acceleration (magnitude and sign) at point D.

a_{int} = slope = (-6.00m/s)/(2.00s) = -3.00 m/s^2 **5**

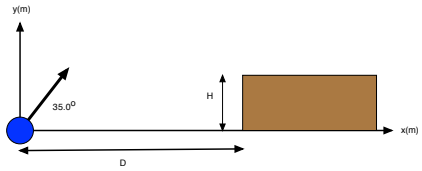
c. Find the instantaneous acceleration (magnitude and sign) at point F.

.

a_{int} = = slope = 0 **5**

d. Find the average acceleration (magnitude and sign) from point B to point G.

$a_{avg} = \Delta v/\Delta t$ = (-6.00m/s – (-3.00m/s)/(6.00s) = -0.500m/s^2 **10**



2. A cannonball is launched from ground level with an initial speed of 125 m/s at an angle of 35.0° with respect to the horizontal.
a. Write the initial velocity in vector notation using the coordinate system in the figure.

v_{xo} = (125 m/s)(cos35.0°) = 102 m/s
v_{yo} = (125 m/s)(sin35.0°) = 71.7 m/s

v = (102 **i** + 71.7 **j**)m/s **10**

b. Find the highest point the cannonball reaches.

$$0 = (71.7)^2 - 2(-9.81)(\Delta y)$$

5

$$\Delta y = 262 m$$

c. Find the time it takes the cannonball to reach its highest point.

$$0 = (71.7) - (-9.81)(t)$$

5

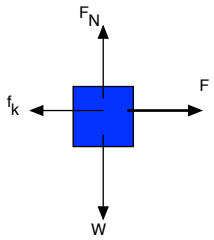
$$t = 7.31 s$$

d. Find the time it takes to hit the top of a cliff of height H = 200 m (with the cannonball on the way down).

$$200 = 0 + (71.7)t + \frac{1}{2}(-9.81)t^2$$

Solve quadratic equation

t = 10.9 s (not 3.75 s) **15**



3. Block A (mass of 5.50 kg) is being pushed with a force of magnitude F and is sliding with an acceleration in magnitude of 4.50 m/s^2 on the top of block B (mass of 8.50 kg). Block B is sliding on a frictionless surface. The coefficient of kinetic friction between the blocks is 0.400.

a. Draw a free body diagram of block A on the figure above and to the right. **5**

b. Find the magnitude of the normal force on block A.

F_n=mg=(5.50)(9.81)= 54.0 N **5**

c. Find the magnitude of the normal force on block B (from the floor).

$F_n=(m_A + m_B)g=(14.0)(9.81)= 137N$ **5**

d. Find the magnitude of the frictional force on block A.

$f_k = \mu_k F_n = (0.400)(54.0) = 21.6$ N **5**

e. Find the magnitude of the pushing force F.

$F - f_k = ma$ **10**

F = 21.6 + (5.50)(4.50) = 46.4 N

f. Find the magnitude of the acceleration of block B.

$f_k = ma$ **10**

a=(21.6)/8.50

a = 2.54 m/s^2