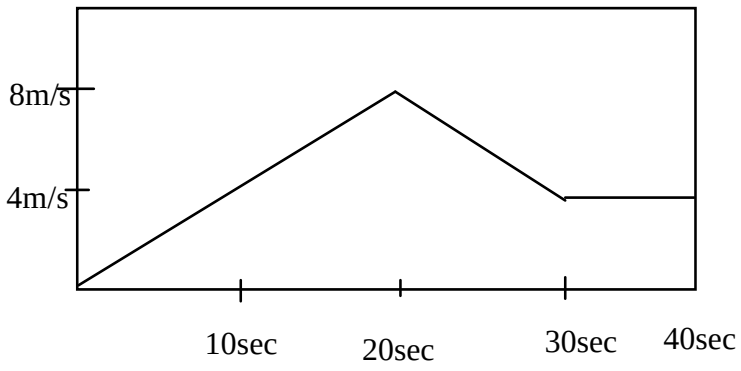
1) A fireworks canister is lobbed directly upwards at 45m/s. How far is it off the ground when it explodes at its peak?

ANSWER: v-ave*time = height = 45/2*4.5= 101.25m

2) How far does the car in this plot travel?



ANSWER: s = v-ave*t for each section = 4*20 + 6*10 + 4*10 = 180 meters

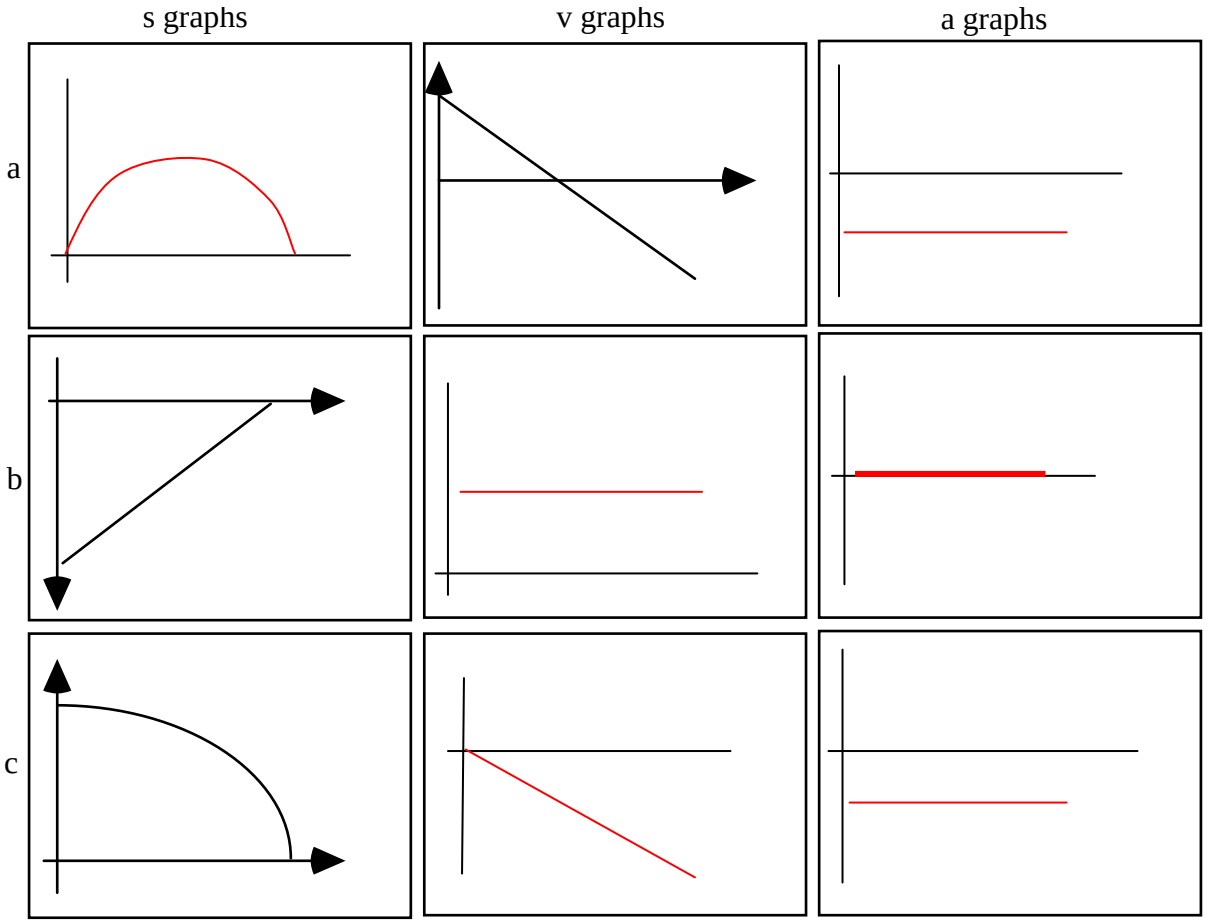
3) A bus has a maximum acceleration of 2.5m/s^2 a maximum speed of 20m/s and a maximum braking deceleration of 5m/s^2. What is the shortest time in which the driver can cover a distance of 280m between stops (starting and finishing at rest)?

ANSWER: s = v-ave*t for each segment = 10*8 + 10*4 = 120 meters for the accelerating and decelerating sections…that leaves 160 meters to be covered at 20 m/s which requires 8 seconds. Total time = 8+8+4 seconds = 20 seconds

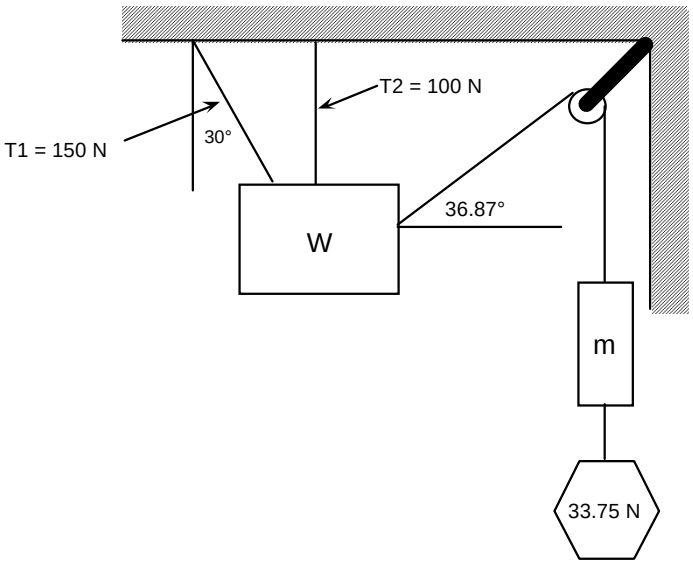
4) Nick travels half of the distance to Pingry from his house at 10m/s and the other half at 30m/s. What is his average speed for the entire trip?

ANSWER: Time = s/10 + s/30 (where s is ½ the distance to Pingry).
Distance = 2s
v-ave = s/t = 2s/(s/10+s/30) = 2s/(4s/30) = 60/4 = 15 m/s

5) In the boxes below you are given 3 graphs. Sketch the shape of each missing s, v or a vs. t plot. As needed, assume that $s_o = 0$.

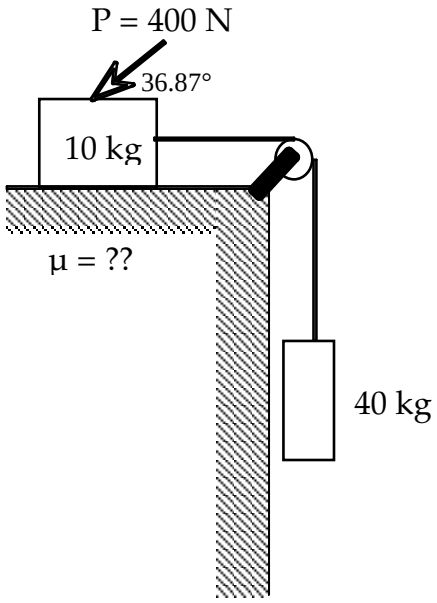


6) Solve for the unknown weight (W) and mass (m).



ANSWER:
T1x = 75N,T1y = 130N
T3x = 75N
T3 = 75/.8 = 93.75 N
T3y = 56.25 N
W=T1y+T2+T3y=286 N
mg + 33.75 = T3
mg = 60 N
m = 6 kg

7) In the drawing to the right, what is the value of μ needed to keep the blocks stationary, and what is the Tension in the rope?



ANSWER:
T = 400 N
Px = 320 N
Py = 240 N
FN = 100 + 240 = 340 N
Ff = 400 - 320 = 80 N (to the left)
μ = Ff/FN = 80/340 = 0.235

8) A ball rolls horizontally off the roof of a building at 12 m/s. If the ball lands 42 meters from the base of the building, how high is the building? What is the ball's impact velocity (magnitude and direction)?

ANSWER: t-air = 42/12 = 3.5 sec; therefore v-y = 35 m/s down and v-x = 12 m/s
v = SQRT(1369) = 37 m/s at 71.1° below the horizontal

9) A soccer ball is kicked at an angle of 36.87° with an initial speed of 30 m/s.
a. How high is the ball if it reaches its peak?

ANSWER: Vo-y = 18 m/s, therefore t-air = 1.8 sec, s = 1.8 * 18/2 = 16.2 m

b. If the ball collides with a high vertical wall 36 meters away, how high does it hit on the wall? Is it on its way up or down when it hits (show your reasoning)?

ANSWER: t-to-wall = 36/ vo-x = 36/24 = 1.5 seconds; s = 1.5*(18+3)/2 = 15.75 m
ball is on the way up since it takes 1.8 seconds to reach peak, but only 1.5 seconds to reach wall.

10) A 3 kg Styrofoam ball falls 20 meters from rest and lands with a speed of 12 m/s. If the air resistance on the ball was constant throughout, what was the acceleration of the ball, and what was the frictional force due to the air?

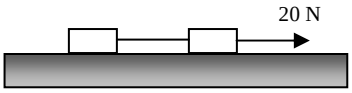
ANSWER: t = s/v-ave = 20/6 = 3.33 sec; a = delta-v/t = 12/3.33 = 3.6 m/s/s
Fnet = mg- Ff = ma; 3*3.6 = 3*10 – Ff; Ff = 19.2 N

11) A 10 kg box is pulled along a rough, horizontal surface (coefficient of friction, μ = 0.4) by a force of 120 N angled at 36.87° above the horizontal. If the block starts from rest, how far must it be pulled to reach a speed of 8 m/s?

ANSWER:
Px – Ff = Fnet = 96 N - μFN = 96 – 0.4*(100-Py) = 96 – 0.4*(100 – 72) = 96 – 11.2 = 84.8 N

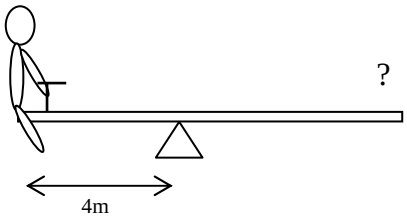
84.8 N = ma = 10a; a=8.48 m/s/s
vf^2 = v0^2 + 2as; 64 = 2*8.48*s; s = 3.77 m

12) Two blocks are tied together by a rope and rest on a frictionless, horizontal surface. The blocks are accelerated forward by a 20 N horizontal force. If the tension in the connecting rope is 12 N, and the acceleration of both blocks is 5 m/s^2, what are the masses of the two blocks?



ANSWER: Fnet = 20-12 = 8 N on front block = m(5 m/s/s); m-front = 1.6 kg
Fnet = 12 N on back block = m(5 m/s/s); m-back = 2.4 kg

13) The board of a see-saw has a mass of 20 kg and is 10 meters long. A small child of mass 40 kg sits on the near end of the board, and the board is pivoted 4 meters from the near end. Where should another child of mass 30 kg sit to balance the board? What is the amount of support force provided by the board's pivot?



ANSWER: Anti-clockwise torque = clockwise torque
400*4 = 200*1 + 300*x; x = 4 meters to the right of the fulcrum
The support force = 400 + 200 + 300 N = 900 N