

Monday Oct 17 Physics

1) Try This Word Problem in Class:

Marvin the marble starts from rest with an acceleration of  $3 \text{ m/s}^2$ . Sammy the sphere starts 2 m behind him with an acceleration of  $5 \text{ m/s}^2$ . How far does each travel before they collide?

**Marvin**  $V_i=0, A = 3, D=??, T=??$

$$D=ViT + 1/2AT^2 \quad D= 0 + \frac{1}{2}(3)T^2 \quad D=1.5T^2$$

**Sammy**  $V_i=0, A = 5, D_{sam}=??=D_{marv}+2, T=??$

$$D+2=ViT + 1/2AT^2 \quad D= 0 + \frac{1}{2}(5)T^2-2 \quad D=2.5T^2-2$$

**Sammy hits Marv in the same place (disp) at the same time so:**

$$\begin{array}{rcl} \text{Sammy} & = & \text{Marv} \\ 2.5T^2-2 & = & 1.5T^2 \\ 1T^2 & = & 2 \end{array}$$

$$T = 1.414 \text{ sec}$$

$$D = 1.5 (1.414)^2 = 3 \text{ meters (marv)}, D_{sam}=5 \text{ meters}$$

- 2) Go over any questions from pg 55, 58 (check answers)
- 3) Finish questions on and hand in Ramp Lab...
- 4) Wed/Thur Start Balls Collide (as part of Ramp Lab) so read ahead!
- 5) Homework, Word Problems on back (do on separate paper please)
- 6) Get yellow light project tomorrow/Thur

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Ball1 rolls down a 2m ramp in 3 seconds.

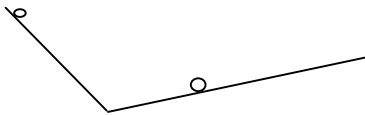
What is its initial velocity?  $V_i=0 \text{ m/s}$

What is its average velocity? (Eq 1 or 2)  $V_{avg}=D/T=2/3=.667 \text{ m/s}$

What is its final velocity? (Eq 1 or 2)  $V_{avg}=(v_i+v_f)/2 \quad .667 = (0+v_f)/2, V_f=1.333 \text{ m/s}$

What is its acceleration? (Eq 3 or 4)  $D=ViT + \frac{1}{2}AT^2 \quad 2=0+1/2A(3)^2, 2=4.5A, A=.4444 \text{ m/s}^2$

OR  $A=(1.333-0)/3=.444 \text{ m/s}^2$



Ball2 rolls down a shallower 2m ramp in 4 seconds.

What is its initial velocity?

$V_i=0 \text{ m/s}$

What is its average velocity?

(Eq 1 or 2)  $V_{avg}=D/T=2/4=.5 \text{ m/s}$

What is its final velocity? (Eq 1 or 2)  $V_{avg}=(v_i+v_f)/2 \quad .5 = (0+v_f)/2, V_f=1 \text{ m/s}$

What is its acceleration? (Eq 3 or 4)  $D=ViT + \frac{1}{2}AT^2 \quad 2=0+1/2A(4)^2, 2=8A, A=.25 \text{ m/s}^2$

OR  $A=(1-0)/4=.25 \text{ m/s}^2$

If I want Ball2 to collide into Ball1, what will be the same between them? **TIME**

Use the TIME of Ball1 and the ACCELERATION of Ball2 and find the Distance I have to place Ball2 at to make it crash into Ball2. **Time = 3 seconds,  $A=.25 \text{ m/s}^2, V_i=0 \text{ m/s}$   $D=????$**

**Eq 4,  $D= ViT+1/2AT^2 \quad D= 0+ \frac{1}{2}(.25)(3)^2 = 1.125 \text{ m to make ball2 collide with ball1}$**

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 A speeder passes a parked police car at a constant 30 m/s. The police car starts from rest with a uniform acceleration of 2.44 m/s<sup>2</sup>.

a) How much time passes before the speeder is overtaken by the police car?

**Speeder:**  $V_i=30, V_f=30, D=V_{avg}T \quad D=30T$   
 $or \ D=V_iT+1/2AT^2=20T+1/2(0)T^2=30T=D$   
**Police:**  $V_i=0, A=2.44, \quad D=V_iT+1/2AT^2=(0)T+\frac{1}{2}(2.44)T^2=1.22T^2$

**“overtaken” means same place (D) at same time (T) so**

$$\begin{array}{lcl} \text{speeder} & = & \text{police} \\ 30T & = & 1.22T^2 \end{array}$$

**one solution is  $T=0$ , but we know they are in the same place then!**

$$\begin{array}{lcl} 30 & = & 1.22T \\ T= & 30/1.22 = & 24.59 \text{ sec} \end{array}$$

b) How far does the speeder get before being overtaken by the police car?

$$D=30T = 30(24.59) = 737.7 \text{ meters}$$

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 I am 50 meters away from an intersection that is 10 m across going 20 m/s. I see the light turn yellow. My car can accelerate at the rate of 3 m/s<sup>2</sup>. What is the shortest time I can make it across the intersection?

$$V_i = 20 \text{ m/s}, D=50+10=60 \text{ meters}, A = 3$$

$$D = V_iT + 1/2AT^2$$

$$60 = 20T + 1/2(3)T^2$$

$$0 = 1.5T^2 + 20T - 60$$

**Using quadratic equation or math solver....**

$$T = 2.522 \text{ sec or } T = -15.86 \text{ so } T = 2.522 \text{ sec...}$$

4) I start off going 30 m/s and deaccelerate at the rate of -2 m/s<sup>2</sup>. How far do I have to travel before I stop?

$$V_i=30 \text{ m/s}, A = -2 \text{ m/s}^2, V_f=0 \quad D=???$$

$$V_f^2 = V_i^2 + 2AD$$

$$0 = (30)^2 + 2(-2)D$$

$$-900 = -4D$$

$$D = 225 \text{ m}$$

\*\*\*\* (H) When will I be 35 m from the start?

$$V_i = 50 \text{ m/s}, D=35 \text{ meters}, A = -2$$

$$D = V_iT + 1/2AT^2$$

$$35 = 50T + 1/2(-2)T^2$$

$$0 = -1T^2 + 50T - 35 \text{ or } 0 = T^2 - 50T + 35$$

**Using quadratic equation or math solver....**

$$T = 49.28 \text{ sec or } T = .71 \text{ both are correct (once going and once in the reverse direction!)}$$

\*\*\*\*(H) One car (Frank) starts 4 meters ahead of another (Bob) . They both accelerate at the rate of  $3 \text{ m/s}^2$ . If car one (Frank) stops accelerating after 4 meters, when will car two (Bob) catch up to him?

**Bob:**  $D_i=0, V_i=0, A=3 \quad D = V_i T + 1/2 A T^2 = (0)T + 1/2 (3)T^2 = 1.5T^2$

**Frank**  $D_i=4, V_i=0, A=3, D_f=8$  for the first part of the journey

$V_f^2 = V_i^2 + 2 A D = 2 (3)(4), V_f = 4.899 \text{ m/s}$  at the end of the first part

$8-4=4 = D = V_i T + 1/2 A T^2 = (0)T + 1/2 (3)T^2$  so  $4=1.5T^2, T=1.633$  for the first part to go 4 meters (8 meters from the start)

for the second part of the journey, Frank went  $4.899 \text{ m/s}$  for  $(T-1.633)$  seconds, so  $D = V_{avg} T = 8.9 (T-1.633)$  for the second part.

So Frank's total displacement (after he stops accelerating) is

$D = 4 \text{ (start)} + 4 \text{ (first part)} + 4.899 (T-1.633) \text{ (even speed)}$

Bob "catch up" to Frank in same place at same time:

<b>Bob</b>	=	<b>Frank</b>
$1.5T^2$	=	$4+4+ 4.899 (T-1.633)$
$0$	=	$1.5T^2 - 4.899 T -4.899(-1.633)-8$
$0$	=	$1.5T^2 - 4.899 T -4.899(-1.633)-8$
$0$	=	$1.5T^2 - 4.899 T \quad +8-8$
$0$	=	$1.5T^2 - 4.899 T \quad +0$

$T = 3.266 \text{ sec}$