SPH4U0-Feb. 2016 **Kinematics Review Quest** Name:________________ Total: ____/46 marks [K/U]

Useful Equations and Constants:

Equations: **Constants: g = 9.80 m/s² [down]**

$$v_{av} = \frac{\Delta d}{\Delta t} \qquad \vec{v}_{av} = \frac{\Delta \vec{d}}{\Delta t} \qquad \Delta\vec{d} = \vec{d}_2 - \vec{d}_1 \qquad \Delta\vec{d}_T = \Delta\vec{d}_1 + \Delta\vec{d}_2 + \Delta\vec{d}_3$$

$$\vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} \qquad \Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2 \qquad \Delta\vec{d} = \vec{v}_2\Delta t - \frac{1}{2}\vec{a}\Delta t^2 \qquad \Delta\vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2}\Delta t$$

$$\Delta\vec{d} = \frac{\vec{v}_2^{\,2} - \vec{v}_1^{\,2}}{2\vec{a}}$$

Math: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Part A: Multiple Choice Answers [10 marks]:

Write the letter representing the best answer for each question in the table below:

1	2	3	4	5	6	7	8	9	10
E	C	A	B	D	E	A	D	E	C

Part B: Short Answer and Problem Solving [27 marks + 1 mark Sig Digs = 28 marks]:

1. The Bramalea Road city bus travels 12.0 km [North] and then turns around and travels 3.0 km [South] when the driver stops for a break. If the entire trip took 35.0 minutes, calculate the average velocity and average speed for the trip. Explain the differences between the two quantities. [4]

$\Delta\vec{d}_1 = 12.0\text{ km [N]}$

$\Delta\vec{d}_2 = 3.0\text{ km [S]}$

$\Delta t = 35.0\text{ min}$

$v_{av} = ?$ $\vec{v}_{av} = ?$

$\Delta\vec{d}_R = \Delta\vec{d}_1 + \Delta\vec{d}_2$ N = +

$= 12.0\text{ km} - 3.0\text{ km}$

$= 9.0\text{ km [N]}$

$\Delta d_T = \Delta d_1 + \Delta d_2$

$= 12.0\text{ km} + 3.0\text{ km}$

$= 15.0\text{ km}$

$\vec{v}_{av} = \frac{\Delta\vec{d}_R}{\Delta t} = \frac{9.0\text{ km [N]}}{35.0\text{ min}}$

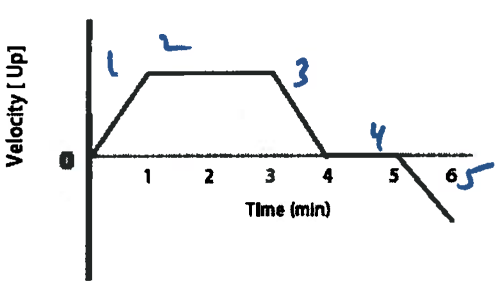
$= 0.26\ \frac{\text{km}}{\text{min}}\text{ [N]}$

$v_{av} = \frac{\Delta d_T}{\Delta t} = \frac{15.0\text{ km}}{35.0\text{ min}}$

$= 0.43\text{ km/min}$

∴ the magnitude of the average velocity is smaller as it includes direction and the bus back-tracked

2. A velocity-time graph for an elevator in a high rise building is shown below. Describe the nature of the elevator's motion over each distinct segment. [3]



1 - moving up, speeding up uniformly

2 - moving at constant velocity up

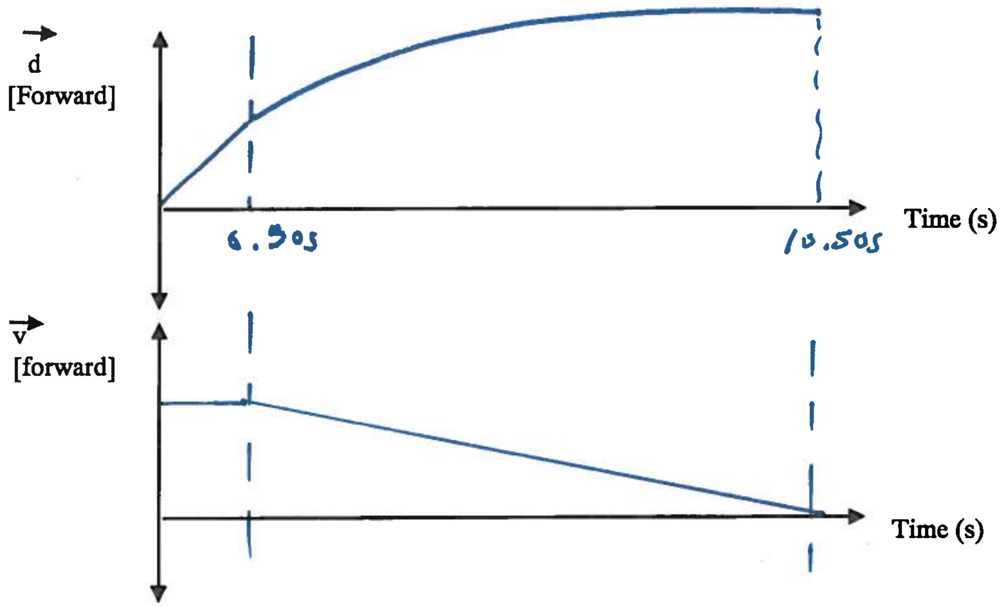
3 - moving up, slowing down, uniformly

4 - at rest

5 - moving down, speeding up uniformly

3. A car, travelling along Bovaird road, is travelling at constant velocity of 15.0 m/s [Forward] when the driver sees a stalled truck up ahead. It takes the driver 0.50 s to react before she applies the brakes. She then accelerates uniformly to rest in 10.0 seconds.

a)Sketch the velocity-time and position-time graphs for the car's motion from the time the driver first sees the stalled truck. (The graphs do not need to be drawn to scale but the time axis for the two graphs should correspond). [3]



b) Determine the displacement of the car from the time the driver sees the stalled truck until the time the car comes to a stop. [5]

$\Delta \vec{d}_R = ?$ Let F = +

$\Delta \vec{d}_1 = ?$ $\Delta t_1 = 0.50s$

$\Delta \vec{d}_2 = ?$ $V_1 = 15.0 m/s [F]$

$\Delta t_2 = 10.0 s$

$\vec{a} = ?$

$V_2 = 0$

$\vec{a} = \frac{V_2 - V_1}{\Delta t_2} = \frac{0 - 15.0 m/s}{10.0 s}$

$= -1.5 m/s^2$

$\Delta \vec{d}_R = \Delta \vec{d}_1 + \Delta \vec{d}_2$

$= V_1 \cdot \Delta t_1 + \left(V_1 \Delta t_2 + \frac{1}{2} a \Delta t_2^2\right)$

$= (15.0)(0.50s) + (15.0 m/s)(10.0s) + \frac{1}{2}(-1.5 m/s^2)(10.0s)^2$

$= 7.5 m + 150.0 m + (-75.0 m)$

$= 82.5 m [F]$

4. Paramvir and Izhan are playing an arcade game which involves sliding pucks up an inclined ramp to reach a target. Paramvir fires his puck up the ramp with an initial velocity of 3.50 m/s [up the ramp]. The puck slows down with an acceleration of 1.25 m/s² [down the ramp]. Find:

a) The displacement of the puck along the ramp before it comes to a stop. [3]

b) The time for the puck to travel up the ramp. [3]

up = +

$V_1 = 3.50\,m/s$ [up]

$\Delta\vec{d} = ?$

$V_2 = 0.0\,m/s$

$\vec{a} = 1.25\,m/s^2$ [down]

$\Delta t =$

$$\Delta\vec{d} = \frac{v_2^2 - v_1^2}{2a} = \frac{0-(3.50\,m/s)^2}{2(-1.25\,m/s^2)} = 4.90\,m \text{ [up]}$$

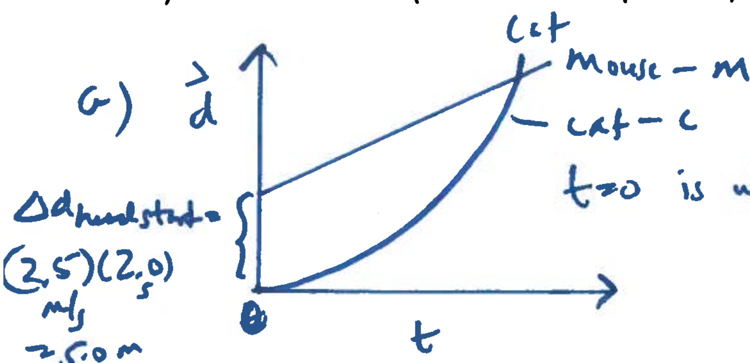
$$\Delta t = \frac{v_2 - v_1}{\cancel{2}a} = \frac{0-3.50\,m/s}{\cancel{2}(-1.25\,m/s^2)} = \cancel{1.40}\ 2.80\,s$$

5. Molly (aka the Mollinator) is Ms. Ryan's younger cat and she is an expert mouse hunter! Molly is resting in the sun when a mouse suddenly runs by at a velocity of 2.5 m/s [F]. Molly watches the mouse for 2.0 seconds and then begins to chase after the mouse, accelerating uniformly at 0.50 m/s² [Forward]. She eventually catches the mouse!

a) Draw a position time graph representing the motions of the mouse and Molly. Label each curve and explain in words the time point that you are considering to be 0.0s. [2]

b) Find the distance (from her initial position) at which Molly catches the mouse. [4]

a)



t=0 is when Molly starts running.

$\Delta d = 5 + 2.5(11.7) = 34.3\,m$

$(2.5\,m/s)(2.0\,s) = 5.0\,m$

$V_m = 2.5\,m/s$ [F]

$\vec{a}_c = 0.50\,m/s^2$ [F]

$\vec{V}_{c_1} = 0.0\,m/s$

$\Delta d_m = 5.0\,m + V_m \cdot \Delta t$

$\Delta d_c = V_1 \cancel{\Delta t}^{\,0} + \frac{1}{2} a_c \Delta t^2 = \frac{1}{2} a_c \Delta t^2$

$\therefore \frac{1}{2}(0.50\,m/s^2)(\Delta t^2) = 5.0\,m + 2.5\,\Delta t$

$0 = 0.\cancel{75}^{25}\,m/s^2\,\Delta t^2 - 2.5\,m/s\,(\Delta t) - 5.0\,m = 0$

$a = 0.\cancel{75}\,0.25\,m/s^2 \quad b = -2.5\,m/s \quad c = -5.0$

$$\Delta t = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{2.5 \pm \sqrt{6.25 - 4(0.25)(-5.0)}}{\cancel{1.50}\ 0.50}$$

$= (2.5 + 3.35)/ \ldots$ -1.70 11.75 or 3.90

____/ 1 mark
[Sig digs]

Part C: Graph Analysis [8 marks]

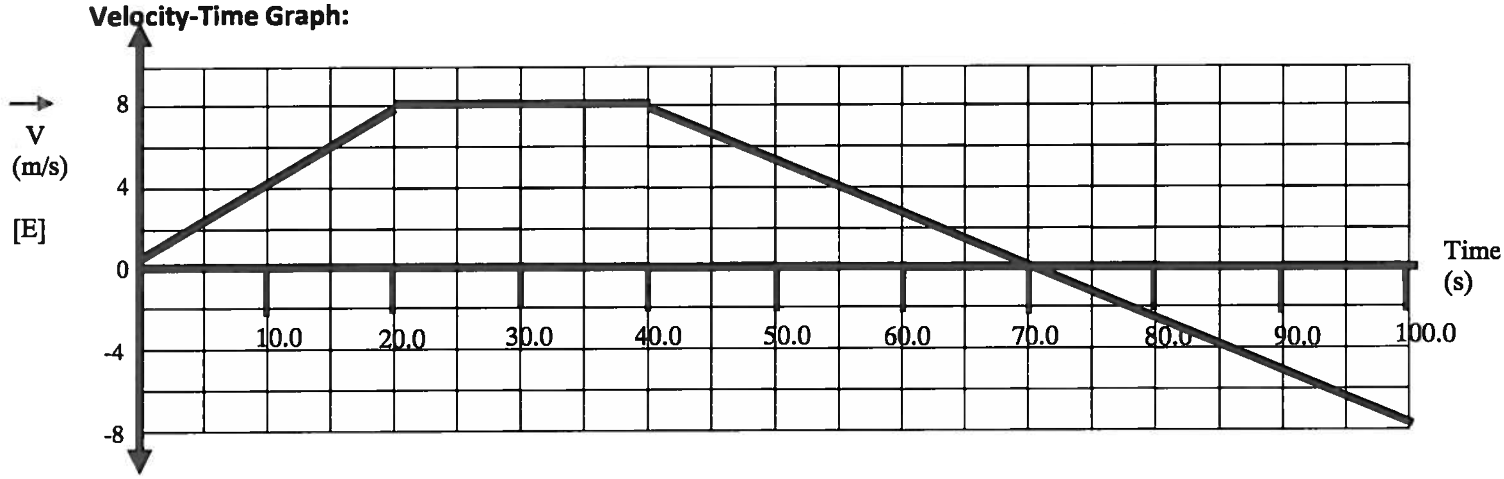
1. The motion of a train engine moving along a straight track in a rail yard is shown on the velocity-time graph below.

i) Draw the acceleration-time graph for the train. [3]

ii) **Assuming that the train starts at the station (origin)**, draw the corresponding position-time graph. [5]

Position-Time Graph:

Velocity-Time Graph:



Acceleration-Time Graph: