Mathematics 414 CST ***Meteor Interception***

You have been hired by NASA to test a new anti-meteorite plasma cannon. It shoots plasma bolts in a straight line. The path of the plasma bolt and the path of the meteorite are each defined by functions where the variables are:

x : time elapsed (in seconds)

y : height (hectometres)

You have already done three test simulations as shown below. In each situation, the path of the plasma bolt is defined by a different linear function.

Please note that drawings are not to scale.

Simulation 1

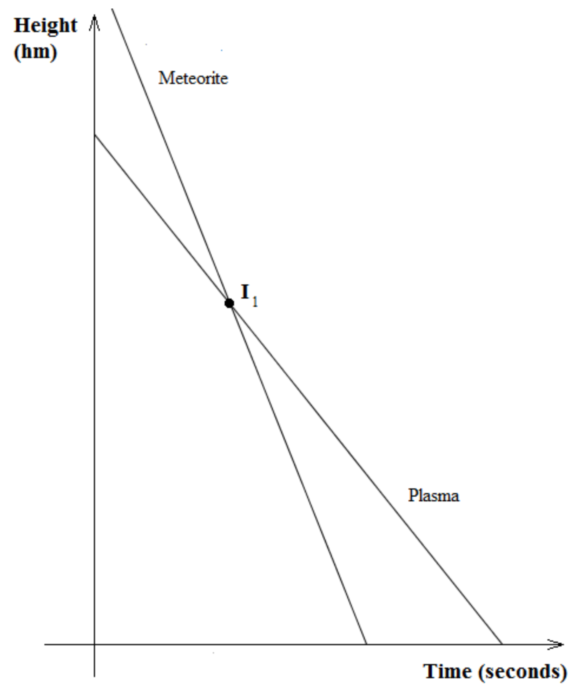
In the first simulation, the rules for the plasma and the meteorites are as follows:

Meteorite: $y = -2.5x + 60$

Plasma bolt: $y = -1.25x + 45$

The plasma bolt intersects the meteorite at point I_1

(**Hint:** Solve the system of equations by comparison)



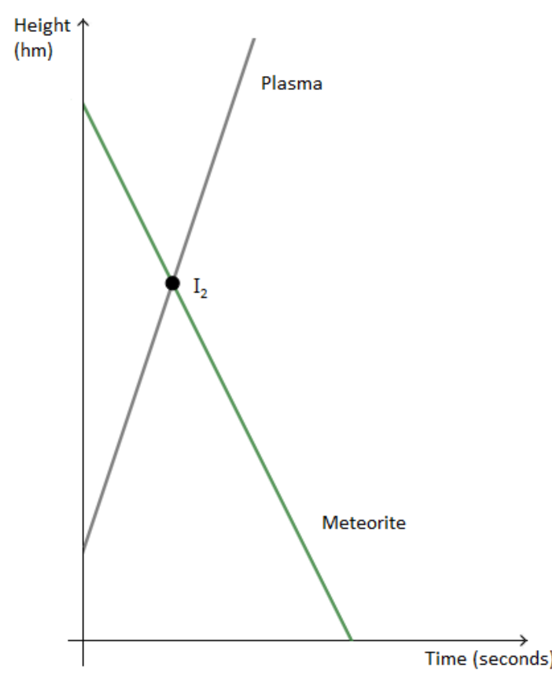
Simulation 2

In the second simulation, the rules for the plasma and the meteorites are as follows:

Meteorite: $y = -2x + 96$

Plasma bolt: $y = 3x + 16$

The plasma bolt intersects the meteorite at point I_2.



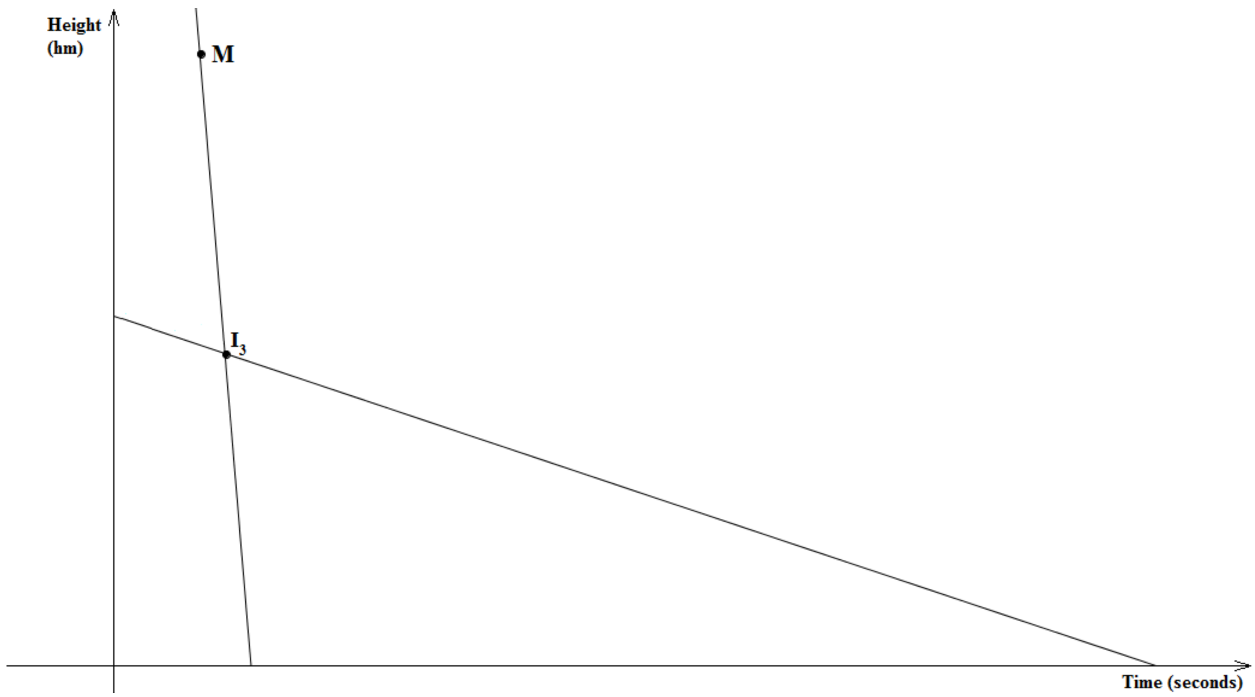
Simulation 3

In the third simulation, the path of the meteorite is a linear function. At 14 seconds, it is at a height of 98 hectometres (point **M = (14, 98)**). Also the rate of change/slope of the line (**a**) is **-12**. (**Hint**: Find y = **a**x+b)

The plasma bolt also follows the rule of a linear function. Its rule is:

$$y = -0.33x + 56$$

The plasma bolt intersects the meteorite at point I_3.



Final Simulation

In the final simulation, the meteorite follows the path of a quadratic function with rule: $y = -2x + 112$

The plasma cannon will shoot a plasma bolt with the rule: $y = \boldsymbol{a}x$ where ***a* is a positive whole number**

NASA has decided to add extra criteria for the intersection of the final meteorite:

- They took the average of the intersection times of the first three simulations. They require that the final intersection of plasma bolt and meteorite take place **later** than that average.

- They also took the average intersection heights of the first three simulations. They require that the final intersection of plasma bolt and meteorite take place at a height that is **higher** than that average.

Your task is to determine a possible value for the *a* parameter of the rule of the plasma bolt in the final simulation that respects the criteria set by NASA. Good luck!

Answer Key

I_1: (12, 30)

I_2: (16, 64)

I_3: (18, 50)

Final simulation

- The average of the intersection times is $15.\overline{3}$ and the average of the intersection heights is 48. Therefore, the final intersection point, I_4, must have an **x value greater than $15.\overline{3}$** and a **y value greater than 48**.
- This next part involves some trial and error: Since **parameter a** needs to be a positive whole number, you can start by selecting a value for **parameter a**. Once you have a value for **parameter a**, you have the rule of the linear function. You can then find the intersection point using **systems of equations (comparison)**. Make sure the x and y coordinates respect the restrictions stated above. There are many possible solutions, but you only need to find one that works.

Possible Answers

Value of parameter a	**Linear function**	**Intersection point**	**Valid solution?**
a=1	y=x	I_4(37.33, 37.33)	No: height is too low
a=2	y=2x	I_4(28, 56)	Yes
a=3	y=3x	I_4(22.4, 67.2))	Yes
a=4	y=4x	I_4(18.67, 74.67)	Yes
a=5	y=5x	I_4(16, 80)	Yes
a=6	Y=6x	I_4(14, 84)	No, time is too low