Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

A student investigates the motion of a trolley along a horizontal runway.

Figure 6 shows the apparatus.

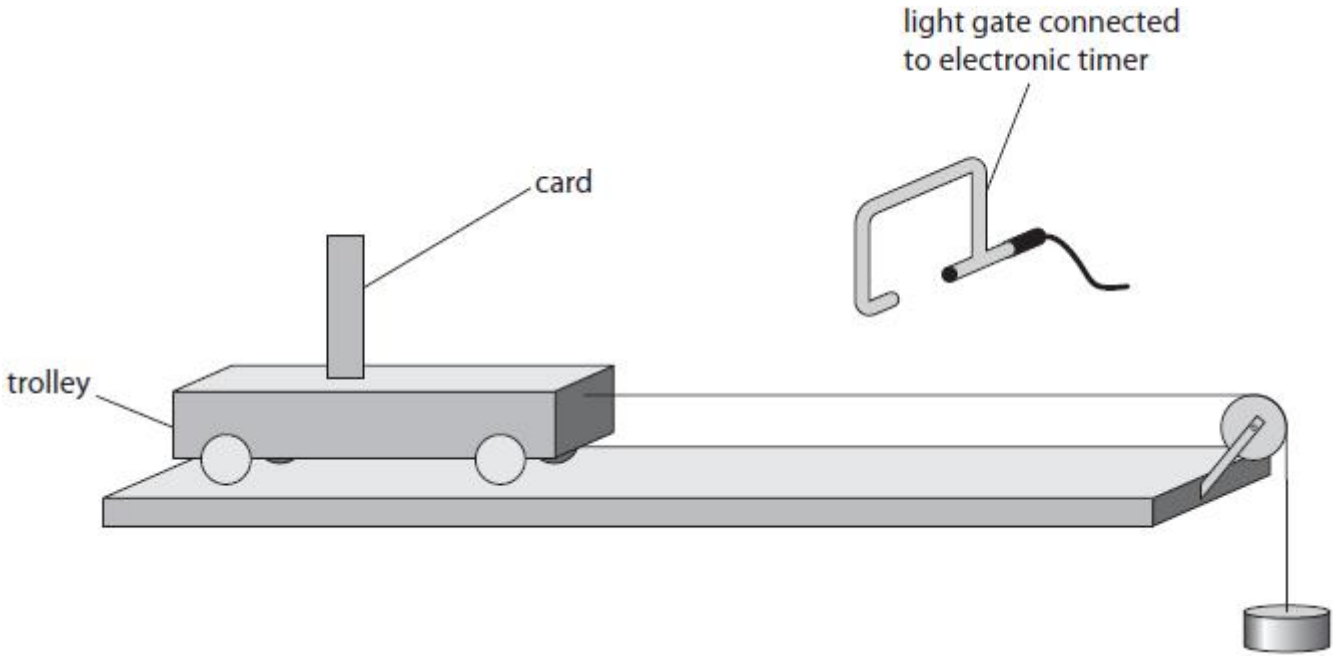

Figure 6

The trolley is attached to a string passing over a pulley.

A 100 g metal disc hangs on the end of the string.

The light gate measures the time it takes for the card to pass through it.

When the trolley is released, it accelerates along the track.

The student repeats the process several times by adding extra 100 g metal discs.

Figure 7 shows a graph of the results.

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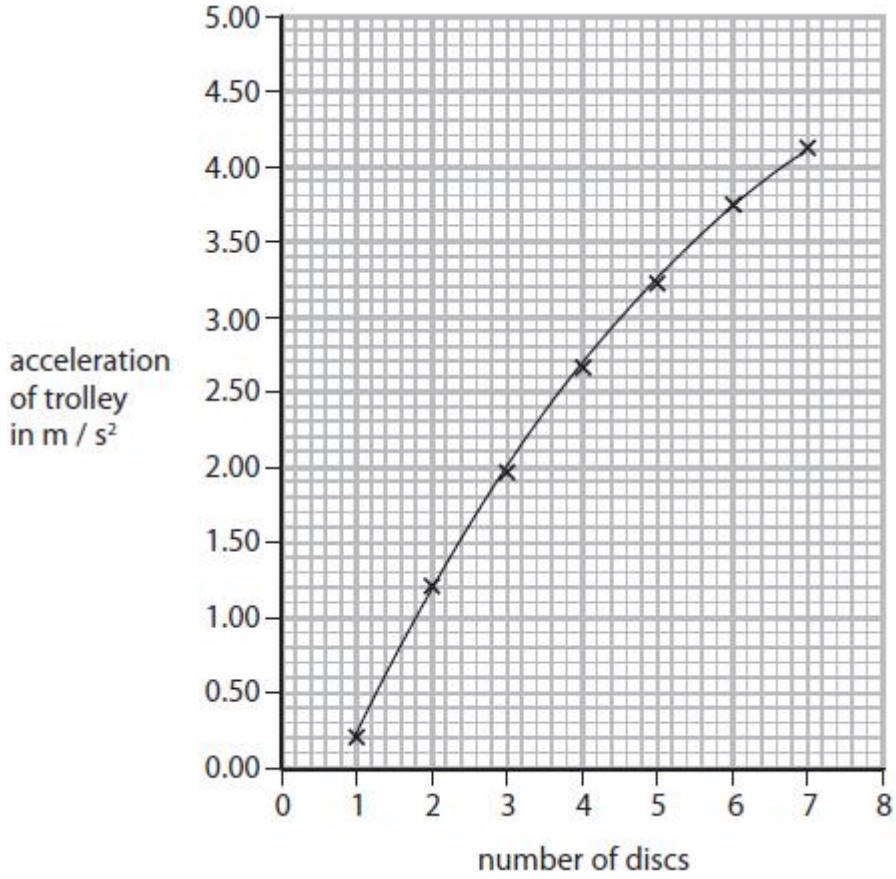

Figure 7

(i) Predict the acceleration if discs with a total mass of 800 g are used.

(1)

acceleration = ... m/s^2

(ii) There are frictional forces in the system.

Identify a feature of the graph that shows there are frictional forces in the system.

(1)

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(iii) Explain how the investigation could be developed to remove the effects of friction.

(2)

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(Total for question = 4 marks)

Q2.

Andrew skis down a hill.

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(a) Andrew starts from the top of the hill and his speed increases as he goes downhill.

He controls his speed and direction by using his skis.

He brings himself to a stop at the bottom of the hill.

Describe the energy changes that happen between starting and stopping.

(3)

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(b) Andrew returns to the top of the hill and starts again.

(i) His mass is 67 kg.

Show that his momentum is about 2000 kg m/s when his velocity is 31 m/s.

(2)

(ii) He falls over when his momentum is 2000 kg m/s.

After he falls over, he slows down by sliding across the snow.
It takes 2.3 s for his momentum to reduce to zero.
Calculate the average force on Andrew as he slows down.

(2)

.....

(iii) Andrew is not injured by the fall even though he was moving quickly.

Use ideas about force and momentum to explain why he is not injured.

(2)

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(Total for Question is 9 marks)

Q3.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

Figure 7 shows a ball being rotated in a horizontal circle.

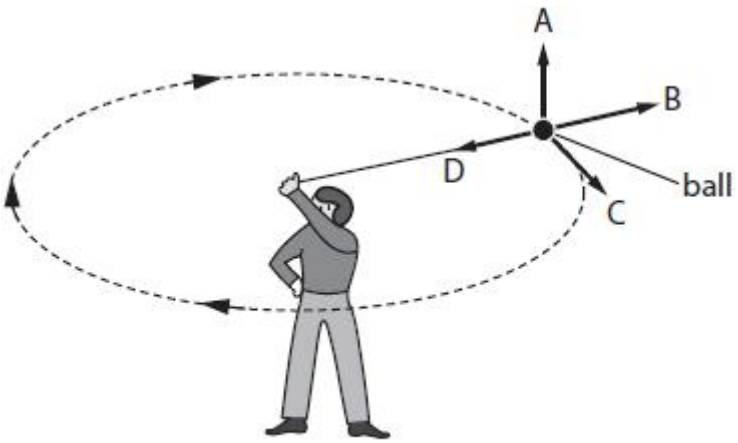

Figure 7

(i) Which arrow in Figure 7 shows the direction of the centripetal force on the ball?

(1)

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

(ii) The ball is moving at constant speed. Give **one** reason why the velocity of the ball is continuously changing.

(1)

.....

.....

(Total for question = 2 marks)

Q4.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Figure 9 is a diagram showing a rocket that is sent into space to try and change the path of a small asteroid.

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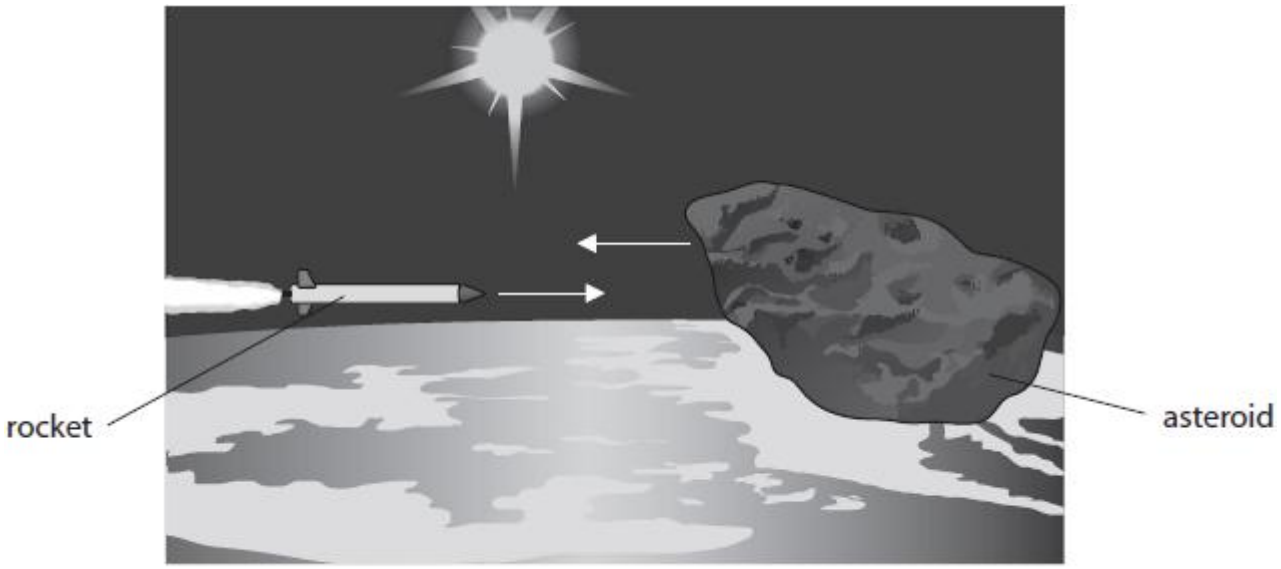

Figure 9

(i) The rocket has a mass of 5.5×10^5 kg and is travelling to the right at 14 km / s.

Which of these is a correct calculation of the momentum of the rocket in kg m / s?
Use the equation

$$p = m \times v$$

(1)

- ☒ **A** 7.7×10^3 kg m / s
- ☒ **B** 7.7×10^6 kg m / s
- ☒ **C** 7.7×10^9 kg m / s
- ☒ **D** 7.7×10^{12} kg m / s

(ii) The asteroid has a momentum of 7.5×10^{10} kg m / s and a mass of 8.0×10^6 kg.

Calculate the speed of the asteroid.

(2)

speed of the asteroid = ... m / s

(Total for question = 3 marks)

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