1 A student investigates how the average speed of the trolley varies with starting height.

Figure 9 shows the trolley and runway.

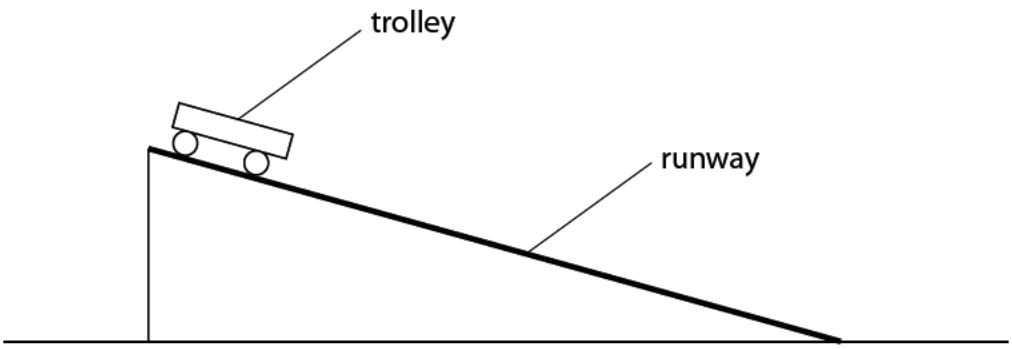


Figure 9

(a) Describe how the student can determine the average speed of the trolley.

(4)

(b) Figure 10 shows his results.

starting height / m	v / ms^{-1}
0.01	0.22
0.02	0.31
0.04	0.44
0.09	0.66
0.12	0.77
0.14	0.83
0.18	0.94

Figure 10

Figure 11 shows the student's graph.

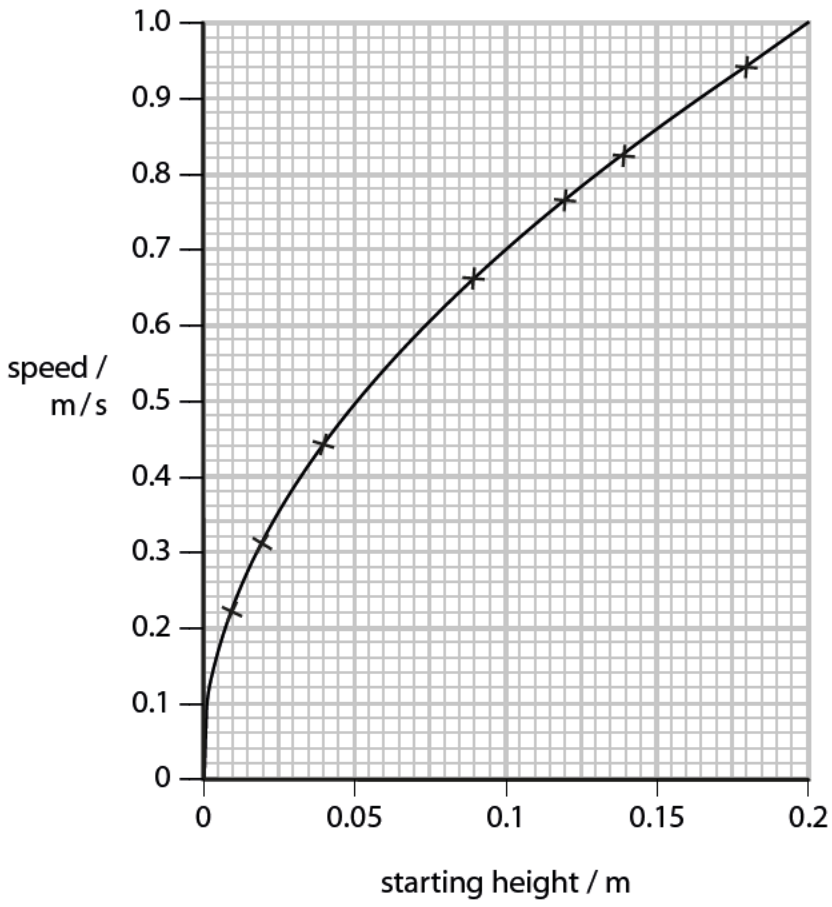


Figure 11

(i) The trolley h

Calculate the average kinetic energy of the trolley which had a starting height of 0.075 m.

(2)

average kinetic energy= ..... J

(ii) Determine the gradient of the graph when the height is 0.1 m.

(2)

gradient = ...

(iii) Describe how the speed of the trolley varies with the changes in height made by the student between 0.04 m and 0.12 m.

(2)

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(c) The student wants to change his experiment to investigate how different surfaces of the runway affect the speed of the trolley down the slope.

Devise an experiment that would allow him to investigate the effect of different surfaces on the average speed of the trolley.

(3)

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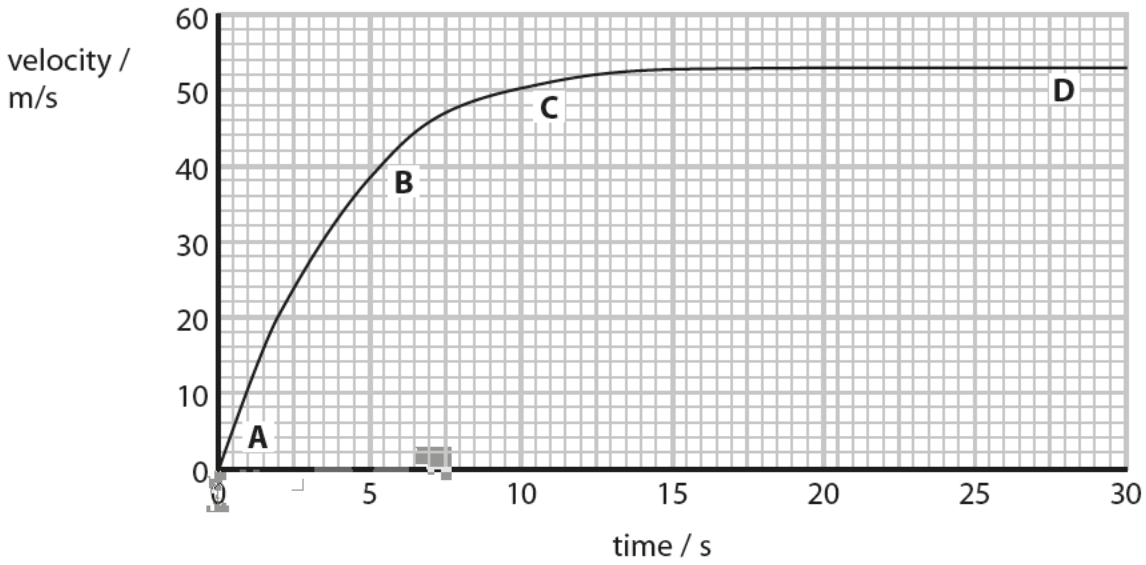
(Total for Question = 13 marks)

Parachuting

2 Christine is a free-fall parachutist.



This is a velocity–time graph for her jump.



(a) Complete the sentence by putting a cross (☒) in a box next to your answer.

On the graph, the greatest acceleration is at

(1)

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

(b) Estimate how far Christine falls in the first 2 s.

(3)

Christine falls = ... m

(c) Explain the difference between velocity and speed.

(2)

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*(d) The graph shows how Christine's velocity changes from the time she leaves the plane until she reaches terminal velocity.

Explain, in terms of forces, why her velocity changes as shown in the graph.

(6)

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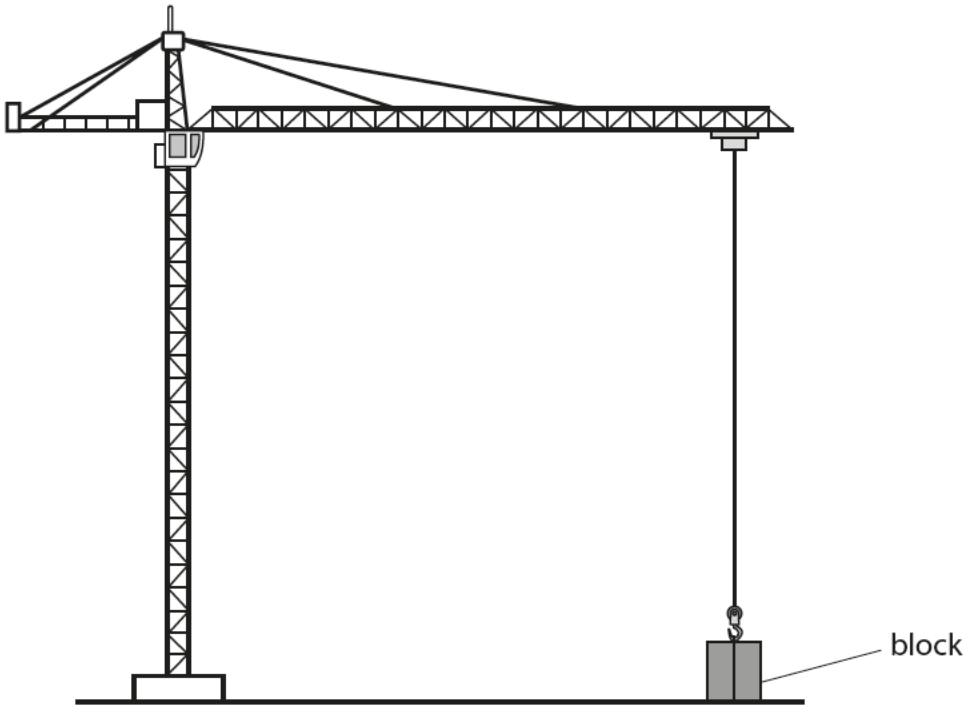
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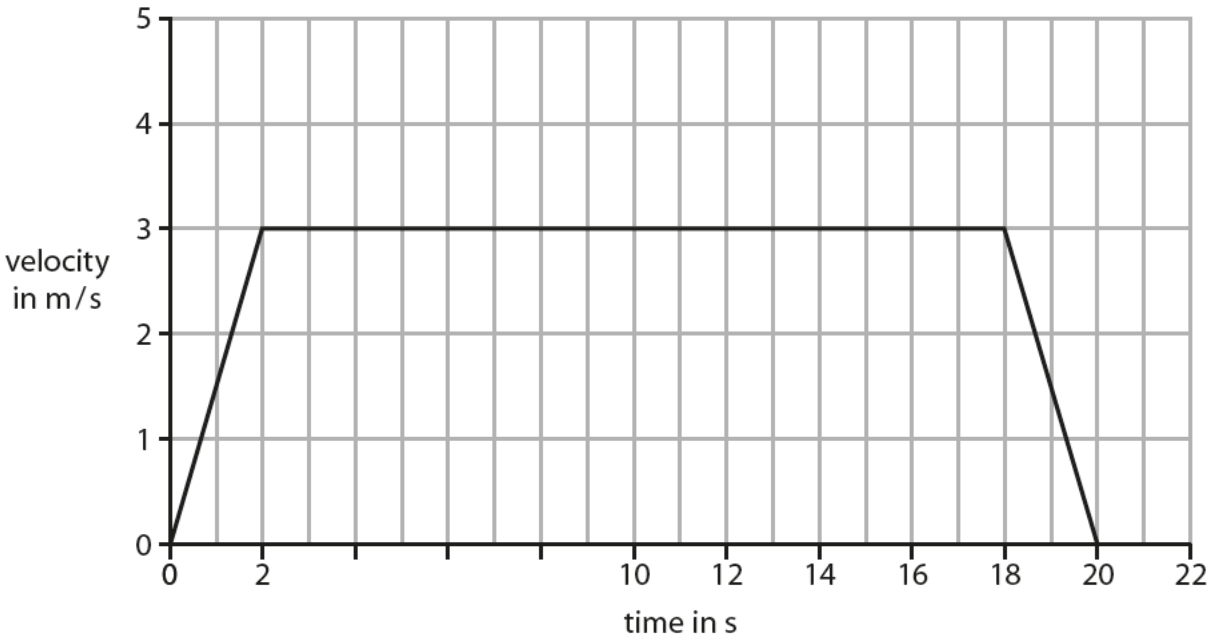
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(Total for Question = 12 marks)

3 (a) A crane is lifting a heavy block from the ground to the top of a building.



This is the velocity/time graph for the block as it travels upwards.

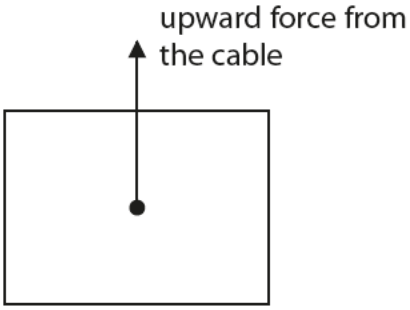


(i) For how many seconds is the block moving at a constant velocity?

(1)

number of seconds = ...

This diagram shows one of the forces acting on the block.



(ii) Draw an arrow on the diagram to represent the weight of the block.

(1)

(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

When the block is moving upwards at a constant velocity, the resultant force on the block is

(1)

☒ **A** upwards and equal to its weight

☒ **B** downwards and equal to its weight

☒ **C** upwards and more than its weight

☒ **D** zero

(iv) Use the velocity/time graph to calculate the acceleration of the block during the first 2 s.
State the unit.

(3)

acceleration = ... unit .....

(v) Explain why the upward force from the cable during the first 2 s is greater than the upward force for the next 4 s.

(2)

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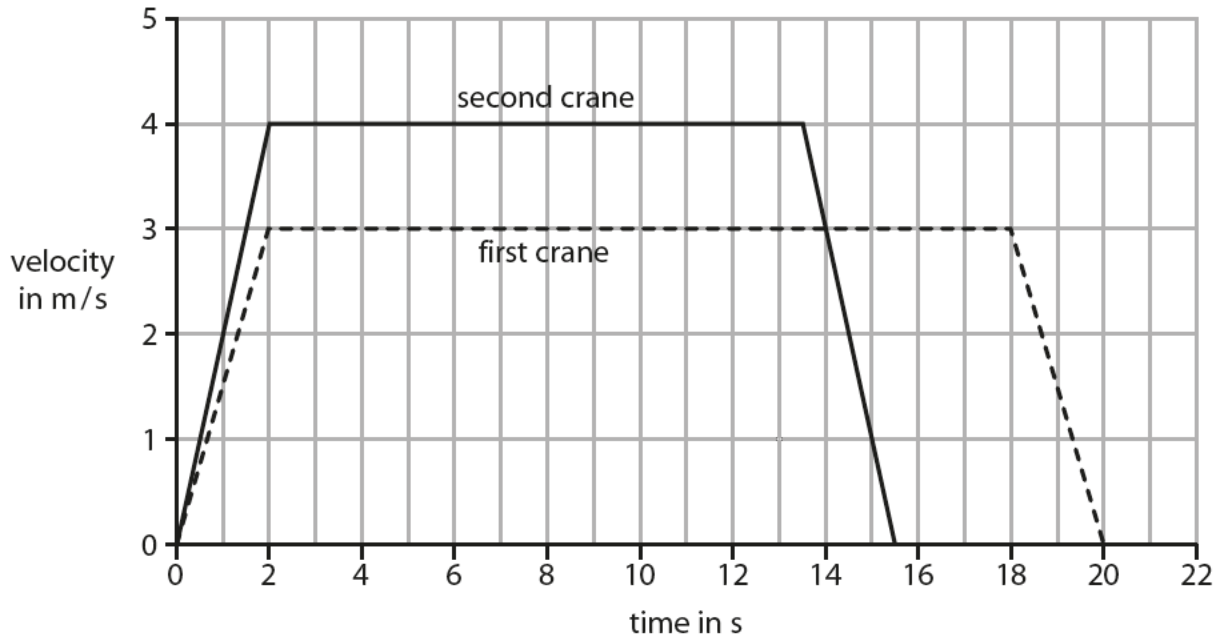
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(b) A second crane lifts an identical block to the same height.

This is the velocity/time graph for the second crane.

The graph for the first crane is shown as a dotted line.



The second crane has a larger power than the first crane.

Explain how the graph shows that the second crane has the larger power.

(2)

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(Total for Question = 10 marks)