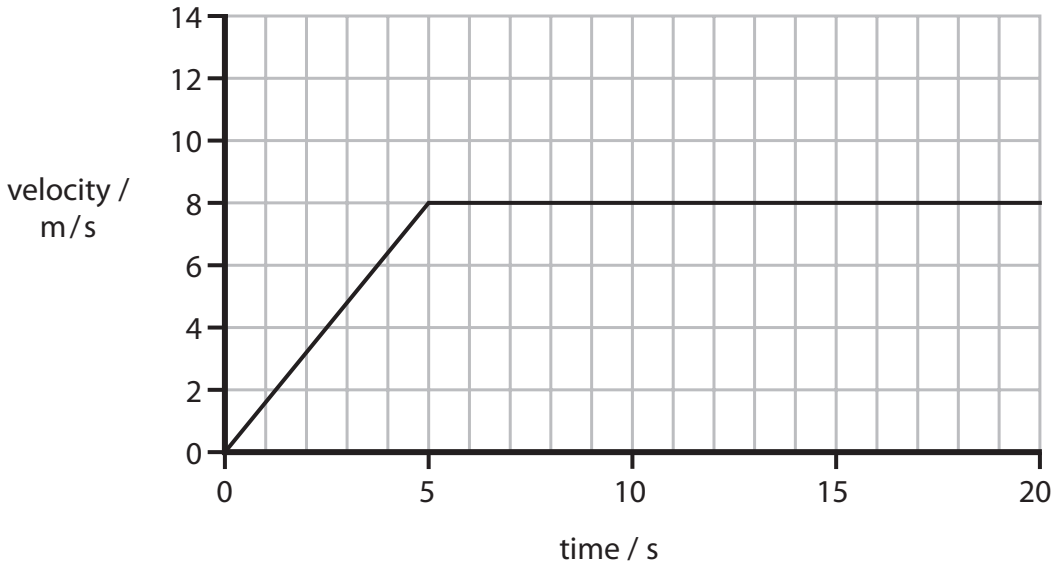
1 (a) Here is the velocity-time graph for a car for the first 20 s of a journey.



(i) Calculate the change in velocity of the car during the first 5 s.

(1)

change in velocity = ... m/s

(ii) Calculate the acceleration of the car during the first 5 s.

(2)

acceleration = ... m/s^2

(iii) State the size of the resultant force between 10 s and 15 s

(1)

resultant force = ... N

(b) The mass of a c

Calculate the resultant force on the car required to produce an acceleration of 0.8 m/s^2.

(2)

resultant force = ... N

*(c) A car, travelling at 20 m/s, with just the driver inside takes 70 m to stop in an emergency.
The same car is then fully loaded with luggage and passengers as well as the driver.

Explain why it will take a different distance to stop in an emergency from the same speed.

(6)

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(Total for Question 5 = 12 marks)

Going downhill

2 Andrew skis down a hill.

(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)

(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)

force = ... N

(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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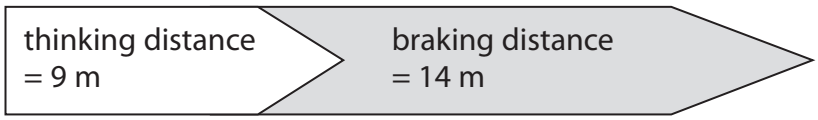
(Total for Question 2 = 9 marks)

Speed and safety

3 The Highway Code gives this information about the stopping distance of a car.

speed = 30 miles per hour



(a) (i) What is the stopping distance?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** 5 m

☒ **B** 9 m

☒ **C** 14 m

☒ **D** 23 m

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

The driver's **thinking** distance is most likely to increase when

(1)

☒ **A** the driver is tired

☒ **B** there is ice on the road

☒ **C** the car is heavier

☒ **D** the car moves at a slower speed

(b) A car has a mass of 800 kg.
It has a velocity of 3.0 m/s.

Calculate the momentum of the car.

(2)

momentum of car = ... kg m/s

(c) (i) The braking force on another car is 600 N.
The force acts for a distance of 15 m.

Calculate the work done by the braking force.

(2)

work done by braking force = ... J

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

The work done by the brakes during braking is equal to

(1)

☒ **A** the energy transferred

☒ **B** the stopping distance

☒ **C** the acceleration

☒ **D** the thinking distance plus braking distance

(Total for Question 1 = 7 marks)