Forces Questions 2

35 Questions

Name: _____

Class: _____

Date: _____

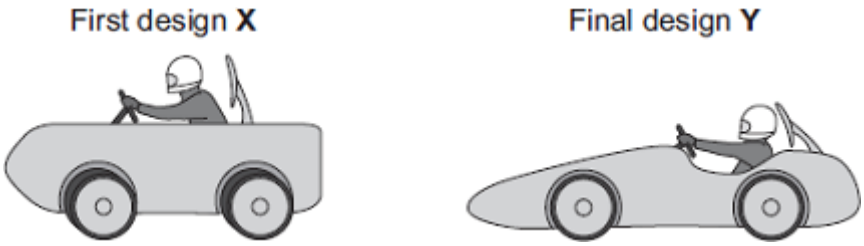
Time:

Marks:

Comments:

Q1.

(a) Some students have designed and built an electric-powered go-kart. After testing, the students decided to make changes to the design of their go-kart.



The go-kart always had the same mass and used the same motor.

The change in shape from the first design (**X**) to the final design (**Y**) will affect the top speed of the go-kart.

Explain why.

_____

_____

_____

_____

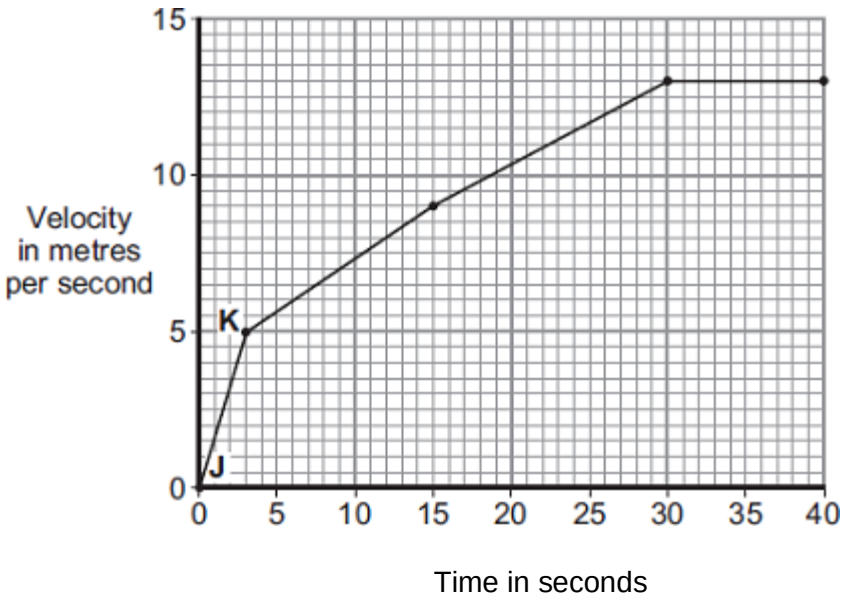
_____

_____

(3)

(b) The final design go-kart, **Y**, is entered into a race.

The graph shows how the velocity of the go-kart changes during the first 40 seconds of the race.



(i) Use the graph to calculate the acceleration of the go-kart between points **J** and **K**.

Give your answer to **two** significant figures.

_____

_____

_____

Acceleration = _____ m/s^2

(2)

(ii) Use the graph to calculate the distance the go-kart travels between points **J** and **K**.

_____

_____

_____

Distance = _____ m

(2)

(iii) What causes most of the resistive forces acting on the go-kart?

_____

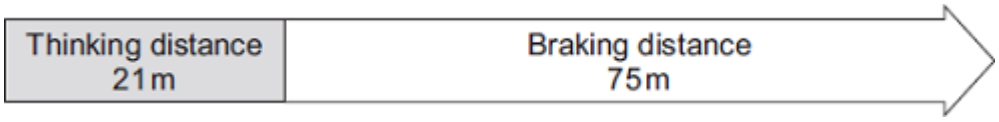
(1)

(Total 8 marks)

Q2.

(a) A car driver makes an emergency stop.

The chart shows the 'thinking distance' and the 'braking distance' needed to stop the car.



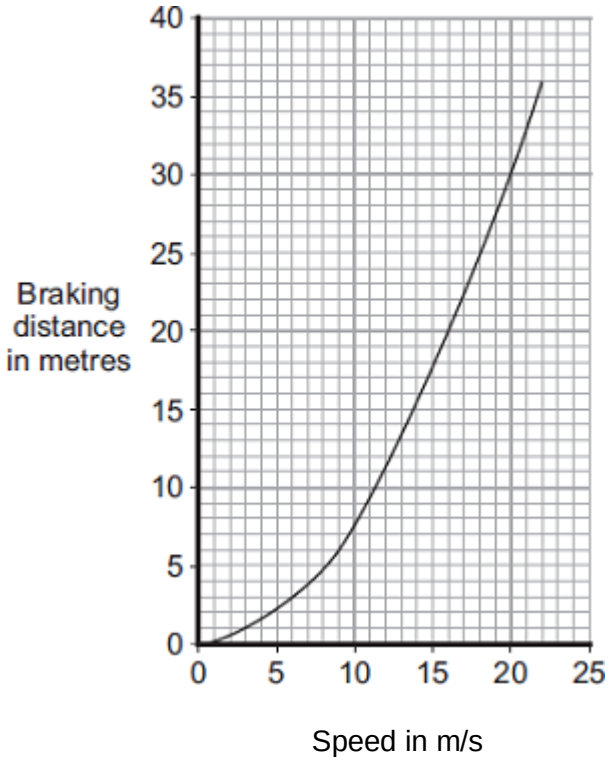
Calculate the total stopping distance of the car.

_____

Stopping distance = _____ m

(1)

(b) The graph shows how the braking distance of a car driven on a dry road changes with the car's speed.



The braking distance of the car on an icy road is longer than the braking distance of the car on a dry road.

(i) Draw a new line on the graph to show how the braking distance of the car on an icy road changes with speed.

(2)

(ii) Which **one** of the following would also increase the braking distance of the car?

Put a tick (✓) in the box next to your answer.

Rain on the road ☐

The driver having drunk alcohol ☐

The driver having taken drugs ☐

(1)

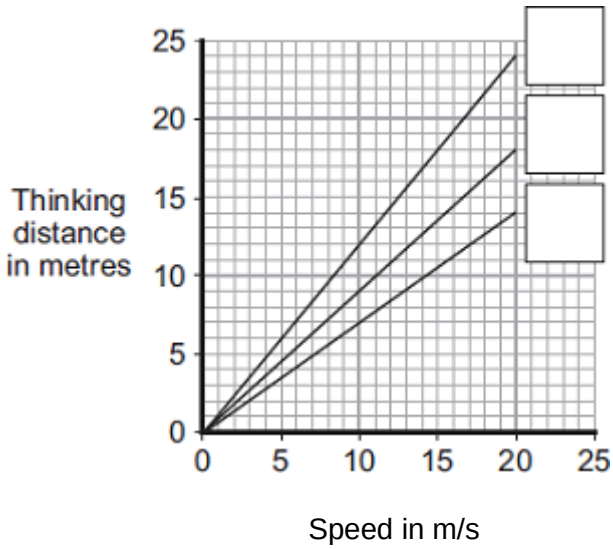
(c) The thinking distance depends on the driver's reaction time.

The table shows the reaction times of three people driving under different conditions.

Car driver	**Condition**	**Reaction time in second**

A	Wide awake with no distractions	0.7
B	Using a hands-free mobile phone	0.9
C	Very tired and listening to music	1.2

The graph lines show how the thinking distance for the three drivers, **A**, **B**, and **C**, depends on how fast they are driving the car.



(i) Match each graph line to the correct driver by writing **A**, **B**, or **C** in the box next to the correct line.

(2)

(ii) The information in the table cannot be used to tell if driver **C**'s reaction time is increased by being tired **or** by listening to music.
Explain why.

_____

_____

_____

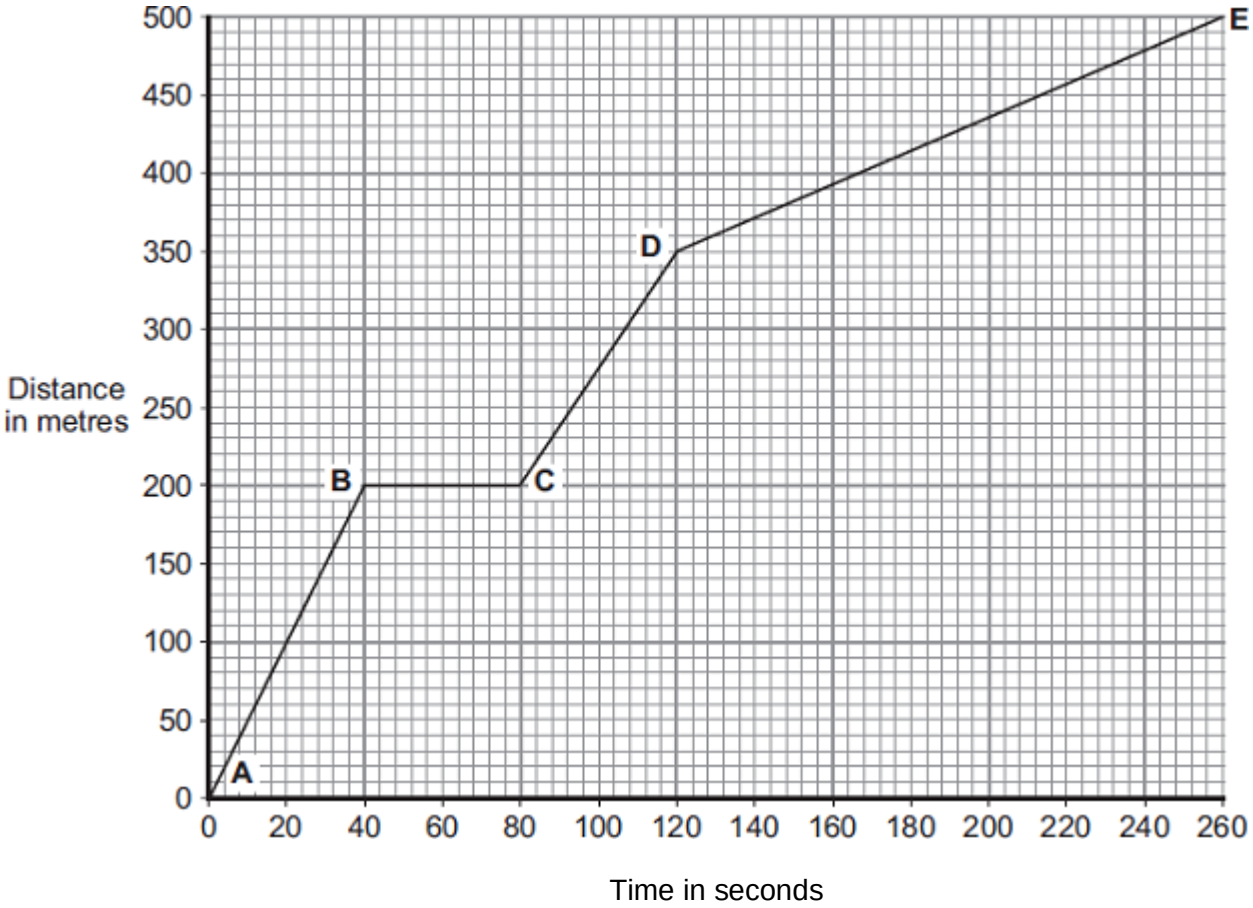
_____

(2)

(Total 8 marks)

Q3.

Part of a bus route is along a high street.
The distance-time graph shows how far the bus travelled along the high street and how long it took.



(a) Between which two points was the bus travelling the slowest?

Put a tick (✓) in the box next to your answer.

Points	**Tick (✓)**
A – B	
C – D	
D – E	

Give a reason for your answer.

_____

_____

(2)

(b) The bus travels at 5 m/s between points **A** and **B**.
The bus and passengers have a total mass of 16 000 kg.

Use the equation in the box to calculate the momentum of the bus and passengers between points **A** and **B**.

momentum = mass x velocity

Show clearly how you work out your answer.

_____

_____

Momentum = _____ kg m/s

(2)

(c) A cyclist made the same journey along the high street.
The cyclist started at the same time as the bus and completed the journey in 220 seconds. The cyclist travelled the whole distance at a constant speed.

(i) Draw a line on the graph to show the cyclist's journey.

(2)

(ii) After how many seconds did the cyclist overtake the bus?

The cyclist overtook the bus after _____ seconds.

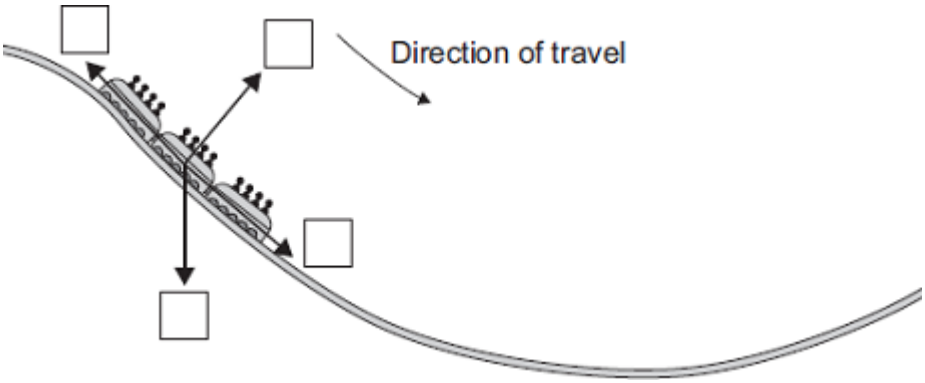
(1)

(Total 7 marks)

Q4.

The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train?
Put a tick (✓) in the box next to your choice.



(1)

(b) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

(i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

_____

_____

Maximum gravitational field strength = _____ N/kg

(1)

(ii) One of the passengers has a mass of 75 kg.

Calculate the maximum weight this passenger seems to have during the ride.

Show clearly how you work out your answer.

_____

_____

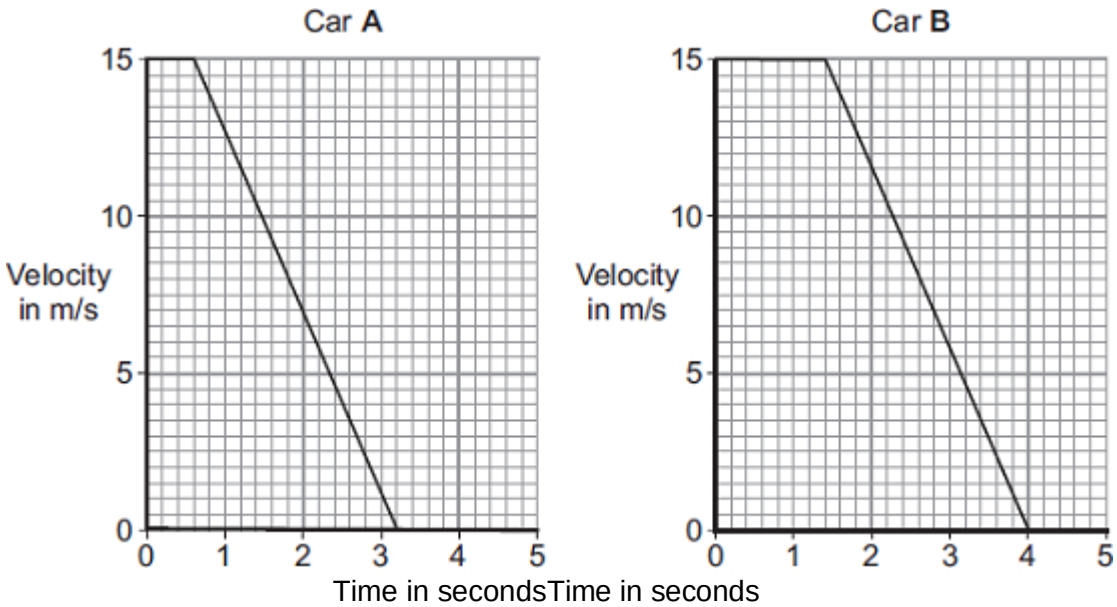
Maximum weight = _____ N

(2)

(Total 4 marks)

Q5.

(a) The graphs show how the velocity of two cars, **A** and **B**, change from the moment the car drivers see an obstacle blocking the road.



One of the car drivers has been drinking alcohol. The other driver is wide awake and alert.

(i) How does a comparison of the two graphs suggest that the driver of car **B** is the one who has been drinking alcohol?

_____

_____

(1)

(ii) How do the graphs show that the two cars have the same deceleration?

_____

_____

(1)

(iii) Use the graphs to calculate how much further car **B** travels before stopping compared to car **A**.

Show clearly how you work out your answer.

_____

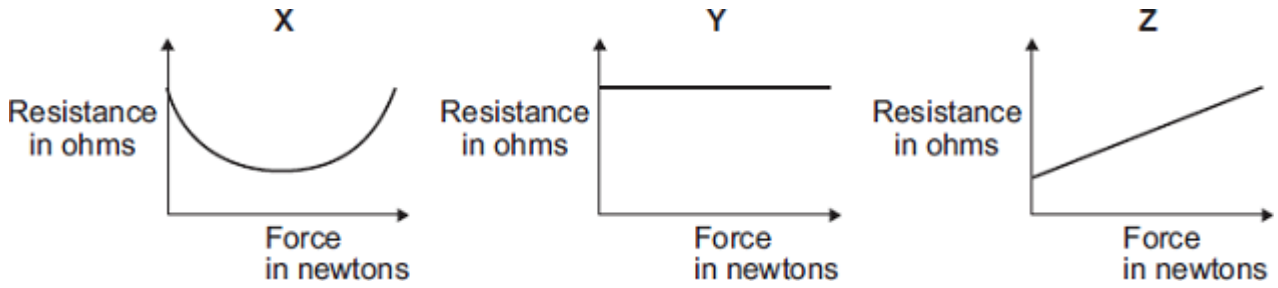
_____

_____

Additional stopping distance = _____ m

(3)

(b) In a crash-test laboratory, scientists use sensors to measure the forces exerted in collisions. The graphs show how the electrical resistance of 3 experimental types of sensor, **X**, **Y**, and **Z**, change with the force applied to the sensor.



Which of the sensors, **X**, **Y** or **Z**, would be the best one to use as a force sensor?

_____

Give a reason for your answer.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q6.

(a) In any collision, the total momentum of the colliding objects is usually conserved.

(i) What is meant by the term 'momentum is conserved'?

_____

_____

(1)

(ii) In a collision, momentum is **not always** conserved.

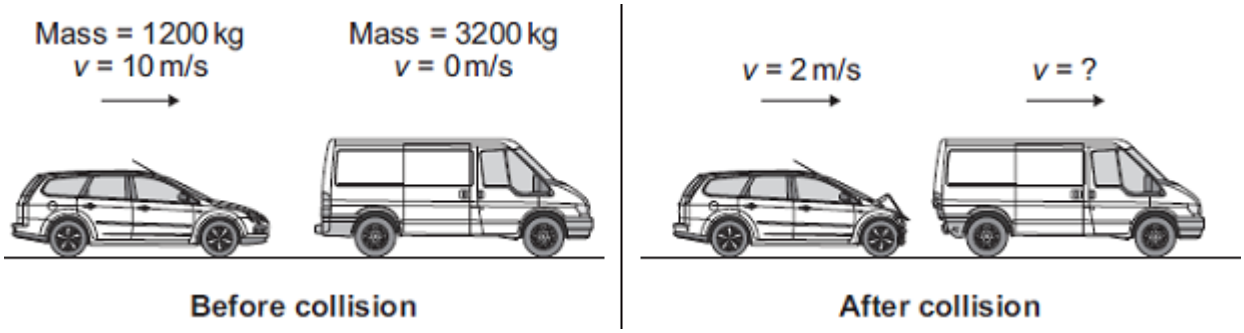
Why?

_____

_____

(1)

(b) The diagram shows a car and a van, just before and just after the car collided with the van.



(i) Use the information in the diagram to calculate the **change** in the momentum of the car.

Show clearly how you work out your answer and give the unit.

_____

_____

_____

_____

Change in momentum = _____

(3)

(ii) Use the idea of conservation of momentum to calculate the velocity of the van when it is pushed forward by the collision.

Show clearly how you work out your answer.

_____

_____

_____

Velocity = _____ m/s forward

(2)

(Total 7 marks)

Q7.

The London Eye is one of the largest observation wheels in the world.

© Angelo Ferraris/Shutterstock

The passengers ride in capsules. Each capsule moves in a circular path and accelerates.

(a) Explain how the wheel can move at a steady speed and the capsules accelerate at the same time.

_____

_____

_____

(2)

(b) In which direction is the resultant force on each capsule?

_____

(1)

(c) The designers of the London Eye had to consider **three** factors which affect the resultant force described in part (b).

Two factors that increase the resultant force are:

- an increase in the speed of rotation
- an increase in the total mass of the wheel, the capsules and the passengers.

Name the other factor that affects the resultant force and state what effect it has on the resultant force.

_____

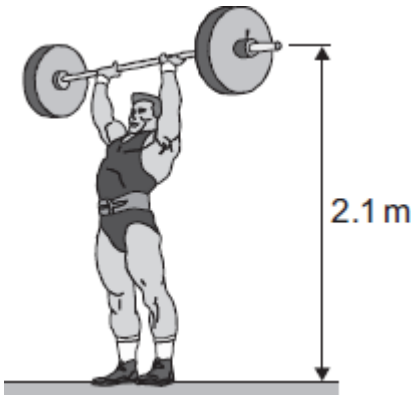
_____

(1)

(Total 4 marks)

Q8.

A powerlifter lifts a 180 kg bar from the floor to above his head.



(a) Use the equation in the box to calculate the weight of the bar.

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

_____

_____

Weight = _____ N

(2)

(b) The powerlifter uses a constant force to lift the bar a distance of 2.1 m.

Use the equation in the box to calculate the work done by the powerlifter.

work done = force applied × distance moved in direction of force

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

joule **newton** **watt**

_____

_____

Work done = _____

(3)

(c) At the end of the lift, the powerlifter holds the bar stationary, above his head, for two seconds.

How much work does the powerlifter do on the bar during these two seconds?

Draw a ring around your answer.

0 **90** **360** **900**

Give a reason for your answer.

_____

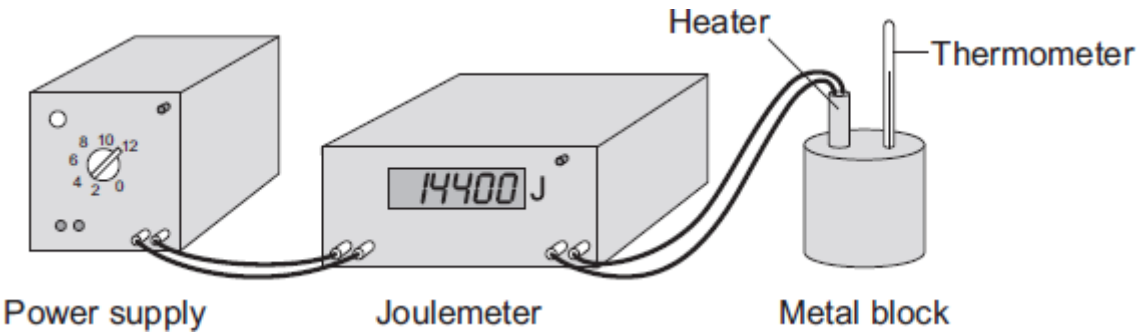
_____

(2)

(Total 7 marks)

Q9.

A student used an electric heater to heat a metal block. The student measured the energy input to the heater with a joulemeter.



Before starting the experiment, the student reset the joulemeter to zero. The student switched the power supply on for exactly 10 minutes. During this time, the reading on the joulemeter increased to 14 400.

(a) (i) Calculate the energy transferred each second from the power supply to the heater.

Show clearly how you work out your answer.

_____

_____

Energy transferred each second = _____ J/s

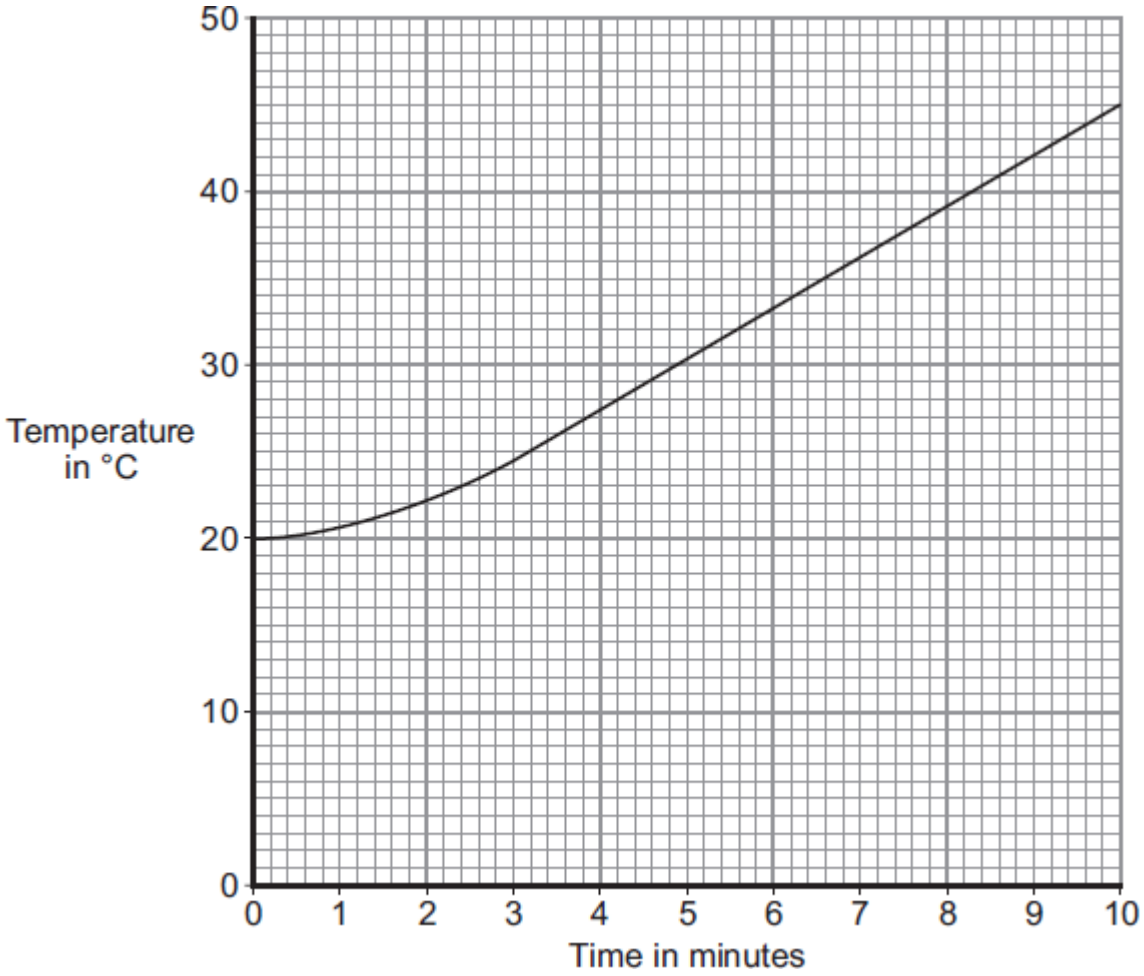
(2)

(ii) What is the power of the heater?

_____

(1)

(b) The student measured the temperature of the metal block every minute. The data obtained by the student is displayed in the graph.



(i) What range of temperatures did the student measure?

From _____ °C to _____ °C

(1)

(ii) Before starting the experiment, the student had calculated that the temperature of the block would go up by 36 °C.

The student's data shows a smaller increase.

Which **one** of the following statements gives the most likely reason for this?

Put a tick (✓) in the box next to your answer.

The student does not read the thermometer accurately. ☐

The block transfers energy to the surroundings. ☐

The power supply is not connected correctly to the joulemeter. ☐

(1)

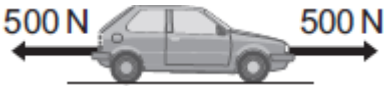
(Total 5 marks)

Q10.

(a) The diagrams, **A**, **B** and **C**, show the horizontal forces acting on a **moving** car.

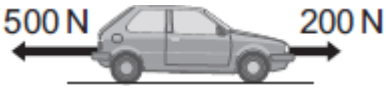
Draw a line to link each diagram to the description of the car's motion at the moment when the forces act.

Draw only **three** lines.



A

B

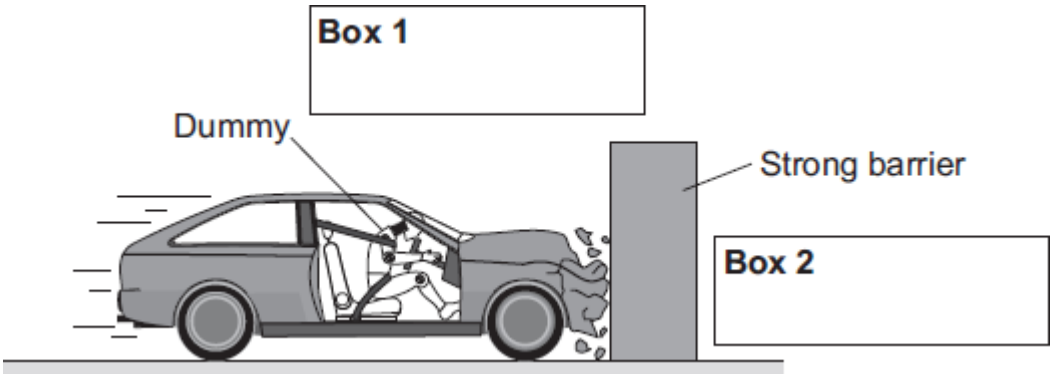


C

stationary
constant speed
slowing down
accelerating forwards

(3)

(b) The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to a dummy inside the car.



(i) Draw an arrow in **Box 1** to show the direction of the force that the car exerts on the barrier.

(1)

(ii) Draw an arrow in **Box 2** to show the direction of the force that the barrier exerts on the car.

(1)

(iii) Complete the following by drawing a ring around the correct line in the box.

The car exerts a force of 5000 N on the barrier. The barrier does not move. The force

exerted by the barrier on the car will be

more than
equal to
less than

5000 N.

(1)

(iv) Which **one** of the following gives the most likely reason for attaching electronic sensors to the dummy?

Put a tick (✓) in the box next to your answer.

To measure the speed of the car just before the impact. ☐

To measure the forces exerted on the dummy during the impact. ☐

To measure the distance the car travels during the impact. ☐

(1)

(Total 7 marks)

Q11.

(a) A car is being driven along a straight road. The diagrams, **A**, **B** and **C**, show the horizontal forces acting on the moving car at three different points along the road.

Describe the motion of the car at each of the points, **A**, **B** and **C**.

A

_____

_____

B

_____

_____

C

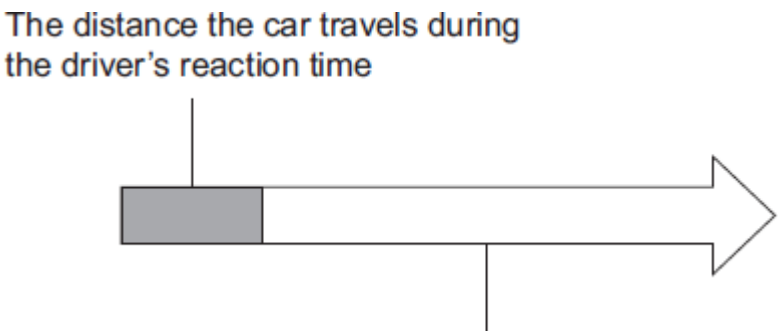
_____

_____

(3)

(b) The diagram below shows the stopping distance for a family car, in good condition, driven at 22 m/s on a dry road. The stopping distance has two parts.

(i) Complete the diagram below by adding an appropriate label to the second part of the stopping distance.



_____

_____

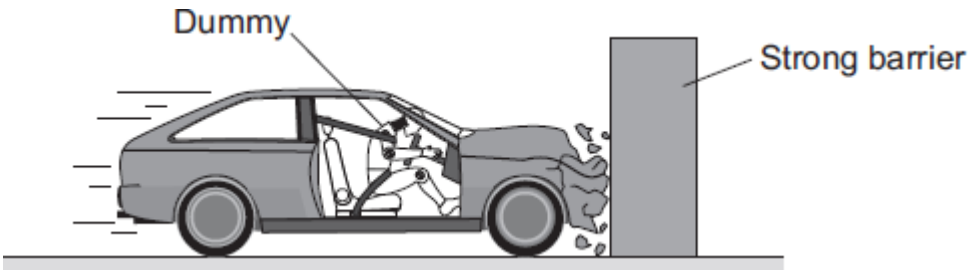
(1)

(ii) State **one** factor that changes both the first part **and** the second part of the stopping distance.

_____

(1)

(c) The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to the dummy inside the car.



(i) At the point of collision, the car exerts a force of 5000 N on the barrier.

State the size and direction of the force exerted by the barrier on the car.

_____

_____

(1)

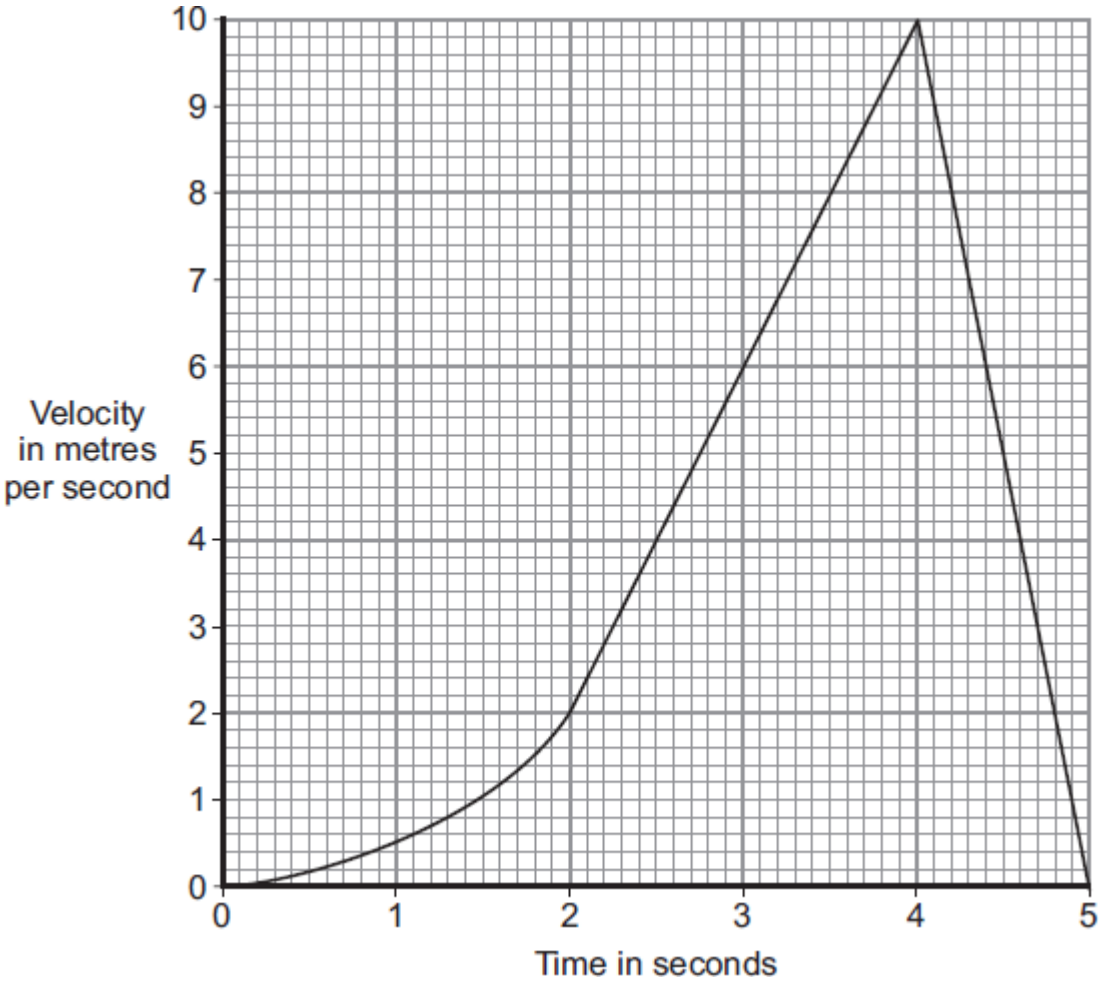
(ii) Suggest why the dummy is fitted with electronic sensors.

_____

_____

(1)

(iii) The graph shows how the velocity of the car changes during the test.



Use the graph to calculate the acceleration of the car just before the collision with the barrier.

Show clearly how you work out your answer, including how you use the graph, and give the unit.

_____

_____

_____

_____

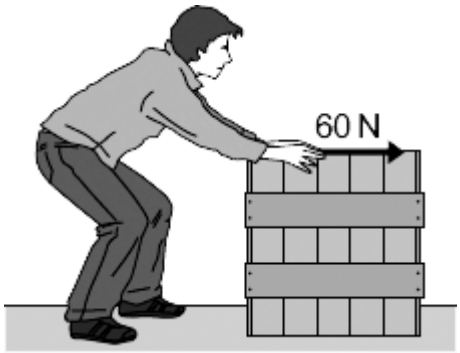
Acceleration = _____

(3)

(Total 10 marks)

Q12.

The diagram shows a worker using a constant force of 60 N to push a crate across the floor.



My Revision Notes AQA GCSE Physics for A* – C,
Steve Witney, © Philip Allan UK

(a) The crate moves at a constant speed in a straight line

(i) Draw an arrow on the diagram to show the direction of the friction force acting on the moving crate.

(1)

(ii) State the size of the friction force acting on the moving crate.

_____ N

Give the reason for your answer.

_____

_____

(2)

(b) Calculate the work done by the worker to push the crate 28 metres.

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

joule **newton** **watt**

_____

_____

Work done = _____

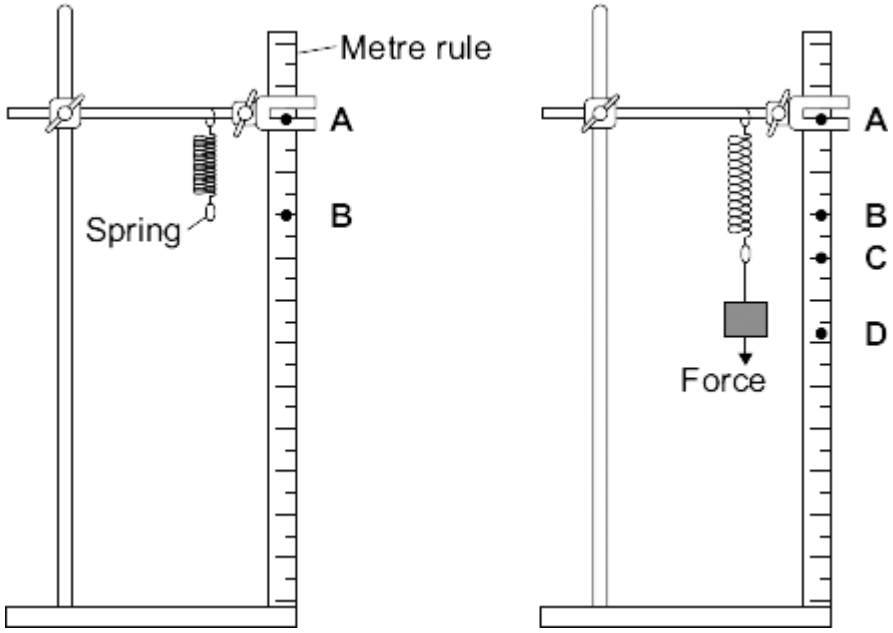
(3)

(Total 6 marks)

Q13.

A student investigated how the extension of a spring depends on the force applied to the spring.

The diagram shows the spring before and after a force had been applied.



(a) (i) Complete the following sentence using letters, **A**, **B**, **C** or **D**, from the diagram.

The extension of the spring is the distance between the positions labelled

_____and _____ on the metre rule.

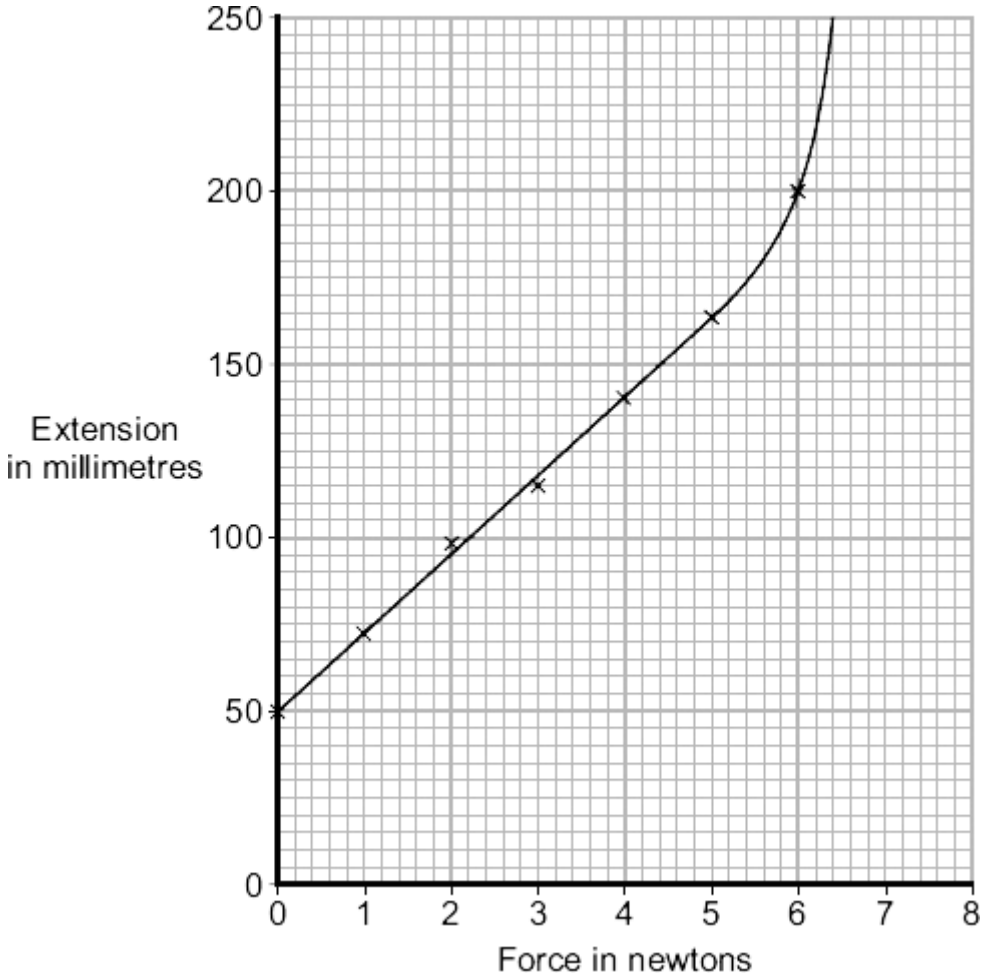
(1)

(ii) What form of energy is stored in the stretched spring?

_____

(1)

(b) The results from the investigation are plotted on the following graph.



(i) The graph shows that the student has made an error throughout the investigation.

What error has the student made?

_____

_____

Give the reason for your answer.

_____

_____

(2)

(ii) The student has loaded the spring beyond its *limit of proportionality*.

Mark on the graph line the *limit of proportionality* of the spring. Label the point **P**.

Give the reason for choosing your point **P**.

_____

_____

_____

(2)

(c) The student uses a different spring as a spring balance. When the student hangs a stone from this spring, its extension is 72 mm.

The spring does not go past the limit of proportionality.

Calculate the force exerted by the stone on the spring.

spring constant = 25 N/m

Show clearly how you work out your answer.

_____

_____

Force = _____ N

(2)

(Total 8 marks)

Q14.

(a) The diagram shows the forces acting on a parachutist in free fall.

The parachutist has a mass of 75 kg.

Calculate the weight of the parachutist.

gravitational field strength = 10 N/kg

Show clearly how you work out your answer and give the unit.

_____

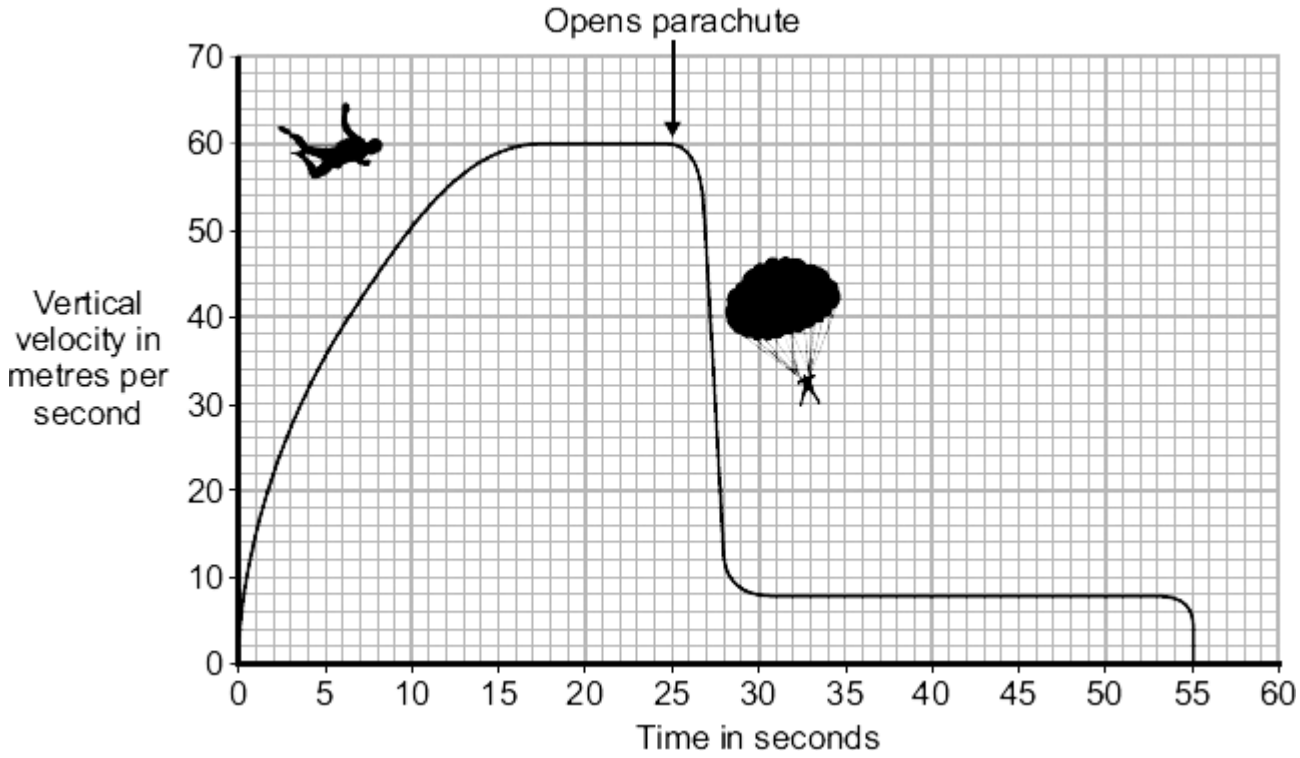
_____

Weight = _____

(3)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The graph shows how the vertical velocity of a parachutist changes from the moment the parachutist jumps from the aircraft until landing on the ground.



Using the idea of forces, explain why the parachutist reaches a terminal velocity and why opening the parachute reduces the terminal velocity.

_____

_____

_____

_____

_____

_____

_____

_____

_____

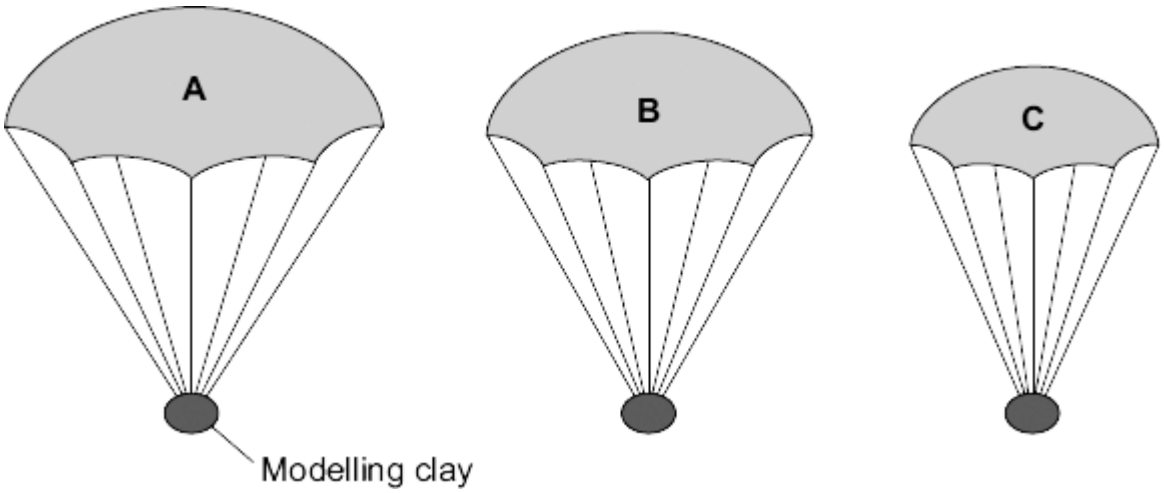
_____

(6)

(c) A student wrote the following hypothesis.

'*The larger the area of a parachute, the slower a parachutist falls.*'

To test this hypothesis the student made three model parachutes, **A**, **B** and **C**, from one large plastic bag. The student dropped each parachute from the same height and timed how long each parachute took to fall to the ground.



(i) The height that the student dropped the parachute from was a control variable.

Name **one** other control variable in this experiment.

_____

(1)

(ii) Use the student's hypothesis to predict which parachute, **A**, **B** or **C**, will hit the ground first.

Write your answer in the box. ☐

Give a reason for your answer.

_____

_____

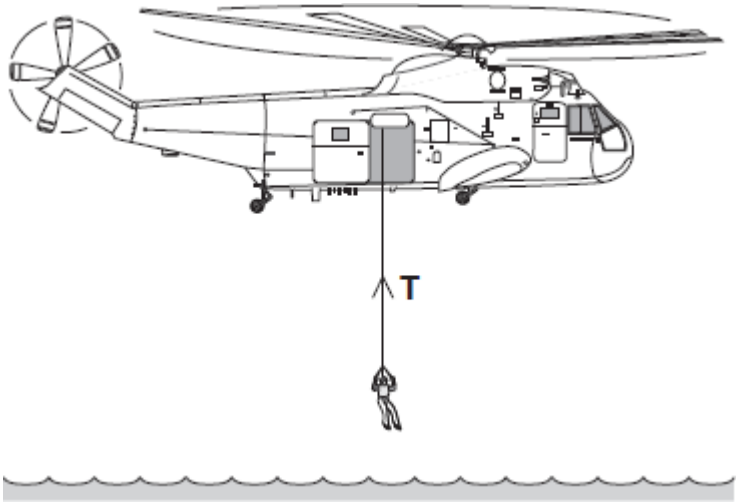
_____

(2)

(Total 12 marks)

Q15.

The diagram shows a helicopter being used to rescue a person from the sea.



(a) (i) The mass of the rescued person is 72 kg.

Use the equation in the box to calculate the weight of the rescued person.

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

_____

_____

Weight = _____ N

(2)

(ii) An electric motor is used to lift the person up to the helicopter.
The motor lifts the person at a constant speed.

State the size of the force, **T**, in the cable.

Force **T** = _____ N

(1)

(b) To lift the person up to the helicopter, the electric motor transformed 21 600 joules of energy usefully.

(i) Use a form of energy from the box to complete the following sentence.

gravitational potential	heat	sound

The electric motor transforms electrical energy to kinetic energy. The kinetic energy

is then transformed into useful _____ energy.

(1)

(ii) It takes 50 seconds for the electric motor to lift the person up to the helicopter.

Use the equation in the box to calculate the power of the electric motor.

$$\text{power} = \frac{\text{energy transformed}}{\text{time}}$$

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

coulomb (C) **hertz (Hz)** **watt (W)**

_____

_____

Power = _____

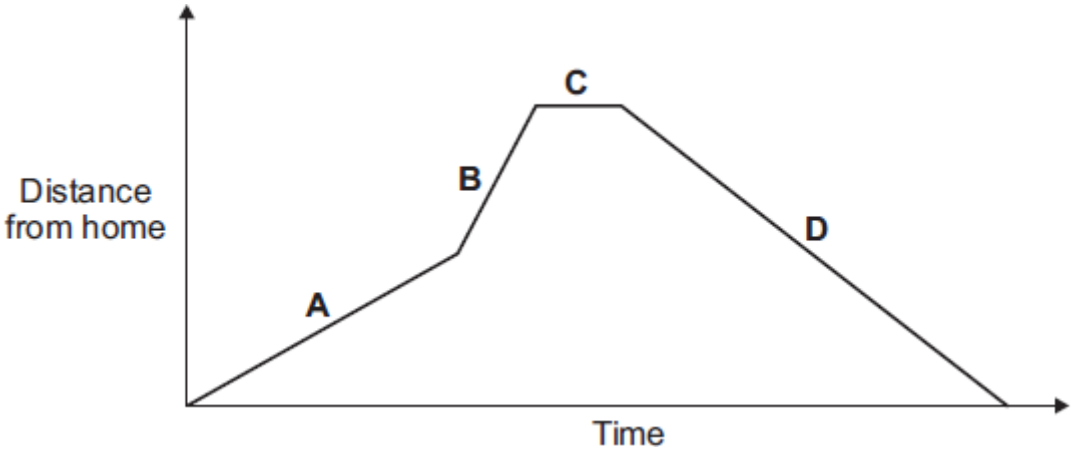
(3)

(Total 7 marks)

Q16.

(a) A person takes their dog for a walk.

The graph shows how the distance from their home changes with time.



Which part of the graph, **A**, **B**, **C** or **D**, shows them walking the fastest?

Write your answer in the box. ☐

Give the reason for your answer.

_____

_____

(2)

(b) During the walk, both the speed and the velocity of the person and the dog change.

How is *velocity* different from *speed*?

_____

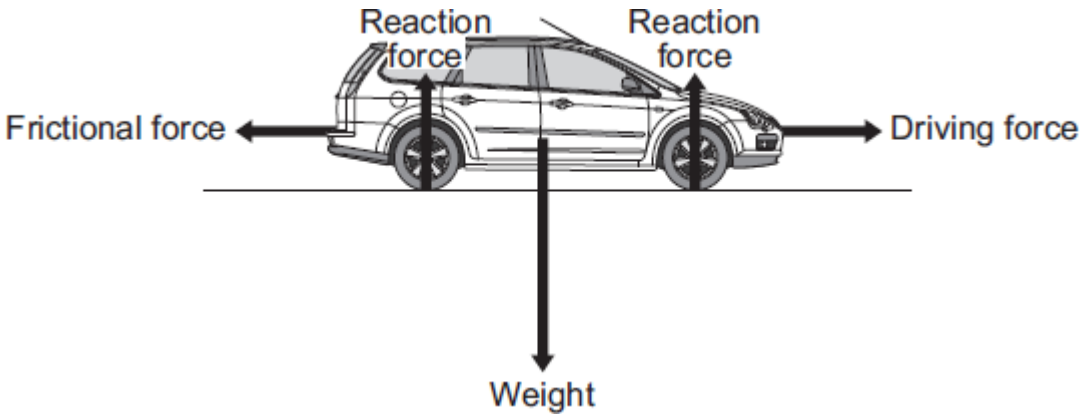
_____

(1)

(Total 3 marks)

Q17.

The diagram shows the forces acting on a car. The car is being driven along a straight, level road at a constant speed of 12 m/s.



(a) The driver then accelerates the car to 23 m/s in 4 seconds.

Use the equation in the box to calculate the acceleration of the car.

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken for change}}$$

Show clearly how you work out your answer and give the unit.

_____

_____

Acceleration = _____

(3)

(b) Describe how the horizontal forces acting on the car change during the first **two** seconds of the acceleration.

_____

_____

_____

_____

_____

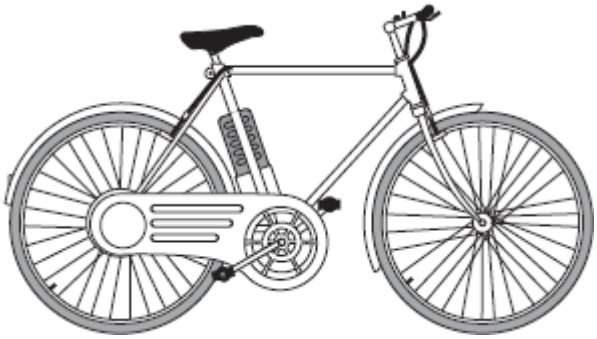
_____

(3)

(Total 6 marks)

Q18.

The picture shows an electric bicycle. The bicycle is usually powered using a combination of the rider pedalling and an electric motor.



(a) A 36 volt battery powers the electric motor. The battery is made using individual 1.2 volt cells.

(i) Explain how a 36 volt battery can be produced using individual 1.2 volt cells.

To gain full marks, you must include a calculation in your answer.

_____

_____

_____

_____

(2)

(ii) The battery supplies a direct current (d.c.).

What is a *direct current (d.c.)*?

_____

_____

(1)

(iii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

Calculate the maximum charge that the battery stores.

Show clearly how you work out your answer and give the unit.

_____

_____

Charge stored = _____

(3)

(b) When powered only by the electric motor, the bicycle can carry a 90 kg rider at a maximum speed of 6 m/s. Under these conditions, the maximum distance that the bicycle can cover before the battery needs recharging is 32 km.

The bicycle has a mass of 30 kg.

(i) Calculate the maximum kinetic energy of the bicycle **and** rider when the rider is not pedalling.

Show clearly how you work out your answer.

_____

_____

Kinetic energy = _____ J

(2)

(ii) The bicycle can be fitted with panniers (bags) to carry a small amount of luggage.

What effect would fitting panniers and carrying luggage have on the distance the bicycle can cover before the battery needs recharging?

_____

Give a reason for your answer.

_____

_____

(2)

(Total 10 marks)

Q19.

(a) The picture shows two teenagers riding identical skateboards.
The skateboards are moving at the same speed and the teenagers have the same mass.

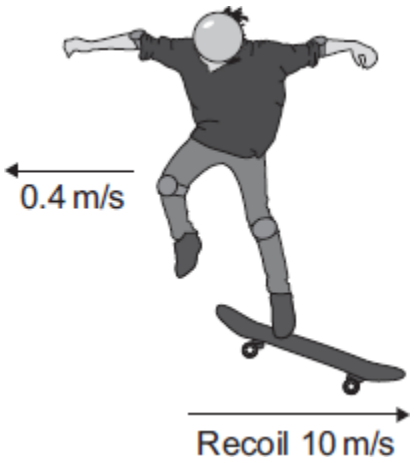
Why do the teenagers **not** have the same momentum?

_____

_____

(1)

(b) One of the skateboards slows down and stops. The teenager then jumps off the skateboard, causing it to recoil and move in the opposite direction.



The momentum of the teenager and skateboard is conserved.

(i) What is meant by 'momentum being conserved'?

_____

_____

(1)

(ii) The teenager, of mass 55 kg, jumps off the skateboard at 0.4 m/s causing the skateboard to recoil at 10 m/s.

Calculate the mass of the skateboard.

_____

_____

_____

Mass = _____ kg

(3)

(c) Once the skateboard starts to recoil, it soon slows down and its kinetic energy decreases.

Explain why.

_____

_____

_____

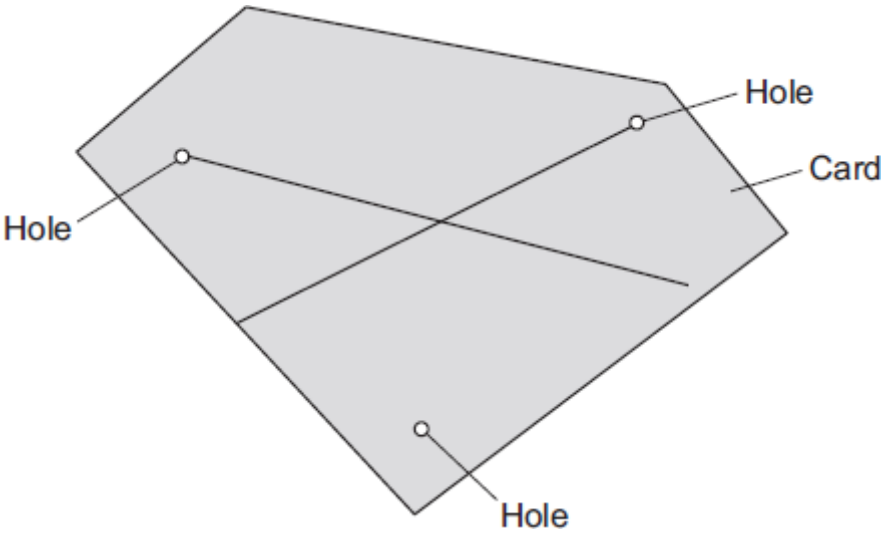
_____

(2)

(Total 7 marks)

Q20.

A student was asked to find the centre of mass of a thin sheet of card. The diagram shows the result of the student's experiment. The student drew two lines onto the card. The centre of mass is where the two lines cross.



(a) Describe how the student found the correct positions to draw the **two** lines.

You may include a labelled diagram in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) Explain how the student can check that the position found for the centre of mass is accurate.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q21.

A high-speed train accelerates at a constant rate in a straight line.

The velocity of the train increases from 30 m/s to 42 m/s in 60 seconds.

(a) (i) Calculate the change in the velocity of the train.

_____

Change in velocity = _____ m/s

(1)

(ii) Use the equation in the box to calculate the acceleration of the train.

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken for change}}$$

Show clearly how you work out your answer and give the unit.
Choose the unit from the list below.

m/s **m/s²** **N/kg** **Nm**

_____

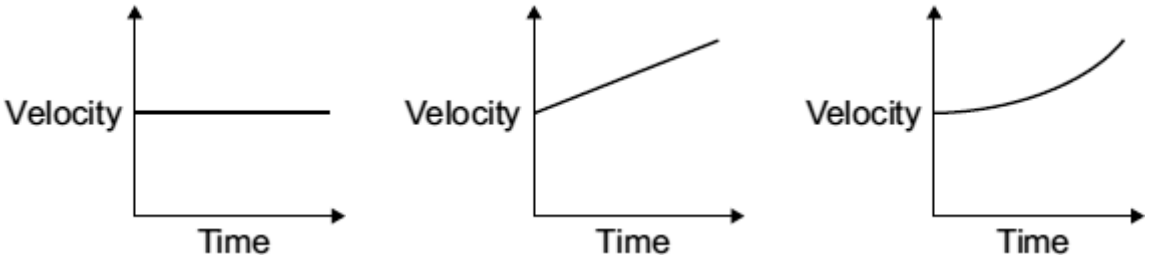
_____

Acceleration = _____

(2)

(b) Which **one** of the graphs, **A**, **B** or **C**, shows how the velocity of the train changes as it accelerates?

Write your answer, **A**, **B** or **C**, in the box.



A **B** **C**

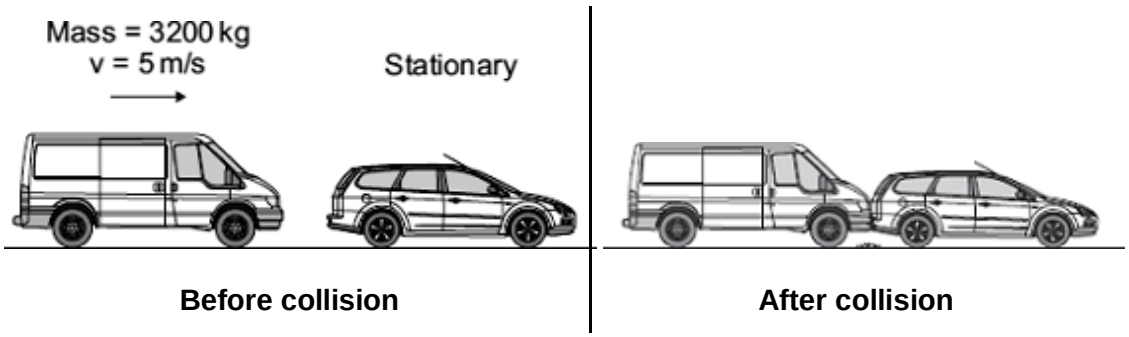
Graph ☐

(1)

(Total 4 marks)

Q22.

(a) A van has a mass of 3200 kg. The diagram shows the van just before and just after it collides with the back of a car.



Just before the collision, the van was moving at 5 m/s and the car was stationary.

(i) Calculate the momentum of the van just before the collision.

Show clearly how you work out your answer.

_____

_____

Momentum = _____ kg m/s

(2)

(ii) The collision makes the van and car join together.

What is the total momentum of the van and the car just after the collision?

Momentum = _____ kg m/s

(1)

(iii) Complete the following sentence by drawing a ring around the correct line in the box.

The momentum of the car before the collision is

more than
the same as
less than

the

momentum of the car after the collision.

(1)

(b) A seat belt is one of the safety features of a car.

In a collision, wearing a seat belt reduces the risk of injury.

Use words or phrases from the box to complete the following sentences.

decreases	stays the same	increases

In a collision, the seat belt stretches. The time it takes for the person held by the seat belt to lose momentum compared to a person not wearing a seat belt,

_____ .

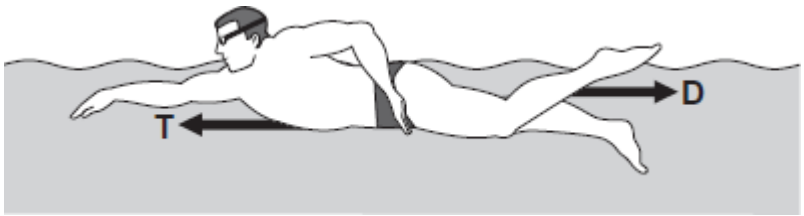
The force on the person's body _____
and so reduces the risk of injury.

(2)

(Total 6 marks)

Q23.

(a) The diagram shows the horizontal forces acting on a swimmer.



(i) The swimmer is moving at constant speed.
Force **T** is 120 N.

What is the size of force **D**?

_____ N

(1)

(ii) By increasing force **T** to 140 N, the swimmer accelerates to a higher speed.

Calculate the size of the initial resultant force acting on the swimmer.

_____

_____

Initial resultant force = _____ N

(1)

(iii) Even though the swimmer keeps the force **T** constant at 140 N, the resultant force on the swimmer decreases to zero.

Explain why.

_____

_____

_____

_____

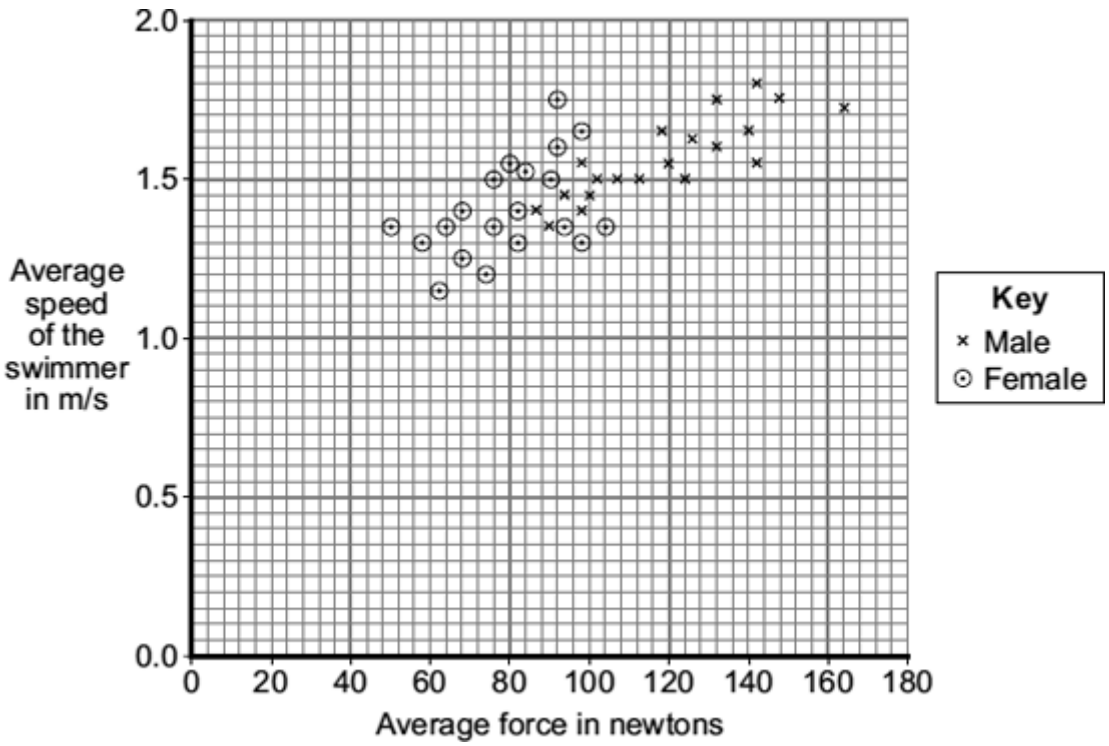
_____

_____

(3)

(b) A sports scientist investigated how the force exerted by a swimmer's hands against the water affects the swimmer's speed.
The investigation involved 20 males and 20 females swimming a fixed distance.
Sensors placed on each swimmer's hands measured the force 85 times every second over the last 10 metres of the swim.
The measurements were used to calculate an average force.
The average speed of each swimmer over the last 10 metres of the swim was also measured.

The data from the investigation is displayed in the graph.



(i) What was the dependent variable in this investigation?

_____

(1)

(ii) Explain **one** advantage of measuring the force 85 times every second rather than just once or twice every second.

_____

_____

_____

_____

(2)

(iii) Give **one** way in which the data for the male swimmers is different from the data for the female swimmers.

_____

_____

(1)

(iv) Considering only the data from this investigation, what advice should a swimming coach give to swimmers who want to increase their average speed?

_____

_____

(1)

(Total 10 marks)

Q24.

(a) Complete the following sentence.

The momentum of a moving object has a magnitude, in kg m/s,

and a _____ .

(1)

(b) A car being driven at 9.0 m/s collides with the back of a stationary lorry.
The car slows down and stops in 0.20 seconds. The total mass of the car and driver is 1200 kg.

Calculate the average force exerted by the lorry on the car during the collision.

Show clearly how you work out your answer.

_____

_____

Force = _____ N

(2)

(c) Within 0.04 s of the car hitting the back of the lorry, the car driver's airbag inflates. The airbag deflates when it is hit by the driver’s head.

Use the idea of momentum to explain why the airbag reduces the risk of the drive sustaining a serious head injury.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q25.

The drawing shows a plastic toy which can stand on its feet.

(a) (i) Draw an **X** on the diagram so that the centre of the **X** marks the likely position of the centre of mass of the toy.

Photograph supplied by Hemera/Thinkstock

(1)

(ii) Explain the reason for your choice in part (a)(i).

_____

_____

(1)

(b) Suggest **two** ways in which the design of the toy could be altered to make the toy more stable.

1. _____

_____

2. _____

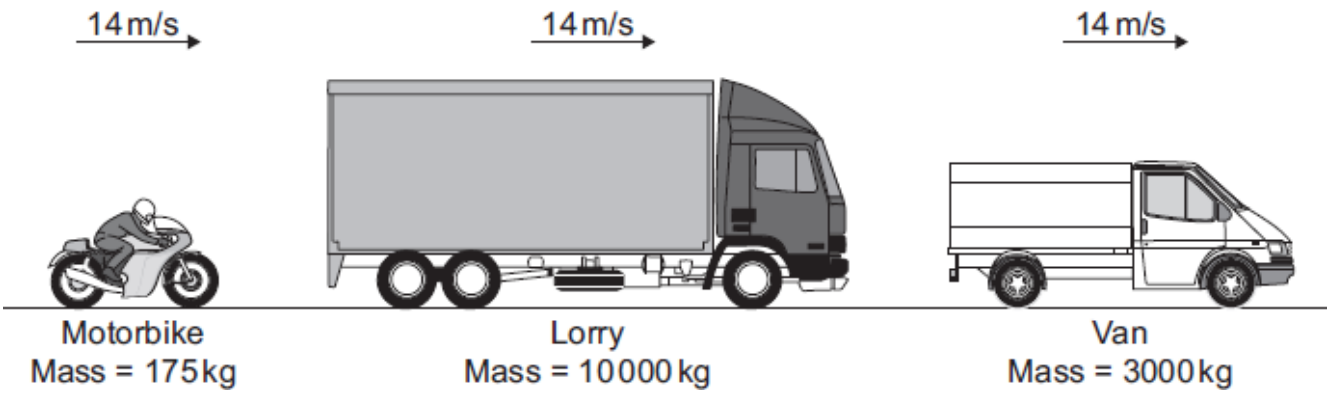
_____

(2)

(Total 4 marks)

Q26.

(a) (i) The diagram shows three vehicles travelling along a straight road at 14 m/s.



Which vehicle has the greatest momentum?

_____

Give the reason for your answer.

_____

_____

_____

(2)

(ii) Use the equation in the box to calculate the momentum of the motorbike when it travels at 14 m/s.

momentum = mass × velocity

Show clearly how you work out your answer.

_____

Momentum = _____ kg m/s

(2)

(b) The motorbike follows the lorry for a short time, and then accelerates to overtake both the lorry and van.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

When the motorbike starts to overtake, the kinetic energy

of the motorbike

decreases.
stays the same.
increases.

(1)

(ii) Give a reason for your answer to part (b)(i).

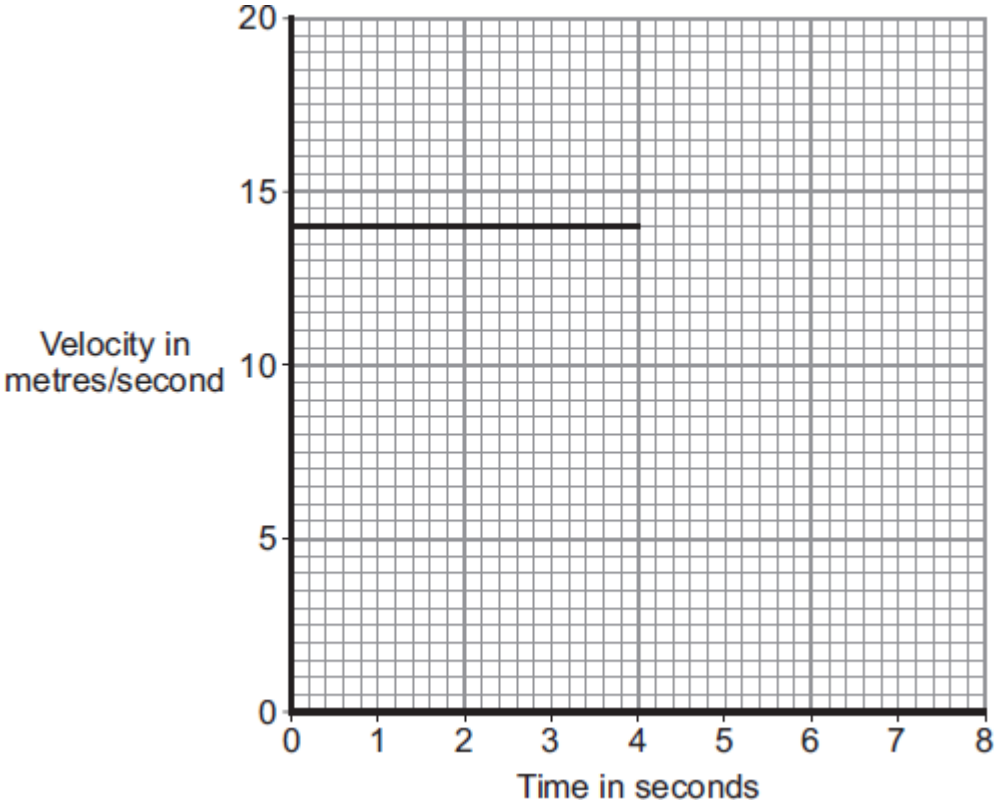
_____

_____

(1)

(iii) The graph shows the velocity of the motorbike up to the time when it starts to accelerate. The motorbike accelerates constantly, going from a speed of 14 m/s to a speed of 20 m/s in a time of 2 seconds. The motorbike then stays at 20 m/s.

Complete the graph to show the motion of the motorbike over the next 4 seconds.



(3)
(Total 9 marks)

Q27.

Motorway accidents have many causes.

(a) Which **one** of the following is most likely to increase the chance of a car being in an accident?

Tick (✓) the box next to your answer.

The car has just had new tyres fitted. ☐

The driver has been drinking alcohol. ☐

A road surface in dry conditions ☐

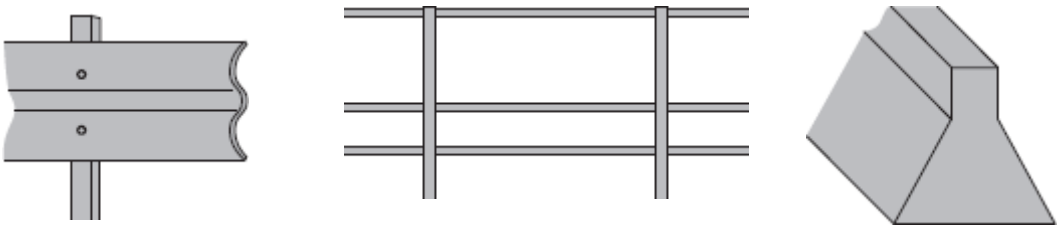
Give a reason for your answer.

_____

_____

(2)

(b) The diagram shows three designs of motorway crash barriers.



Steel sheets Steel 'ropes' Solid concrete

Before a new design of barrier is used, it must be tested.
A car of mass 1500 kg is driven at 30 m/s to hit the barrier at an angle of 20 degrees.
This barrier must slow the car down and must not break.

Explain why the mass of the car, the speed of the car and the angle at which the car hits the barrier must be the same in every test.

_____

_____

_____

_____

_____

(2)

(c) A group of scientists has suggested that new designs of crash barriers should be first tested using computer simulations.

Which **two** statements give sensible reasons for testing new barrier designs using a computer simulation?

Put a tick (✓) in the box next to each of your answers.

The design of the barrier can be changed easily. ☐

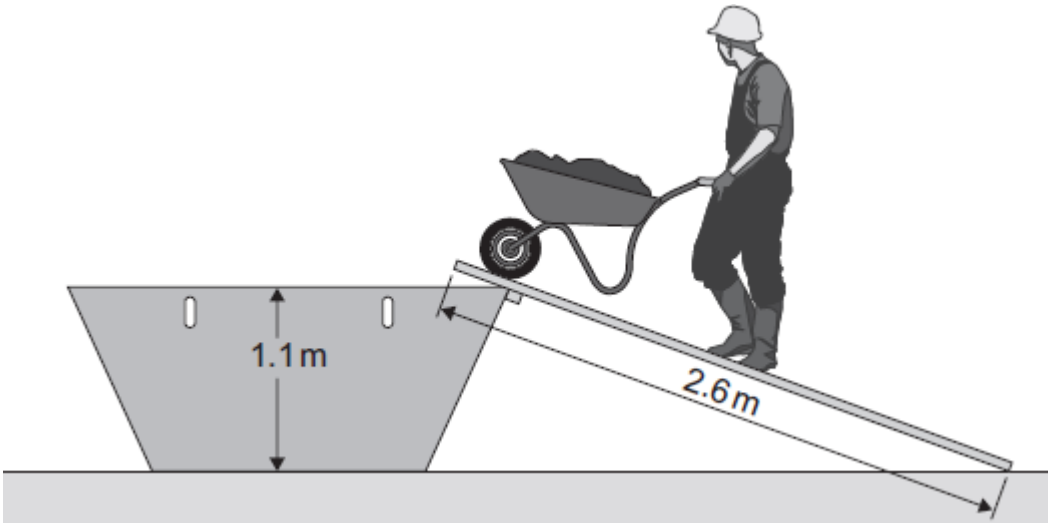
Data for different conditions can be obtained quickly. ☐

Simulations are more realistic than using cars and barriers. ☐

(1)
(Total 5 marks)

Q28.

(a) The diagram shows a builder using a plank to help load rubble into a skip.



The builder uses a force of 220 N to push the wheelbarrow up the plank.

Use information from the diagram to calculate the work done to push the wheelbarrow up the plank to the skip.

Show clearly how you work out your answer.

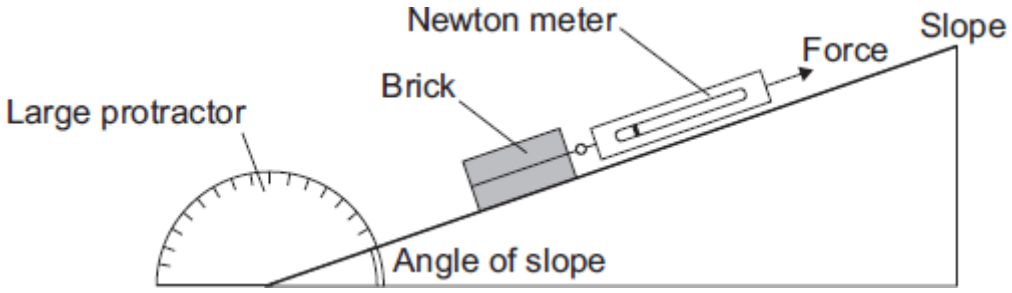
_____

_____

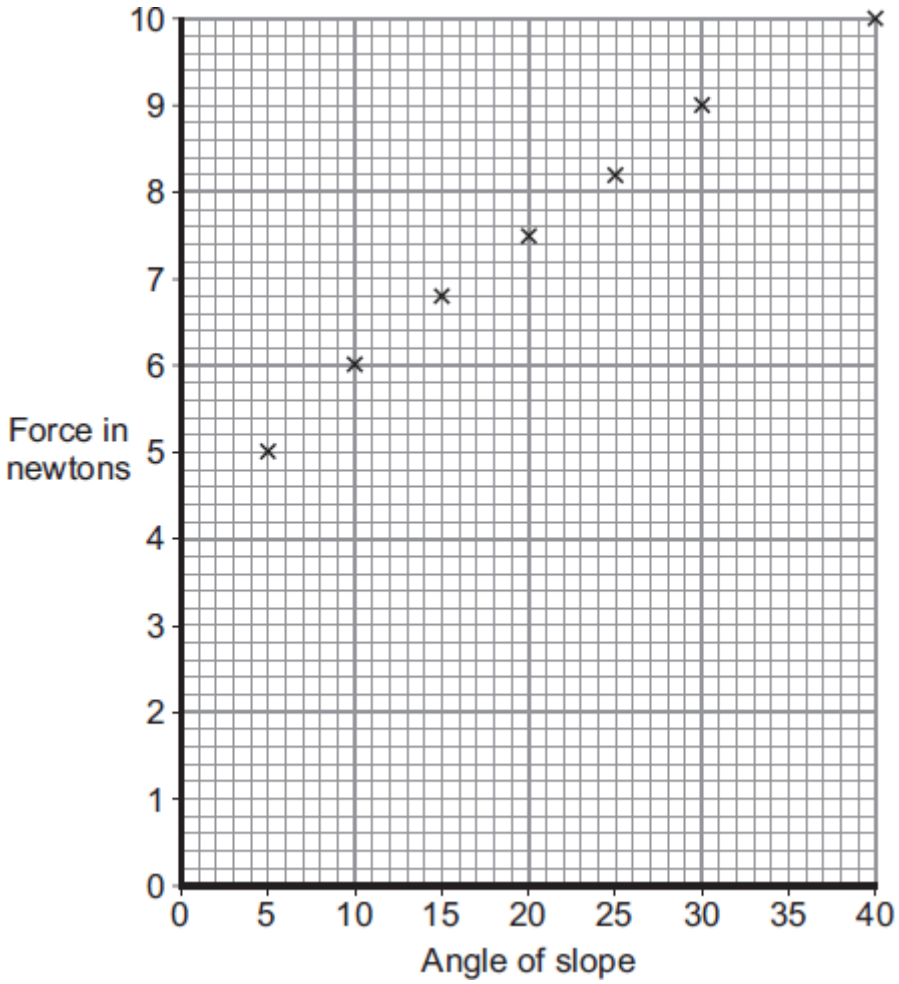
Work done = _____ J

(2)

(b) A student investigated how the force needed to pull a brick up a slope, at a steady speed, depends on the angle of the slope.
The apparatus used by the student is shown in the diagram.



The student used the results from the investigation to plot the points for a graph of force used against the angle of the slope.



(i) Draw a line of best fit for these points.

(1)

(ii) How does the force used to pull the brick up the slope change as the angle of the slope increases?

_____

_____

(1)

(iii) Consider the results from this experiment.
Should the student recommend that the builder use a long plank or a short plank to help load the skip?

Draw a ring around your answer.

long plank **short plank**

Explain the reason for your answer.

_____

_____

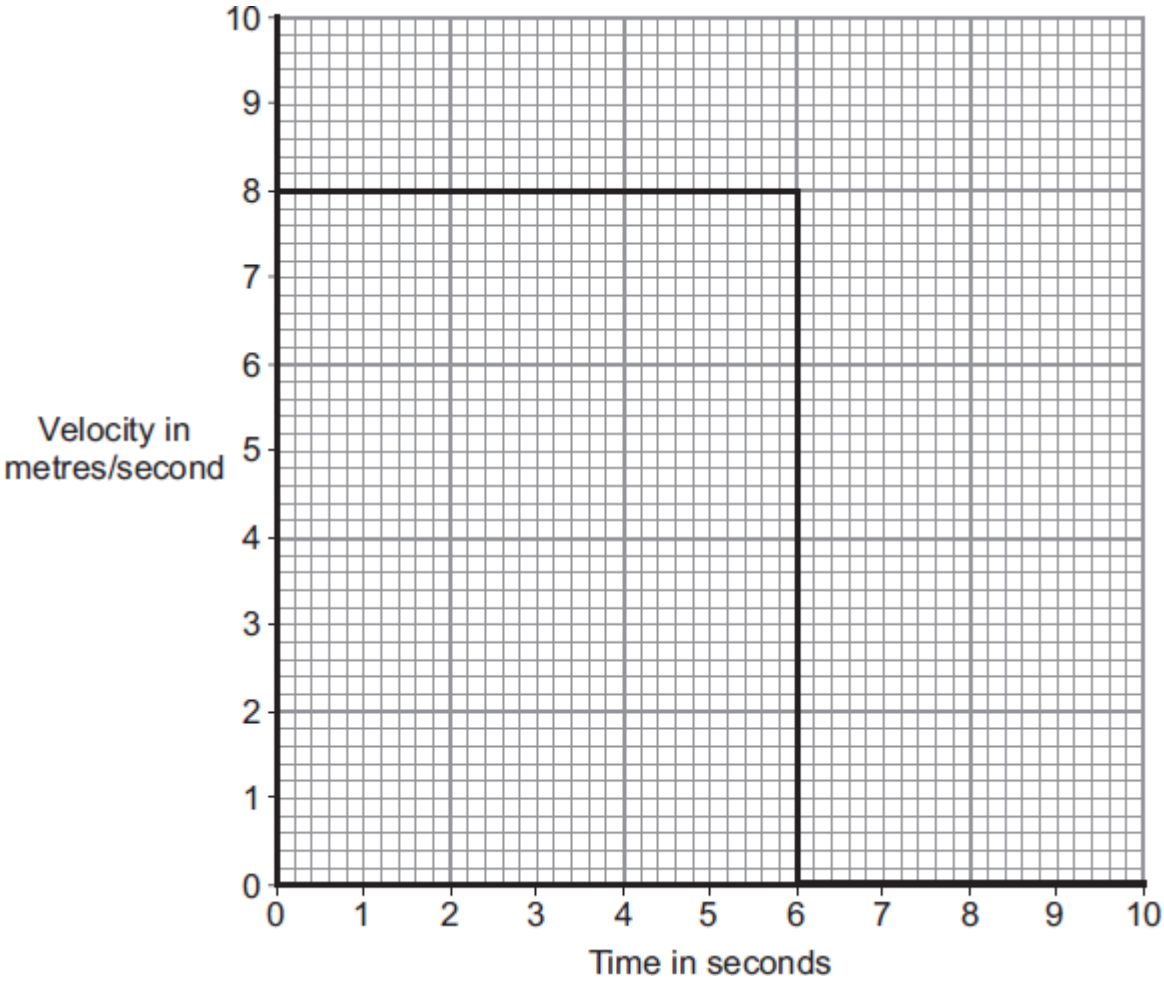
_____

_____

(2)
(Total 6 marks)

Q29.

The diagram shows the velocity-time graph for an object over a 10 second period.



(a) Use the graph to calculate the distance travelled by the object in 10 seconds.

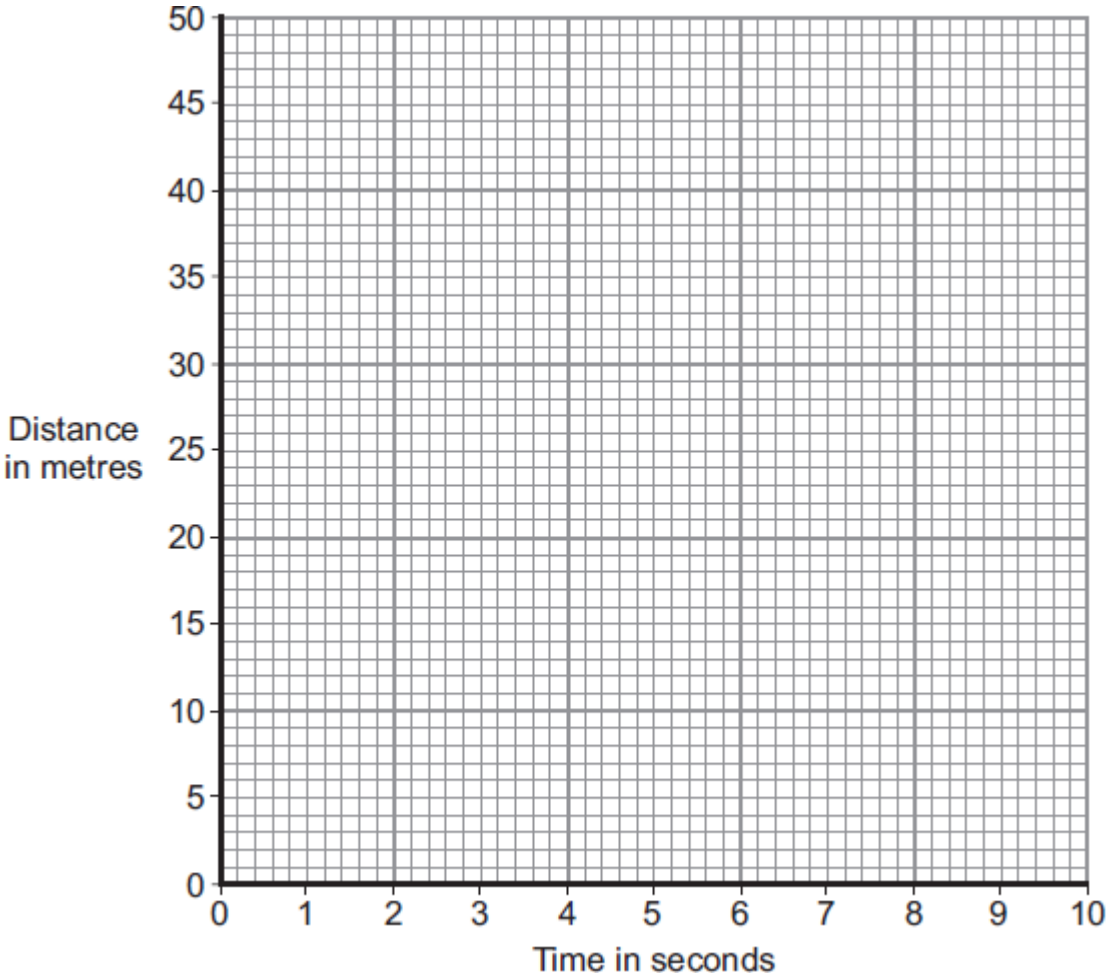
Show clearly how you work out your answer.

_____

Distance = _____ m

(2)

(b) Complete the distance-time graph for the object over the same 10 seconds.



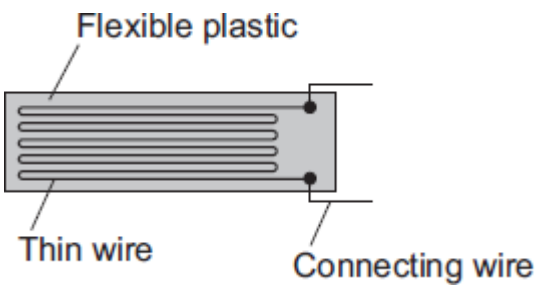
(2)

(Total 4 marks)

Q30.

The diagram shows a strain gauge, which is an electrical device used to monitor a changing force.

Applying a force to the gauge causes it to stretch.
This makes the electrical resistance of the wire change.



(a) (i) Using the correct symbols, **add** to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above.

(2)

(ii) When in use, the strain gauge is always connected to a d.c. power supply, such as a battery.

How is a d.c. (direct current) power supply different from an a.c. (alternating current) power supply?

_____

_____

_____

(1)

(b) Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it.

(i) Calculate the resistance of the unstretched gauge.

Show clearly how you work out your answer.

_____

_____

Resistance = _____ Ω

(2)

(ii) Stretching the gauge causes the current flowing through the gauge to decrease.

What happens to the resistance of the gauge when it is stretched?

_____

_____

(1)

(iii) What form of energy is stored in the gauge when a force is applied and the gauge stretches?

_____

(1)

(Total 7 marks)

Q31.

A cyclist travelling along a straight level road accelerates at 1.2 m/s^2 for 5 seconds. The mass of the cyclist and the bicycle is 80 kg.

(a) Calculate the resultant force needed to produce this acceleration.

Show clearly how you work out your answer and give the unit.

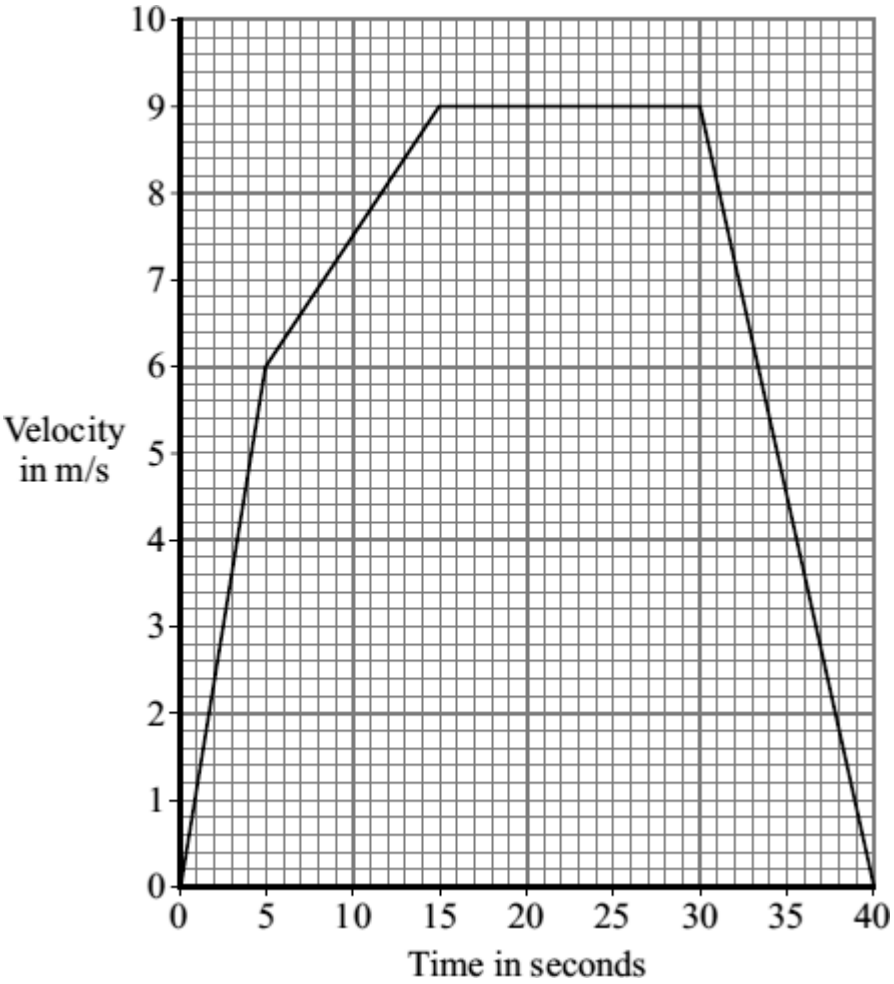
_____

_____

Resultant force = _____

(3)

(b) The graph shows how the velocity of the cyclist changes with time.



(i) Complete the following sentence.

The velocity includes both the speed and the _____ of the cyclist.

(1)

(ii) Why has the data for the cyclist been shown as a line graph instead of a bar chart?

_____

_____

(1)

(iii) The diagrams show the horizontal forces acting on the cyclist at three different speeds. The length of an arrow represents the size of the force.

A **B** **C**

Which **one** of the diagrams, **A**, **B** or **C**, represents the forces acting when the cyclist is travelling at a constant 9 m/s?

_____

Explain the reason for your choice.

_____

_____

_____

_____

_____

_____

(3)
(Total 8 marks)

Q32.

(a) In any collision, the total momentum of the colliding objects is usually conserved.

(i) What is meant by the term ‘momentum is conserved’?

_____

_____

(1)

(ii) In a collision, momentum is **not** always conserved.

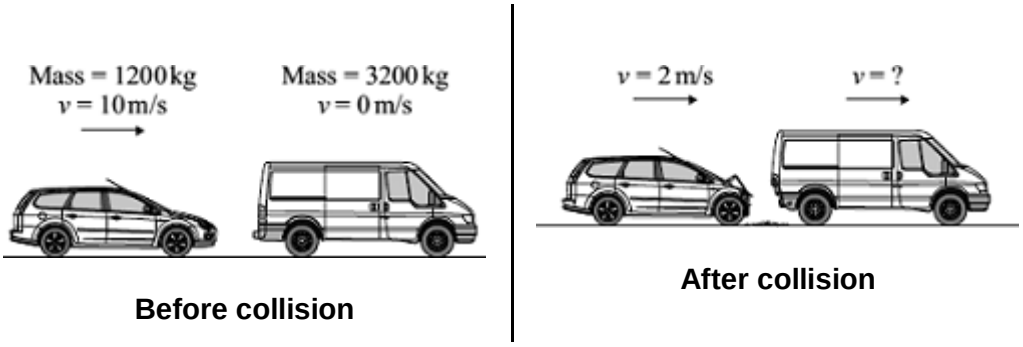
Why?

_____

_____

(1)

(b) The diagram shows a car and a van, just before and just after the car collided with the van.



Before collision **After collision**

(i) Use the information in the diagram to calculate the **change** in the momentum of the car.

Show clearly how you work out your answer and give the unit.

_____

_____

_____

_____

Change in momentum =_____

(3)

(ii) Use the idea of conservation of momentum to calculate the velocity of the van when it is pushed forward by the collision.

Show clearly how you work out your answer.

_____

_____

_____

Velocity =_____ m/s forward

(2)

(Total 7 marks)

Q33.

(a) The total stopping distance of a car has two parts. One part is the distance the car travels during the driver's reaction time. This distance is often called the 'thinking distance'.

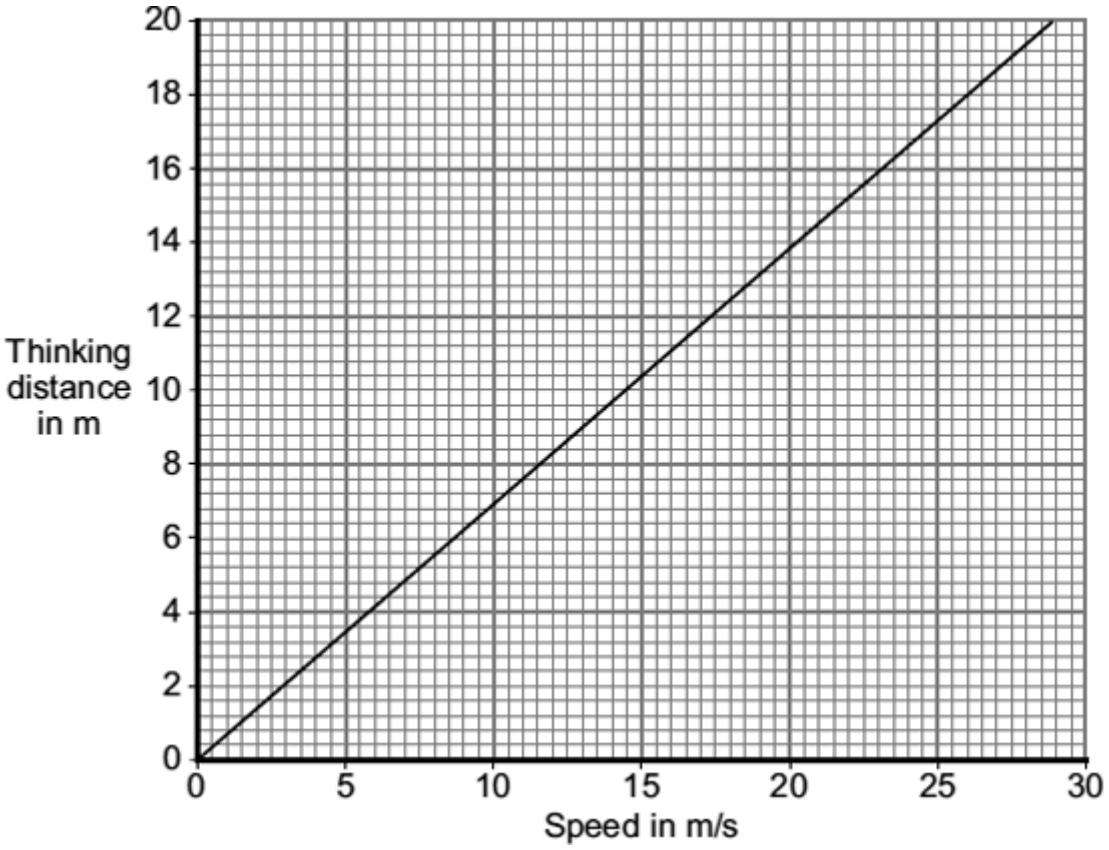
What distance is added to the 'thinking distance' to give the total stopping distance?

_____

_____

(1)

(b) The graph shows the relationship between the speed of a car and the thinking distance.



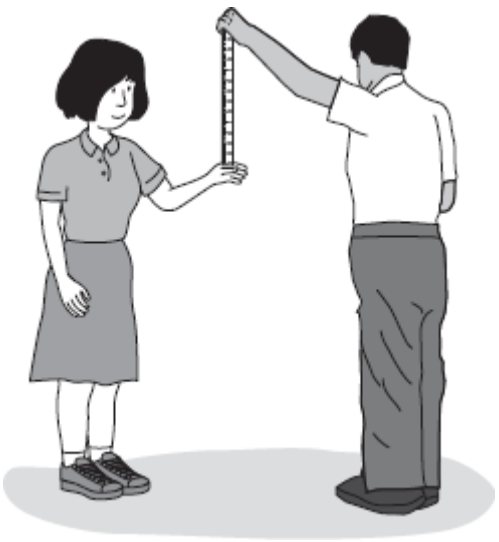
Describe the relationship between speed and thinking distance.

_____

_____

(2)

(c) The diagram shows two students investigating reaction time.



One student holds a 30 cm ruler, then lets go. As soon as the second student sees the ruler fall, she closes her hand, stopping the ruler. The further the ruler falls before being stopped, the slower her reaction time.

(i) One student always holds the ruler the same distance above the other student's hand.
In this experiment, what type of variable is this?

Put a tick (✓) in the box next to your answer.

independent variable ☐

dependent variable ☐

control variable ☐

(1)

(ii) Describe how this experiment could be used to find out whether listening to music affects reaction time.

_____

_____

_____

_____

(2)

(d) The following information is written on the label of some cough medicine.

WARNING: Causes drowsiness. Do not drive or operate machinery.

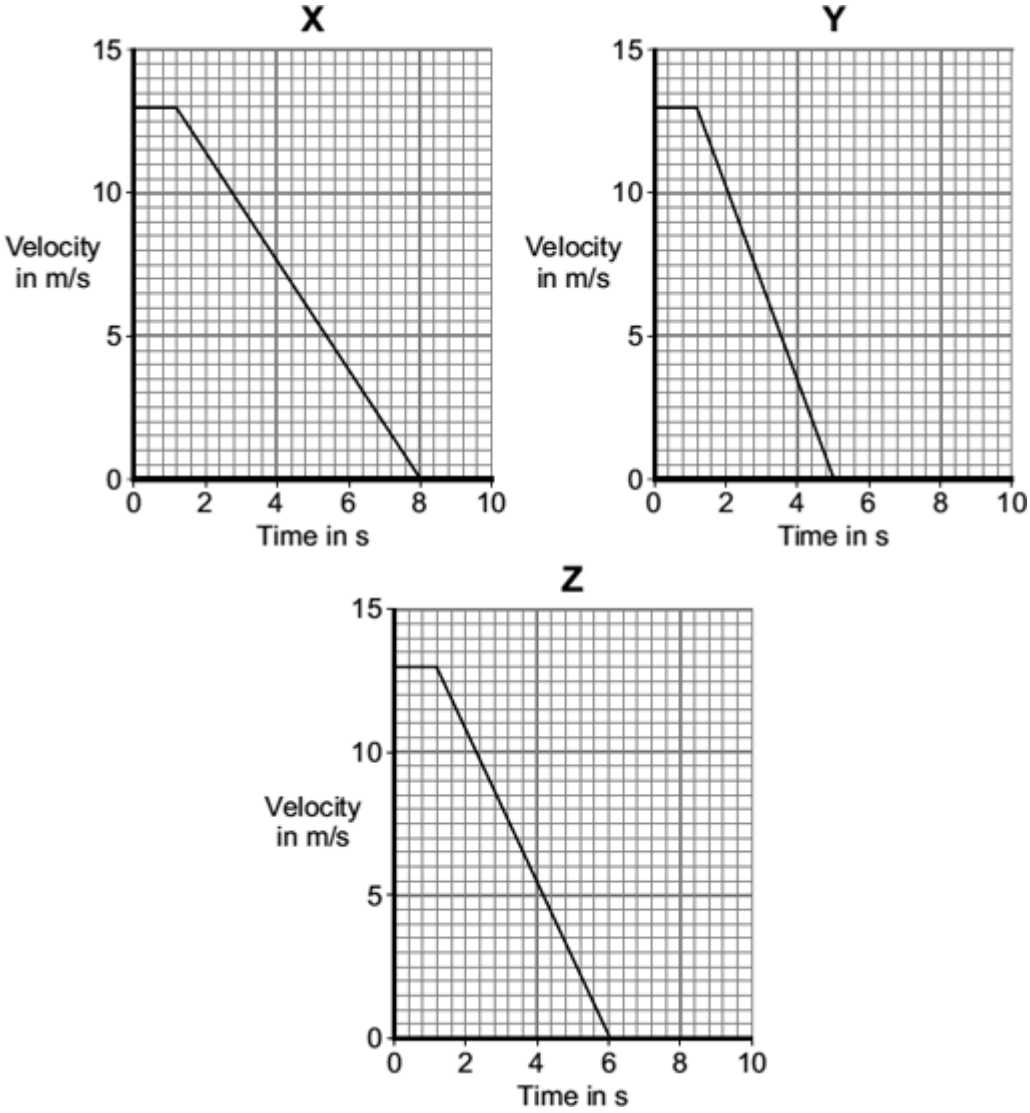
How is feeling drowsy (sleepy) likely to affect a driver's reaction time?

_____

_____

(1)

(e) Three cars, **X**, **Y** and **Z** , are being driven along a straight road towards a set of traffic lights.
The graphs show how the velocity of each car changes once the driver sees that the traffic light has turned to red.



Which one of the cars, **X**, **Y** or **Z** , stops in the shortest distance?

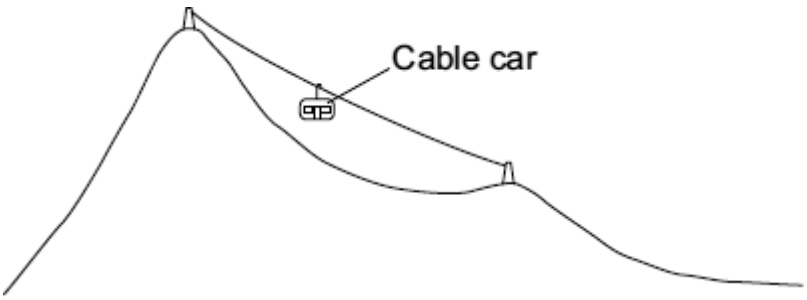
_____

(1)

(Total 8 marks)

Q34.

(a) The diagram shows a cable car used to take skiers to the top of a mountain.



(i) The total mass of the cable car and skiers is 7500 kg.

Calculate the weight of the cable car and skiers.

gravitational field strength = 10 N/kg

Show clearly how you work out your answer and give the unit.

_____

_____

Weight = _____

(3)

(ii) The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Calculate the work done to lift the cable car and skiers.

Show clearly how you work out your answer.

_____

_____

Work done = _____ J

(2)

(b) The diagram shows a skier who is accelerating down a steep ski slope.

(i) Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

(1)

(ii) How and why does the kinetic energy of the skier change?

_____

_____

_____

_____

(2)

(c) Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet. However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

_____

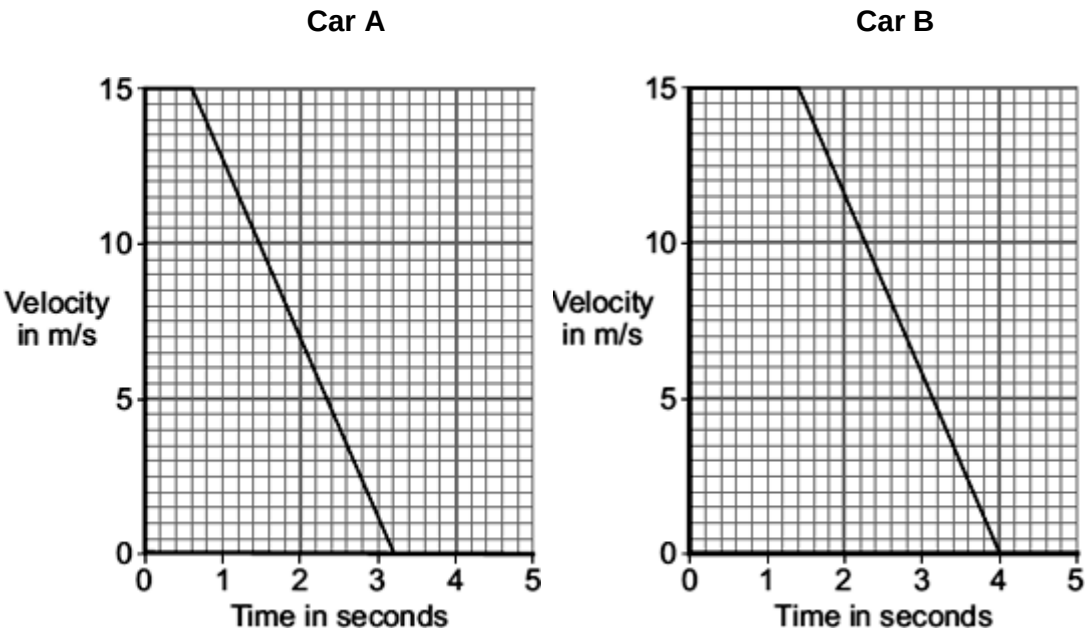
_____

(1)

(Total 9 marks)

Q35.

(a) The graphs show how the velocity of two cars, **A** and **B**, change from the moment the car drivers see an obstacle blocking the road.



One of the car drivers has been drinking alcohol. The other driver is wide awake and alert.

(i) How does a comparison of the two graphs suggest that the driver of car **B** is the one who has been drinking alcohol?

_____

_____

(1)

(ii) How do the graphs show that the two cars have the same deceleration?

_____

_____

(1)

(iii) Use the graphs to calculate how much further car **B** travels before stopping compared to car **A**.

Show clearly how you work out your answer.

_____

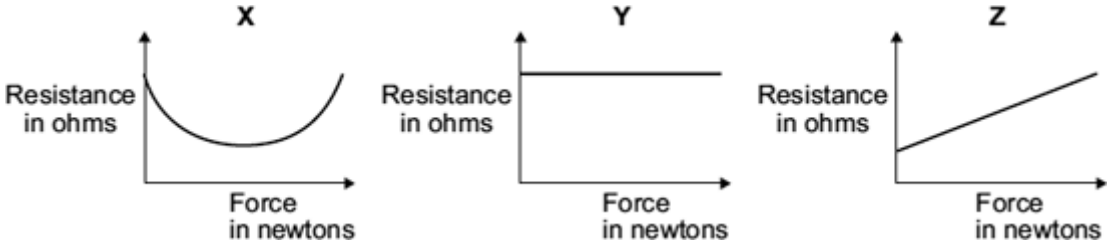
_____

_____

Additional stopping distance = _____ m

(3)

(b) In a crash test laboratory, scientists use sensors to measure the forces exerted in collisions. The graphs show how the electrical resistance of 3 experimental types of sensor, **X**, **Y** and **Z**, change with the force applied to the sensor.



Which of the sensors, **X**, **Y** or **Z**, would be the best one to use as a force sensor?

_____

Give a reason for your answer.

_____

_____

_____

_____

(2)

(Total 7 marks)

Mark schemes

Q1.

(a) more streamlined

accept decrease surface area

1

air resistance is smaller (for same speed)

accept drag for air resistance

friction is insufficient

1

so reaches a higher speed (before resultant force is 0)

ignore reference to mass

1

(b) (i) 1.7

*allow **1** mark for correct method, ie* $\frac{5}{3}$

***or** allow **1** mark for an answer with more than 2 sig figs that rounds to 1.7*

***or** allow **1** mark for an answer of 17*

2

(ii) 7.5

*allow **1** mark for correct use of graph, eg* $\frac{1}{2} \times 5 \times 3$

2

(iii) air (resistance)

accept wind (resistance)

drag is insufficient

friction is insufficient

1

[8]

Q2.

(a) 96 (m)

1

(b) (i) similar shape curve drawn <u>above</u> existing line going <u>through (0,0)</u>

*allow **1** mark for any upward smooth curve or straight upward line <u>above</u> existing line going through (0,0)*

2

(ii) Rain on the road

1

(c) (i) all three lines correctly labelled

*allow **1** mark for one correctly labelled*

top line – **C**

accept 1.2

middle line – **B**

accept 0.9

bottom line – **A**

accept 0.7

2

(ii) any **two** from:

- (table has) both variables are together
  accept tired and music as named variables
- both (variables) could / would affect the reaction time
  accept cannot tell which variable is affecting the drive (the most)
- cannot tell original contribution
- need to measure one (variable) on its own
  accept need to test each separately
- need to control one of the variables
  fair test is insufficient

2

[8]

Q3.

(a) **D** – **E**

reason only scores if D – E chosen

1

shallowest slope / gradient

accept smallest distance in biggest time
accept longest time to travel the same distance
accept the line is not as steep
accept it is a less steep line
*do **not** accept the line is not steep*

1

(b) 80 000

*allow **1** mark for correct substitution, ie 16 000 × 5 provided no subsequent step shown*

2

(c) (i) straight line starting at origin

accept within one small square of the origin

1

passing through t = 220 and d = 500

1

(i) 186

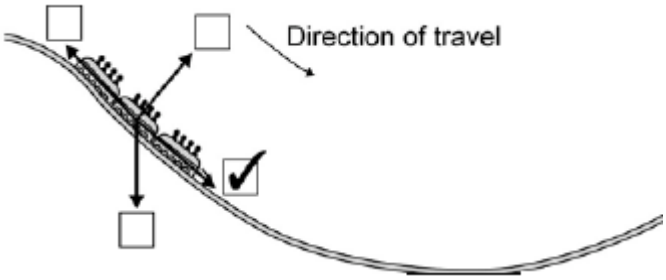
accept any value between 180 and 188
accept where their line intersects given graph line correctly read ±4 s

1

[7]

Q4.

(a) correct box ticked



1

(b) (i) 30

ignore added units

1

(ii) 2250 **or** their (b)(i) × 75 correctly calculated

*allow **1** mark for correct substitution ie 75 × 30 **or** their (b)(i) × 75 provided no subsequent step shown*

*an answer of 750 gains **1** mark only if answer to (b)(i) is 10*

2

[4]

Q5.

(a) (i) longer reaction time

accept slower reactions

*do **not** accept slower reaction time unless qualified*

or

greater thinking distance

accept greater thinking time

or

greater stopping distance

accept greater stopping time

greater braking distance negates answer

1

(ii) lines / slopes have the same gradient

accept slopes are the same

or

velocity decreases to zero in same time / in 2.6 seconds

accept any time between 2.4 and 2.8

accept braking distances are the same

1

(iii) 12

*accept extracting both reaction times correctly for **1** mark (0.6 and 1.4)*

or

*time = 0.8 (s) for **1** mark*

*accept 0.8 × 15 for **2** marks*

*accept calculating the distance travelled by car **A** as 28.5 m*

or
*the distance travelled by car **B** as 40.5 m for **2** marks*

3

(b) **Z**

1

different force values give a unique / different resistance

*only scores if **Z** chosen*

*do **not** accept force and resistance are (directly) proportional*

*accept answers in terms of why either **X** or **Y** would not be best eg*

***X** – same resistance value is obtained for 2 different force values*

***Y** – all force values give the same resistance*

1

[7]

Q6.

(a) (i) momentum before = momentum after

accept no momentum is lost

accept no momentum is gained

or
(total) momentum stays the same

1

(ii) an external force acts (on the colliding objects)

accept colliding objects are not isolated

1

(b) (i) 9600

allow 1 mark for correct calculation of momentum before or after ie 12000 or 2400
or
correct substitution using change in velocity = 8 m/s
ie 1200 × 8

2

kg m/s
or
Ns

this may be given in words rather than symbols
*do **not** accept nS*

1

(ii) 3 or their (b)(i) 3200 correctly calculated

allow 1 mark for stating momentum before = momentum after

or

clear attempt to use conservation of momentum

2

[7]

Q7.

(a) any **two** from:

- (acceleration occurs when) the direction (of each capsule) changes
- velocity has direction
- acceleration is (rate of) change of velocity

2

(b) to(wards) the centre (of the wheel)

1

(c) the greater the radius / diameter / circumference (of the wheel) the smaller the (resultant) force (required)

accept 'the size' for radius
both parts required for the mark

1

[4]

Q8.

(a) 1800 (N)

*allow **1** mark for correct substitution ie 180 × 10 provided no further steps shown*

2

(b) 3780
or
their (a) × 2.1 correctly calculated

*allow **1** mark for correct substitution*
*ie 1800 **or** their (a) × 2.1 provided no further steps shown*

2

joule

accept J
accept any clear indication of correct answer

1

(c) 0

reason does not score if 0 not chosen

1

work is only done when a force makes an object move

accept distance moved is zero
accept no energy transfer (to the bar)
accept the bar is not moving/is stationary
'it' refers to the bar/weights

1

[7]

Q9.

(a) (i) 24

*allow **1** mark for converting time to 600 seconds*
***or** showing method ie 14400/10*

$\frac{14400}{10 \times 60}$

or

provided no further steps shown

2

(ii) 24

ignore any unit

or

their (a)(i)

1

(b) (i) 20 45

both *required – either order*

1

(ii) the block transfers energy to the surroundings

1

[5]

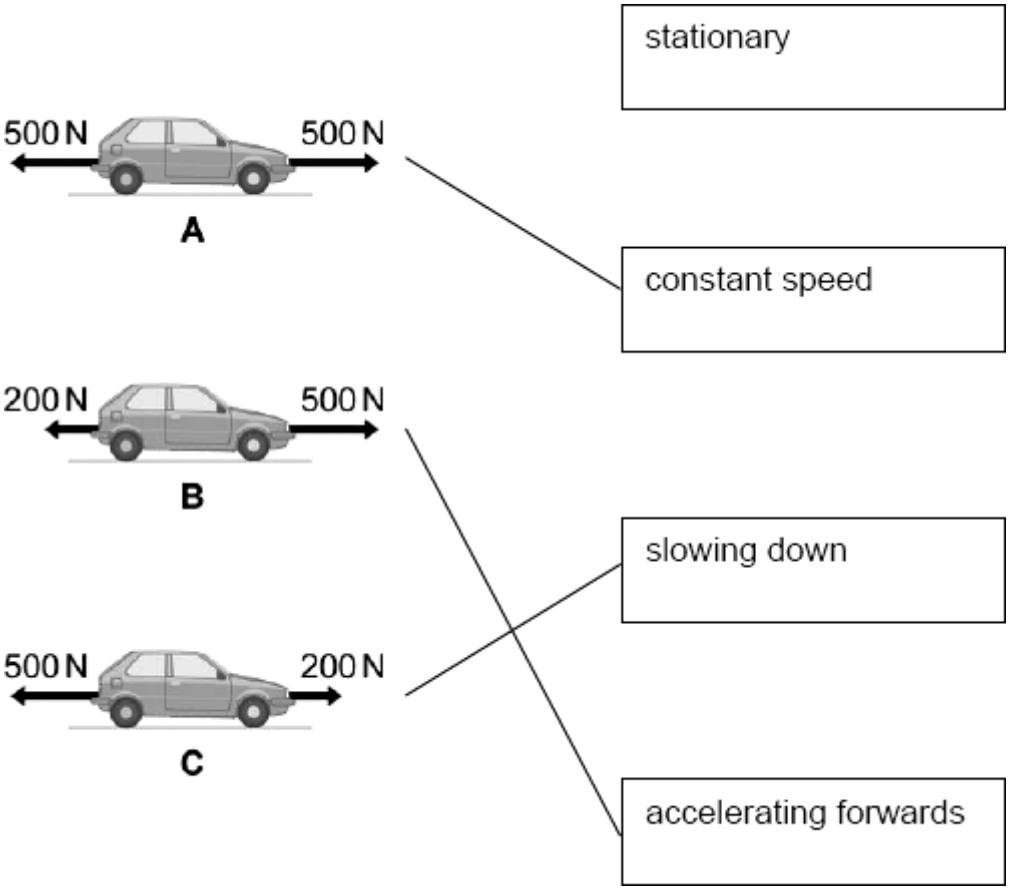
Q10.

(a) *3 lines drawn*

all correct

*allow **1** mark for each correct line*

if two or more lines are drawn from any diagram then all these lines are incorrect



3

(b) (i) horizontal arrow to the right

judge by eye

accept an arrow drawn outside the box if it is labelled correctly

1

(ii) horizontal arrow to the left

judge by eye

accept an arrow drawn outside the box if it is labelled correctly

1

(iii) equal to

1

(iv) to measure the forces exerted on the dummy during the impact

1

[7]

Q11.

(a) **A** constant speed / velocity

accept steady pace

*do **not** accept terminal velocity*

*do **not** accept stationary*

1

B acceleration

accept speeding up

1

C deceleration

accept slowing down

accept accelerating backwards

accept accelerating in reverse

*do **not** accept decelerating backwards*

1

(b) (i) the distance the car travels under the braking force

accept braking <u>distance</u>

1

(ii) speed/velocity/momentum

1

(c) (i) 5000 (N) to the left

***both** required*

accept 5000(N) with the direction indicated by an arrow drawn pointing to the left

accept 5000(N) in the opposite direction to the force of the car (on the barrier)

accept 5000(N) towards the car

1

(ii) to measure/detect forces exerted (on dummy / driver during the collision)

1

(iii) 4

*allow **1** mark for showing a triangle drawn on the straight part of the graph*

***or** correct use of two pairs of coordinates*

2

m/s^2

*do **not** accept mps^2*

1

[10]

Q12.

(a) (i) horizontal arrow pointing to the left

judge by eye

drawn anywhere on the diagram

1

(ii) 60 (N)

1

(at steady speed) resultant force must be zero

accept forces must balance/are equal

accept no acceleration

*do **not** accept constant speed*

1

(b) 1680

*allow **1** mark for correct substitution, ie 60 x 28 provided no subsequent step shown*

2

joule

accept J

do not accept j

1

[6]

Q13.

(a) (i) **B C**

either order

1

(ii) elastic <u>potential</u> (energy)

accept strain for elastic

1

(b) (i) *mark both parts together*

1

measured / recorded the length of the spring (and not extension)

*accept measured **A–C** (and not **B–C**)*

accept did not work out/measure the extension

extension does not equal zero when force = 0

accept line should pass through the origin

1

(ii) point marked at 5.5 (N)

accept any point between 5.0 and 5.6 inclusive

1

up to that point force and extension are (directly) proportional

accept it's at the end of the straight part (of the graph line)

accept past that point force and extension are no longer (directly) proportional

accept the line starts to curve

1

(c) 1.8

*allow **1** mark for correct substitution, ie 25 x 0.072 provided no subsequent step shown*

*an answer 1800 gains **1** mark*

*an incorrect conversion from mm to m with a subsequent correct calculation gains **1** mark*

2

[8]

Q14.

(a) 750

*allow **1** mark for correct substitution, ie 75 × 10 provided no subsequent step shown*

2

newton(s) / N

*do **not** accept n*

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the Marking Guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a brief attempt to explain why the velocity / speed of the parachutist changes.
or
the effect of opening the parachute on velocity/speed is given.

Level 2 (3-4 marks)
The change in velocity / speed is clearly explained in terms of force(s)
or
a reasoned argument for the open parachute producing a lower speed.

Level 3 (5-6 marks)
There is a clear and detailed explanation as to why the parachutist reaches terminal velocity
and
a reasoned argument for the open parachute producing a lower speed

examples of the physics points made in the response to explain first terminal velocity

- on leaving the plane the only force acting is weight (downwards)

  accept gravity for weight throughout

- as parachutist falls air resistance acts (upwards)

accept drag / friction for air resistance

- weight greater than air resistance
  or
  resultant force downwards

- (resultant force downwards) so parachutist accelerates

- as velocity / speed increases so does air resistance

- terminal velocity reached when air resistance = weight
  accept terminal velocity reached when forces are balanced

to explain second lower terminal velocity

- opening parachute increases surface area

- opening parachute increases air resistance

- air resistance is greater than weight

- resultant force acts upwards / opposite direction to motion

- parachutist decelerates / slows down

- the lower velocity means a reduced air resistance

air resistance and weight become equal but at a lower (terminal) velocity

6

(c) (i) any **one** from:

- mass of the (modelling) clay
  accept size/shape of clay size/amount/volume/shape of clay
  accept plasticine for (modelling)clay

- material parachute made from
  accept same (plastic) bag

- number / length of strings

1

(ii) **C**

*reason only scores if **C** is chosen*

1

smallest (area) so falls fastest (so taking least time)

accept quickest/quicker for fastest

*if **A** is chosen with the reason given as 'the largest area so falls slowest' this gains **1** mark*

1

[12]

Q15.

(a) (i) 720

*allow **1** mark for correct substitution,*

ie 72 × 10 provided no subsequent step shown

2

(ii) 720
or
their (a)(i)

1

(b) (i) gravitational potential
allow gravitational
allow potential

1

(ii) 432

*allow **1** mark for correct substitution, ie* $\frac{21600}{50}$ *provided no subsequent step shown*

2

watt / W

1

[7]

Q16.

(a) **B**

reason only scores if B is chosen

1

gradient / slope is the steepest / steeper
answers must be comparative
accept steepest line
ignore greatest speed

1

(b) (velocity includes) direction
'it' refers to velocity

1

[3]

Q17.

(a) 2.75

*allow **1** mark for correct substitution, ie* $\frac{11}{4}$
or $\frac{23-12}{4}$
provided no subsequent step shown

2

m/s^2

1

(b) driving force increases

1

frictional force increases
accept air resistance / drag for frictional force

1

driving force > frictional force

1

[6]

Q18.

(a) (i) (connect) 30 (cells)

1

in series

1

(ii) current always flows in the same direction
or
current only flows one way

1

(iii) 36 000

*allow **1** mark for correctly converting 2 hours to 7200 seconds*

*answers 10 or 600 score **1** mark*

2

coulombs / C

*do **not** accept c*

1

(b) (i) 2160

*allow **1** mark for correct substitution, ie ½ × 120 × 6^2*

*answers of 1620 or 540 score **1** mark*

2

(ii) reduce it

1

any **one** from:

- draws a larger current (from battery)
- motor draws greater power (from battery)
  accept energy per second for power
  accept more energy needed to move the bicycle
- greater resistance force (to motion) / air resistance / drag / friction
  accept less streamlined
  more mass to carry is insufficient

1

[10]

Q19.

(a) (moving in) different / opposite directions

accept one has positive momentum the other negative momentum

accept they have different velocities

1

(b) (i) momentum before = momentum after

or
(total) momentum stays the same

accept no momentum is lost

accept no momentum is gained

1

(ii) 2.2

*allow **1** mark for calculation of teenagers' momentum as 22 (kgm/s) and*

*allow **1** mark for correct statement, eg momentum before = momentum after*

or

*allow **2** marks for a numerical expression of above, eg*

55 × 0.4 = m × 10

***or** 0 = (55 × 0.4) + (m × (-10))*

3

(c) any **two** from:

- work is done
- (against) friction

  any reference to increasing friction negates this marking point
- (transforming) (kinetic) energy into heat

2

[7]

Q20.

Resource currently unavailable

Q21.

(a) (i) 12

1

(ii) 0.2

*allow **1** mark for their (a)(i) ÷ 60 and correctly calculated*

1

m/s^2

accept correct unit circled in list

accept ms^{-2}

*do **not** accept mps^2*

1

(b) **B**

1

[4]

Q22.

(a) (i) 16 000

*allow **1** mark for correct substitution ie 3200 × 5*

2

(ii) 16 000 or their (a)(i)

1

(iii) less than

1

(b) increases

1

decreases

correct order only

1

[6]

Q23.

(a) (i) 120

1

(ii) 20

accept 140–their (a)(i) provided answer is not negative

1

(iii) as speed increases

1

drag force / water resistance / friction / **D** increases

1

(until) **D** = 140 N or (until) **D** = **T**

forces balance is insufficient

1

(b) (i) (average) speed (of swimmer)

1

(ii) any **two** from:

- more data
  accept results for data
  *do **not** accept more accurate data*
- force may vary (a lot) / change
- give more <u>reliable average</u>
  ignore references to anomalies
  ignore accurate / precise

2

(iii) examples of acceptable responses:

- most / some females produce smaller forces
  *do **not** accept <u>all</u> females produce smaller forces*

- most / some males produce larger forces
  *do **not** accept all males produce larger forces*
- some females swim as fast as males but use a smaller force
- most of the faster swimmers are male
  *do **not** accept all males swim faster*
- most of the slower swimmers are female
  *do **not** accept all females swim slower*
- range of the (average) speed of males is smaller than the range of the (average) speed of females
- range of the (average) force of the males is greater than the range of the (average) force of the females

1

(iv) exert maximum (hand) force (throughout the swim / stroke)

accept (any method to) increase (hand) force

practise more is insufficient

1

[10]

Q24.

(a) direction

1

(b) 54 000

*allow **1** mark for calculating and identifying momentum as 10 800*

or

*allow **1** mark for correct substitution into second equation*

ie $\frac{1200 \times 9}{0.2}$

2

(c) increases the time taken (for head) to stop

accept increases impact time

*do **not** accept reference to slowing down time unless qualified*

1

decreases rate of change in momentum

accept reduces acceleration / deceleration

*accept increases the time taken to reduce momentum to zero is worth **2** marks*

reduces momentum is insufficient

1

reduces the force (on the head)

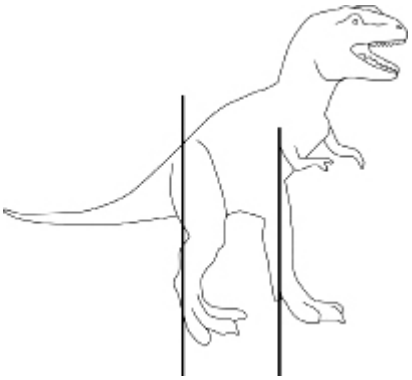
1

[6]

Q25.

(a) (i) centre of **X** above the feet and in the body

*a vertical line from their **X** falls between two lines in diagram - judged by eye*



1

(ii) where the mass seems to be concentrated

accept it's above the base (area)

accept because otherwise it would topple

accept line of action (of weight) passes through the base

*do **not** accept where the mass is concentrated*

1

(b) any **two** from:

- make (the area of) feet / base bigger
- make feet wider apart
- makes legs shorter / heavier
- make head smaller / lighter
- make tail touch the ground / make the tail longer

accept 'make centre of mass / gravity lower'

2

[4]

Q26.

(a) (i) lorry

reason only scores if lorry chosen

1

greatest mass

accept weight for mass

accept heaviest

accept correct calculations for all 3 vehicles

the biggest is insufficient

1

(ii) 2450

*allow **1** mark for correct substitution*

ie 175 × 14

2

(b) (i) increases

accept any clear indication of the correct answer

1

(ii) speed increases

accept velocity for speed

accept gets faster

*do **not** accept it accelerates on its own*

moves more is insufficient

1

(iii) straight line going to 6, 20

*allow **1** mark for a curve going to 6,20*

***or** a straight line diagonally upwards but missing 6,20*

2

horizontal line from 6,20 to 8,20

*allow a horizontal line from where their **diagonal** meets 20m/s to 8,20*

1

[9]

Q27.

(a) The driver has been drinking alcohol.

reason only scores if this box is ticked

1

driver's reaction time increases

accept slower reactions

accept slower reaction time

or

thinking distance / stopping distance increases

do not accept braking distance increases

or

driver less alert

accept driver may fall asleep / be tired

1

(b) they are all variables that could affect outcome / results

accept specific effect of changing one of the variables

accept to make the test valid

ignore reliable

1

so data / barriers can be compared

accept to see which is / works best / safest

*do **not** accept fair test on its own*

1

(c) ticks in both the top <u>and</u> middle boxes

1

[5]

Q28.

(a) 572

*allow **1** mark for correct substitution,*

ie 220 × 2.6

*allow **1** mark for*

220 × 260 = 57 200

or

220 × 2600 = 572 000

but to score this mark the entire calculation must be shown

2

(b) (i) smooth curve drawn

accept a line that is extrapolated back to 0 degrees, but not through the origin

accept a straight line of best fit (point at 40 degrees can be treated as anomalous and line may stop at 30 degrees)

*do **not** accept straight lines drawn 'dot to dot' or directly from first to last point or a line going through the origin*

1

(ii) increases

accept a positive correlation

*do **not** accept proportional*

1

(iii) long plank

no mark for this, the marks are for the explanation

makes the angle small(er) (than a short plank)

accept increases the distance

accept small(er) slope

1

a small(er) force is needed

or

short plank

no mark for this, the marks are for the explanation

a large(r) force is used over a short(er) distance (1)

less work done (1)

accept less energy transfer

1

[6]

Q29.

(a) 48

*allow for **1** mark correct method shown, ie 6 × 8*

***or** correct area indicated on the graph*

2

(b) diagonal line from (0,0) to (6,48) / (6, their (a))

if answer to (a) is greater than 50, scale must be changed to gain this mark

1

horizontal line at 48m between 6 and 10 seconds

accept horizontal line drawn at their (a) between 6 and 10 seconds

1

[4]

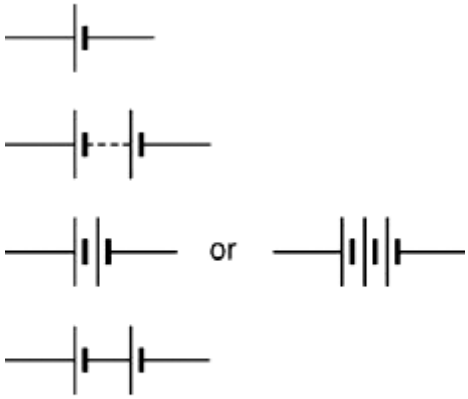
Q30.

(a) (i) ammeter and battery **in series** with the **gauge**

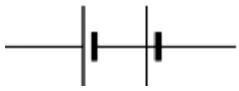
symbols must be correct

ignore a voltmeter drawn in series

accept



not



or cells reversed to cancel out

1

voltmeter in parallel with the gauge

symbol must be correct

accept a freestanding circuit

diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge

1

(ii) d.c. flows only in one direction

a.c. changes direction is insufficient

1

(b) (i) 75

this answer only

*allow **1** mark for correct substitution **and** transformation,*

ie resistance = $\frac{3.0}{0.040}$

2

(ii) increases

1

(iii) elastic / strain <u>potential</u>

*do **not** accept potential*

1

[7]

Q31.

(a) 96

*allow **1** mark for correct substitution*
ie 80 × 1.2

2

newton or N

allow Newton
*do **not** allow n*

1

(b) (i) direction

1

(ii) velocity <u>and</u> time are continuous (variables)

answers must refer to both variables
accept the variables are continuous / not categoric
accept the data / 'it' is continuous
accept the data / 'it' is not categoric

1

(iii) **C**

1

velocity is not changing

*the **2** marks for reason may be scored even if **A** or **B** are chosen*
accept speed for velocity
accept speed is constant (9 m/s)
*accept **not** decelerating*
*accept **not** accelerating*
accept reached terminal velocity

1

forces must be balanced

accept forces are equal
accept arrows are the same length / size

or

resultant force is zero

*do **not** accept the arrows are equal*

1

[8]

Q32.

(a) (i) momentum before = momentum after

or

(total) momentum stays the same

accept no momentum is lost
accept no momentum is gained

1

(ii) an external force acts (on the colliding objects)

accept colliding objects are not isolated

1

(b) (i) 9600

*allow **1** mark for correct calculation of momentum before or after*

ie 12000 or 2400

or

correct substitution using change in velocity = 8 m/s

ie 1200 × 8

2

kg m/s

this may be given in words rather than symbols

or

Ns

1

(ii) 3 or their (b)(i) ÷ 3200 correctly calculated

*allow **1** mark for stating momentum before = momentum after*

or

clear attempt to use conservation of momentum

2

[7]

Q33.

(a) distance travelled under the braking force

accept braking (distance)

1

(b) (directly) proportional

accept a correct description using figures

or

increase in the same ratio

eg if speed doubles then

thinking <u>distance</u> doubles

*accept for **1** mark positive correlation*

*accept for **1** mark as speed*

increases so does thinking <u>distance</u>

accept as one increases the other increases

accept as thinking <u>distance</u> increases speed increases

2

(c) (i) control variable

1

(ii) experiment done, student listens to music / ipod (etc)

1

experiment (repeated), student not listening to music

for both marks to be awarded there must be a comparison

1

(d) increase it

accept an answer which implies reactions are slower

*do **not** accept answers in terms of thinking distance only*

1

(e) **Y**

1

[8]

Q34.

(a) (i) 75 000

*accept correct substitution for **1** mark*

ie 7500 × 10

2

newtons / N

*do **not** accept n*

*full credit for using g = 9.8 **or** 9.81*

1

(ii) 60 000 000

accept for both marks

their (a)(i) × 800 correctly calculated

*accept correct substitution for **1** mark*

ie their (a)(i) × 800

2

(b) (i) arrow drawn parallel (to) **and** down (the) slope

accept arrow drawn anywhere on the diagram

1

(ii) increases

1

GPE transformed to KE

or

speed increasing

accept is accelerating

however 'speed increasing' only scores if correctly linked to increasing kinetic energy

1

(c) so more likely to wear one

or

they know wearing a helmet is likely to / will reduce (risk) head injury

or

so can make an (informed) choice (about wearing one)

1

[9]

Q35.

(a) (i) longer reaction time

accept slower reactions

*do **not** accept slower reaction time unless qualified*

or

greater thinking distance

accept greater thinking time

or

greater stopping distance

accept greater stopping time

greater braking distance negates answer

1

(ii) lines / slopes have the same gradient

accept slopes are the same

or

velocity decreases to zero in same time / in 2.6 seconds

accept any time between 2.3 and 2.8

accept braking distances are the same

1

(iii) 12

*accept extracting both reaction times correctly for **1** mark*

*(0.6 and 1.4) **or** time = 0.8(s) for **1** mark*

*accept 0.8 × 15 for **2** marks*

accept calculating the distance

*travelled by car **A** as 28.5 m **or** the distance travelled by car **B** as 40.5 m for **2** marks*

3

(b) **Z**

1

different force values give a unique / different resistance

*only scores if **Z** chosen*

*do **not** accept force andresistance are (directly) proportional*

accept answers in terms of why

*either **X or Y** would not be the best eg*

***X** – same resistance value is obtained for 2 different force values*

***Y** – all force values give the same resistance*

1

[7]