Q1.

(a) A driver may have to make an emergency stop.

Stopping distance = thinking distance + braking distance.

Give **three** different factors which affect the thinking distance or the braking distance. In your answer you should explain what effect **each** factor has on the stopping distance.

1. ....

....

....

....

2. ....

....

....

....

3. ....

....

....

....

(6)

(b) Complete the following sentences by writing in the **two** missing words.

Acceleration is the rate of change of ....

The acceleration of a car depends on the force applied by the engine and the

.... of the car.

(2)

(c) A car moves because of the force applied by the engine.

Name **two** other forces which act on the car when it is moving. Give the direction in which **each** of these factors acts.

1. Name of force ....

   Direction of this force ....

2. Name of force ....

   Direction of this force ....

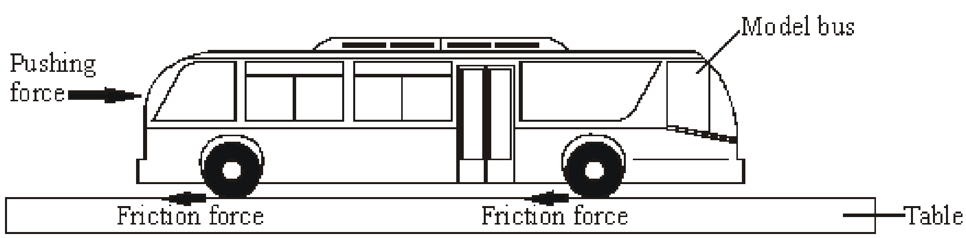
(4)

(d) Complete the following sentence by writing in the missing word.

The velocity of a car is its speed in a particular ....

(1)
(Total 13 marks)

Q2. (a) The model bus is being pushed on a table.



(i) At first the pushing force does **not** make the model bus move. Explain why.

....

....

(1)

(ii) Write down **two** things that happen as the pushing force increases.

1 ....

....

2 ....

....

(2)

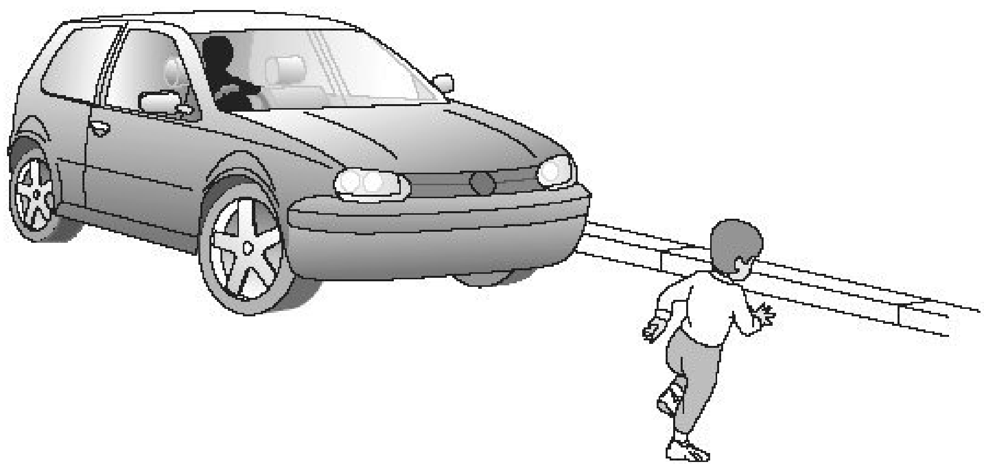
(iii) Complete the formula by choosing the correct words from the box.

acceleration **distance moved** **force applied**	
speed **time taken**	

Work done on the model bus = ... × ....

(2)

(b) In this situation, the car driver needs to stop the car in the shortest possible distance.



(i) Complete the table by putting ticks (✓) to show which factors would make the stopping distance greater. The first one has been done for you.

Factor	**Tick (✓) makes stopping distance greater**
brakes are old and worn	✓
car is travelling fast	
driver has been drinking alcohol	
four new tyres are fitted	
hot, dry, sunny weather	
ice on the road	

(3)

(ii) Complete the sentence by writing the correct words in the spaces.

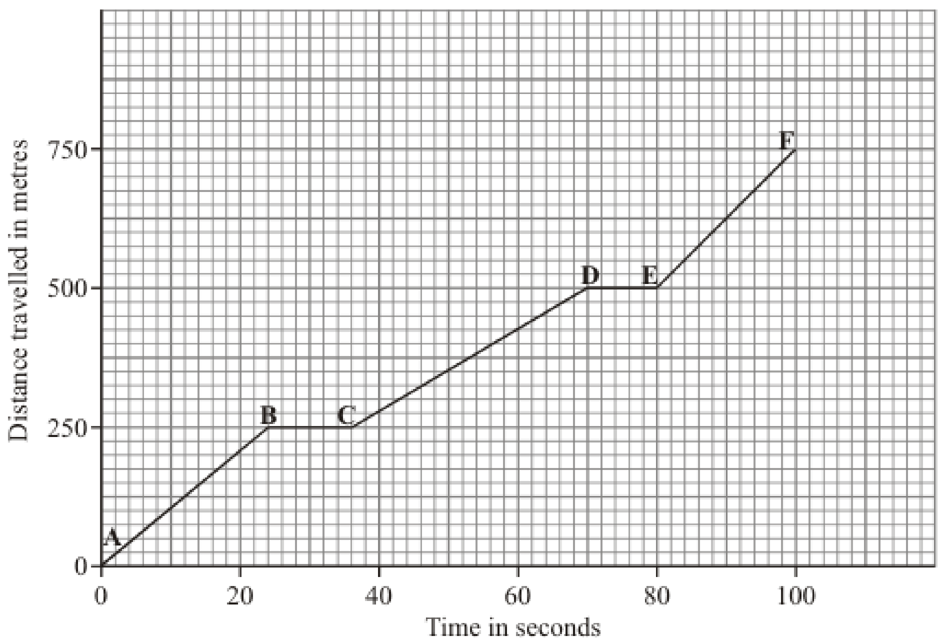
The car will skid if the braking force is too big compared with the friction between

the car's .... and the ....

(1)
(Total 9 marks)

Q3. This question is about a car travelling through a town.

(a) The graph shows how far the car travelled and how long it took.



(i) Between which points was the car travelling fastest? Tick (✓) your answer.

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

(1)

(ii) Between which points was the car stationary?

....

....

(1)

(b) Complete the sentences by writing the correct words in the spaces.

When a car has to stop, the **overall** stopping distance is greater if:

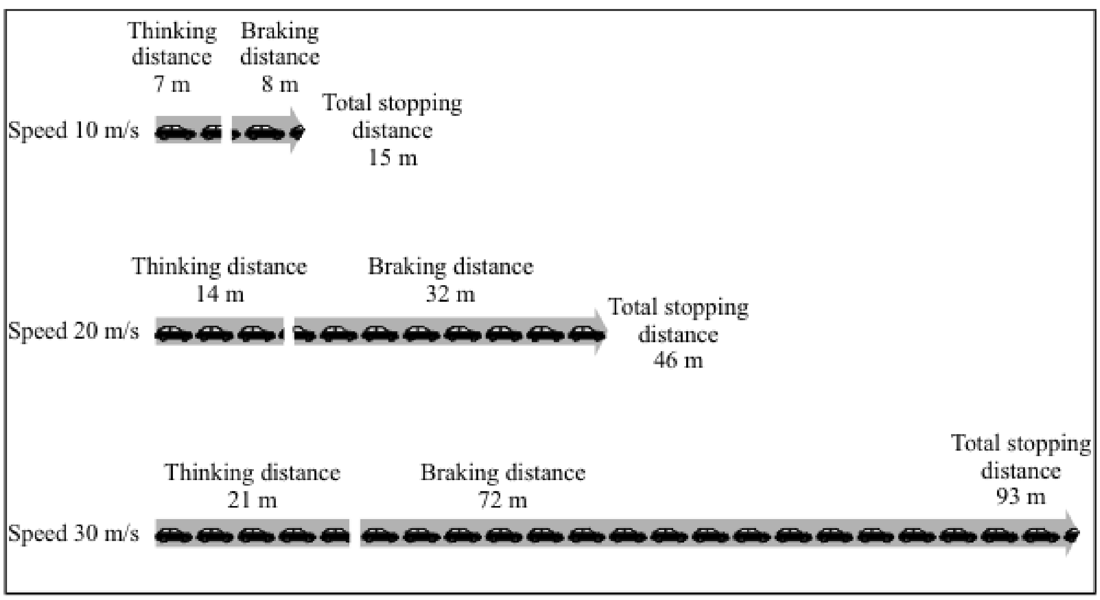
- the car is poorly maintained;
- there are adverse weather conditions;
- the car is travelling .... ;
- the driver's reactions are ....

Also, the greater the speed of the car, then the greater the braking ....

needed to stop in a certain time.

(3)
(Total 5 marks)

Q4. The diagram below shows the thinking distances, braking distances and total stopping distances at different speeds.



(a) Look at the total stopping distances at each speed.

Complete the sentence by choosing the correct words from the box.

distance	**force**	**mass**	**time**

The total stopping distance depends on the distance the car travels during the driver's reaction .... and under the braking ....

(2)

(b) Give **three** other factors that could cause the total stopping distance of a car to be greater.
Do **not** give the factors in **Figure 1.**

1 ....

....

2 ....

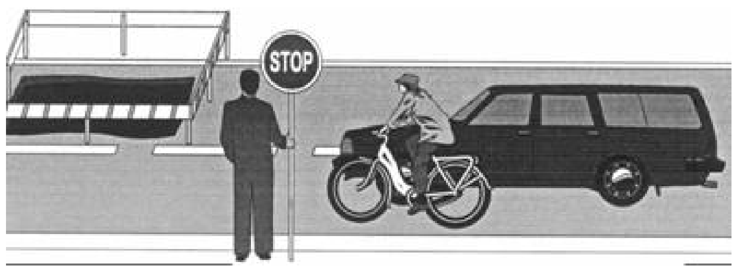
....

3 ....

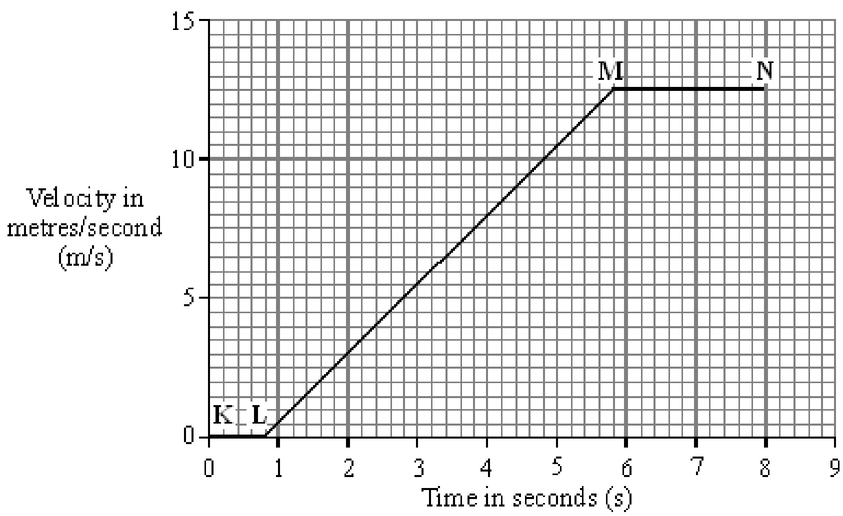
....

(3)
(Total 5 marks)

Q5. A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



(a) Between which two points on the graph is the car moving at constant velocity?

....

(1)

(b) Between which two points on the graph is the car accelerating?

....

(1)

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time = ... seconds

(1)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol ☐

Wet roads ☐

Worn car brakes ☐

(1)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

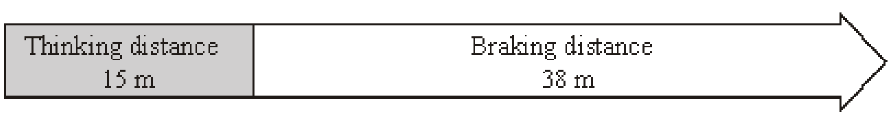
Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

(2)

(Total 6 marks)

Q6. (a) A car driver makes an emergency stop.

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



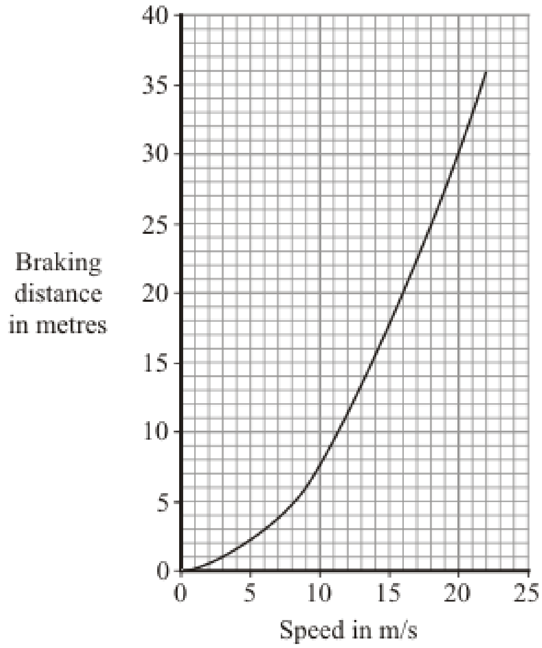
Calculate the total stopping distance of the car.

....

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 **two** of the following would also increase the braking distance of the car?

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

rain on the road ☐

the driver having drunk alcohol ☐

car brakes in bad condition ☐

the driver having taken drugs ☐

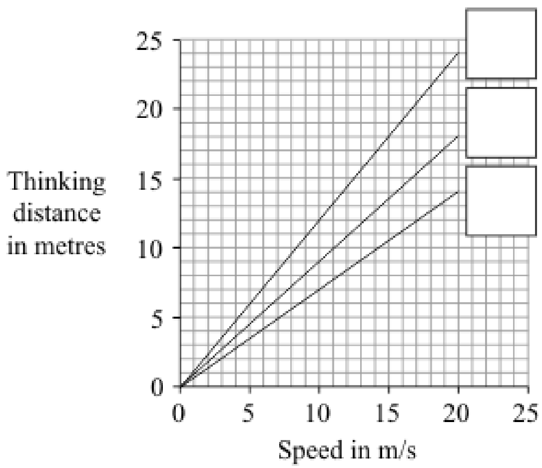
(2)

(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 seconds**
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 9 marks)

(i) How many hours does it take for the count rate to fall from 300 counts per minute to 150 counts per minute?

Time = ... hours

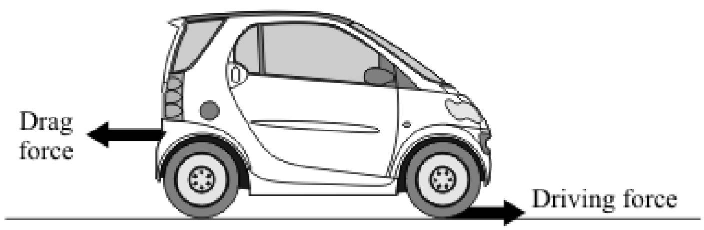
(1)

(ii) What is the half-life of technetium-99?

Half-life = ... hours

(1)
(Total 7 marks)

Q7. The diagram shows the horizontal forces acting on a car travelling along a straight road.



(a) Complete the following sentences by drawing a ring around the correct word in each box.

(i) When the driving force equals the drag force, the speed of the car is

decreasing
constant
increasing

(1)

(ii) Putting the brakes on transforms the car's kinetic energy mainly into

heat
light
sound

(1)

(b) The charts, **A**, **B** and **C** give the thinking distance and the braking distance for a car driven under different conditions.

(i) Draw straight lines to match each chart to the correct conditions.

Draw only **three** lines.

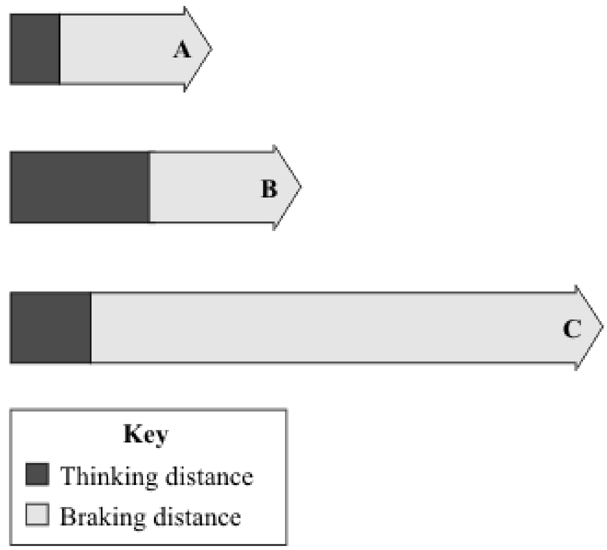
Conditions

Speed = 22 m/s
driver wide awake

Speed = 13 m/s
driver wide awake

Speed = 13 m/s
driver very tired

Charts



(2)

(ii) The three charts above all apply to dry road conditions.

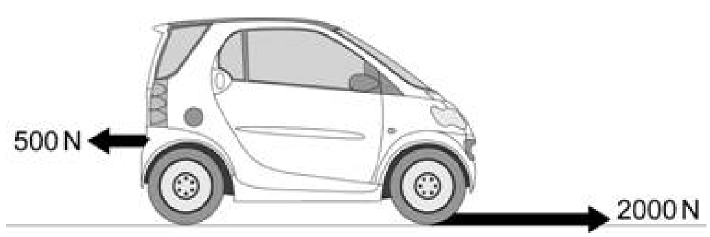
How would the braking distances be different if the road were wet?

....

....

(1)
(Total 5 marks)

Q8. (a) The diagram shows the horizontal forces acting on a car travelling along a straight road.



(i) Calculate the size of the resultant force acting on the car.

Show clearly how you work out your answer.

....

....

Resultant force = ... N

(2)

(ii) Describe the motion of the car when the forces shown in the diagram act on it.

....

....

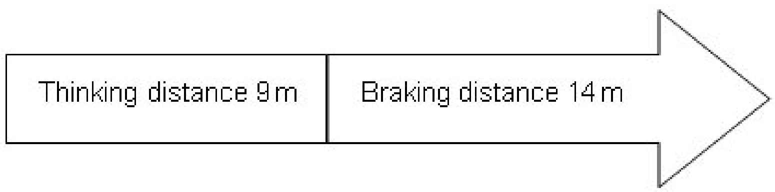
....

....

(2)

(b) A car driver makes an emergency stop.

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



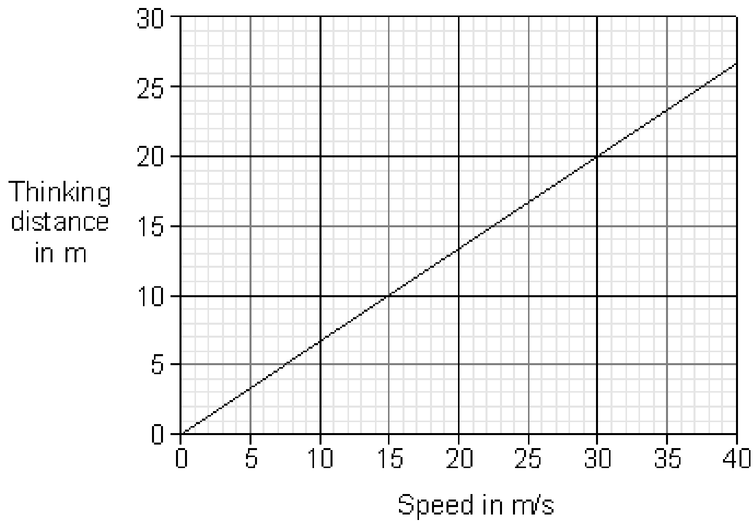
(i) Calculate the total stopping distance of the car.

....

Stopping distance = ... m

(1)

(ii) The graph shows that speed affects thinking distance.



Use the graph to find the thinking distance for a car driven at 30 m/s.

Thinking distance = ... m

(1)

(iii) Give **one** further factor that will affect the thinking distance.

....

(1)
(Total 7 marks)

Q9. (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'.

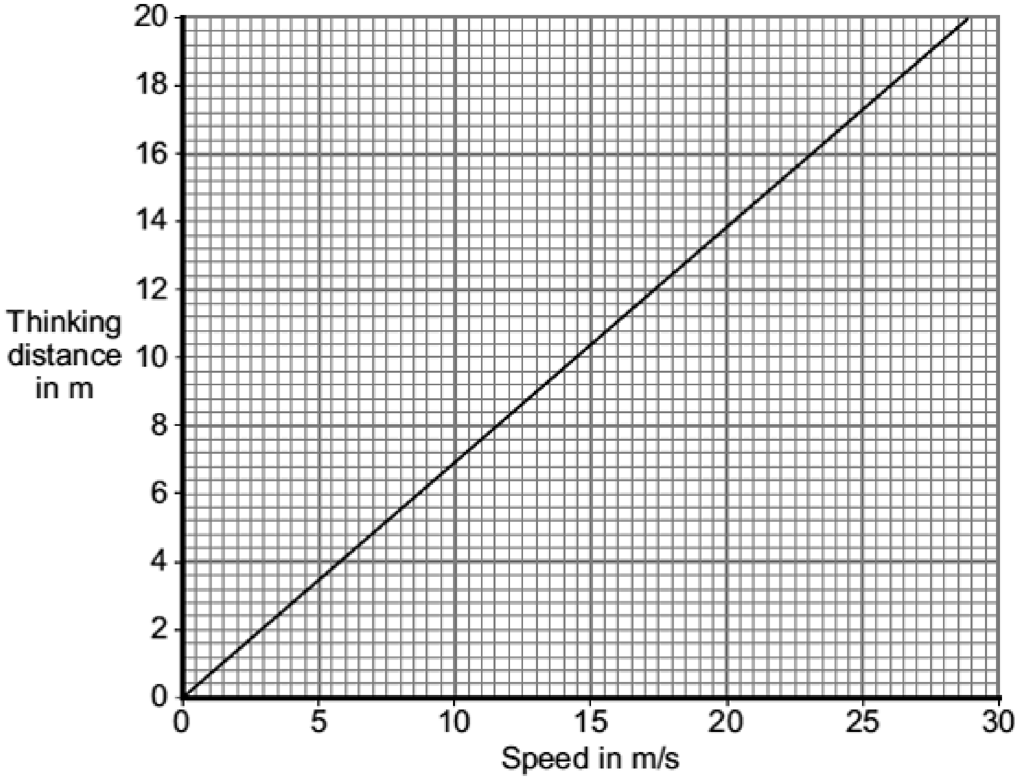
What distance is added to the 'thinking distance' to give the total stopping distance?

....

....

(1)

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



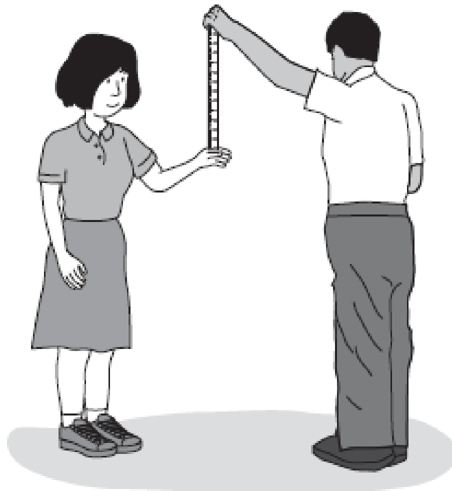
Describe the relationship between speed and thinking distance.

....

....

(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.

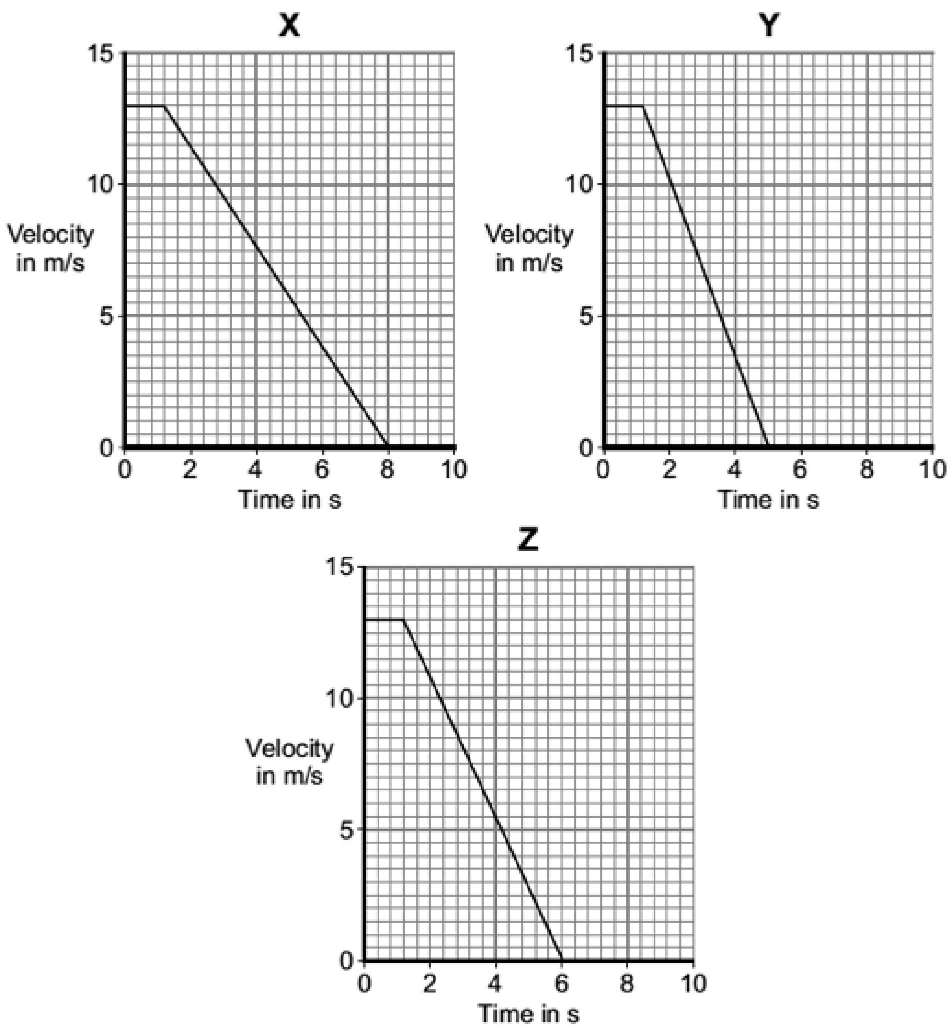
How is feeling drowsy (sleepy) likely to affect a driver's reaction time?

....

....

(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.

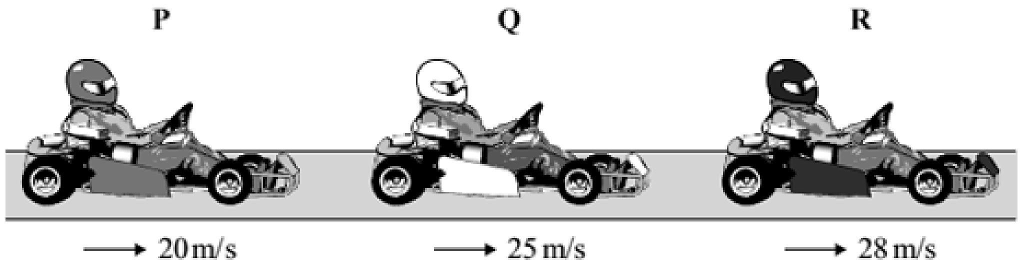


Which one of the cars, **X**, **Y** or **Z** , stops in the shortest distance?

....

(1)
(Total 8 marks)

Q10. (a) The diagram shows three identical go-karts, **P**, **Q** and **R**, travelling at different speeds along the straight part of an outdoor racetrack.



Which **go-kart**, **P**, **Q** or **R**, has the greatest momentum?

....

Give the reason for your answer.

....

....

(2)

(b) The total mass of go-kart **Q** and the driver is 130 kg.

(i) Use the equation in the box to calculate the total momentum of go-kart **Q** and the driver.

momentum = mass × velocity

Show clearly how you work out your answer.

....

....

Momentum = ...

(2)

(ii) Which of the following is the unit of momentum?

Draw a ring around your answer.

J/s	**kg m/s**	**Nm**

(1)

(c) To race safely at high speed, a go-kart driver must have fast reaction times and the outdoor racetrack should be dry.

(i) How would being tired affect a driver's reaction time?

....

(1)

(ii) How would a wet track affect the braking distance of a go-kart?

....

(1)
(Total 7 marks)

Q11. 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	☐

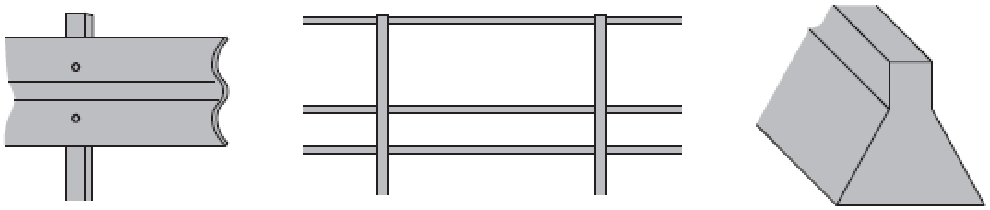
Give a reason for your answer.

....

....

(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. ☐

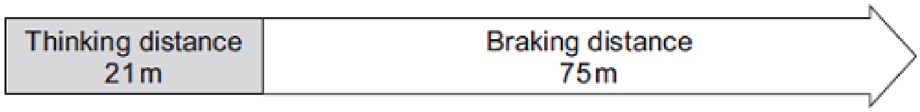
Data for different conditions can be obtained quickly. ☐

Simulations are more realistic than using cars and barriers. ☐

(1)
(Total 5 marks)

Q12. (a) A car driver makes an emergency stop.

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



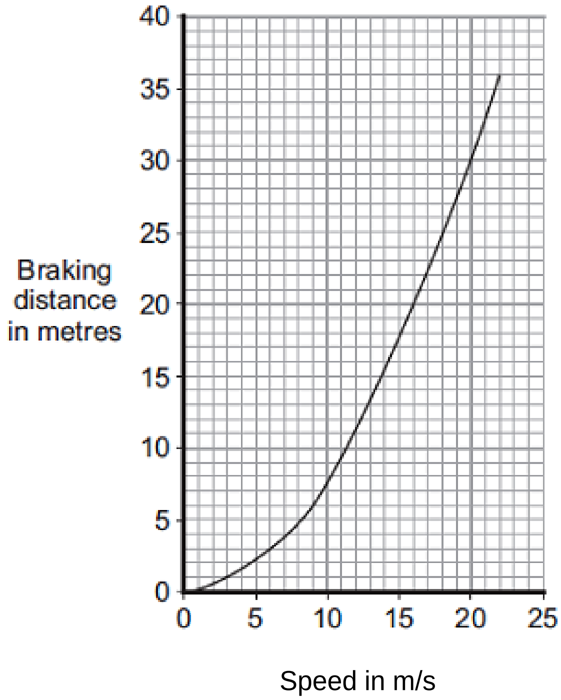
Calculate the total stopping distance of the car.

....

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 ☐

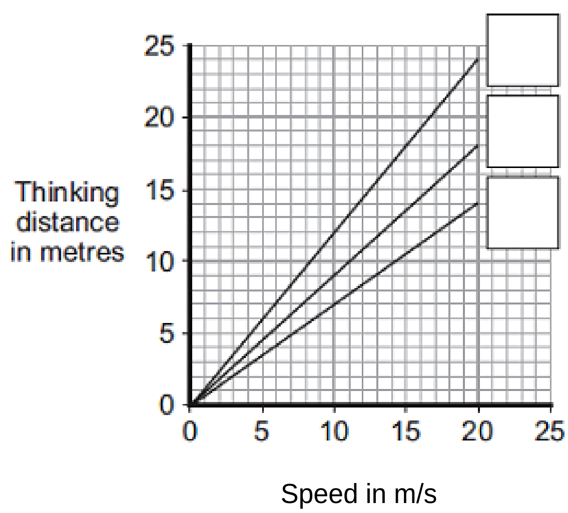
(1)

(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.

....

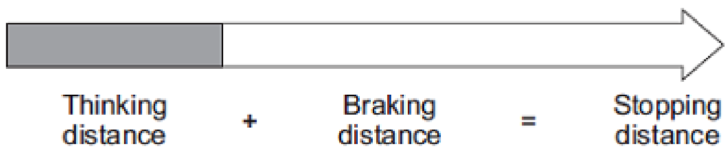
....

....

....

(2)
(Total 8 marks)

Q13. The diagram shows how the thinking distance and braking distance of a car add together to give the stopping distance of the car.



(a) Use words from the box to complete the sentence.

distance	**energy**	**force**	**time**

The stopping distance is found by adding the distance the car travels during the

driver's reaction .... and the distance the car travels under the

braking ....

(2)

(b) Which **one** of the following would **not** increase the thinking distance?

Tick (✓) **one** box.

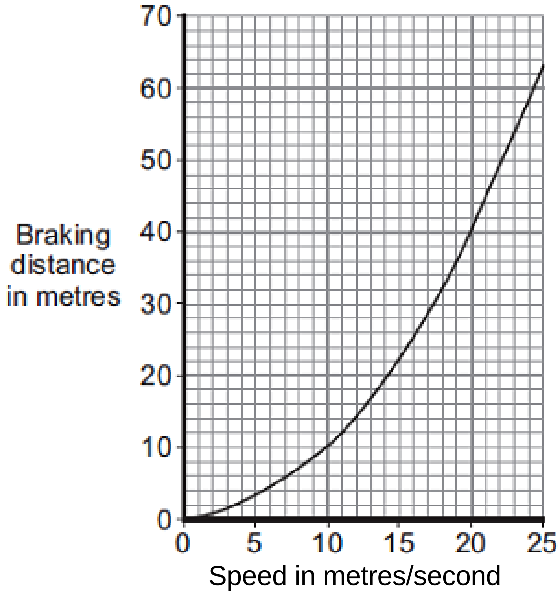
The car driver being tired. ☐

The car tyres being badly worn. ☐

The car being driven faster. ☐

(1)

(c) The graph shows how the braking distance of a car changes with the speed of the car. The force applied to the car brakes does not change.



(i) What conclusion about braking distance can be made from the graph?

....

....

....

....

(2)

(ii) The graph is for a car driven on a dry road.

Draw a line on the graph to show what is likely to happen to the braking distance at different speeds if the same car was driven on an icy road.

(1)

(d) A local council has reduced the speed limit from 30 miles per hour to 20 miles per hour on a few roads. The reason for reducing the speed limit was to reduce the number of accidents.

(i) A local newspaper reported that a councillor said:

"It will be much safer because drivers can react much faster when driving at 20 miles per hour than when driving at 30 miles per hour."

This statement is wrong. Why?

....

....

(1)

(ii) The local council must decide whether to introduce the lower speed limit on a lot more roads.

What evidence should the local council collect to help make this decision?

....

....

....

....

(2)
(Total 9 marks)