Q1. The stopping distance of a car is the sum of the thinking distance and the braking distance.

The table below shows how the thinking distance and braking distance vary with speed.

Speed in m / s	Thinking distance in m	Braking distance in m
10	6	6.0
15	9	13.5
20	12	24.0
25	15	37.5
30	18	54.0

(a) What is meant by the braking distance of a vehicle?

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.....

(1)

(b) The data in the table above refers to a car in good mechanical condition driven by an alert driver.

Explain why the stopping distance of the car increases if the driver is very tired.

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(2)

(c) A student looks at the data in the table above and writes the following:

thinking distance $\propto$ speed

thinking distance ∝ speed

Explain whether the student is correct.

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(2)

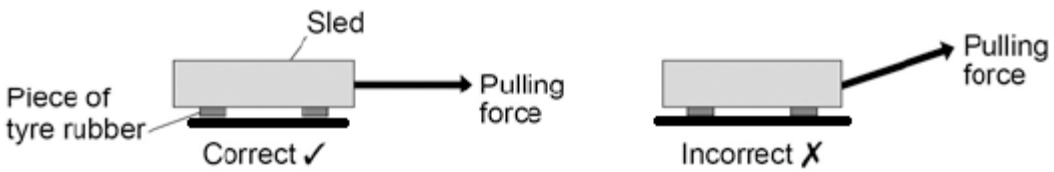
(d) Applying the brakes with too much force can cause a car to skid.

The distance a car skids before stopping depends on the friction between the road surface and the car tyres and also the speed of the car.

Friction can be investigated by pulling a device called a 'sled' across a surface at constant speed.

The figure below shows a sled being pulled correctly and incorrectly across a surface.

The constant of friction for the surface is calculated from the value of the force pulling the sled and the weight of the sled.



Why is it important that the sled is pulled at a constant speed?

Tick **one** box.

If the sled accelerates it will be difficult to control. ☐

If the sled accelerates the value for the constant of friction will be wrong. ☐

If the sled accelerates the normal contact force will change. ☐

(1)

(e) If the sled is pulled at an angle to the surface the value calculated for the constant of

friction would not be appropriate.

Explain why.

.....

.....

.....

.....

(2)

(f) By measuring the length of the skid marks, an accident investigator determines that the distance a car travelled between the brakes being applied and stopping was 22 m.

The investigator used a sled to determine the friction. The investigator then calculated that the car decelerated at 7.2 m / s^2.

Calculate the speed of the car just before the brakes were applied.

Give your answer to two significant figures.

Use the correct equation from the Physics Equation Sheet.

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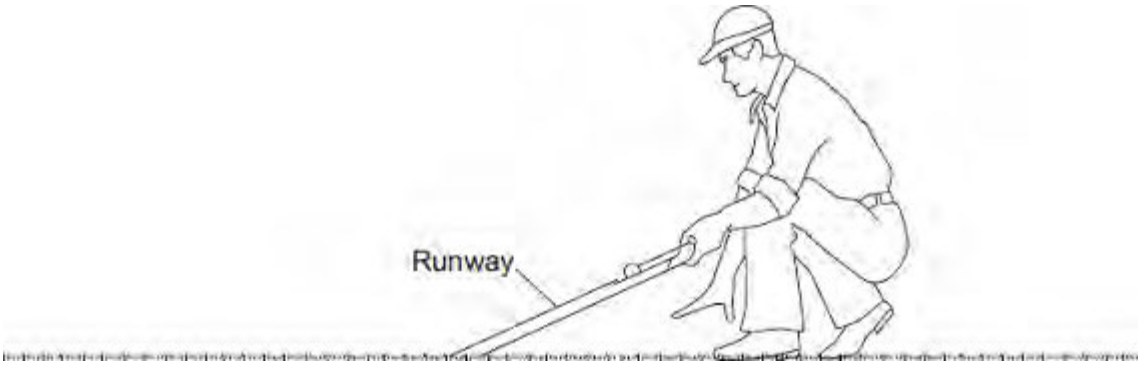
Speed = ... m / s

(3)

(Total 11 marks)

Q2.Figure 1 shows a golfer using a runway for testing how far a golf ball travels on grass.
One end of the runway is placed on the grass surface.
The other end of the runway is lifted up and a golf ball is put at the top.
The golf ball goes down the runway and along the grass surface.

Figure 1



(a) A test was done three times with the same golf ball.

The results are shown in **Figure 2**.

Figure 2



(i) Make measurements on **Figure 2** to complete **Table 1**.

Table 1

Test	Distance measured in centimetres
1	8.5
2	
3	

(2)

(ii) Calculate the mean distance, in centimetres, between the ball and the edge of the runway in **Figure 2**.

.....

Mean distance = ... cm

(1)

(iii) **Figure 2** is drawn to scale.
Scale: 1 cm = 20 cm on the grass.

Calculate the mean distance, in centimetres, the golf ball travels on the grass surface.

.....

Mean distance on the grass surface = ... cm

(1)

(iv) The distance the ball travels along the grass surface is used to estimate the 'speed' of the grass surface.

The words used to describe the 'speed' of a grass surface are given in **Table 2**.

Table 2

'Speed' of grass surface	**Mean distance the golf ball travels in centimetres**
Fast	250
Medium fast	220
Medium	190
Medium Slow	160
Slow	130

Use **Table 2** and your answer in part **(iii)** to describe the 'speed' of the grass surface.

.....

(1)

(b) The shorter the grass, the greater the distance the golf ball will travel.
A student uses the runway on the grass in her local park to measure the distance the golf ball travels.

(i) Suggest **two** variables the student should control.

.....

.....

.....

(2)

(ii) She carried out the test five times.
Her measurements, in centimetres, are shown below.

75 95 84 74 79

What can she conclude about the length of the grass in the park?

.....

.....

(1)

(c) Another student suggests that the 'speed' of a grass surface depends on factors other than grass length.

She wants to test the hypothesis that 'speed' depends on relative humidity.

Relative humidity is the percentage of water in the air compared to the maximum amount of water the air can hold. Relative humidity can have values between 1% and 100%.

The student obtains the data in **Table 3** from the Internet.

Table 3

Relative humidity expressed as a percentage	Mean distance the golf ball travels in centimetres
71	180

79	162
87	147

(i) Describe the pattern shown in **Table 3**.

.....

.....

(1)

(ii) The student writes the following hypothesis:
'The mean distance the golf ball travels is inversely proportional to relative humidity.'

Use calculations to test this hypothesis and state your conclusion.

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(3)

(iii) The data in **Table 3** does **not** allow a conclusion to be made with confidence.

Give a reason why.

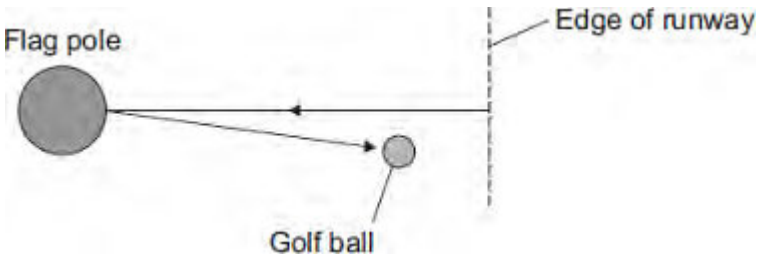
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(1)

(d) In a test, a golf ball hits a flag pole on the golf course and travels back towards the edge of the runway as shown in **Figure 3**.

Figure 3



The distance the ball travels and the displacement of the ball are **not** the same.

What is the difference between distance and displacement?

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(2)
(Total 15 marks)