4 The manufacturer of a car claims that the car can accelerate from rest to $30\,m\,s^{-1}$ in 7.5 s.

What is the average acceleration of the car over this time period?

- ☒ **A** $0.53\,m\,s^{-2}$
- ☒ **B** $2.0\,m\,s^{-2}$
- ☒ **C** $4.0\,m\,s^{-2}$
- ☒ **D** $8.0\,m\,s^{-2}$

(Total for Question 4 = 1 mark)

Questions 5 and 6 refer to the information below.

Two groups of students were asked to perform an experiment to determine the acceleration of free-fall. Each group repeated their experiment three times to check their results. In each experiment a steel ball fell through a height of just under 1 m and the time for the ball to fall was measured.

- **Group 1** used a stopwatch to measure the time.
- **Group 2** used light gates connected to a data logger to measure the time.

5 The students measured the height the ball fell using a metre rule.

The height should be recorded as

- ☒ **A** 85 cm
- ☒ **B** 0.85 m
- ☒ **C** 0.850 m
- ☒ **D** 8.5×10^{-1} m

(Total for Question 5 = 1 mark)

2 Which of the following statements describes the gravitational field strength acting on a body at a point?

- ☒ **A** gravitational force per unit length
- ☒ **B** gravitational force per unit mass
- ☒ **C** gravitational potential energy per unit length
- ☒ **D** gravitational potential energy per unit mass

(Total for Question 2 = 1 mark)

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2 A coin and a feather are dropped from the same height, through air.

Which row of the table is correct as the coin and feather fall to the ground?

	Initial acceleration	Time taken to reach the ground
☒ **A**	Greater for coin	Less for coin
☒ **B**	Greater for coin	Same for coin and feather
☒ **C**	Same for coin and feather	Less for coin
☒ **D**	Same for coin and feather	Same for coin and feather

(Total for Question 2 = 1 mark)

13 The photograph shows an area of land where golfers can practise their golf shots. Distances are marked out along the land in front of where the golfer stands, to measure the distance travelled by the ball.

Two levels are available. If the lower level is used, the ball lands at the same height from which it was hit. If the higher level is used, this enables the ball to be hit further.



Source: www.golfnews.co.uk

(a) A ball is given an initial velocity of $33\,m\,s^{-1}$ at an angle of 28° to the horizontal.

When hit from the lower level, this ball travels a horizontal distance of 92 m before landing. Use of the higher level increases the horizontal distance travelled before landing by 10 m.

Deduce whether an upper level at a height of 4.5 m would be sufficient to produce this increase. You should ignore air resistance.

(5)

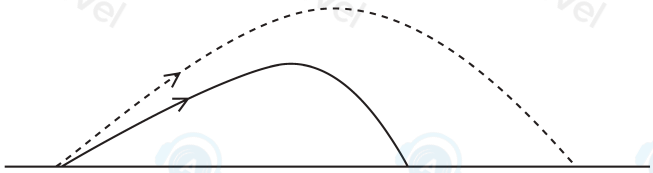
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*(b) Your answer to part (a) did not consider the effect of air resistance.

The trajectories of the motion of the golf ball with air resistance and without air resistance are shown.



Trajectory without air resistance ----------

Trajectory with air resistance _____

Explain the differences between the two paths.

(6)

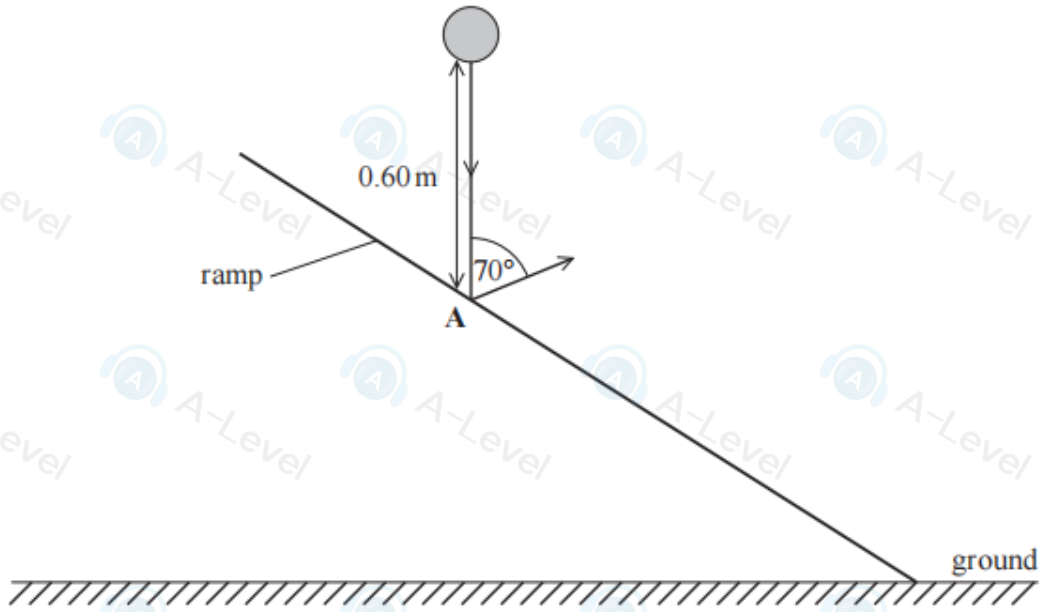
(Total for Question 13 = 11 marks)

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15 A ball falls through a vertical height of 0.60 m before bouncing at point A on a ramp, as shown.



(a) Show that the velocity of the ball immediately before the bounce is about 3 m s^{-1}.

(2)

.....

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(b) Kinetic energy is conserved as the ball bounces off the ramp. The ball bounces at an angle of 70° to the vertical.

State expressions for the horizontal and vertical components of velocity of the ball immediately after the bounce.

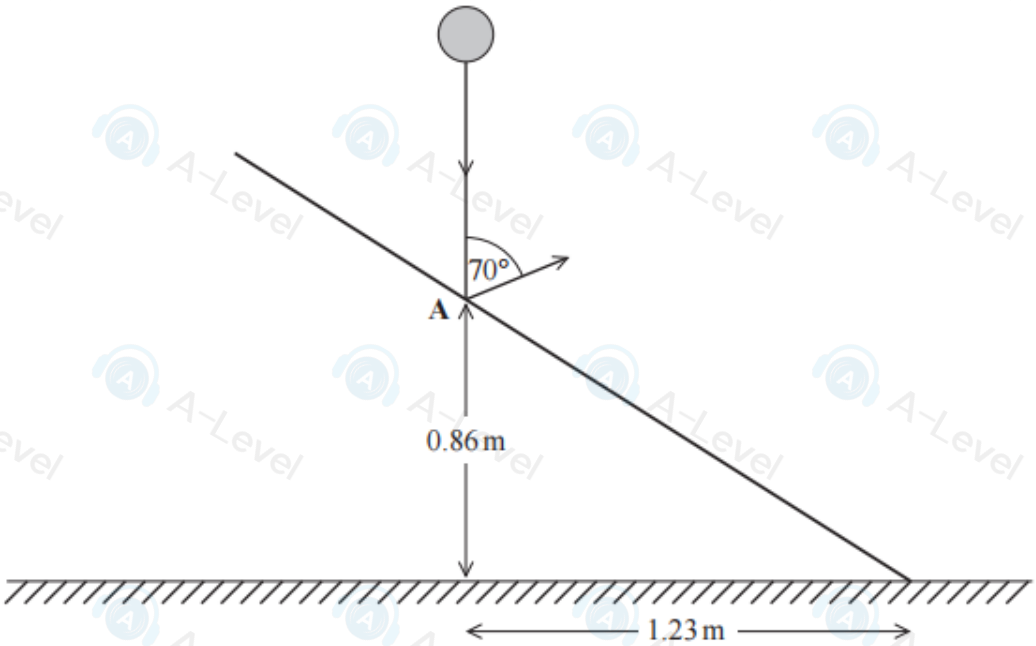
(2)

Horizontal component = ...

Vertical component = ...

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(c) Point A is 0.86 m vertically above the ground and 1.23 m horizontally from the end of the ramp as shown.



Deduce whether the ball will bounce a second time on the ramp.

(4)

(Total for Question 15 = 8 marks)

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17 A distress flare may be launched from a boat, to signal for help.

(a) A flare was launched from a stationary boat at an angle of 30° to the horizontal.

(i) The flare was launched to the right from the launch position marked ✕ on the boat in the diagram below.

Complete the diagram to show the path taken by the flare before it hit the sea.

(1)



(ii) The maximum height of the flare above the launch position was 42 m.

Show that the flare was launched at a speed of about 60 m s^{-1}.

(3)

(iii) The flare was visible from a maximum distance of 8 km. A rescue boat was 8.2 km from the boat in distress.

Determine whether the flare travelled a sufficient distance to be visible from the rescue boat.
You should assume that the flare was launched in the direction of the rescue boat.

(4)

(Total for Question 17 = 8 marks)