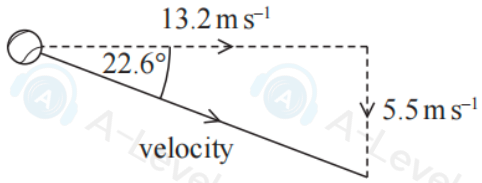
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4 A tennis ball is moving through the air. The diagram shows the horizontal and vertical components of its velocity.



Which of the following expressions gives the magnitude of the velocity in m s^{-1}?

☒ **A** $\frac{13.2}{\sin 22.6°}$

☒ **B** $13.2 \times \sin 22.6°$

☒ **C** $\frac{5.5}{\sin 22.6°}$

☒ **D** $5.5 \times \sin 22.6°$

(Total for Question 4 = 1 mark)

5 A student dropped a table tennis ball. The ball fell for time t and had velocity v just before it hit the ground.

The student used the equations of motion to calculate t and v. These equations ignore air resistance.

Which row of the table shows how the actual values compared with the student's calculated values for t and v?

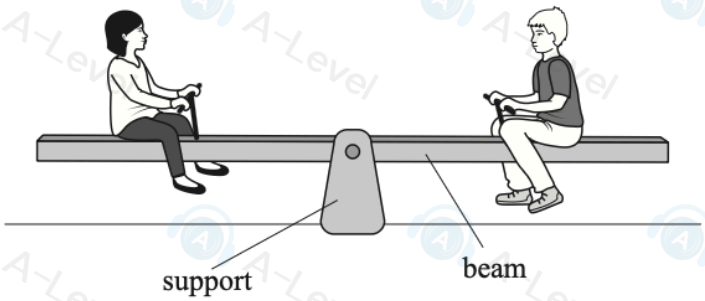
	t	v
☒ **A**	Less than calculated	Less than calculated
☒ **B**	Less than calculated	Greater than calculated
☒ **C**	Greater than calculated	Less than calculated
☒ **D**	Greater than calculated	Greater than calculated

(Total for Question 5 = 1 mark)

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2: A see-saw is a uniform beam that balances on a support. The beam can rotate around the top of the support.

Two children of equal weight sit on a see-saw at equal distances from the support, as shown.



Which row of the table describes the resultant force and resultant moment on the beam?

	Resultant force	Resultant moment
☒ **A**	zero	zero
☒ **B**	zero	anticlockwise
☒ **C**	downwards	zero
☒ **D**	downwards	anticlockwise

(Total for Question 2 = 1 mark)

2 A box was placed at the top of a ramp and released.

The free-body force diagram for the box as it moved down the ramp at a constant velocity is shown.



D = air resistance

F = frictional force

R = normal contact force

W = weight of the box

Which two forces acting on the box have, according to Newton's third law, corresponding forces acting on the ramp?

☒ **A** F and D

☒ **B** F and R

☒ **C** W and D

☒ **D** W and R

(Total for Question 2 = 1 mark)

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1 Which of the following units is equivalent to the watt?

- ☒ **A** $\mathrm{N\,m}$
- ☒ **B** $\mathrm{N\,m^{-1}}$
- ☒ **C** $\mathrm{J\,s}$
- ☒ **D** $\mathrm{J\,s^{-1}}$

(Total for Question 1 = 1 mark)

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9 A person stands on some bathroom scales in a stationary lift. The lift begins to move upwards with a constant acceleration.

The reading on the scales will

- ☒ **A** increase but then remain constant.
- ☒ **B** increase at a constant rate.
- ☒ **C** decrease but then remain constant.
- ☒ **D** decrease at a constant rate.

(Total for Question 9 = 1 mark)

Questions 8 and 9 refer to the information below.

A ball is dropped and is caught after the first bounce.

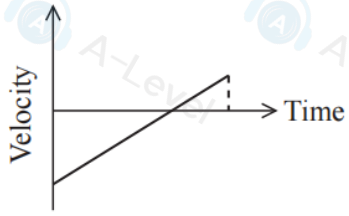
8 The ball takes 1.6 s to reach the ground.

From what height was the ball dropped?

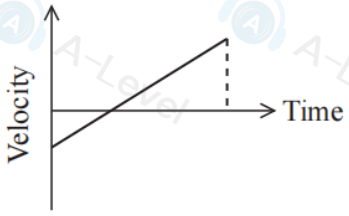
- ☒ **A** 7.8 m
- ☒ **B** 13 m
- ☒ **C** 16 m
- ☒ **D** 25 m

(Total for Question 8 = 1 mark)

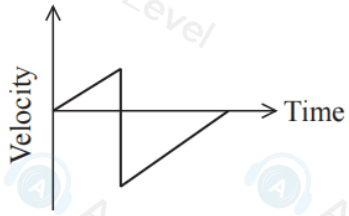
9 Which of the following is the velocity-time graph for the motion of the ball?



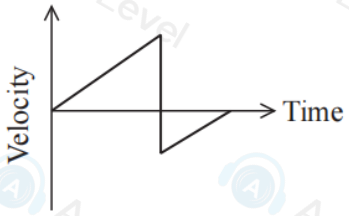
A



B



C



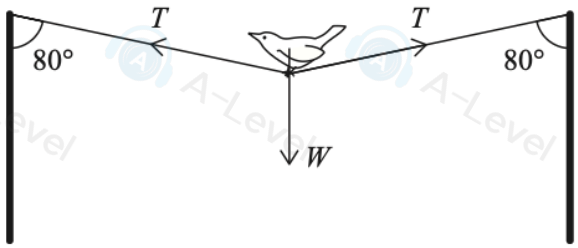
D

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 9 = 1 mark)

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6 A length of string is attached between two vertical posts. A bird of weight W stands on the middle of the string causing tension T in the string. The string makes an angle of 80° with each post, as shown.



Which of the following expressions is correct?

☒ **A** $T = \dfrac{W}{2\sin 80°}$

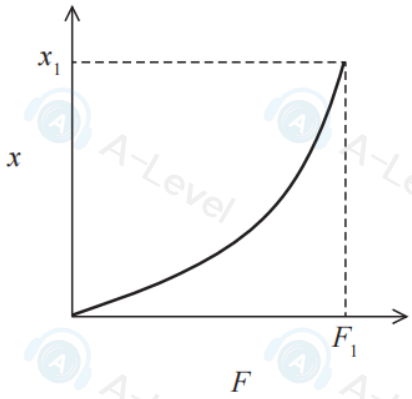
☒ **B** $T = W \times 2\sin 80°$

☒ **C** $T = \dfrac{W}{2\cos 80°}$

☒ **D** $T = W \times 2\cos 80°$

(Total for Question 6 = 1 mark)

6 The graph shows how the extension x of a spring varies with the applied force F.



Select the expression that best describes the work done W in extending the spring.

☒ **A** $W = F_1 x_1$

☒ **B** $W = \dfrac{1}{2} F_1 x_1$

☒ **C** $W < \dfrac{1}{2} F_1 x_1$

☒ **D** $W > \dfrac{1}{2} F_1 x_1$

(Total for Question 6 = 1 mark)

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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)

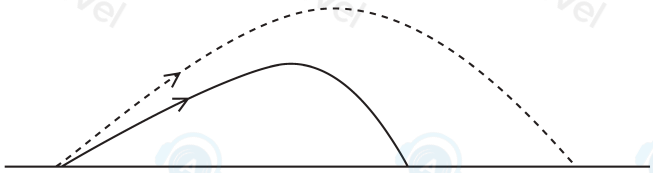
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*(b) Your answer to part (a) did not consider the effect of air resistance.

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)

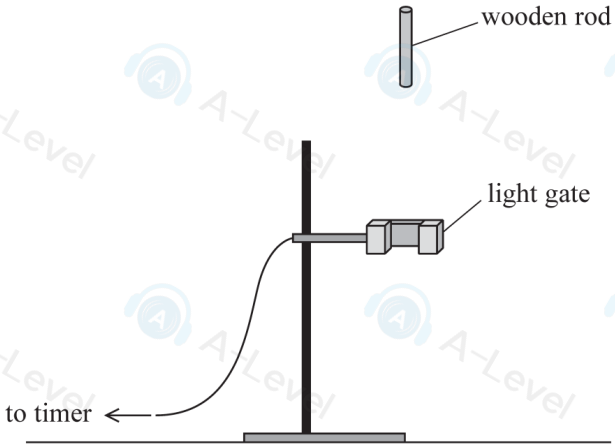
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12 A student carries out an experiment to determine a value for g, the acceleration of free fall. A short wooden rod is released above a light gate. A timer connected to the light gate is used to measure the time taken for the wooden rod to pass through the light gate.

The experimental arrangement is shown.



The student uses the equation $v^2 = u^2 + 2as$, where $u = 0$, and a graphical method to determine a value for g.

(a) State the additional measurements the student should take.

(2)

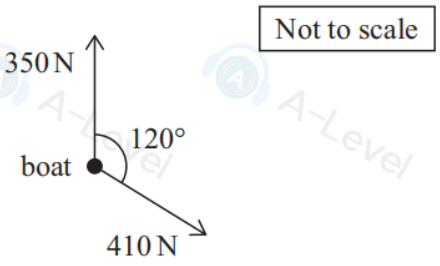
(b) Describe how the velocity v of the wooden rod as it passes through the light gate can be determined accurately.

(2)

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12 A sailing boat is moving through water.
The force of the wind on the boat is 350 N towards north.
The force of the water on the boat is 410 N at an angle of 120° from north, as shown.



Determine the magnitude and direction of the resultant force on the boat using a scaled vector diagram.

Magnitude of resultant force = ...

Angle of resultant force from north = ...