please turn over this page

Answer ALL questions.

All multiple choice questions must be answered with a cross ☒ in the box for the correct answer from A to D. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

☒

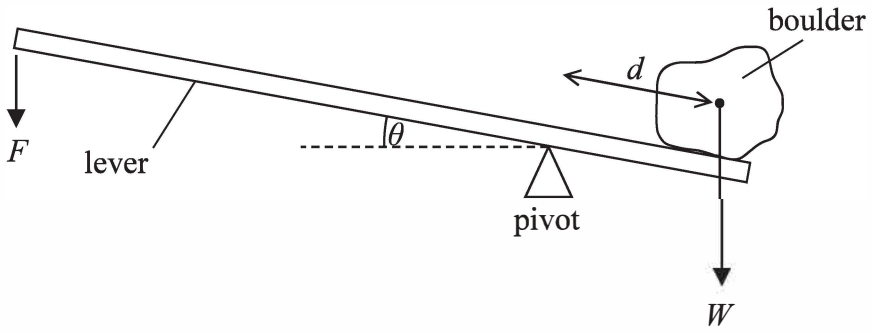
☒

☒

☒

(Total for Question 1 = 1 mark)

2 A person uses a pivoted lever to lift a boulder of weight W as shown.



The centre of gravity of the boulder is a distance d from the pivot. The angle of the lever to the horizontal is θ.

Which expression is equal to the moment of W about the pivot?

☒ **A** Wd

☒ **B** $Wd\cos\theta$

☒ **C** $Wd\sin\theta$

☒ **D** $Wd\tan\theta$

(Total for Question 2 = 1 mark)

3 A space rocket lifts off vertically.

The rocket lifts off because

☐ **A** the exhaust gases exert a force on the ground.

☐ **B** the exhaust gases exert a force on the rocket.

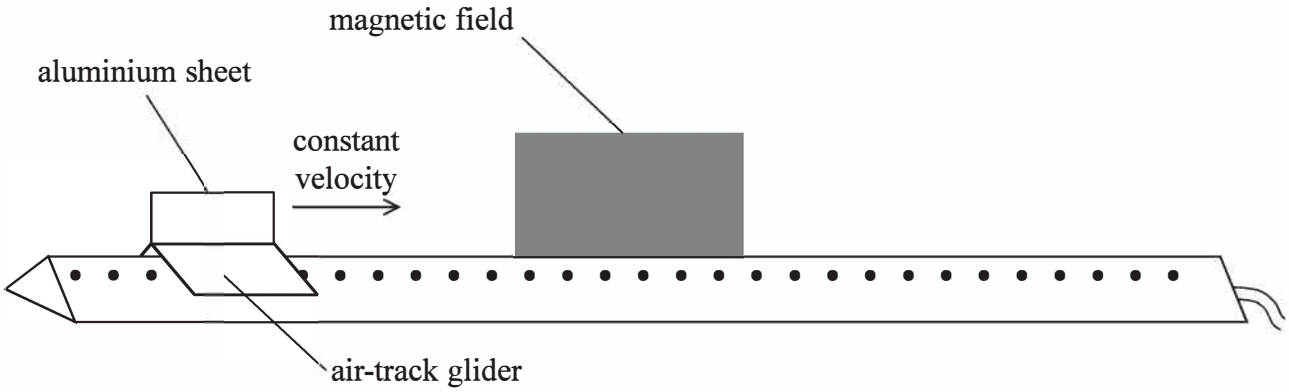
☐ **C** the ground exerts a force on the rocket.

☐ **D** the rocket exerts a force on the ground.

(Total for Question 4 = 1 mark)

9 A rectangular sheet of aluminium is attached to an air-track glider as shown.

The glider moves towards a region of uniform magnetic field at a constant velocity. When the glider enters the magnetic field, the magnetic flux is perpendicular to the aluminium sheet.

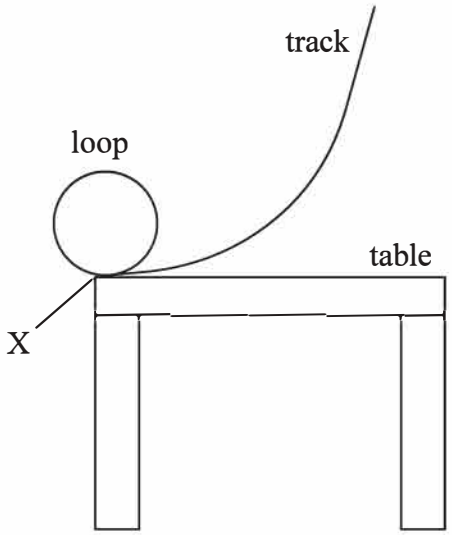


Which row of the table describes the velocity of the glider as it enters the magnetic field, when it is completely within the magnetic field and as it leaves the magnetic field?

	Enters the magnetic field	Within the magnetic field	Leaves the magnetic field
☒ **A**	constant	decreasing	constant
☒ **B**	decreasing	constant	increasing
☒ **C**	decreasing	constant	decreasing
☒ **D**	decreasing	decreasing	decreasing

(Total for Question 9 = 1 mark)

11 A track for toy cars can be built with a circular loop as shown.



A toy car is placed on the track at various heights. It travels around the loop before leaving the track horizontally at X.

(a) The loop has radius r and the mass of the toy car is m. It is possible for a toy car to complete the loop without losing contact with the inside of the track.

For this to occur the minimum speed of the toy car at the top of the loop v_{top} is given by

$$v_{top} = \sqrt{gr}$$

Explain why.

(2)

(b) The toy car just completes the loop without losing contact with the track.

Show that the speed of the toy car at the bottom of the loop is about $3\,m\,s^{-1}$.

$r = 0.15\,m$

(3)

(c) The toy car leaves the track at X with a horizontal velocity of $3.0\,m\,s^{-1}$.

X is 0.65 m above the floor.

Calculate the horizontal displacement of the car from X when it hits the floor.

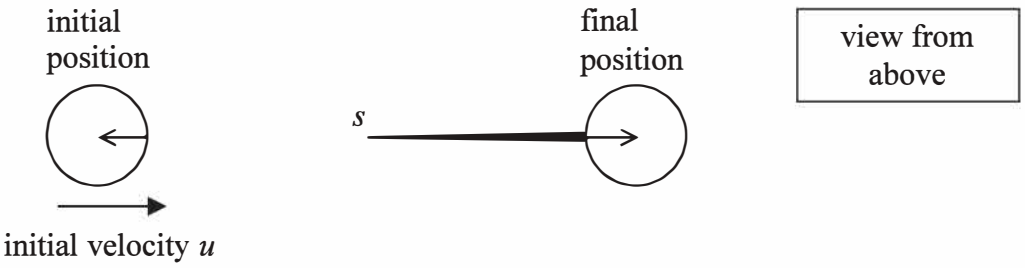
(4)

Horizontal displacement = ...

(Total for Question 11 = 9 marks)

14 A student carried out an experiment with coins.

(a) She gave a 2p coin a sharp tap, so that it slid along a horizontal surface and came to rest as shown.



The student recorded the distance s moved by the coin.

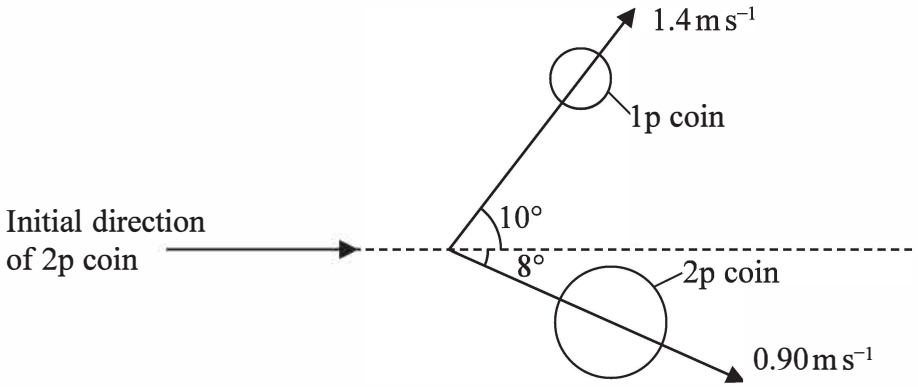
She then replaced the 2p coin with a 1p coin and repeated the process.

The student read that the frictional force between an object and a surface is directly proportional to the mass of the object. She suggested that, in her experiment, u is directly proportional to $\sqrt{s}$ and is independent of the mass of the coin.

Discuss the validity of this suggestion.

(6)

(b) She arranged a collision between a 2p coin and a stationary 1p coin. She noted the directions in which the coins moved after the collision and determined their velocities.



(i) Show that the velocity of the 2p coin just before the collision was about $2\,m\,s^{-1}$.

mass of 2p coin = 7.1 g

mass of 1p coin = 3.6 g

(4)

(ii) Show that the collision was inelastic.

(2)

(Total for Question 14 = 12 marks)