(Total for Question 1 = 1 mark)

2 A trolley, mass 0.50 kg, has a speed of 2.0 m s^{-1}. A second trolley, mass 1.0 kg, has a speed of 2.0 m s^{-1}. The two trolleys are travelling in opposite directions and collide.

Which of the following could be a correct value of total momentum, in kg m s^{-1}, after the collision?

☒ **A** 0

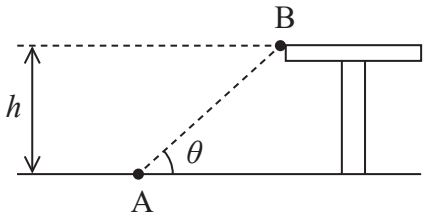
☒ **B** 1.0

☒ **C** 2.0

☒ **D** 3.0

(Total for Question 2 = 1 mark)

4 An object of mass m is moved from point A on the ground, to point B on a bench of height h as shown in the diagram.



Which of the following is a correct expression for the work done on the object?

☒ **A** $\dfrac{mgh}{\sin\theta}$

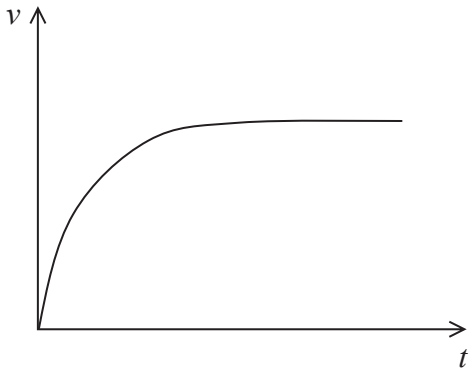
☒ **B** $\dfrac{mgh}{\cos\theta}$

☒ **C** mgh

☒ **D** $mgh\sin\theta$

(Total for Question 4 = 1 mark)

11 A sports class is studying cycling. They produce a video of a cyclist on a horizontal lawn. The cyclist starts from rest.
They produce a sketch graph of the velocity v of the cyclist against time t.



(a) Explain the shape of this graph and include a consideration of force as part of your answer.

(3)

(b) A student makes the following statement.

The work done by the cyclist is converted into the kinetic energy of the cyclist and bicycle.

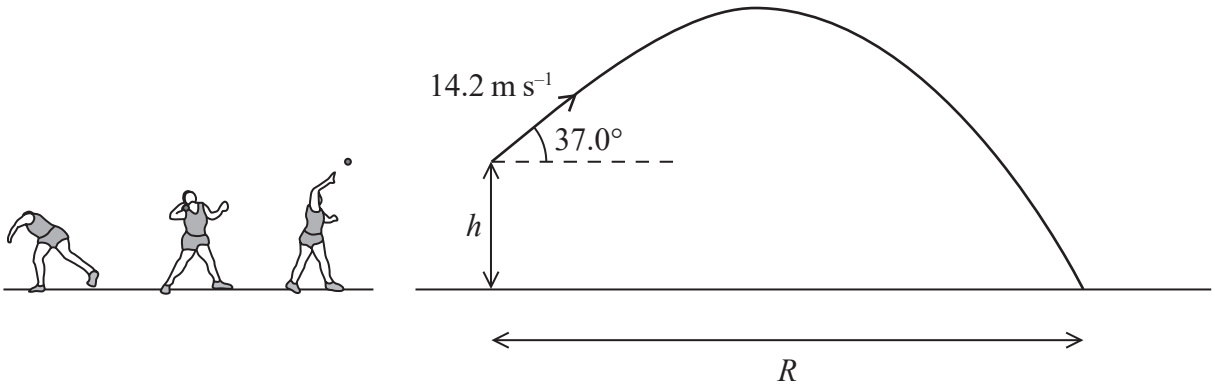
Criticise this statement.

(3)

(Total for Question 11 = 6 marks)

12 The shot put is an Olympic field event. The distance for the women's world record shot put is in excess of twenty two metres.

The shot is a metal ball, which is thrown from a standing position so that it lands on the ground a horizontal distance R away from the thrower.



A shot is thrown from a height h above the ground with an initial velocity of 14.2 m s^{-1} at an angle of 37.0° to the horizontal. The time it takes for the shot to reach the ground is 1.98 s.

(a) Show that the vertical component of the initial velocity is about 8.6 m s^{-1}.

(2)

(b) Calculate the height h above the ground from which the shot was thrown.

(3)

$h =$ .....

(c) Calculate the horizontal distance R for this throw.

(3)

.....

.....

.....

.....

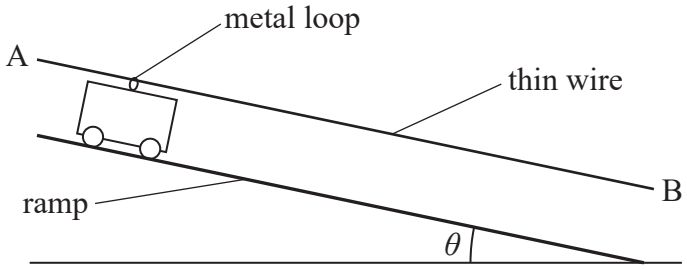
.....

$R =$ .....

(Total for Question 12 = 8 marks)

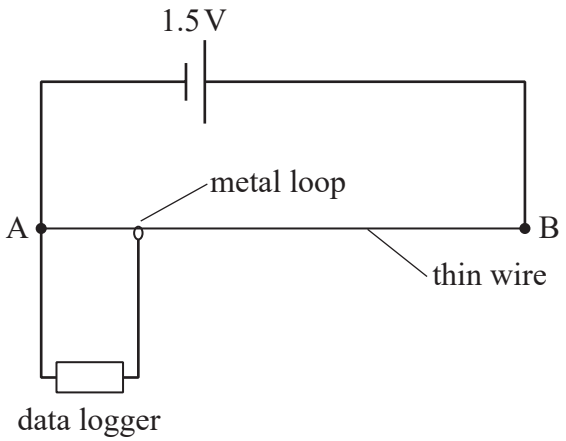
17 A student investigates the motion of a friction-free trolley down a ramp. On the top of the trolley there is a metal loop which makes contact with a length of thin resistance wire, AB, fixed above the ramp. The resistance wire has a uniform diameter.

The trolley accelerates down the ramp and the metal loop stays in contact with the wire along the full length of the ramp.



The student uses a protractor to measure the angle θ between the ramp and the horizontal and records a value of 4° with an uncertainty of ±1°.

(a) The two ends of the wire are connected to a 1.5 V cell. A data logger, set to measure potential difference, is connected to the metal loop and to the negative terminal of the cell.



Explain how the potential difference recorded by the data logger will vary as the loop moves along the length of the wire AB.

(3)

(c) The student calculated the velocity of the trolley at 2.0 s to be 1.5 m s^{-1}.

By considering the acceleration of the trolley, determine whether the student's measurement of θ was within the uncertainty quoted.

(4)

(Total for Question 17 = 11 marks)