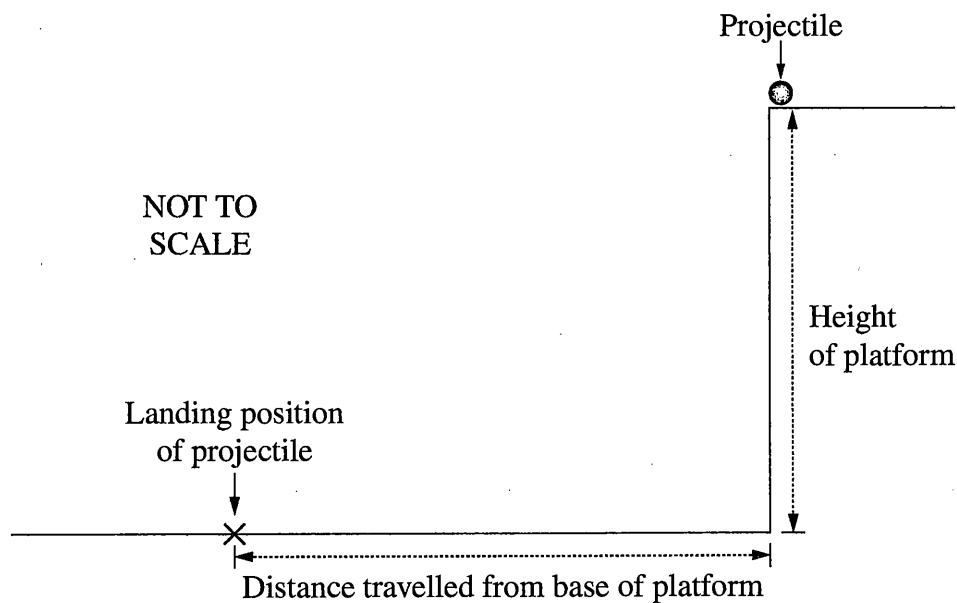


Question 21 (4 marks)

A projectile is fired horizontally from a platform.



Measurements of the distance travelled by the projectile from the base of the platform are made for a range of initial velocities.

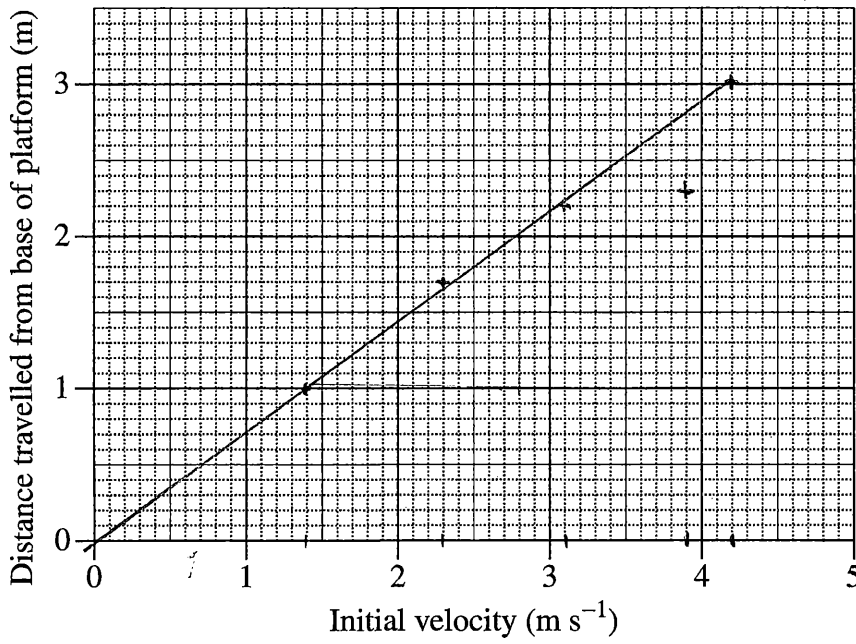
<i>Initial velocity of projectile (m s^{-1})</i>	<i>Distance travelled from base of platform (m)</i>
1.4	1.0
2.3	1.7
3.1	2.2
3.9	2.3
4.2	3.0

Question 21 continues on page 15

Question 21 (continued)

(a) Graph the data on the grid provided and draw the line of best fit.

2



(b) Calculate the height of the platform.

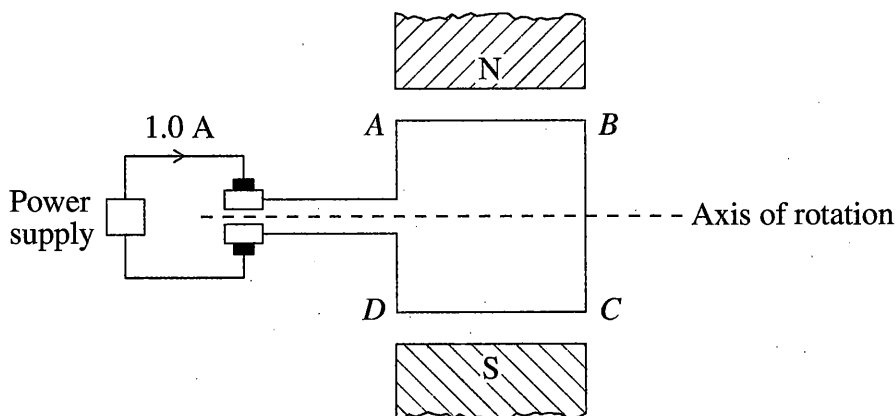
2

~~$h = 1.5 \times 9.8 / 2$~~ ~~1.5~~
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End of Question 21

Question 22 (5 marks)

The diagram represents a simple DC motor. A current of 1.0 A flows through a square loop $ABCD$ with 5 cm sides in a magnetic field of 0.01 T.



- (a) Determine the force acting on section AB and the force acting on section BC due to the magnetic field, when the loop is in the position shown. 3

force acting from the opposite poles magnetic force south acting on DC and magnetic North acting on AB

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- (b) How is the direction of the torque maintained as the loop rotates 360° from the position shown? 2

Magnetic force produces enough momentum to continue motion for AB & DC to reach the opposite end of 180° to gain momentum from the magnetic poles North & South

Question 23 (5 marks)

- (a) Outline a procedure that could be used to model electrical conduction in a semiconductor. 3

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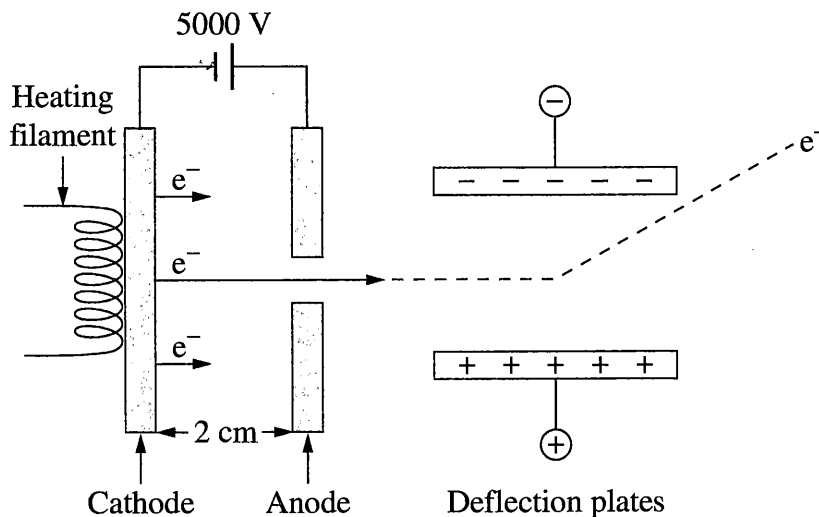
- (b) Explain a limitation of the model outlined in part (a). 2

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Question 24 (7 marks)

A part of a cathode ray oscilloscope was represented on a website as shown.



Electrons leave the cathode and are accelerated towards the anode.

- (a) Explain why the representation of the path of the electron between the deflection plates is inaccurate. 3

As the negative electron moves towards the deflection plates the negative deflection plate produces a force which acts on the negative electron pushing it away. Representation in the deflection plates is inaccurate due to the positive plate applying a force of attraction to the negative electron pulling it toward the pos. t. plate change the direction give in the diagram. e⁻ moves to +

Question 24 continues on page 19

Question 25 (6 marks)

- (a) Outline the conversion of electrical energy by devices in the home into TWO other forms of energy. 3

Blender has a ~~use~~ conversion of electrical to mechanical
the use of electrical energy ~~to~~ transforms to spinning blade.
As the oven electrical energy into heating transfer
from electrical to heating/cooking same with heater
electrical energy transferred into electrical heating

- (b) The diagram shows a label on a transformer used in an appliance. 3

Input:	240 V AC	5.0 A
Output:	2 kV AC	1.0 A

Explain why the information provided on the label is not correct. Support your answer with calculations.

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Question 26 (6 marks)

Consider the following two models used to calculate the work done when a 300 kg satellite is taken from Earth’s surface to an altitude of 200 km.

You may assume that the calculations are correct.

<i>Model X</i>	<i>Model Y</i>
Data: $g = 9.8 \text{ m s}^{-2}$ $m = 300 \text{ kg}$ $\Delta h = 200 \text{ km}$ $W = Fs$ $= mg\Delta h$ $= 3 \times 10^2 \times 9.8 \times 2.0 \times 10^5$ $= 5.9 \times 10^8 \text{ J}$	Data: $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ $r_{\text{Earth}} = 6.38 \times 10^6 \text{ m}$ $r_{\text{orbit}} = 6.58 \times 10^6 \text{ m}$ $M = 6.0 \times 10^{24} \text{ kg}$ $m = 300 \text{ kg}$ $W = \Delta E_p$ $\Delta E_p = E_{p \text{ final}} - E_{p \text{ initial}}$ $= -\frac{GMm}{r_{\text{orbit}}} - \left(-\frac{GMm}{r_{\text{Earth}}} \right)$ $= -1.824 \times 10^{10} - (-1.881 \times 10^{10})$ $= 5.7 \times 10^8 \text{ J}$

- (a) What assumptions are made about Earth’s gravitational field in models X and Y that lead to the different results shown? 2

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- (b) Why do models X and Y produce results that, although different, are close in value? 1

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Question 26 continues on page 22

Question 26 (continued)

- (c) Calculate the orbital velocity of the satellite in a circular orbit at the altitude of 200 km.

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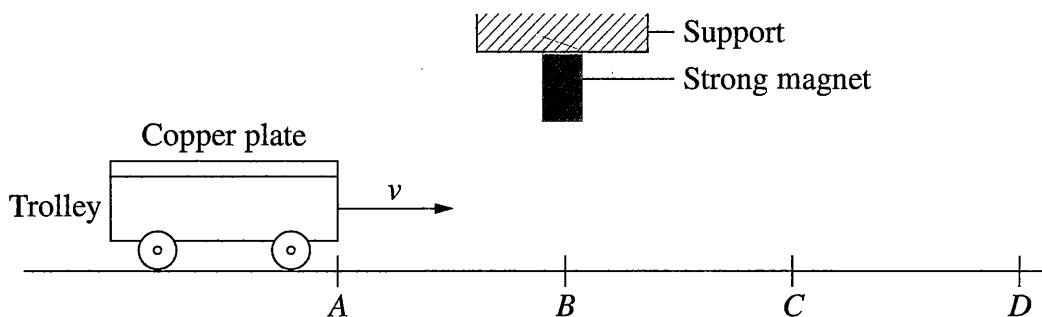
End of Question 26



Question 28 (5 marks)

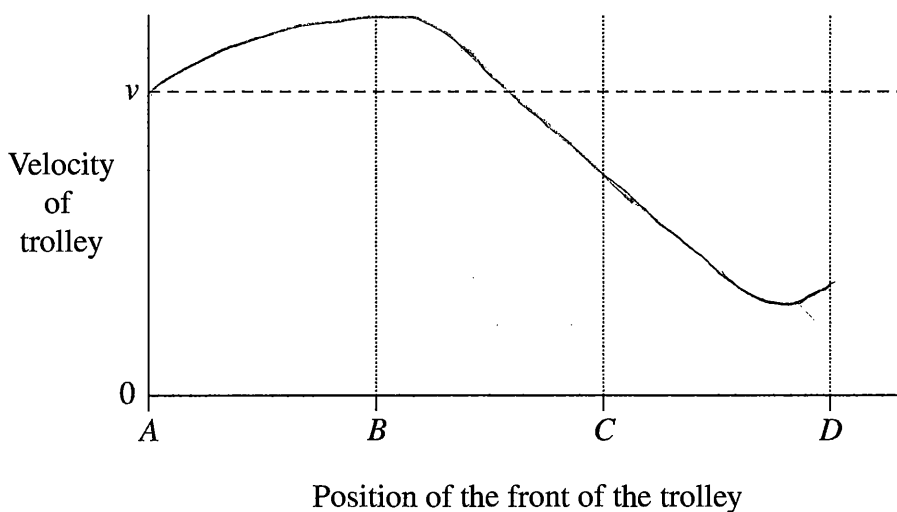
A copper plate is attached to a lightweight trolley. The trolley moves at an initial velocity, v , towards a strong magnet fixed to a support.

5



The dashed line on the graph shows the velocity of the trolley when the magnet is not present.

On the axes, sketch the graph of the velocity of the trolley as it travels from A to D under the magnet, and justify your graph.



...velocity... of... the... moving... cart... stays... at a... constant...
 ...velocity... once... the... magnet... turns... on... the... magnetic...
 ...force... from... the... magnet... will... attract... the... copper... plate...
 ...increasing... velocity... until... trolley... is... directly... under...
 ...after... once... the... trolley... keeps... on... heading... passed...
 ...B... towards... D... the... magnet... ~~pulls~~ ^{starts} pulling ^{force} the...
 ...trolley... back... towards... the... magnet... .. trolley... gains...
 ...velocity... increasing... the... magnet... can't... be... able... to...
 ...stop... the... trolley... and... the... field... will... reduce... causing...
 ...the... trolley... to... revert... back... to... initial... velocity...

Question 29 (5 marks)

In the Large Hadron Collider (LHC), protons travel in a circular path at a speed greater than $0.9999 c$.

- (a) What are the advantages of using superconductors to produce the magnetic fields used to guide protons around the LHC? **2**

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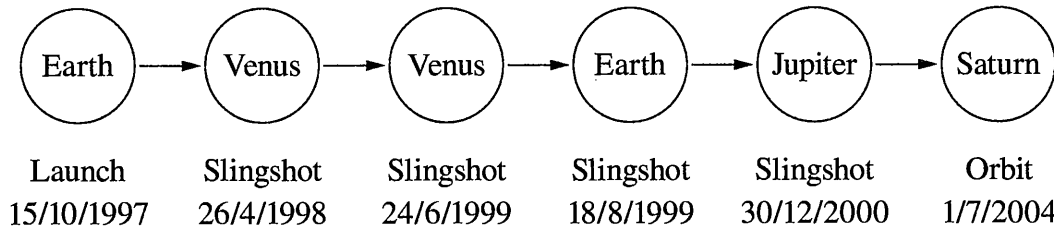
- (b) Discuss the application of special relativity to the protons in the LHC. **3**

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Question 30 (6 marks)

The following is a timeline for the Cassini space probe mission to Saturn.

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Explain how Newton’s Laws of Motion and Universal Gravitation were applied to the Cassini mission.

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