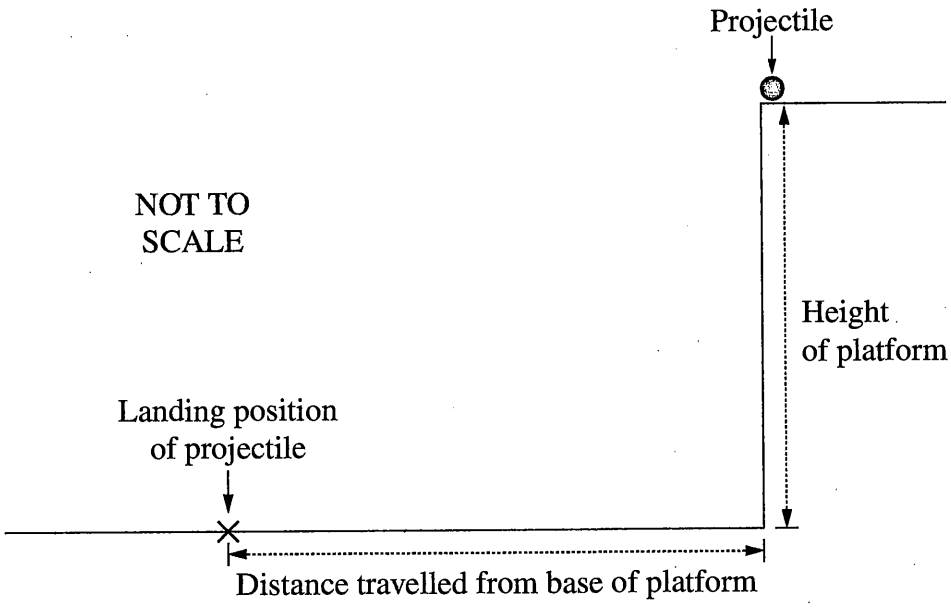
Question 21 (4 marks)

A projectile is fired horizontally from a platform.



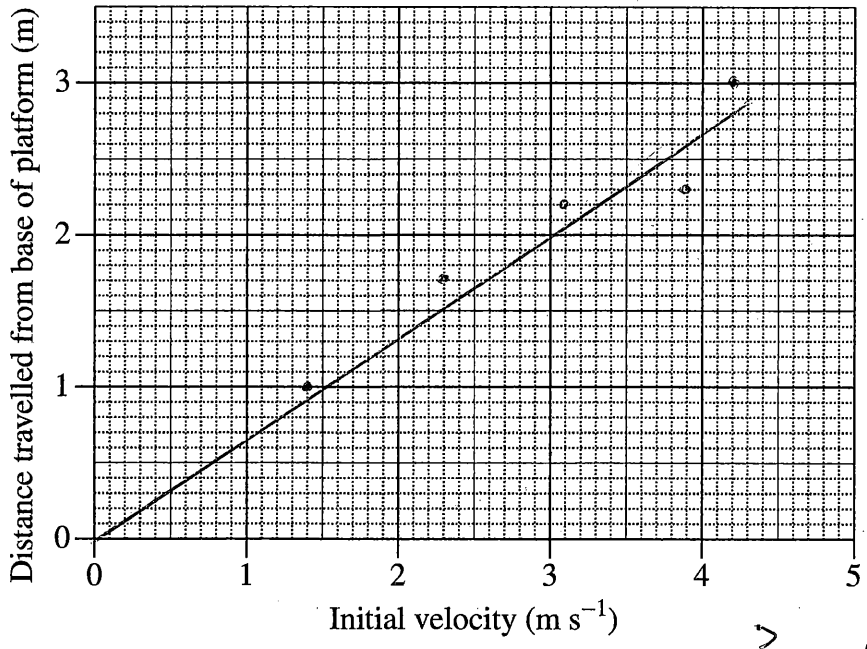
Measurements of the distance travelled by the projectile from the base of the platform are made for a range of initial velocities.

Initial velocity of projectile ($m\ s^{-1}$)	*Distance travelled from base of platform* (m)
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**



$\frac{3-1}{4.2-1.4}$

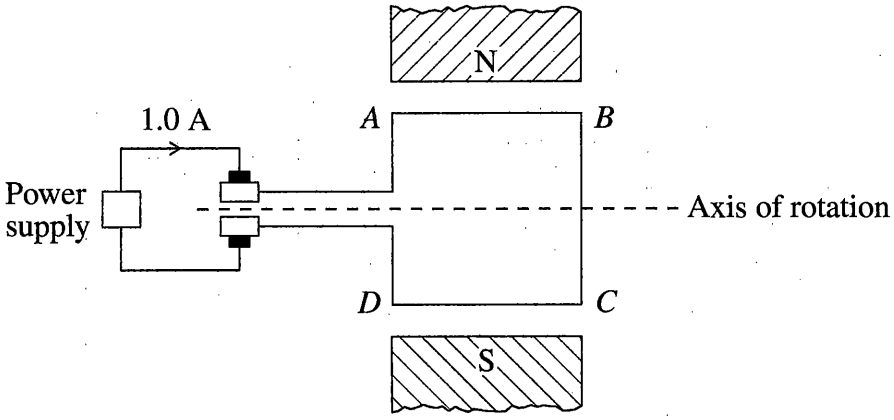
(b) Calculate the height of the platform. **2**

$= 0.714\ m$

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**

The force would be a push on one side and a pull on the other. This happens at a constant rate however it shows the the square rotating on the axes of rotation.

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

the torque remains the same ~~that~~ due to the constant energy given through the power supply.

Question 23 (5 marks)

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

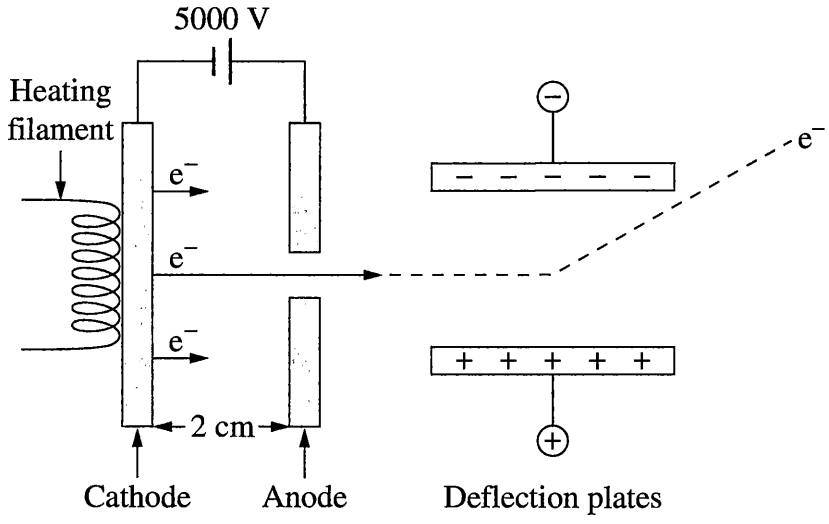
Non attempt

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

The model is not shown to 3D. The energy from the power supply, may not be strong enough to cause that much of an effect.

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 e⁻ do isn't supposed to just lean towards the negative plate, it should be getting deflected from the positive then completely attracted towards the negative plate by touching it.

Question 24 continues on page 19

Question 24 (continued)

(b) Calculate the force on an electron due to the electric field between the cathode and the anode. **2**

(0.02 x 5000 = 100

(c) Calculate the velocity of an electron as it reaches the anode. **2**

Non attempt

End of Question 24

Question 25 (6 marks)

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

Electrical energy could be used to heat up the stove, there for from electrical it is converted into heat energy. ~~light~~ electricity goes up into the light bulbs in which they are then illuminated causing an energy of light.

(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.

Being a transformer the Amps should not be dropping.

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.

Model X	*Model Y*
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: $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ $r_{\text{Earth}} = 6.38 \times 10^6 \text{ m}$ $r_{\text{orbit}} = 6.58 \times 10^6 \text{ m}$ $M = 6.0 \times 10^{24} \text{ kg}$ $m = 300 \text{ kg}$ $W = \Delta E_P$ $\Delta E_p = E_{p\,\text{final}} - E_{p\,\text{initial}}$ $= -\frac{GMm}{r_{\text{orbit}}} - \left(\frac{GMm}{r_{\text{Earth}}}\right)$ $= -1.824 \times 10^{10} - \left(-1.881 \times 10^{10}\right)$ $= 5.7 \times 10^8 \text{ J}$

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

In X, Earths gravitational field relies only on its acceleration (g). But in Y it is shown that a higher number of calculations are made, this may cause a small difference but results are quite close.

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

It is close due to the fact that both models had data of Earth implemented therefor its sure to be close.

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. **3**

$v = \sqrt{\frac{2000}{300}} = \sqrt{9.8 \times 200 \times 300}$

$v = 766.8 \text{ ms}^{-1}$

End of Question 26

Question 27 (6 marks)

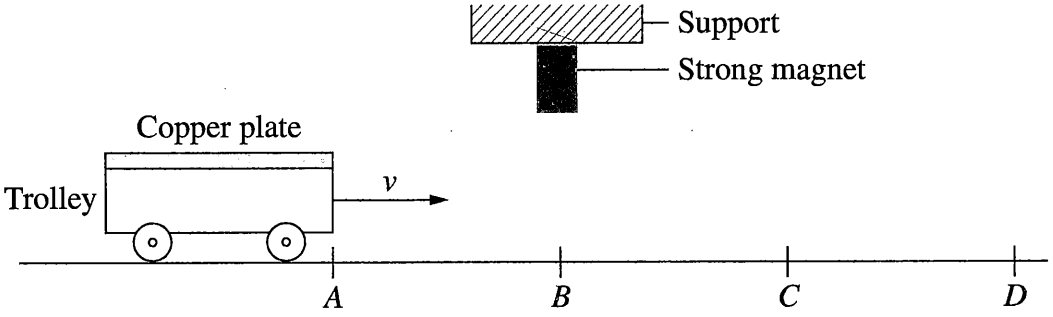
In 1865, James Clerk Maxwell developed the theory of electromagnetism. This theory explained the nature of light. It also predicted the existence of other electromagnetic waves. **6**

How did Hertz test and validate Maxwell's theory?

Hertz tested this by attempting to create light light globes, where light could be shown as well as the existence of ~~electromagnetic waves~~ electromagnetic waves.

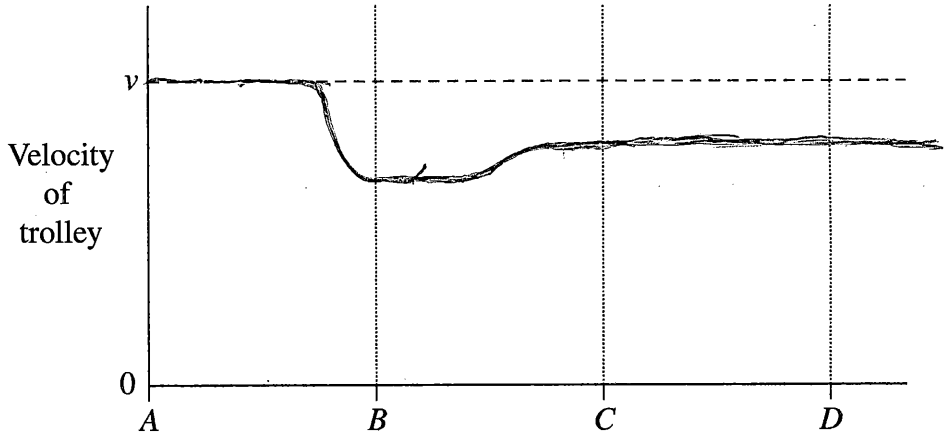
Question 28 (5 marks)

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.



The Copper plate is attracted to the strong magnet so it starts slowing down a bit after point A. Once it is past the magnet it then starts moving again, but never reaches the initial velocity unless an external force intervenes. This is due to the magnet slowing the trolley down and the flat track prevents the initial velocity being reached.

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**

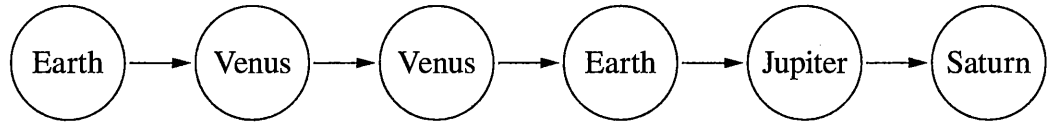
Non attempt

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

None Attempt

Question 30 (6 marks)

The following is a timeline for the Cassini space probe mission to Saturn. **6**



Launch	Slingshot	Slingshot	Slingshot	Slingshot	Orbit
15/10/1997	26/4/1998	24/6/1999	18/8/1999	30/12/2000	1/7/2004

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

Newtons Second Law states that an object accelarates when an exterior force is acted upon it. The acceleration then causes the object to go at a constant rate. This then shows that the bigger the planet gets the longer time it takes for the space probe to slingshot around the planets. Due to the constant speed rate the speed of the space probe doesn't decrease or increase.