

Core 1

(a) Fig. 1 illustrates a cathode-ray tube.

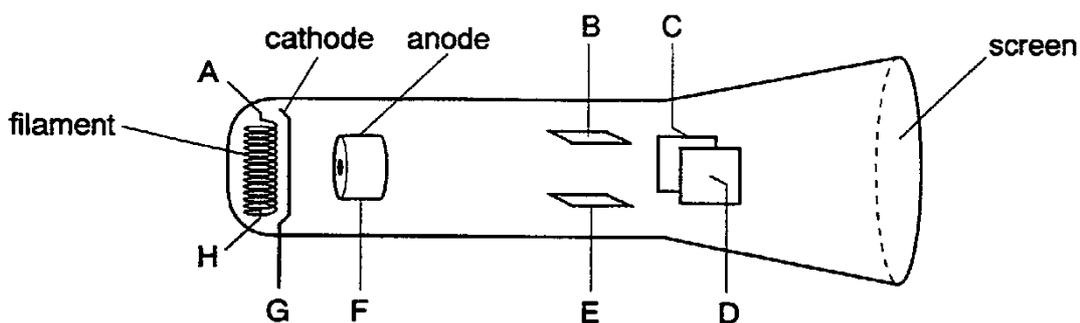


Fig. 1

(i) Between which two points would you connect a low potential difference in order to heat the cathode?

Between and

(ii) Between which two points would you connect a high potential difference in order to produce cathode rays?

Between and

(iii) Between which two points would you connect a potential difference in order to deflect the cathode rays upwards?

Between and

[3]

Core 1

- (b) When the time base of a cathode-ray oscilloscope is turned on, there is a horizontal trace across the screen, as shown in Fig. 2

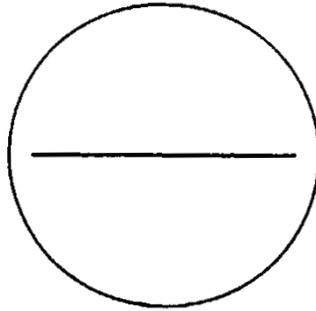


Fig. 2

- (i) An alternating potential difference of constant frequency and constant amplitude is connected to the Y-input of the oscilloscope.

On Fig. 2 , sketch the trace which might be obtained.

- (ii) The time base is switched off but the alternating potential difference is left connected. Describe what would be seen on the screen.

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[4]

- (c) A microphone is connected to another cathode-ray oscilloscope, with the time base switched to a suitable setting. First, a lady with a high-pitched voice sings into the microphone. Then a man with a low-pitched voice sings into the microphone. Describe how the traces seen on the screen would differ.

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[2]

Alternative to Practical 1

- (a) The circuit symbol for a diode is shown in Fig. 3. The diode conducts when the polarity is as shown.

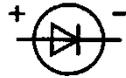


Fig. 3

Draw a circuit diagram showing the following components, all connected in series:
 a d.c. power supply, labelled to show its polarity,
 a fixed resistor,
 a diode,
 a switch.

On your circuit diagram, the switch should be shown open and the diode should be able to conduct when the switch is closed.

[3]

- (b) (i) Redraw your circuit diagram, adding an ammeter to measure the current in the diode. Label the polarity of the ammeter terminals.

- (ii) Is there any other position in the circuit where you could put the ammeter to measure the current through the diode? Tick one box.

yes	<input type="checkbox"/>
no	<input type="checkbox"/>

Give one reason to support your answer.

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[3]

Alternative to Practical 1

- (c) (i) Assuming that the fixed resistor has a resistance of $100\ \Omega$ and that the potential difference of the power supply is $3.0\ \text{V}$, calculate the maximum current I_{max} in the circuit.

$I_{\text{max}} = \dots\dots\dots$

- (ii) In order to calculate the value for I_{max} in (i) above, what assumption did you make about the resistance of the circuit?

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.....

[2]

Extension 1

(a) Fig. 4 shows a beam of electrons about to enter the region between two charged metal plates.

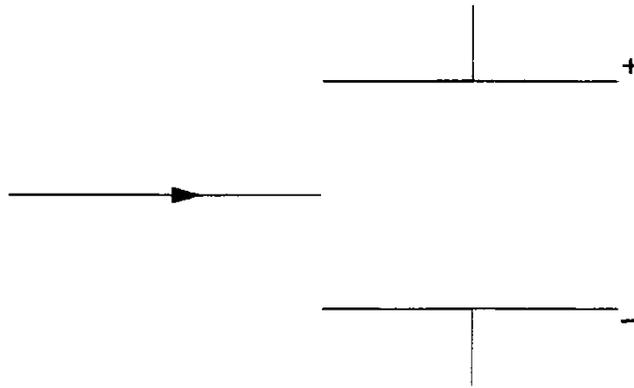


Fig. 4

On Fig. 9.1 continue the path of the electron beam between the plates

- (i) for plates with a very small charge (label this path **P**),
- (ii) for plates with the opposite charges to those shown on Fig. 4 (label this path **R**). [3]

(b) Fig. 5 shows another arrangement, similar to the first, but in this case the electron beam continues in a straight line because a magnet (which is not shown) has been placed near the plates.

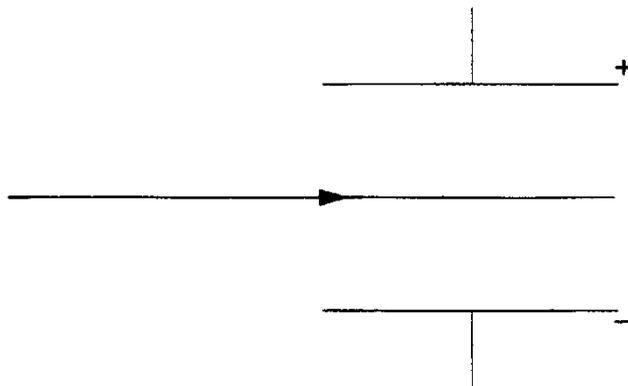


Fig. 5

Explain where you would place the N-pole of the magnet in order to achieve this effect. You may draw on the diagram if you feel that it will make your answer clearer.

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.....[3]

Extension 2

Fig. 6 shows part of a cathode-ray tube. An electron beam PQ is entering the region between two horizontal, charged metal plates.

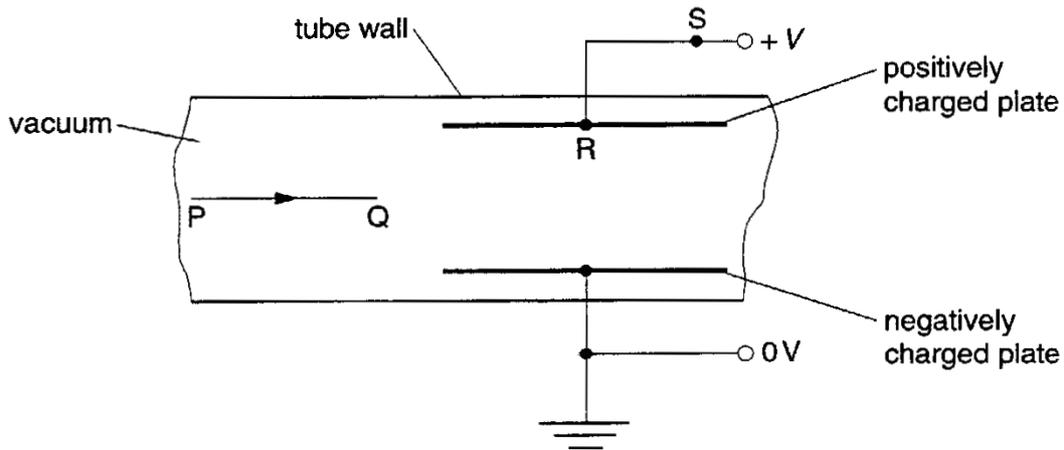


Fig. 6

- (a) (i) On Fig. 6, draw the electron beam from Q to show its path between the charged plates.
- (ii) Explain any change of direction of the electron beam when it is between the charged plates.

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- (iii) On Fig. 6, show the direction of the conventional current in the electron beam by drawing an arrow and labelling it D.

[5]

- (b) The voltage across the plates is increased so that one of the plates collects 10^{14} electrons in 10 s. Each electron carries a charge of 1.6×10^{-19} C.

- (i) Calculate the total charge collected by the plate in 10 s.

charge =

- (ii) State an equation linking charge and current. Hence calculate the current in wire RS.

.....

current =

[4]

Extension 2

- (c) Air containing charged dust particles flows between two metal plates. A high potential difference is connected across the plates as illustrated in Fig. 7

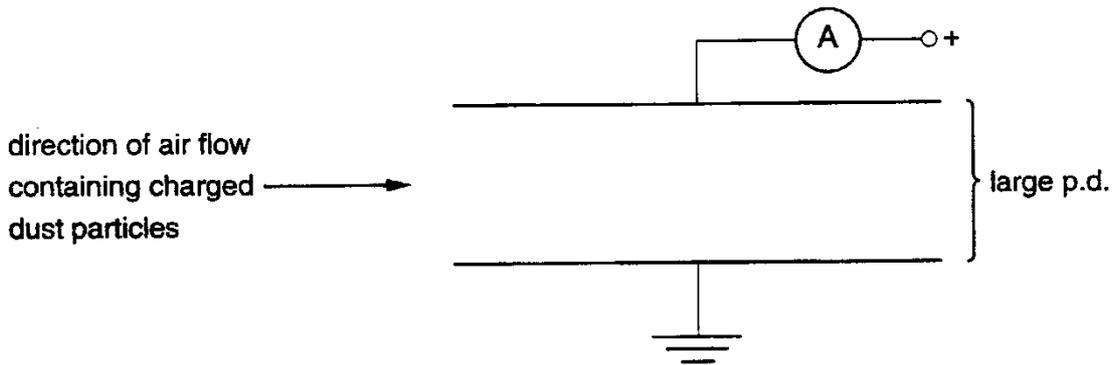


Fig. 7

The charged particles are attracted to the upper plate and move through a potential difference of 10 000 V. The ammeter records a current of 2.1×10^{-6} A.

Calculate

- (i) the energy supplied by the voltage source in 10 minutes (600 s),

energy =

- (ii) the power supplied.

power =

[6]

Extension 2

(d) Fig. 8 shows a beam of electrons entering the magnetic field of a coil. This magnetic field is directed into the paper.

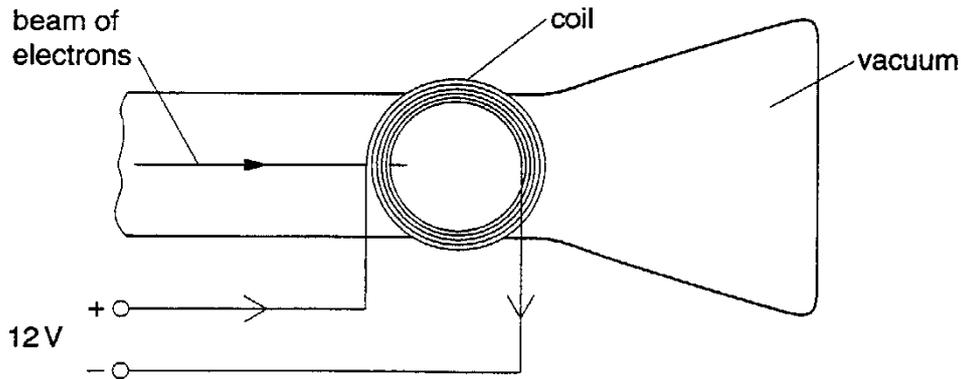


Fig. 8

(i) On Fig. 8 , sketch the path of the electron beam until it hits the end of the tube. Explain your choice of path.

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(ii) The resistance of the coil producing the magnetic field is 100Ω . Calculate the current in the coil.

current =

(iii) State the effect on the electron deflection of increasing **and** reversing the potential difference connected across the coil.

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[7]

Core 1

a(i) A and H

(ii) G and F

(iii) B and E

b(i) a waveform of approximately constant period and amplitude

(ii) a vertical line

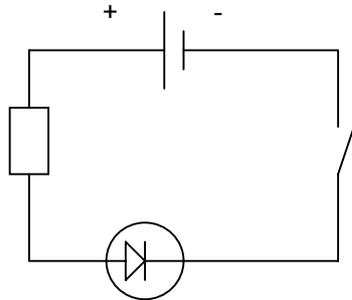
c different spacing

higher voice with closer waves than lower voice

Alternative to Practical 1

- a four acceptable (textbook) symbols in series
power-supply polarity labelled and correct diode connection
open switch

e.g.



- b(i) the ammeter should be placed anywhere in series with the other components and with its polarity compatible with the diode connections

- (ii) Yes
the current is the same at every point in the circuit

c(i) $I_{\max} = 3/100 \text{ A}$ or 30 mA

- (ii) no other resistance in the circuit or 3 volt across 100 Ω or maximum resistance is 100 Ω

Extension 1

- a(i) smooth curve P deviated upwards
- (ii) smooth curve R deviated downwards

- b in front or behind the paper or at right angles to the electric field
the N-pole should be “in front” of the paper to give field lines downwards in to the paper
or an explanation in terms of Fleming’s rule

Extension 2

- a(i) a smooth curve upwards towards the positive plate
- (ii) electrons are negatively charged
unlike charges attract
positive plate attracts electrons
- (iii) an arrow pointing towards P anywhere on the line PQRS
- b(i) total charge/s = $10^{13} \times 1.6 \times 10^{-19}$
= $1.6 \times 10^{-6} \text{ C}$
- (ii) charge = current \times time
current = $1.6 \times 10^{-6} / 1$
= $1.6 \times 10^{-6} \text{ A}$
- c(i) Energy = $V I t$ or $V q$
= $10\,000 \times 2.1 \times 600 \text{ J}$
= $1.3 \times 10^7 \text{ J}$
- (ii) Power = E / t
= $1.3 \times 10^7 / 600$
= $2.1 \times 10^4 \text{ W}$
- d(i) the path should be curved downwards while in the field of the coil
in accordance with Fleming's left hand rule
- (ii) current = $12 / 100$
= 0.12 A
- (iii) a bigger deflection in the opposite direction