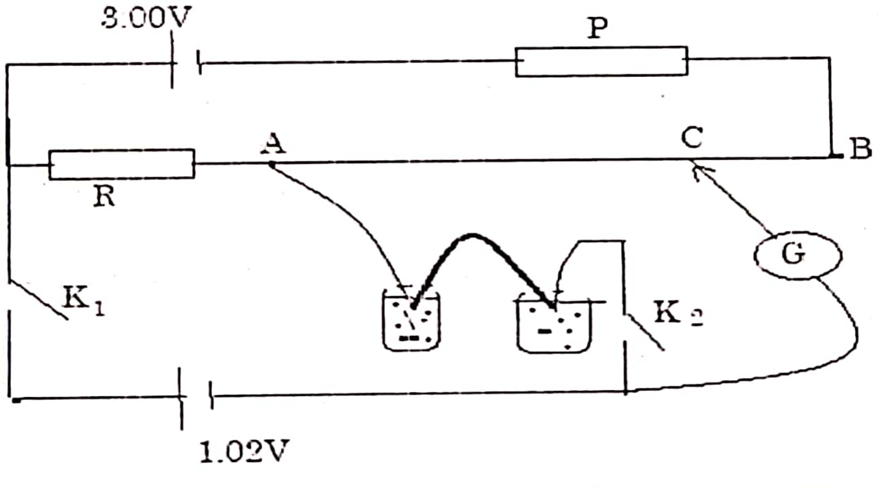
S.6 Physics Paper 2 test Time : 1 hour .

Answer all questions

1(a)(i) What is an electric field line. (1)
(ii). State three characteristics of electric field lines. (3)
(b) Two point charges Q_1 and Q_2 of +48.0μC and +24.0μC respectively are placed in a straight line in a vacuum at a distance of 90cm apart. A third charge -36.0μC is placed between Q_1 and Q_2 at a distance of 40cm from Q_2 .
(i) Find the resultant force on Q_1 . (5)
(ii). Sketch the electric field pattern in the region of these charges. (2)
(c)(i). What is meant by electrostatic screening? (1)
(i) Explain with the aid of a diagram, how a charged body can be screened against external electric fields. (4)
d) Describe an experiment to measure the capacitance of a capacitor. (6)

2(a)(i) Distinguish between electrical resistivity and electrical conductivity. (2)
(ii) Explain any two factors on which the resistance of a conductor depends. (6)
(b).(i) What is a superconductor? (1)
(ii) State three uses of superconducting materials. (3)
c (i) Outline the principle of a potentiometer. (3)
(ii) Explain why the potentiometer is unreliable for comparing low resistances. (3)
d) (i) Describe an experiment to measure the electromotive force of a thermocouple. (5)
In the figure below two resistors P and R are connected in series with a driver cell D of negligible internal resistance and emf 3.0 V ,to a uniform resistance wire of resistance 5.0 ohms and length 1.00m. A standard cell of emf 1.02V , a thermocouple and a centre- zero galvanometer are connected as shown in the diagram below.



The value of R is fixed to 280 ohms, and when K_1 is closed and K_2 open the galvanometer shows zero deflection when AC is 90cm. With K_1 open and K_2 closed the balance length AC is 52.4cm. Determine the e.m.f of the thermocouple and the resistance of P . (5)

END

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S.6 PHYSICS 2 ALADIN24.

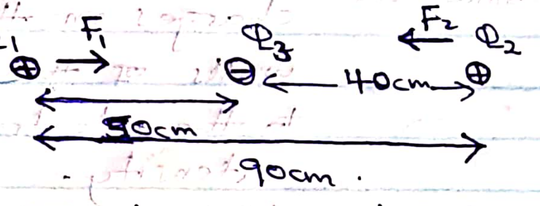
x/50

1a) i) An electric field line is a line that shows the path taken by a free positive charge placed at a point in an electric field. 01

ii) They do not meet (cross or interfect)
They originate from positive and terminate at the negative charge.
The electric field lines represent the magnitude and direction of an electric field or force.

03

b)



$$F = \frac{KQ_1Q_3}{r_1^2} + \frac{KQ_3Q_2}{r_2^2}$$

$$F_1 = \frac{(9\times10^9)(48\times10^{-6})(36\times10^{-6})}{(50\times10^{-2})^2}$$

$F_1 = 62.208N$ to the right

$$F_2 = \frac{(9\times10^9)(48\times10^{-6})(24\times10^{-6})}{(90\times10^{-2})^2}$$

$F_2 = 12.8$ to the left

05

$$F = F_1 + -F_2$$
$$= 62.208 + -12.8$$
$$= 62.208 - 12.8$$
$$= 49.408 \text{ to the right}$$

02

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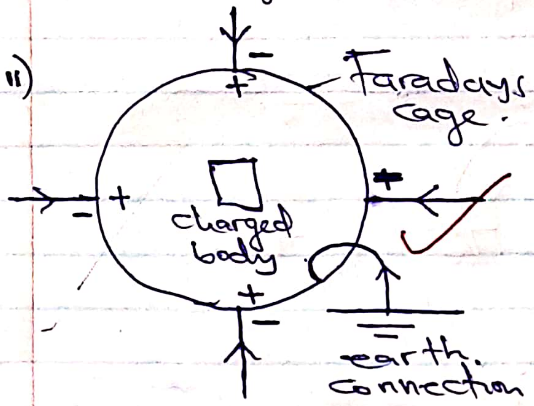
c i) Electrostatic screening is a process of creating an electrically neutral space in the neighbourhood of an electric field. 01

ii)

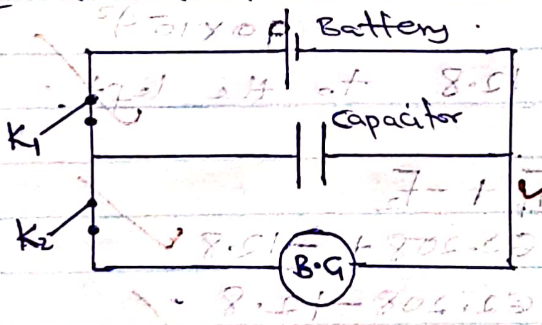


Consider a charged body placed inside a faradays cage. The electric fields from the vicinity induce opposite charges on the cage.

This intern creates opposite charges inside the cage which are then neutralized by the electrons from the ground due to the earth connection on the inner wall of the faraday's cage. 03

c ii) Experiment to determine the Capacitance of a parallel plate Capacitor.

1. Using a Ballistic Galvanometer.



A standard capacitor, a battery and a ballistic garanometer are connected as shown in the circuit above.

With switch K_1 closed and K_2 open, the capacitor the capacitor gets fully charged by the battery.

switch k_1 is then open and ~~k_2~~ closed and the capacitor discharges through the ballistic galvanometer and the deflection θ_s read and recorded.

The standard capacitor is then replaced with a capacitor whose capacitance, C is required.

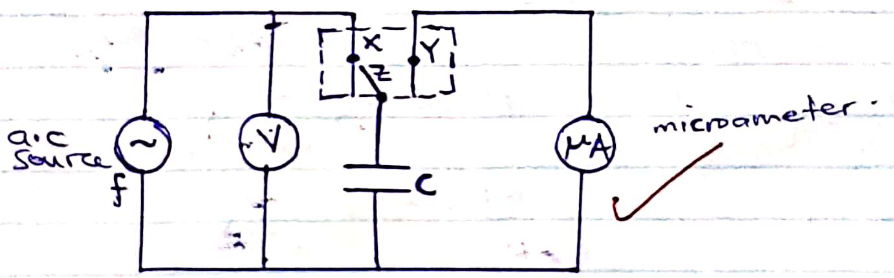
The procedures are then repeated as above and the deflection θ on the ballistic galvanometer is read and recorded.

The capacitance is then calculated from;

$$C = \left(\frac{\theta}{\theta_s}\right) C_s$$

06

2. Using a Vibrating Reed switch.



The circuit is connected as shown above with the reed switch operated by the a.c mains of frequency, f.

As the reed switch oscillates at a frequency, f the vibrating bar, Z makes contact with X and Y.

With the ~~standard~~ capacitor of unknown capacitance, C_x at an instant when Z makes contact with X, the capacitor gets fully charged.

At an instant when the bar Z is in contact with point Y, the capacitor discharges through the microameter and pulses of charge per second are noted as Current, I.

The voltage across the reed switch is also read and noted as V.

Capacitance of the Capacitor is then determined from;

$$C = \frac{I}{Vf}.$$

06

TOTAL = 22MRKS

2a i) Electrical resistivity is the resistance of a conductor of length one metre, and uniform cross sectional area of one square metre.
while:
Electrical conductivity is the measure of a materials ability to allow the flow of an electric current though it.

02

ii) Length of a Material (Conductor)
Increase in the length of a conductor increases, the number of collisions of the drifting electrons onto the vibrating atoms.
Thus few electrons finally drift through per second which reduces the current flow due to increased resistance.

03

Cross Sectional Area of a Conductor.
Increasing the area of cross section provides more space for the drifting electrons and less collisions with the stationary atoms occur.
More electrons finally drift through per second and this gives a large value of current since resistance has reduced.

03

b i) Super Conductors are conductors whose resistance gradually reduces to zero kelvin ~~(0K)~~ as temperature approaches −273K or 0°C.

01

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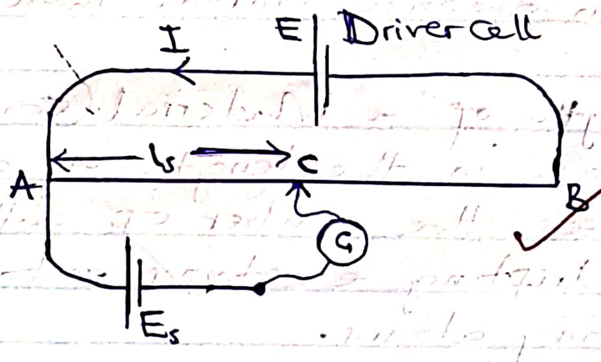
ii) - Magnetic Levitation
- Particle accelerators
- Power transmission
- Electric motors and Generators.

03

c) i) Principle of a Potentiometer.



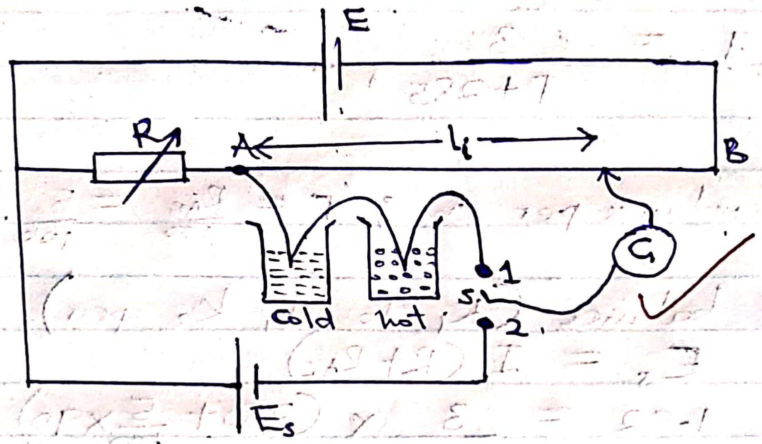
A driver cell is connected accross a slide wire AB with uniform resistance R.
The current that flows in ~~the~~ primary circuit $I = \frac{E}{R}$.
The secondary cell of unknown emf E_s is connected in opposition to the driver cell.
The jockey is then moved along the slide wire AB until the galvanometer shows no deflection.
The balance length l_s is read and recorded at point C.
The potential difference per centimeter K is determined.
The emf E_s is then calculated from $E_s = Kl_s$.

03

ii) Potentiometers have a high internal resistance which can affect the accuracy of low resistances due to errors in the readings.
They are not made to measure low resistances since they have high sensitivity to temperatures that brings errors in the readings during the comparison of low resistances.

03

Experiment to Measure the Electromotive force of a thermo couple.



The potentiometer is connected as shown above.

When switch S is at position 2, the jockey is moved along the slide wire AB until the galvanometer shows no deflection.

The balance length, l_1 is read and recorded.

$$E_s = Kl_1 = I(R + rl_1) \quad \text{--- (1)}$$

When switch S is connected to position 1, the jockey is moved along wire AB until the galvanometer shows a zero deflection.

The balance length, l_2 is read and recorded from the metre rule.

$$\cancel{E_T = I(R + rl_2)} \quad E_T = rIl_2 \quad \text{--- (2)}$$

From (1) $\quad I = \dfrac{E_s}{R + rl_1}$ --- (3)

equation (3) into equation (2)

$$E_T = \frac{E_s r l_2}{R + rl_1}$$

05

E_T is the electromotive force of a thermocouple and r is the resistance per centimeter along the slide wire.

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primary circuit

d ii) $E = I(R+P+R_{AB})$

$3 = I(P+280+5)$

$I = \dfrac{3}{P+285}$

Resistance per cm ; $r = \dfrac{R_{AB}}{100} = \dfrac{5}{100}\ \Omega cm^{-1}$

at balance (K_1 closed, K_2 open). $R_{AC} = rl_1$

$l_1 = 90cm$

$E_s = I(R+R_{AC})$

$1.02 = \dfrac{3}{P+285} \times (280 + \dfrac{5}{100} \times 90)$

$1.02(P+285) = 3(280+4.5)$

$1.02(P+285) = 853.5$

$P = \dfrac{853.5}{1.02} - 285$

$P = 551.76\Omega$

Current in the circuit :

$I = \dfrac{3}{P+285} = \dfrac{3}{551.76+285}$

$I = 3.59 \times 10^{-3} A$

At balance (K_1 open, K_2 closed) $l_2 = 52.4cm$

Emf of thermocouple; $E_T = kl_2$

$= rIl_2$

$E_T = \dfrac{5}{100} \times 3.59 \times 10^{-3} \times 52.4$

$E_T = 9.39 \times 10^{-3} A$

OR $E_T = 0.0094A$

OR $E_T = 9.4 mA$

05

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TOTAL = 28MRKS