

**PHYSICS DEPARTMENT**

**S5 Test**

**October 2015**

**Paper 2**

**Time 1½hours**

Attempt **ALL** the questions.

*Assume where necessary:*

*Permittivity of free space, ε0 =8.85 x 10-12 Fm-1*

1. (a) Define the following.

(i) **Electromotive force** of a source (1)

(ii) **Resistivity** of a conductor (1)

(b) Describe an experiment to verify Ohm’s law. (5)

(c) In the circuit shown below, a source of emf E and internal resistance r is connected to a variable passive resistance R

R

(i) Derive an expression for the maximum power that the source can deliver in the circuit. (4)

(ii) Sketch a graph of power output against the load R. (2)

(d) In the circuit shown below, AB is a uniform wire of length 1 m and resistance 6 ohms. X is a steady source of emf 3V and negligible internal resistance.

3V

4Ω

S

3Ω

A

B

X

D

Y

(i) Find the balance length AD when the switch S is open. (3)

(ii) If the balance length is 70 cm when the switch is closed, find the internal resistance of Y. (4)

2. (a) Explain the following:

(i) When a conductor is brought near the cap of a charged electroscope the divergence of the leaves decreases. (2)

(ii) Charging by contact is not as successful as that by induction. (2)

(b) Two point charges X and Y of 6μC and 4μC respectively are separated by a distance of 20 cm. Find

(i) the location of a point Z between X and Y where the electric intensity is zero (4)

(ii) thework done in reducing the separation to 10 cm. (3)

(c) With the aid of a diagram, describe how you would determine the ratio of the capacitances of two given capacitors (5)

(d) Two capacitors, of capacitance 200μF and 300μF, are connected as shown in the circuit below to batteries A and B which have emf 6V and 10V respectively.

A

300μF

200μF

B

Find the energy stored in each capacitor. (4)

3. (a) What is meant by

(i) **focal length** of a diverging lens. (1)

(ii) **conjugate points** for a lens. (1)

(b) Draw a ray diagram to show how a converging lens forms a real image of a virtual object. (2)

(c) Two lenses of respective focal lengths f1 and f2 are placed coaxially in contact.

Derive an expression for the focal length of the combination. (5)

(d) Describe an experiment to determine the refractive index of a liquid using a plane mirror and a converging lens. (5)

(e) A lens L1 forms a real image, at A, of a distant object.

A

L1

When another lens, L2, is placed between L1 and A, at a distance of 10 cm from L1, the image shifts by 4 cm towards L1. When L2 is placed 5 cm from L1, the image shifts further by 3.5 cm towards L1. Find the focal length of each lens. (6)