This examination paper contains six questions. Candidates are requested to answer any **FIVE (5)** questions. Candidates are also requested to include all their work in the booklet provided. Every answer should include all workings, any necessary diagrams and formulae. Use a fresh page for each different question. Each question carries 20 marks.

1. A coil of inductance 159.2mH and resistance 20Ω is connected in series with a 60Ω resistor to a 240V, 50Hz supply.

   Draw a well labelled diagram showing the circuit configuration.   **(3 marks)**

   Calculate;

a)	The impedance of the circuit	**(2 marks)**
b)	The current in the circuit	**(2 marks)**
c)	The circuit phase angle	**(2 marks)**
d)	The potential difference across the 60Ω resistor	**(2 marks)**
e)	The potential difference across the coil	**(5 marks)**
f)	Draw the circuit phasor diagram showing all the voltages.	**(4 marks)**

2. a) Briefly explain the construction of a Mica capacitor and an Electrolytic capacitor. Give a reason why an Electrolytic capacitor cannot be connected to an A.C. supply.   **(6 marks)**

   b) In the figure below capacitors P,Q and R have the same value and the total capacitance of the circuit is 3µF. Determine the values of capacitors P,Q and R.   **(14 marks)**

   3.5 µF

   2 µF

   4.5 µF

   P   **Q**   **R**
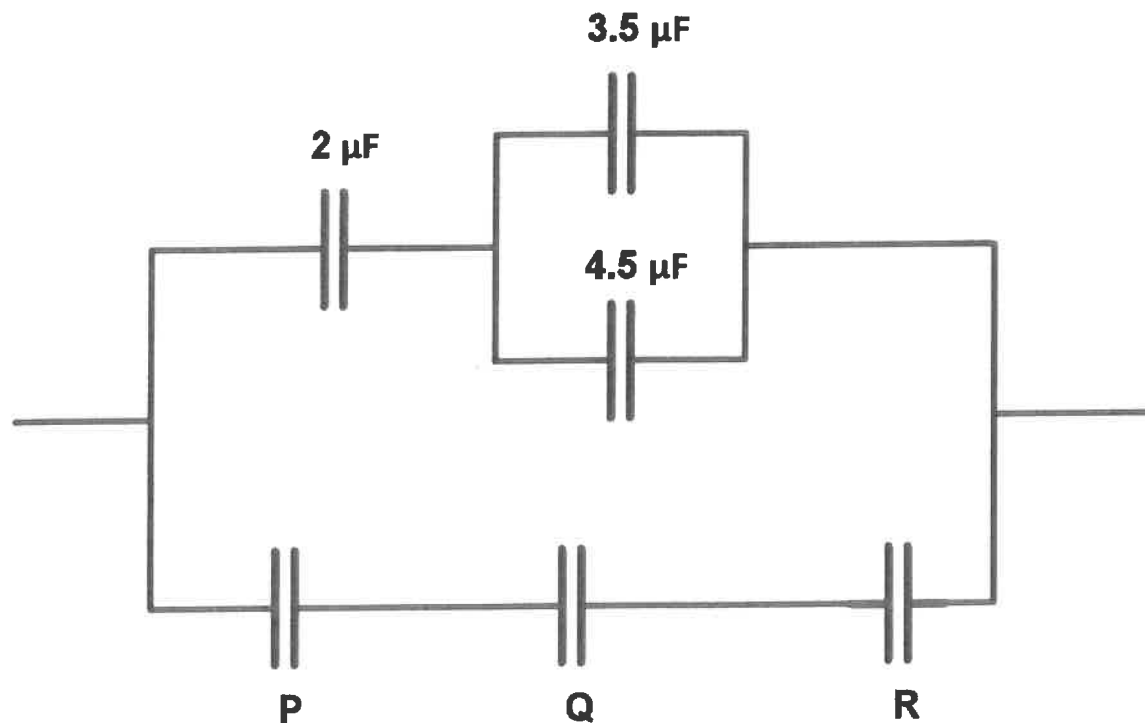
3. a) Name **TWO** types of batteries.   **(2 marks)**

   b) Which type of battery is used in cars?   **(2 marks)**

   c) A battery consisting of nine primary cells is connected to an external resistance of 10 ohms. If each cell has an e.m.f. of 1.5 volts and internal resistance of 0.45 ohm, determine the circuit current and volt drop across the 10 ohms resistor when the cells are arranged in the following configurations:

(i)	series	**(5 marks)**
(ii)	parallel	**(5 marks)**
(i)	three sets in parallel, each consisting of three cells in series.	**(6 marks)**

4. a) Describe clearly what is meant by the following terms:

(i)	Coefficient of utilization (CU)	
(ii)	Maintenance factor (MF)	**(4 marks)**

   b) An office area has a length of 20 metres, a width of 10 metres and a height of 3 metres. The ceiling to the desk surface is 2 metres. The office area is to be illuminated to a general level of 250 lux, using twin lamp 32 watt luminaires with a space height ratio (SHR) of 1.25. Each lamp has an initial output efficiency of 85 lumen per watt. The lamps has a Maintenance Factor (MF) of 0.63, and a Utilization Factor (UF) of 0.69.

   Calculate the following:

(i)	the total power.	**(3 marks)**
(ii)	the lumen per fixtures.	**(3 marks)**
(iii)	the number of fixtures required.	**(4 marks)**
(iv)	the minimum spacing between each fixture	**(2 marks)**
(v)	For the above office area what will be the number of rows of fixtures along the width of the room. State also the number of fixtures required in each row. **(4 marks)**

5. a) A 60 watts metal filament lamp is connected in parallel to a 100 watts lamp. The supply voltage is 240 volts.
Calculate:

    i.   the current in each lamp.   **(2 marks)**

    ii.   the resistance of each lamp.   **(2 marks)**

    iii.   the total current from the supply.   **(2 marks)**

b) If the two lamps are connected in series to the same supply;

    iv.   What is the total current in the circuit?   **(2 marks)**

    v.   What is the voltage drop across each lamp?   **(2 marks)**

    vi.   What is the power dissipated by each lamp?   **(2 marks)**

c) If the lamps' resistances were measured when cold, would the resistances be greater or less than the values found above? Give reasons for your answer.   **(8 marks)**

6. a) Calculate the power required to raise $0.25m^3$ of water per minute through a vertical height of 54m if the mass of $1m^3$ of water is 10^3 kg.   **(10 marks)**

b) The pump performing the above operation has an efficiency of 85%. Find the power required to drive the pump.   **(10 marks)**

END OF PAPER

Examination for Authorisation A

Paper 1:   Theory

Date: July 2021

Time: 09:00 – 12:00 (Three hours)