



5. (a) Explain the meaning of the following terms as applied to an illumination scheme:
- Coefficient of Utilisation factor (2 marks)
 - Maintenance factor (2 marks)
 - Spacing to Mounting Height ratio (2 marks)
- (b) An office measuring 60m by 30m requires an illumination at desk level of 550 lux. The lighting fittings selected to illuminate the office contains 80-W fluorescent tubes. The manufacture catalogue specifies that when the fittings are new, each fitting provides 5400 lumens. The mounting height of the fittings above desk level will be 3 m. Assuming a Utilisation factor of 0.7 and a Maintenance factor of 0.85. Calculate:
- i. The number of lighting fitting required to illuminate the office (5 marks)
 - ii. The annual cost of electricity if the lighting fittings are used on average 5 days a week and 8 hours daily. Assume that the office is supplied from a single-phase supply and that the cost of electricity is 15 cents per kWh. (9 marks)
6. (a) Mention and briefly explain **five** types of capacitors that are commonly used. (5 marks)
- (b) Capacitance of $6\mu\text{F}$, $12\mu\text{F}$, and $24\mu\text{F}$ are connected in series to a direct voltage supply of 350V. Determine:
- i. the equivalent circuit capacitance (5 marks)
 - ii. the charge on each capacitor (5 marks)
 - iii. the potential difference across each capacitor. (5 marks)

Examination for Authorisation A

Paper 1: Theory

Date: 1 February 2021

Time: 15:00 – 18:00 (Three hours)

END OF PAPER

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. Resistors of 4 ohms and 5 ohms are connected in parallel. A 6 ohms resistor, is connected in series with the group. The combination is wired to a 100 volt supply.
- Draw the circuit diagram. **(1 mark)**
 - Find the total resistance of the circuit. **(3 marks)**
 - Find the total current in the circuit. **(4 marks)**
 - Find the current in the 5 ohm resistor. **(4 marks)**
 - Find the current in the 4 ohm resistor. **(4 marks)**
 - Find the voltage drop across the 6 ohm resistor. **(4 marks)**
2. A tank of volume 0.5m x 0.75m x 0.75m is filled with water initially at 18° Celsius. Keeping in mind that:
- 1m³ of water = 1000 kg = 1000 litres
 specific heat capacity of water (c) = 4187 joules
 1 kWh = 3.6 x 10⁶ Joules
- Taking the efficiency of the tank as 78%. Calculate the rating in KW of a heater which will raise the temperature of the water to 82° Celsius in 2 hours. **(8 marks)**
 - Determine the cost of the operation if electrical energy cost 2.96 cents per KWH. **(6 marks)**
 - Calculate the resistance of the element of the heater, taking the supply voltage as 240 volts. **(6 marks)**

3. (a) Define the following Cells:
- Primary cells **(4 marks)**
 - Secondary cells
- (b) With the aid of diagrams explain how by connecting batteries in different configurations, one can obtain different voltage supplies and currents for a variety of applications. **(4 marks)**
- (c) A 12 Volts battery is made up of 6 cells. The battery is charged at a constant rate of 10 amps from a 24 Volts d.c. supply. If the e.m.f. of each cell at the beginning and end of the charge is 1.9 Volts and 2.4 volts respectively, calculate the value of the maximum resistance that need to be connected in series with the battery. Consider the resistance of the battery as negligible. **(6 marks)**
- (d) A discharged battery is charged at 8 amps for 2 hours after which it is discharged through a resistor of R ohms. If the discharge period is 6 hours and the terminal voltage remains fixed at 12 Volt, find the value of R, assuming the Ampere Hour (Ah) efficiency of the battery to be 80 percent. **(6 marks)**
4. A coil of resistance 10 ohms and inductance 135 mH in series are connected in series with a 100 μF capacitor to a 300 V, 50 Hz supply.
- Draw a well labelled diagram for this configuration and **(3 marks)**
 - Determine the following:
 - the current flowing in the circuit **(5 marks)**
 - the phase difference between the supply voltage and current **(3 marks)**
 - the voltage across the coil and its phase angle **(5 marks)**
 - the voltage across the capacitor. **(4 marks)**