WRITE ALL YOUR WORK IN THE ANSWER BOOK PROVIDED. EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY DIAGRAMS AND FORMULAE.

START EACH ANSWER ON A FRESH PAGE.

Choose any **FIVE** questions.

1. A 3m x 1m kitchen working top for food preparation is to have lighting design fixed 60cm above that would satisfy minimum 538 lux.

i. Describe and define Utilisation Factor (UF) in lighting design. **(3 marks)**

ii. Name two factors affecting the utilisation factor. **(2 marks)**

iii. Describe Maintenance Factor (MF) in lighting design. **(5 marks)**

iv. Describe and define the space height ratio. **(2 marks)**

Using the Lumen Method and considering 5050 LED light with average 19 lumens, UF of 0.6 and MF 0.7. Calculate:

v. how many LEDs are required. **(3 marks)**

vi. the minimum spacing between each LED, including:

(a) numbers in rows,
(b) LEDs per row,
(c) axial spacing and
(d) transverse spacing. **(5 marks)**

2. (a) Name two methods for charging secondary batteries. For each method briefly explain how the batteries are charged. **(8 marks)**

(b) Twelve cells each of emf 2.2V and internal resistance of 0.15 Ohm are arranged in three parallel rows. The whole cells arrangement forms a battery which is supplying a load of resistance 8 Ohms. Calculate,

i. The load current, **(4 marks)**

ii. The battery terminal voltage **(4 marks)**

iii. The load power supplied by the battery. **(4 marks)**

3. (a) State Ohm's Law as applied to a direct current (DC) circuit **(3 marks)**

(b) A circuit consisting of three resistors of resistances 8 Ohms, 7 Ohms and 4 Ohms connected in parallel, in series with a fourth resistor of resistance 3.5 Ohms across a 20 Volts direct current (DC) supply.

Draw the circuit showing the resistors combination. **(3 marks)**

(c) Calculate:

i. The total resistance **(2 marks)**
ii. The total current **(2 marks)**
iii. The voltage drop across the 3.5 Ohms resistor **(2 marks)**
iv. The current though the 8 Ohms resistor **(2 marks)**
v. The total power **(2 marks)**
vi. The power dissipated by the 4 Ohms resistor **(2 marks)**
vii. The power dissipated by the 3.5 Ohms resistor **(2 marks)**

4. A test on an electric kettle gave the following results:

Volume of water	0.001 m^3
Supply voltage	235 Volts
Current	6.2 Amps
Initial temperature	18° C
Final temperature	100° C
Time taken	330 seconds

Taking that:	mass of 1m^3 of water	= 1000 kg = 1000 litres
	temperature coefficient of water	= 4187 Joules
	1 kWh	= 3.6 x 10^6 Joules

Determine the efficiency of the kettle.

(20 marks)

5. A resistor of 200 Ohms and a capacitor of unknown value are connected in series to a 240 Volts supply at a frequency of 50 Hz. A current of 0.85 Amperes flows in the circuit.

i. Draw the circuit diagram. **(4 marks)**

ii. Find the impedance of the circuit. **(6 marks)**

iii. Calculate the value of the capacitor in microfarads. **(10 marks)**

6. A 95% efficient 50 litre water electric boiler is to raise the temperature of water by 40°C in 30 minutes. Calculate:

i. The heat energy required by the water **(5 marks)**
ii. The electrical energy input to the heater **(5 marks)**
iii. The average electric power supplied, and **(5 marks)**
iv. The cost of energy at €0.11/kWh. **(5 marks)**

Neglecting the heat absorbed by the surroundings.

Specific heat capacity of water is 4.186 J/g/°C.

END OF PAPER

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EXAMINATION: AUTHORISATION A

Paper I (Theory) Time Allowed - 3Hrs

February 2018

[redacted]

[redacted]