

WRITE ALL YOUR WORK ON 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) Sketch a complete cycle of an A.C. sine wave voltage waveform. Define, label and mark the following terms on the sketched sine wave.
- Peak Value, (2 marks)
  - RMS Value, (2 marks)
  - Average Value. (2 marks)

- (b) A coil of resistance  $5\ \Omega$  and inductance  $120\text{mH}$  is connected in series with a capacitor of  $100\ \mu\text{F}$  across a  $230\text{V}$ ,  $50\ \text{Hz}$  supply. Calculate:
- i. The current flowing in the circuit. (4 marks)
  - ii. The phase difference between the supply voltage and the current. (2 marks)
  - iii. The voltage across the coil. (3 marks)
  - iv. The voltage across the capacitor. (2 marks)
  - v. Sketch a phasor diagram showing all the voltages across the circuit. (3 marks)

2. (a) State Ohm's law as applied to a direct current (D.C.) circuit. (3 marks)

- (b) For the circuit shown in Figure 1 calculate:
- i. The current flowing through the  $3\ \Omega$  resistor. (14 marks)
  - ii. The Power rating of the  $3\ \Omega$  resistor. (3 marks)

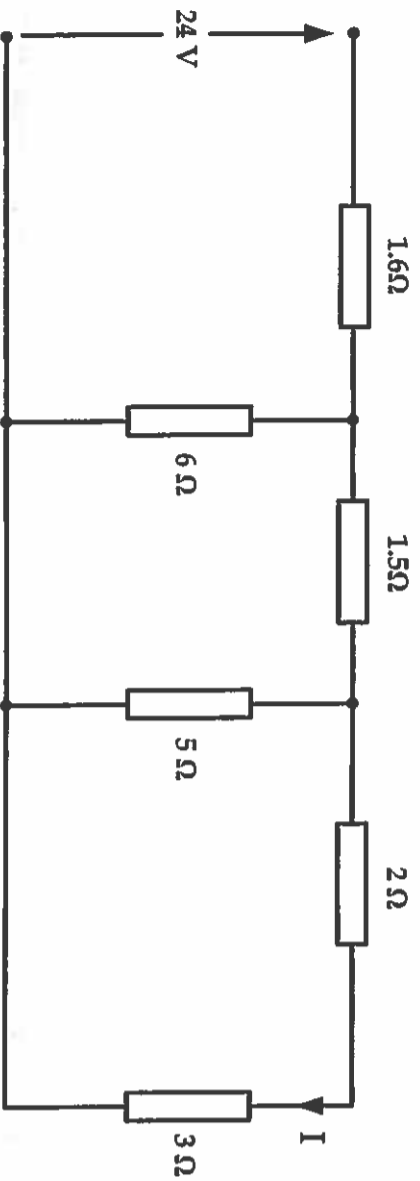


Figure 1

3. (a) A water heater containing 80 litres of water at  $15^\circ\text{C}$  is electrically heated by an immersion heater of 2500 watts connected to a  $230\text{V}$   $50\text{Hz}$  supply. Assuming that the system is 90% efficient, calculate:

- i. The time taken for the temperature of the water to reach  $80^\circ\text{C}$ . Take the specific heat of water as  $4200\ \text{J/kg}^\circ\text{C}$  and 1 litre of water have a mass of 1kg. (10 marks)
- ii. If the immersion heater is kept on for 5 hours daily. Calculate the cost of electricity at 11 cents per kWh for a period of 13 weeks. (10 marks)

4. a. Write the formula for the emf induced in a conductor when it moves through a magnetic field at right angle to the field. (6 marks)

- b. A conductor of effective length  $225\ \text{mm}$  is moving at right angles through a magnetic field at a speed of  $7\ \text{m/s}$ . If the emf induced is  $2.48\ \text{volts}$  what is the magnetic flux density? (7 marks)

- c. The flux linking a coil of 60 turns changes from  $0.073\ \text{Wb}$  to  $0.124\ \text{Wb}$  in  $0.004\ \text{seconds}$ . Calculate the emf induced. (7 marks)

5. A business uses an element of an electric heater of resistance  $30\ \text{ohms}$ . A current of 10 amps flows through it. The business uses two of these electric heaters for an average of 25 hours each per week together with six 100 watt lights for 37.5 hours each per week. If the cost of electricity is 14.25 Euro cents per unit, determine the following:

- a) the power of the electric fire; (4 marks)
- b) the total weekly energy used per week; (10 marks)
- c) the weekly cost of electricity to the business; (3 marks)
- d) Assuming that 20% of the energy is wasted, determine the actual energy being utilised. (3 marks)

6. (a) Refer to Figure 3 below:  
 A lighting fitting in dining room producing a luminous intensity of 1570 candela in all directions below the horizontal is suspended 4.25 m above the floor. Calculate the luminance produced at point z immediately below the lamp. (5 marks)

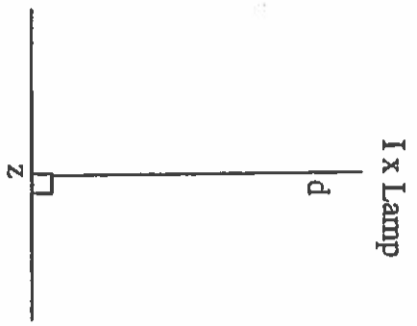


Figure 3

- (b) The above lighting fitting is raised by 1.5 metres. Calculate the new luminance produced at point z. (5 marks)

- (c) Refer to Figure 4 below:

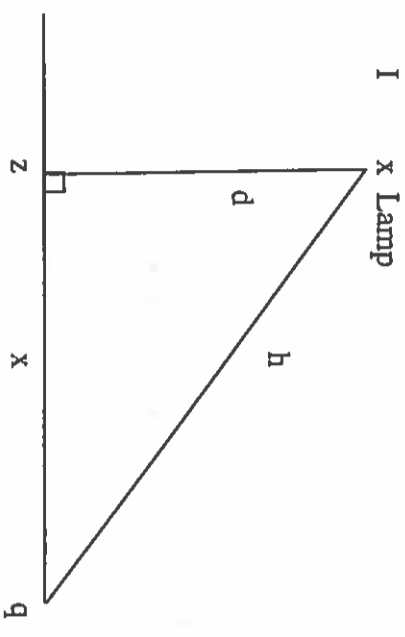


Figure 4

- Considering the same conditions given in the above question (a) and (b) and calculate the illumination at a point q 2.5 m away from z in the horizontal line. (10 marks)

END OF PAPER

EXAMINATION: AUTHORIZATION A

Paper I (Theory)

Time Allowed - 3Hrs

February 2016