

**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) Explain why it is necessary to have a protective earthing conductor in a final sub-circuit protected by an RCD. **(2 marks)**
- (b) A 230V, plug-in heater has an output of 2kW. The supply voltage to the heater fluctuates between 230V to 240V.
Describe the effect this voltage fluctuation has on the power output of the heater elements. **(2 marks)**
- (c) State **TWO** main functions of a ballast (choke) in a fluorescent light fitting. **(2 marks)**
- (d) State **ONE** reason why a polarity test is carried out on the mains of a single-phase, low voltage electrical installation. **(1 mark)**
- (e) State **ONE** reason why the protective device for the 230V single-phase domestic installation will not operate if a phase/neutral inversion occurs. **(2 marks)**
- (f) A RCCB and MCB protect a final sub-circuit supplying a 230V, single-phase wash-down pump.
The phase and neutral were inverted at the supply side of the motor isolating switch. The motor was turned on. State:
 - i. **ONE** reason why the motor still operates. **(1 mark)**
 - ii. the reason why the RCCB does not operate. **(1 mark)**
 - iii. the reason why the RCCB continues to provide protection to the motor final sub-circuit. **(1 mark)**
 - iv. the reason why the MCB does not operate. **(1 mark)**
 - v. the reason why the MCB continues to provide protection to the motor final sub-circuit. **(1 mark)**
 - vi. **ONE** hazard that exists because of the phase/neutral inversion. **(1 mark)**
- (g) A RCCB and MCB protect a final sub-circuit supplying a 230V, single-phase wash-down pump. The neutral and earth were transposed at the supply side of the motor isolating switch. What would occur when the pump was turned on?
State a reason to support your answer. **(3 marks)**
- (h) State **TWO** tests/checks that would detect the interchange of the phase and neutral conductors before the final sub-circuit is energised. **(2 marks)**

2. (a) You are using the voltage tester on the front of a 230V switched socket outlet to ensure power is present. **(3 marks)**
 - i. What voltage would you expect to find with the switch OFF between:
 - Active – Neutral
 - Active – Earth
 - Neutral – Earth
 - ii. What voltage would you expect to find with the switch ON between:
 - Active – Neutral
 - Active – Earth
 - Neutral – Earth

- (b) You are using the voltage tester on the front of a 230V switched socket outlet to ensure power is present and get the following results.

Test between Socket Terminals	Voltages Switch OFF	Voltages Switch ON
Active - Neutral	0V	230V
Active - Earth	0V	0V
Neutral - Earth	0V	0V

State **TWO** reasons why you would get these readings? **(2 marks)**

- (c) You are using the voltage tester on the front of a 230V switched socket outlet to ensure power is present and get the following results:

Test between Socket Terminals	Voltages Switch OFF	Voltages Switch ON
Active - Neutral	0V	230V
Active - Earth	0V	0V
Neutral - Earth	0V	0V

State the reason why you would get these readings. **(1 mark)**

- (d) A heater is rated at 2 kW when operating at 230V.
 - i. What effect will a voltage drop of 5% have on the resistance of the heater elements? **(1 mark)**
 - ii. By how much will the power dissipated by the heater change if the voltage drops by 5%. **(1 mark)**
 - (e) Explain the difference between:
 - i. A 10 kW pump motor that has been isolated.
 - And
 - ii. A 10 kW pump motor that has been switched off. **(3 marks)**
 - (f) Explain the term sensitivity in relation to an RCD. **(1 mark)**
 - (g) Define the term breaking (or rupturing) capacity as it applies to an HRC fuse. **(1 mark)**
 - (h) Define the term total clearing time as it applies an HRC fuse. **(1 mark)**
 - (i) Define the term current rating as it applies to an HRC fuse. **(1 mark)**
 - (j) State why the IET Regulations (BS 7671) requires that every installation shall be divided into circuits. **(5 marks)**
3. (a) Make a neat and well-labelled diagram showing the basic construction of a low-pressure mercury fluorescent lamp. Your diagram should show clearly all the parts of the lamp including the tube, the cathodes, bi-pin caps, the gas etc. **(7 marks)**
 - (b) Make a neat and well-labelled diagram showing a typical switch start circuit for a low-pressure mercury fluorescent lamp. Your diagram should include the fluorescent tube, starter switch, choke, local switch and power factor (pf) capacitor. **(7 marks)**
 - (c) What is the purpose of
 - i. The starter switch **(2 marks)**
 - ii. The choke **(2 marks)**
 - iii. The pf capacitor ? **(2 marks)**

4. The scope of the IET regulations is to ensure the safety of the user of the installation. Good workmanship is essential to comply with the regulations. Show that you are a safe and careful worker by answering correctly the following questions.
- (a) What precautions would you take when making terminations to cables and wires in switches, socket-outlets, fuse boards etc? **(5 marks)**
 - (b) What precautions would you take when preparing and before installing metal conduits? **(5 marks)**
 - (c) What precautions would you take to prevent the spread of fire where conductors pass through walls and floors? **(5 marks)**
 - (d) How would you prevent condensation in conduits? **(5 marks)**

Illustrate your answers with neat diagrams.

5. (a) Explain what is meant by and where the following could occur:
- i. Voltage drop **(1 mark)**
 - ii. Overload **(1 mark)**
 - iii. Trip Current **(1 mark)**
 - iv. Maximum load **(1 mark)**
 - v. Water tight fitting **(1 mark)**
- (b) In your own words describe how you would:
- i. size a cable **(3 marks)**
 - ii. connect a stationary equipment such as a cooker to an installation **(3 marks)**
 - iii. test an Earth electrode **(3 marks)**
 - iv. test a new installation. In your answer mention the tests you would perform and expected values. **(6 marks)**
6. (a) With the aid of a diagram explain what is meant by the term “Discrimination”. Explain how good discrimination is achieved in an electrical installation. **(5 marks)**
- (b) How is the current demand of a final circuit determined. **(5 marks)**
- (c) A small shop is to be supplied from a single phase 230V 50Hz supply. The load connected to the installation comprises of the following items:
- i. 5 x 100 W Filament fitting
 - ii. 8 x 60 W Twin fluorescent fitting
 - iii. 2 ring Circuits
 - iv. An 3 kW cooker controlled from a cooker unit combined with a 13A socket outlet.
- Calculate the assumed current demand for the installation by applying the diversity factor as provided in the table below and state what will it be your recommendation to the owner. **(10 marks)**

The following table gives the necessary diversity information that must be applied.

Purpose of the final circuit	Diversity to be applied
Lighting	66% of the total current demand
Cooking appliance	10 Amp + 30% full load of the connected cooking appliance in excess of 10 Amp + 5 Amp if a socket outlet is incorporated
Heating and Power	100% of total current demand up to 10 Amp + 50% of any current demand in excess of 10 Amp.

END OF PAPER

EXAMINATION: AUTHORISATION A

July 2018

Paper II (Electrical Installation Technology)

Time Allowed - 3Hrs