



Total: 100 marks

END OF EXAMINATION PAPER

Examination for Authorisation A

Paper 2: Electrical Installation Technology

Date: 4 July 2019

Time: 09:00 – 12:00 (Three hours)

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) Explain the following electrical installation terms and give one application for each:
 - (i) plastic (PVC) conduit (3 marks)
 - (ii) metal conduit (3 marks)
 - (iii) cable trunking (3 marks)
 - (iv) cable trays (3 marks)
- (b) For (a) (i) and (ii) above draw four conduit fittings commonly used in electrical installations. (8 marks)

2. (a) With the aid of diagrams explain the main difference between for the following transformers:
 - (i) a single-phase double-wound transformer (4 marks)
 - (ii) a single-phase auto-transformer (4 marks)
 - (iii) List and briefly explain the type of losses commonly encountered when using transformers. (4 marks)
- (b) List two disadvantages of an auto transformer. (4 marks)
- (c) State for what purposes an auto-transformer may be used and what general precautions would be necessary. (4 marks)

3. (a) i. Using a simple but neat and well-labelled diagram explain what you understand by a circuit breaker. What is the main difference between a circuit-breaker and a fuse? (9 marks)
- ii. State **five** advantages of a circuit breaker over a fuse. (5 marks)
- (b) Certain terms are used when fuses and circuit breakers are mentioned. Explain in your own words what you understand by the following:
 - i. Fusing factor (2 marks)
 - ii. Discrimination (2 marks)
 - iii. Cut-off factor (2 marks)

Fig 3.3A Fuses to BS 88-2.2 and BS 88-6

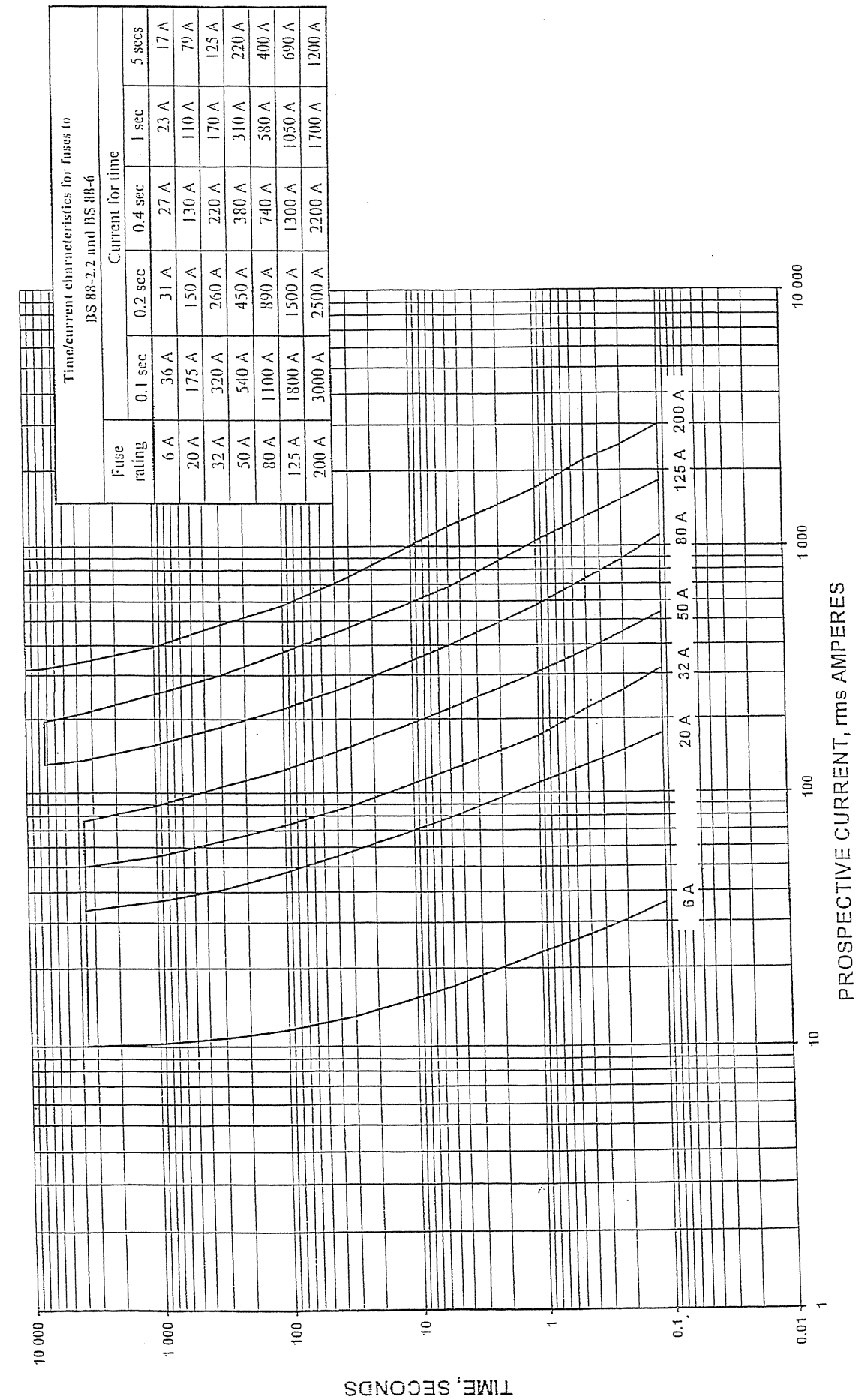
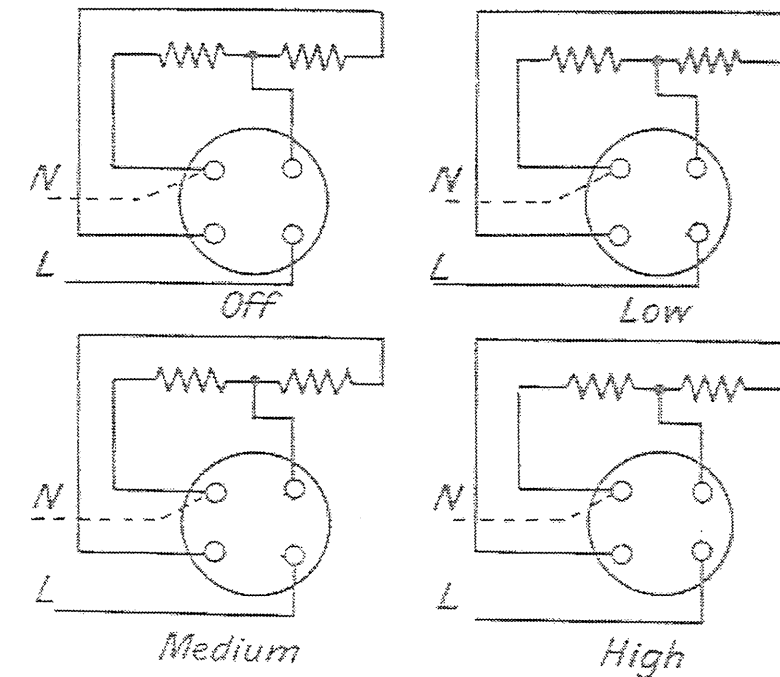


Table 6 B – Values of Resistance of combinations of copper conductors

Cross- Sectional area (mm ²)		(R ₁ + R ₂)(mΩ/m)
Phase conductor	Protective conductor	
1	1	36.2
1.5	1	30.2
1.5	1.5	24.2
2.5	1	25.51
2.5	1.5	19.51
2.5	2.5	14.82
4	1.5	16.71
4	2.5	12.02
4	4	9.22
6	2.5	10.49
6	4	7.69
6	6	6.16
10	4	6.44
10	6	4.91
10	10	3.66
16	5	4.23
16	10	2.98
16	16	2.3
25	10	2.557
25	16	1.877
25	25	1.454
35	16	1.674
35	25	1.251
35	35	1.048

4. (a) A 16 kW electric cooker is to be installed in a kitchen. The cooker is to be installed to a cooker unit which includes a 13 amps socket-outlet. If the supply voltage is 230 volts what will be the assumed current demand if diversity factors allowed by the IET Regulations are applied? (6 marks)
- (b) The cooker has a rotary three-heat switch. Describe such a switch and explain how it works. (6 marks)
- (c) The diagrams below shows the four positions of a typical rotary three-heat switch. Copy the diagrams in the answer booklet and complete the connections so that the switch works correctly in each position. (8 marks)



5. (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) In a consumer unit (or distribution board) there are protective devices which provide protection to the final sub-circuits. What sort of protection these provide to the final sub-circuit? (3 marks)
- (c) An apartment is to be supplied from a single phase 230 volts 50Hz supply. The load connected to the installation comprises the following items:
- (i) Lighting: 6 twin fluorescent fittings where each tube is rated at 80 Watts
 - (ii) Power: A water pump motor rated at 2 kW

- (ii) Cooking Appliance: a cooker with a rated power 4kW. The control unit supplying this cooker has a socket outlet incorporated.
- (iii) 2 ring circuits each protected by a 32 amp MCB.

Calculate the total 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. (12 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
Heating and Power	100% full load of largest appliance + 75% full load of remaining appliances.
Cooking appliance	10 amps + 30% full load of the connected cooking appliance in excess of 10 amperes + 5 amperes if a socket outlet is incorporated
Socket- Outlets	100% of total current demand of largest point of utilization + 50% of current demand of every other point of utilization

- 6. A 230 volt single-phase cable supplying a distribution board is to be wired in PVC insulated single-core cables to BS 6004. The cable length is 65m and the live conductors are of 25mm² cross-sectional area. The circuit is intended to supply fixed equipment and is to be protected by an 80 amp fuse to BS 88. The loop impedance external to the installation has been ascertained to be 0.325 ohms.

The maximum permissible disconnection time for fixed equipment is 5 seconds and the minimum fault current is 40 amps. Take the temperature coefficient of resistance multiplier for PVC as 1.38.

Take the value of **k** for protective conductor which are cores in cables or bunched as 115. The size of the cpc can be calculated by using the adiabatic equation.

Referring to the provided graph (on page 7) and table below, calculate the cross-sectional area of the circuit protective conductor.

$$S = \left(\frac{\sqrt{I^2 t}}{k} \right)$$

Table 6 A – Values of Resistance of copper conductors

Cross-Sectional area, mm ²	Resistance ,mΩ/m
1	18.10
1.5	12.10
2.5	7.41
4	4.61
6	3.08
10	1.83
16	1.15
25	0.727
35	0.524