5. (a) Draw a cross-sectional view of a DC machine showing all the relevant parts of the machine. **(4 marks)**

(b) Name and describe briefly six components parts of the machine drawn in question (a) above. **(6 marks)**

(c) Name and describe briefly two types of armature windings used for DC machines. **(2 marks)**

(d) What is commutation in a DC machine? **(3 marks)**

(e) Name five methods which are used to reduce the sparking of the brushes of a DC machine. **(5 marks)**

6. (a) A switch fuse containing a 30 Amp semi-enclosed fuse protects a radial circuit feeding fixed equipment. The supply voltage is 230 V and the external impedance Z_e is 0.36 ohm. The resistance of the phase conductor to the fixed equipment (R_1) is 0.05 ohm and due to a damaged conduit joint, the resistance of the protective conductor (R_2) is 6 ohms. The fusing factor of the fuse is 1.80.

(i) With the aid of a diagram explain earth-loop impedance (Z_s). **(4 marks)**

Calculate the following:

(ii) The value of the total earth-loop impedance (Z_s). **(3 marks)**

(iii) The prospective earth fault current I_f. **(3 marks)**

(iv) The prospective shock voltage between the metal case of the fixed equipment and the general mass of earth. **(4 marks)**

(b) Will the fuse operate and render the circuit safe? **(3 marks)**

(c) Draw a sketch to illustrate the answer given above. **(3 marks)**

END OF PAPER

EXAMINATION: AUTHORISATION B

Paper II (Electrical Installation Technology)

Time Allowed: 3 Hrs

February 2017

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.

Answer any **FIVE** Questions

1. (a) Compare the advantages and disadvantages of the following type of cables:

   i. Paper Insulated, Lead sheathed and armoured cables
   ii. PVC insulated, armoured and PVC served cables
   iii. Thermosetting insulated, armoured and PVC served cables **(5 marks)**

   (b) With the aid of diagrams answer the following questions

   i. Why are single core cables for use in 3-phase a.c. systems usually not armoured? **(3 marks)**

   ii. Why is protection given to such cables to prevent them being damaged when installed underground? **(3 marks)**

   iii. What is meant by single point bonding as applied to single core cables with non-magnetic armour? **(3 marks)**

   iv. What precaution should be taken when installing single core cables with non-magnetic armour bonded at one point only? **(3 marks)**

   v. From a current rating point of view is solid bonding to be preferred to single point bonding? Give reasons for your answer. **(3 marks)**

2. (a) Draw suitably labelled diagrams illustrating the construction and connection of a wound type and bar primary type current transformer. **(6 marks)**

   (b) Why do transformers need to be cooled? Describe the methods which are used for cooling the transformers **(6 marks)**

   (c) Draw neat diagrams of:

   i. A Three-Phase Step-Up transformer **(3 marks)**
   ii. A Single-Phase Step-Up transformer with centre-tapping **(3 marks)**
   iii. A Single-Phase Step-Up auto-transformer **(2 marks)**

   Show in each case which parts of the transformer need to be earthed

3. (a) Mention six safety measures that should be taken when using electricity on a construction site. **(6 marks)**

   (b) An electric drilling machine develops an earth fault of 5 ohms to its metal frame. The machine has a power of 1.5 KW at 0.7 power factor when it is connected to a 240 volts supply.

   Assuming that the fuse protecting the circuit will not blow with a current less than 30A and that the circuit has a total earth loop impedance of 10 ohms:

   i. Draw a circuit diagram indicating clearly the current paths between the machine and the supply transformer under fault conditions. **(4 marks)**

   ii. Calculate the fault current and the total current taken from the supply under fault conditions. **(4 marks)**

   iii. Calculate the voltage above earth of the metal casing of the machine under fault conditions, assuming that the resistance between the substation's earth and the consumer's earth electrode is zero. **(3 marks)**

   iv. Comment on the safety and protection of the machine. **(3 marks)**

4. (a) With the aid of a diagram explain the construction and operation of a 3-phase Squirrel-Cage induction motor. It is important to consider both the electrical and mechanical aspects. **(8 marks)**

   (b) Explain when a 3-phase auto-transformer is used to start an induction motor. Using a line diagram explain how this is done. **(6 marks)**

   (c) How is the rotation of a Squirrel-Cage induction motor obtained? **(6 marks)**