

## 25.0 ELECTRICITY

### 25.1 Electricity Paper 1 (448/1)

#### 1. (a) Safety precautions

Do not climb electric power posts  
Avoid touching any broken overhead cable  
Do not climb trees near overhead cables  
Avoid felling trees near overhead power lines  
Never erect building below power lines.

(Any 3×1)

#### (b) Areas of specialisation

Electrical (power option)  
Electronics  
Telecommunication  
Instrumentation

(4x %)

#### 2. (a) Tools

Hacksaw  
Scriber  
Steel rule  
Try square  
Tape measure  
Chisel

Dot punch  
(Any 4 x %)

#### (b) Magnetic lines of force

Each line forms a closed loop  
Lines never intersect  
Stretched elastic cords always trying to shorten themselves  
Direction of line is that of north-seeking pole

(Any 3 x 1)

#### 3. (a) Inductor cores

Air core  
Ferrite core  
Iron core

(Any 2 x %)

#### (b) Silver

is very expensive/ rare  
not mechanically strong

(2×1)

#### 4. (a) Resistance

(i) 630 Ω ± 10%  
(ii) 820 kΩ ± 20%  
(iii) 599 ± 5%

(3 x 1)

#### (b) Inductance of a coil

Number of turns in a coil  
Length of the coil  
Cross-section area of the coil  
Relative permeability of the core

(Any 2×1 = 2 marks)

5. (a) **Determining polarity**  
 The terminal at the crimped end of capacitor is the positive.  
 The negative terminal is identified by a broad strip marked (-) on the body and vice versa.  
 The shorter terminal of an unused capacitor is the negative and vice versa.  
 The positive terminal is identified by a red spot. (Any 2 x 1)

- (b) (i) **Power rating** =  $I \times V$   
 $= 12 \times 0.8 \text{ A}$   
 $= 9.6 \text{ W}$  (1% marks)

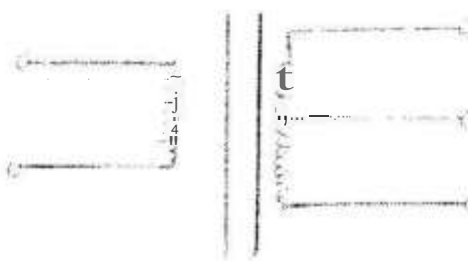
$$= P = \frac{V^2}{R}$$

$$- R = \frac{V^2}{P}$$

$$- \frac{12^2}{9.6} = 15 \Omega$$

(1% marks)

6. (a) **Transformers**



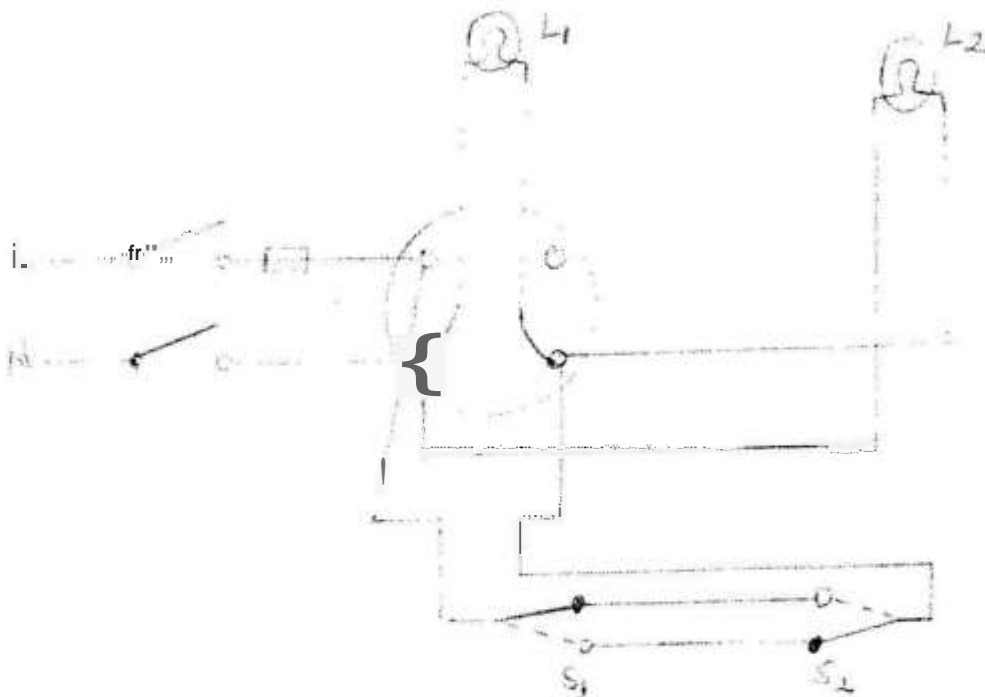
(2x1)

- (b) **Eddy currents**  
 Minimized by • Laminations  
 - Insulating material. (2 x 1)

7. (a) **Equipment**  
 Meter Main fuse  
 Sealing chamber  
 Armoured cable  
 Ripple timer  
 (Any 4 x %)

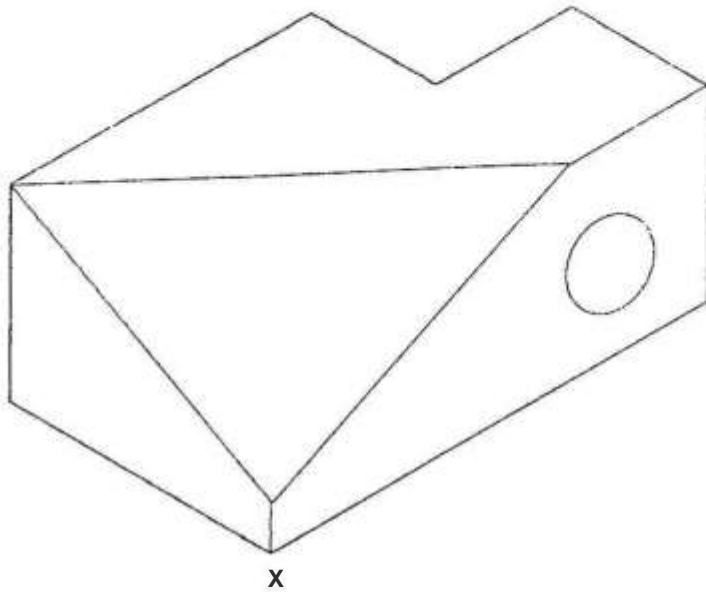
- (b) **Protection gear**  
 Protects circuit against excess current  
 Protects circuit against earth leakage  
 Enables isolation of the installation from the supply. (3 x 1)

8. (a) **Uses of LED**  
 indicators in instrument panels.  
 numerical displays  
 lighting  
 photocopying (Any 3 x 1)
- (b) **Diodes**  
 Rectifier diode operates in forward bias.  
 Zener diode operates in the reverse bias. (2 x 1)
9. (a) **Indicating instruments** **Method of damping**  
 Permanent magnet moving soil - Eddy current  
 Moving iron - Air  
 Thermocouple - Eddy current  
 Electrostatic - **Air**  
 (Any 2 x 1) (2 x h) = 1
- (b) **Visual inspections**  
 Check for: Broken conductor tracks  
 Metal tying across conductor tracks  
 Components showing sign of damage - colour  
 Dry joints (Any 3 x 1)
10. (a) **Materials**
- |             |                       |                     |             |
|-------------|-----------------------|---------------------|-------------|
|             | Lead Acid             | Leclanche           |             |
| + electrode | lead dioxide          | Carbon              |             |
| - electrode | lead                  | Zinc                |             |
| Electrolyte | dilute sulphuric acid | Potassium hydroxide | (6 x h = 3) |
- (b) **Wiring diagram**



- |                       |   |
|-----------------------|---|
| Correct cable routing | 1 |
| Correct circuit       | 2 |
| Correct symbols       | 2 |

11.



12. (a)  $Z = \sqrt{X^2 + R^2} = \sqrt{250,000 + 1,000,000}$

$= 1118 \text{ } \Omega$

(b) Circuit current  $I = \frac{V_s}{Z}$   
 $= \frac{125}{1118} = 0.1118 \text{ A}$

(c) Voltage drop across:

Inductor  $= I, X, = 0.1118 \times 500 = 55.9 \text{ V}$

(d) Apparent power  $= V_s \times I,$   
 $= 125 \times 0.1118 = 13.975 \text{ VA}$

(e) True power dissipated by resistor

$P_T = (I^2) R = (0.1118)^2 \times 1000 = 0.0125 \times 1000$   
 $= 12.5 \text{ W}$

(f) Power factor

$PF = \frac{P_T}{P_s} = \frac{12.5 \text{ W}}{13.975 \text{ VA}} = 0.89$

(2 x 6 = 12 marks)

13. (a) **Controlling devices**

Spring control

Gravity control

(2 x 1)

(b) **Advantages**

High sensitivity

Uniform scale

Well shielded from stray magnetic field

(3 x 1)

- (c) (i) Potential drop =  $2 \times 200 = 0.4 \text{ V}$   
Voltage drop across R =  $10 - 0.4 = 9.6 \text{ V}$   
hence  $R = \frac{9.6}{0.2} = 48 \Omega$

(4 x 1)

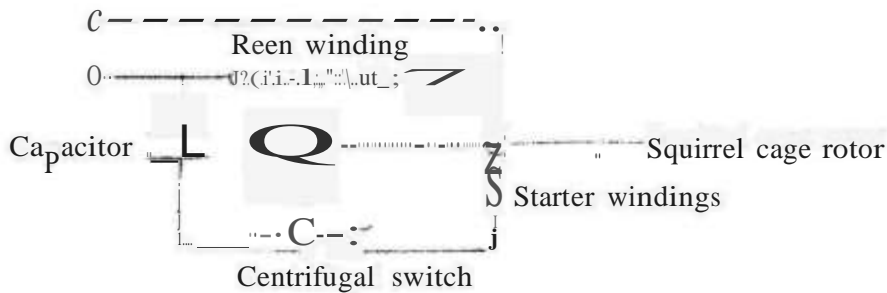
- (ii) Low resistance shunt S is connected across the milliammeter shunt carries the rest of the current i.e  $10 - 0.2 = 9.8 \text{ A}$

$$S = 0.2 \times 2 = 9.8 \times 0.04 = 0.04 \Omega$$



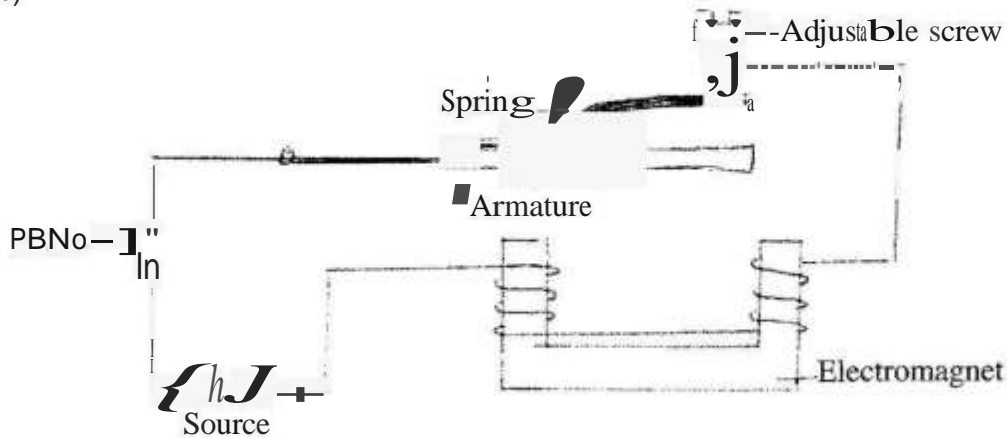
(3 x 1)

14. (a) **Capacitor - start induction motor**



Sketch = 1  
Labelling (4 x h) = 2  
3 marks

(b)



When push button is closed, the circuit is completed. Current flows through the coils which become an electromagnet, and attract the armature. The armature pulls the spring and disconnects the contact points, breaking the circuit and demagnetizing the coils. The armature - spring assembly completes the circuit again and the process is repeated again, creating the buzzing sound at the contacts for as long as the push button remains pressed.

15. (a) (c)

$$= 50 + \frac{(50 + 100) 100}{(50 + 100) + 100}$$

$$= 50 + \frac{15000}{250}$$

$$= 50 + 60 = 110 \Omega$$

(ii) P.d across R,

$$I = \frac{E}{R_T}$$

$$= \frac{22}{110} = 0.2 \text{ A}$$

1 mark

$I_T = I_1 + I_2 + I_3 + I_4$  where  $I_2$  is current through R, and  $I_1$  is current through R, and R, 1 mark

$$I_T = I_1 + I_2 + I_3 + I_4$$

$$\text{P.d across R,} = I_2 R = 0.2 \times 100 = 20 \text{ V}$$

$$= 22 - I_1 R = 22 - 10 = 12 \text{ V}$$

$$\therefore I_1 = \frac{12 \text{ V}}{100 \Omega} = 0.12 \text{ A}$$

$$I_3 = I_1 = 0.12 \text{ A}$$

$$I_4 = I_T - I_1 - I_2 = 0.2 - 0.12 - 0.12 = 0.08 \text{ A}$$

$$\text{P.d across R,} = I_4 R = 0.08 \times 100 = 8 \text{ V}$$