25.0 ELECTRICITY

25.1 Electricity Paper 1 (448/I)

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 x 1)

(b) **Areas of specialisation**
Electrical (power option)
Electronics
Telecommunication
Instrumentation (4 x ½)

2. (a) **Tools**
Hacksaw
Scriber
Steel rule
Try square
Tape measure
Chisel
Dot punch
(Any 4 x ½)

(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 ½)

(b) **Silver**
is very expensive/ rare
not mechanically strong (2 x 1)

4. (a) **Resistance**
(i) 630 Ω ± 10%
(ii) 820 kΩ ± 20%
(iii) 59 Ω ± 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 x 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 x V
= 12 x 0.8 A
= 9.6 W (1½ marks)

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

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

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

(1½ marks)

6. (a) **Transformers**

(2 x 1

(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 ½)

(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 ½) = 1

(b) **Visual inspections**

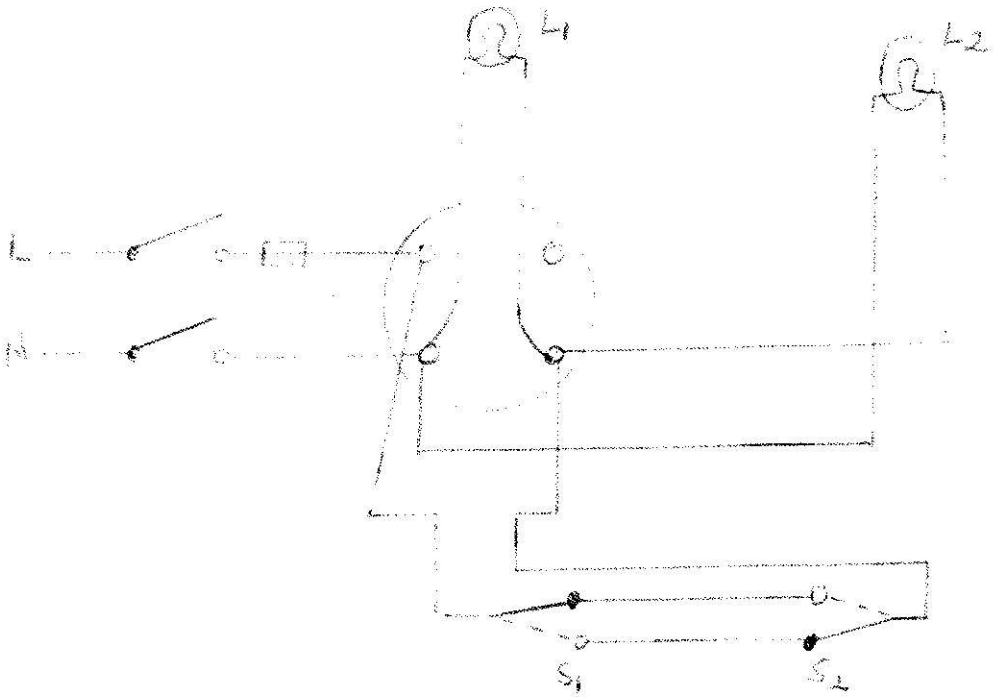
Check for: Broken conductor tracks
Metal lying across conductor tracks
Components showing sign of damage - colour
Dry joints (Any 3 x 1)

10. (a) **Materials**

	Lead Acid	Leclanche
+ electrode	lead dioxide	Carbon
- electrode	lead	Zinc
Electrolyte	dilute sulphuric acid	Potassium hydroxide

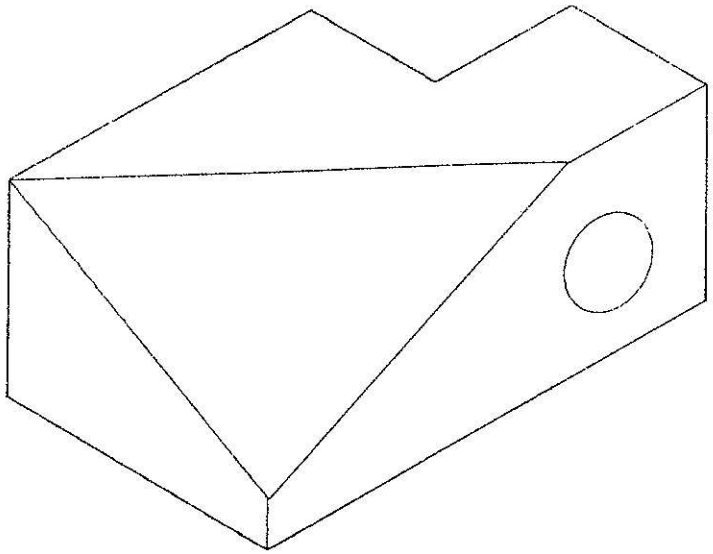
(6 x ½ = 3)

(b) **Wiring diagram**



Correct cable routing	1
Correct circuit	2
Correct symbols	2

11.



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

$= 1118\ \Omega$

(b) Circuit current $I_T = \dfrac{Vs}{Z}$

$= \dfrac{125}{1118} = 0.1118\ A$

(c) Voltage drop across:

Inductor = $I_T X_L = 0.1118 \times 500 = 55.9\ V$

(d) Apparent power = $Vs \times I_T$

$= 125 \times 0.1118 = 13.975\ VA$

(e) True power dissipated by resistor

$PT =, (I_T)^2R = (0.1118)^2 \times 1000 = 0.0125 \times 1000$

$= 12.5\ W$

(f) Power factor

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

(2 x 6 = 12 marks)

13. (a) **Controlling devices**

Spring control

Gravity control

(2 x 1)

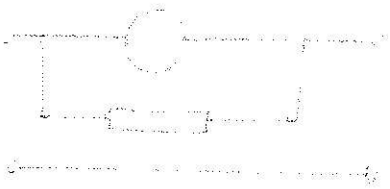
(b) **Advantages**
High sensitivity
Uniform scale
Well shielded from stray magnetic field (3 x 1)

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

(4 x 1)

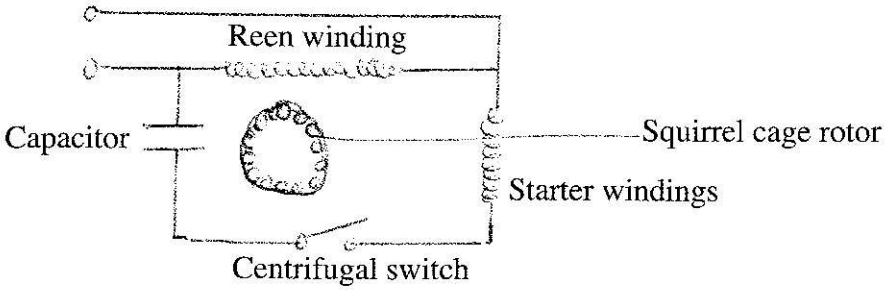
(ii) Low resistance shunt S is connected across the milliameter shunt carries the rest of the current i.e 10 - 0.2 = 9.8A

$\therefore$ = 0.2 x 2 = S x 9.8 = 0.04 Ω



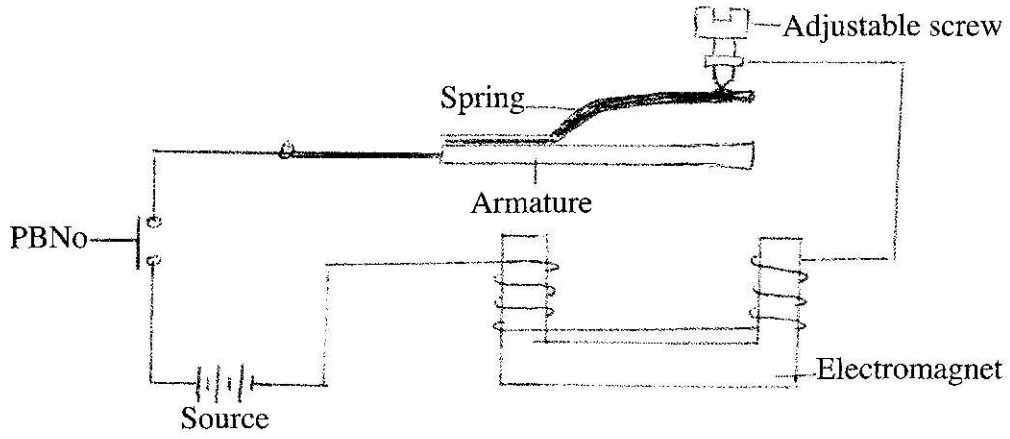
(3 x 1)

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



Sketch = 1
Labelling (4 x ½) = 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) (i)

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

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

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

(ii) P.d across R_4

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

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

1 mark

$I_T = I_2 + I_4$ where I_2 is current through R_2 and I_4 is current through R_3 and R_4 1 mark

$I_4 = I_T - I_2$

P.d across R_2 $= 22 - I_T R_1$

$= 22 - (0.2 \times 50) = 22 - 10$

$= 12$ V

$$\therefore I_2 = \frac{12V}{100\Omega} = 0.12A$$

$I_4 = I_T - I_2 = 0.2 - 0.12 = 0.08$ A

P.d across $R_4 = I_4 R_4$ $= 0.08 \times 100$

$= 8$V