4.20 ELECTRICITY (448)

4.20.1 Electricity Paper 1 (448/1)

1 (a) Classes of materials

(i) Conductor - silver, copper, gold, aluminium.
(ii) Semi-conductor - carbon, silicon, germinium.
(iii) Insulators - PVC, porcelain, rubber, mica.

Classification (3 x $\frac{1}{2}$) = $1\frac{1}{2}$ marks
Examples (3 x $\frac{1}{2}$) = $1\frac{1}{2}$ marks
3 marks

(b) Career - profession or occupation chosen as one's life's work. (1 x 1) = 1 mark

2. (a) **Four** characteristics.

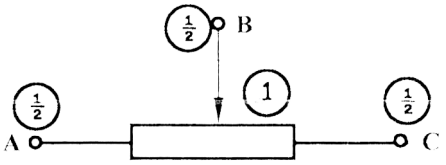
- Self confident.
- Optimistic.
- Action oriented.
- Futuristic.
- Achievement motivation.
- Respond positively to challenges.

(Any 4 x $\frac{1}{2}$) = 2 marks

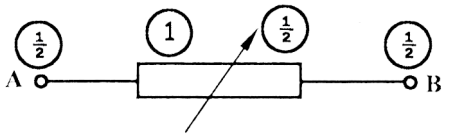
(b) (i) Discharge the capacitor by shorting the terminals (1) guard against contact with any part of the body.
(ii) Be dressed so that no (1) part of the clothing may accidentally be caught up in the rotating part of the machine.

2 x 1 = 2 marks

3. (i) Potentiometer.



(ii) Rheostat



Terminals (6 x $\frac{1}{2}$) = 3 marks
Correct diagram (1 x 2) = 2 marks
5 marks

4. (a) $W = Pt$ (1)

$= (0.5 \times 6) + (3 \times 2) + (3.5 \times 3) + (5 \times 2)$ (1)

= 29.5 kwh (1)

(b) Cost of electricity

$= (29.5\text{kwh} \times 7.00) \times 30$ (1)

$= 6195$ (1)

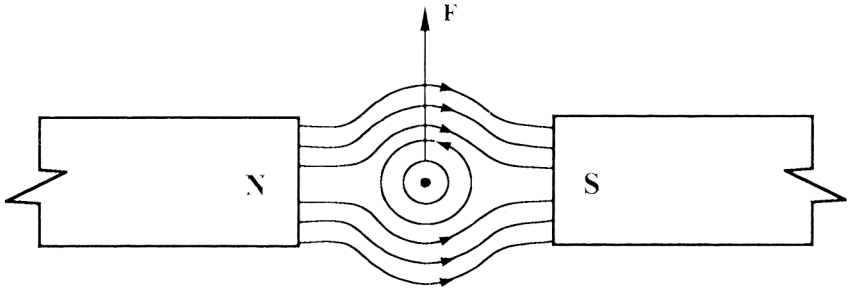
$= 100 + 6195 = 6295$ (1)

(6 x 1) = 6 marks

5. (a)
- Number of turns. ($\frac{1}{2}$)
- Amount of current. ($\frac{1}{2}$)
- Type of core material. ($\frac{1}{2}$)
- Ratio of length to width of coil. ($\frac{1}{2}$)

(4 x $\frac{1}{2}$) = 2 marks

(b)



- Lines of flux around the conductor

- lines of flux around the conductor. (1)
- Lines of flux between the magnets. (1)

(2 x 1) = 2 marks

6. (a) (1) ($\frac{1}{2}$)

$$R_2 = \frac{5V - 1V}{2mA} = \frac{4}{2} = 2\ K\Omega$$

(b) $E = 5 + (2\ mA \times 2\ k)$ (1)

$= 5 + 4 = 9\ V$ ($\frac{1}{2}$)

3 marks

7. (a)
- Lamp holders.
- Bulbs/tubes.
- Switches.
- CCU.

(4 x $\frac{1}{2}$) = 2 marks

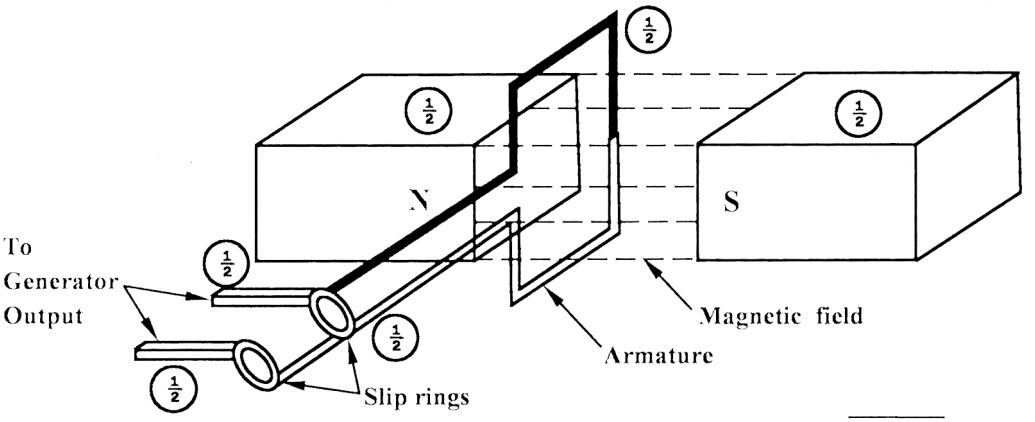
(b)
- MIMS sheathing is made of copper while PVC sheathing is made of PVC.
- MIMS has a good heat resistance while PVC cannot withstand high temperatures.

Any 1 x 2 = 2 marks

8. (a)
- Separately excited.
- Shunt wound.
- Series wound.
- Compound wound.

(Any 2 x $\frac{1}{2}$) = 1 mark

(b)



3 marks

- A loop of conductor is rotated between poles of a pair of magnets. ($\frac{1}{2}$) The loop is mounted in a such away that it is free to be rotated between the fields of the two magnets.
- If the loop is rotated and cuts the magnetic flux, an emf is induced ($\frac{1}{2}$) in the loop.
- The two ends of the loop are connected to two copper rings called (1) slip rings which provide a path for the induced current to the external circuit.

2 marks

9. (a) $2^5\ 2^4\ 2^3\ 2^2\ 2^1\ 2^0$
$1\ 0\ 1\ 1\ 0\ 1$ $\left(\frac{1}{2}\right)$

$(32 \times 1) + (8 \times 1) + (4 \times 1) + (1 \times 1)$ $\left(\frac{1}{2}\right)$

$= 32 + 8 + 4 + 1$

$= 40 + 5 = 45_{10}$ $\left(\frac{1}{2}\right)$

	46
2	23 - 0
2	11 - 1
2	5 - 1
2	2 - 1
	1 - 0

$= 1\ 0\ 1\ 1\ 1\ 0_2$ $\left(\frac{1}{2}\right)$

(b) (i) NOR gate (1)

A	B	Q	
0	0	1	$\left(\frac{1}{2}\right)$
0	1	0	$\left(\frac{1}{2}\right)$
1	0	0	$\left(\frac{1}{2}\right)$
1	1	0	$\left(\frac{1}{2}\right)$

5 marks

(c) (i) Zener diode shorted

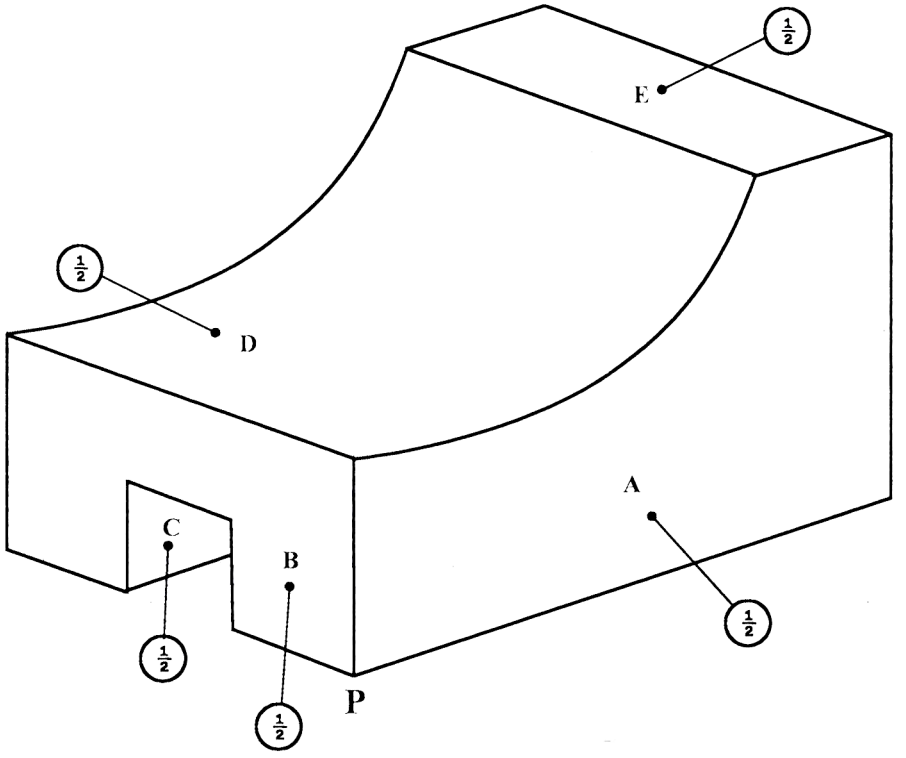
- Zero voltage across R_L. (1)

(ii) Zener diode open

- Increased voltage across R_L. (1)

2 marks

10.



Correct position of P	=	1
Correct faces:		
A	=	½
B	=	½
C	=	½
D	=	½
E	=	½
Neatness / proportionality	=	½
Curves (2 x ½)	=	1
TOTAL	=	5 marks

SECTION B

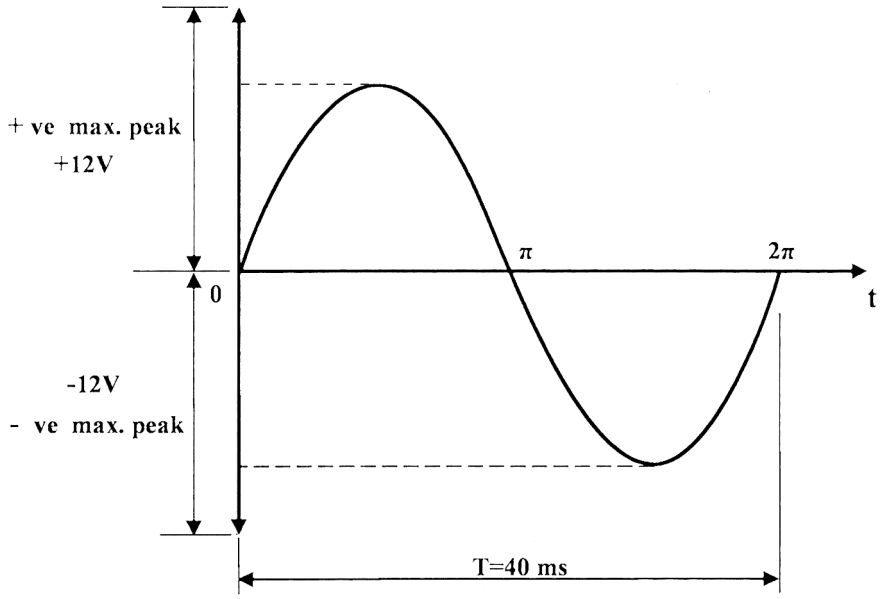
11. (a) (i) Amplitude is the maximum value, positive or negative of an alternating quantity. (1)

(ii) Period is the time taken by an alternating quantity to complete one cycle. (1)

(iii) Frequency is the number of cycles of an alternating quantity completed in a unit time. (1)

(1 x 3) = 3 marks

(b) Waveform



Axes - 1
Peak values - 1
Wave form - 1
Period - 1
4 marks

(i) Frequency,

$$f = \frac{1}{T} = \left(\frac{1}{40ms} = \frac{1}{0.04}\right) = 25Hz$$

(1) (½) (½)

2 marks

(ii) Average value,

$$V_{av} = 0.637 \times V_{max}$$

(1)

$$= 0.637 \times 12\ V \quad (\tfrac{1}{2})$$

$$= 7.644\ V \quad (\tfrac{1}{2})$$

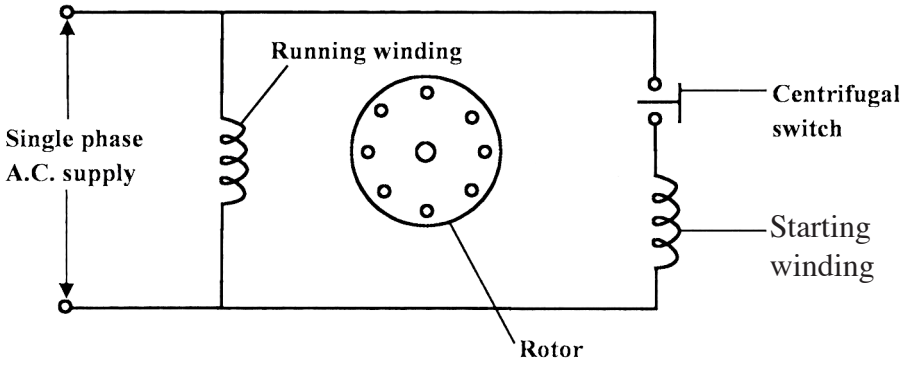
2 marks

(iii) Rms value, VRMs = 0.707 × Vmax (1)

$$0.707 \times 12 = 8.484 \text{ V} \quad (\tfrac{1}{2}) \quad (\tfrac{1}{2})$$

2 marks
Total = 13 marks

12.



Correctness = 1 mark
Components 5 x $\frac{1}{2}$ = 2$\frac{1}{2}$ marks
3$\frac{1}{2}$ marks

- A rotating field is achieved for starting purpose by having the motor with two stator windings in order to produce a phase difference between the currents in the two windings. (1)
- The method of switching the starting winding is by a centrifugal switch. (1) This allows the starting winding to be switched off before the motor reaches its normal speed. (1)
- Once the motor reaches its normal speed, it runs with only one winding energized. (1)

4 marks

(b) (i) Load current $I_2 = \frac{P}{V}$ $(\tfrac{1}{2})$

$(\tfrac{1}{2})$

$$= \left(\frac{24000}{240}\right) = 100\text{A} \quad (\tfrac{1}{2})$$

(ii) For an ideal transformer

Output power = input power $(\tfrac{1}{2})$ = $I_2 = \frac{\text{power}}{\text{voltage}}$ $(\tfrac{1}{2})$

Input current $I_2 = \left(\frac{24000}{480}\right)$ $(\tfrac{1}{2})$ = 50A $(\tfrac{1}{2})$

(iii) Transformer ratio

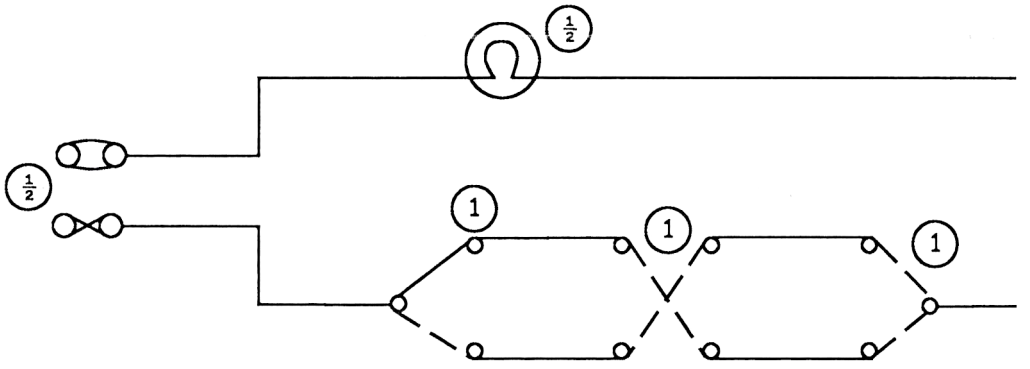
$$\frac{N1}{N2} = \frac{V1}{V2} = \frac{240}{480} = 1:2$$

(1) (½) (½)

13 marks

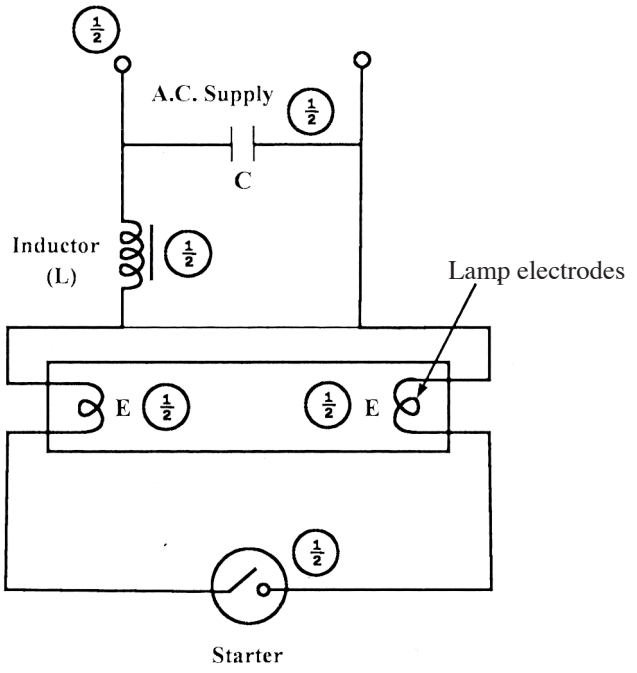
13.

(a)



4 marks

(b)



Six items labelled @ ½		3
Correctness	=	1
Total	=	4 marks

Operation

- When the supply is switched on with starter switch closed, current flows through inductor (L) and through lamp electrodes E.
- This initial currents heats the lamp electrodes in readiness for striking the lamp.
- The starting switch is now opened making a sudden interruption in the current flowing through the inductor and causing a high voltage to be induced.
- The voltage starts a discharge between the two lamp electrodes and current rises rapidly due to the inductor.
- The starter switch is left open while the lamp is alight, the electrodes maintaining their operating temperature as long as they continue to pass the discharge current.

5 marks

14. (a) (i) Heating.

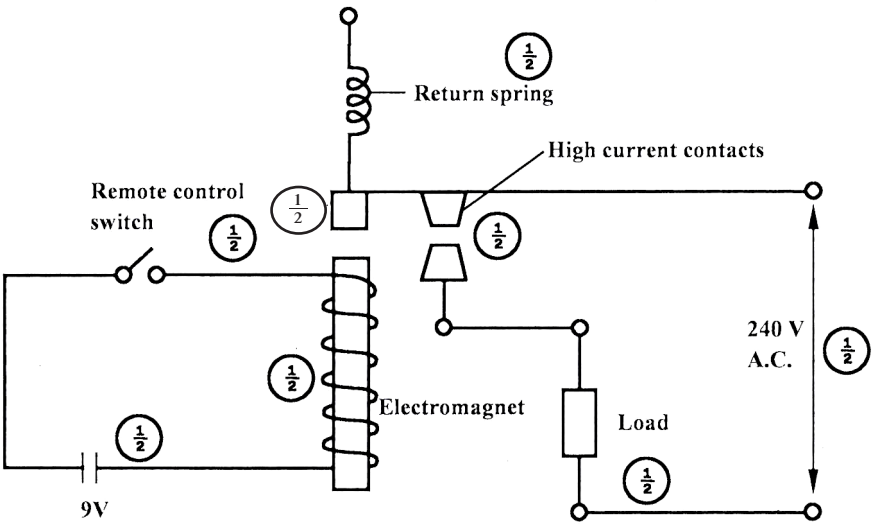
- A ferromagnet metal alloy is heated to bright red hot (1) then allowed to cool in a powerful magnetic field. (1)

(ii) Stroking

- This involves stroking a piece of hard steel with one pole of magnet along the length of metal piece. (1) At the end of each stroke the magnet is lifted up and taken through a reasonable curve. The starting end takes the same polarity as the stroking pole of the magnet. (1)

4 marks

(b)

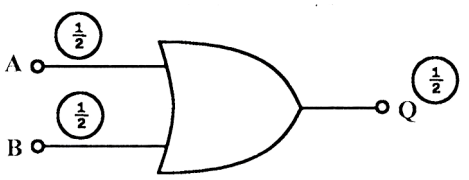


8 parts @ $\frac{1}{2}$	=	4 marks
Low / high current circuit	=	2 marks
TOTAL	=	6 marks

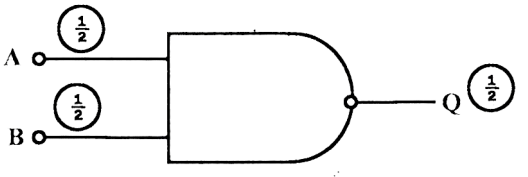
- When the remote switch is closed. Current flows through the coil making it an electromagnet. (1)
- The electromagnet attracts the armature which closes the circuit. (1)
- The load in the controlled circuit then operates and when the switch is opened, the load stops to operate. (1)

9 marks

15. (a) OR gate



(ii) NAND gate



(6 x $\frac{1}{2}$ = 3 marks)

(b) Truth table for NAND gate

A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

Inputs (4 x $\frac{1}{2}$)= 2
Output (4 x $\frac{1}{2}$) = 2
4 marks

(c)
- Inspect the top plug, cable and kettle for burn-out signs. (1)
- Open the top plug ($\frac{1}{2}$) and check for loose connections.
- Check for fuse continuity. (1)
- Check for continuity of cables/conductors. (1)
- Remove the element and check continuity (1) of the element. (1 $\frac{1}{2}$)

6 marks