

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, germanium.
- (iii) Insulators - PVC, porcelain, rubber, mica.

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

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

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

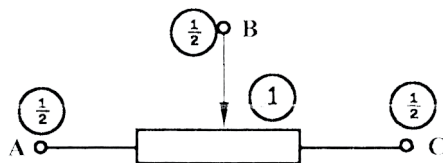
- Self confident.
- Optimistic.
- Action oriented.
- Futuristic.
- Achievement motivation.
- Respond positively to challenges.

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

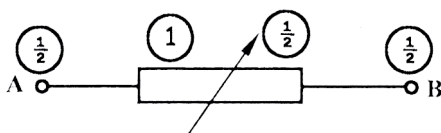
- (b) (i) Discharge the capacitor by shorting the terminals (1) guard against contact with any part of the body.
- (ii) Be dressed so that no (1) part of the clothing may accidentally be caught up in the rotating part of the machine.

2 x 1 = 2 marks

3. (i) Potentiometer.



(ii) Rheostat



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

4. (a) $W = Pt$ (1)
 $= (0.5 \times 6) + (3 \times 2) + (3.5 \times 3) + (5 \times 2)$ (1)
 $= 29.5 \text{ kwh}$ (1)

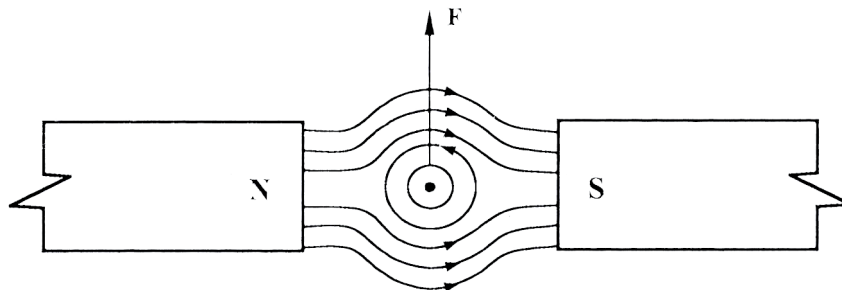
(b) Cost of electricity
 $= (29.5 \text{ kwh} \times 7.00) \times 30$ (1)
 $= 6195$ (1)
 $= 100 + 6195 = 6295$ (1)

(6 x 1) = 6 marks

5. (a) - Number of turns. (1/2)
 - Amount of current. (1/2)
 - Type of core material. (1/2)
 - Ratio of length to width of coil. (1/2)

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

(b) $E = 5 + (2 \text{ mA} \times 2 \text{ k})$ (1)
 $= 5 + 4 = 9 \text{ V}$ (1/2)

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

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

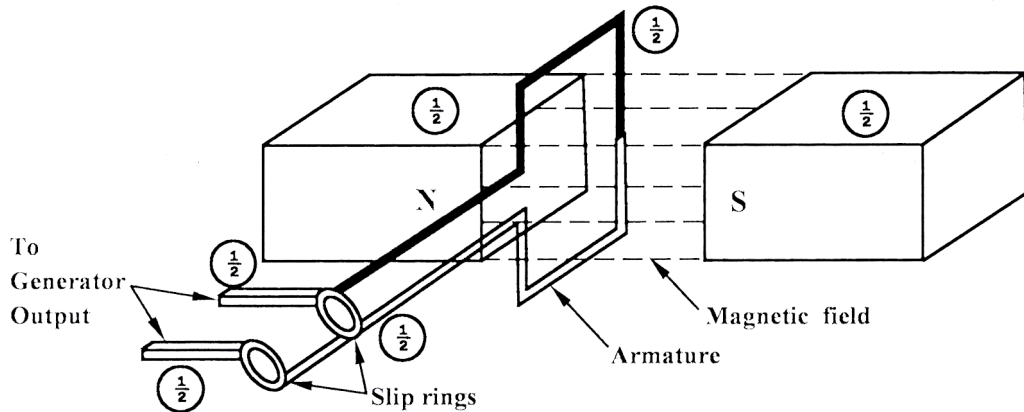
- (b) - MIMS sheathing is made of copper while PVC sheathing is made of PVC.
 - MIMS has a good heat resistance while PVC cannot withstand high temperatures.

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 way 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 $\frac{1}{2}$ slip rings which provide a path for the induced current to the external circuit.

2 marks

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

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

$= 32 + 8 + 4 + 1$

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

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

$= 101110_2$ $\left(\frac{1}{2}\right)$

(b) (i) NOR gate $\left(\frac{1}{2}\right)$

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

$\left(\frac{1}{2}\right)$

$\left(\frac{1}{2}\right)$

$\left(\frac{1}{2}\right)$

$\left(\frac{1}{2}\right)$

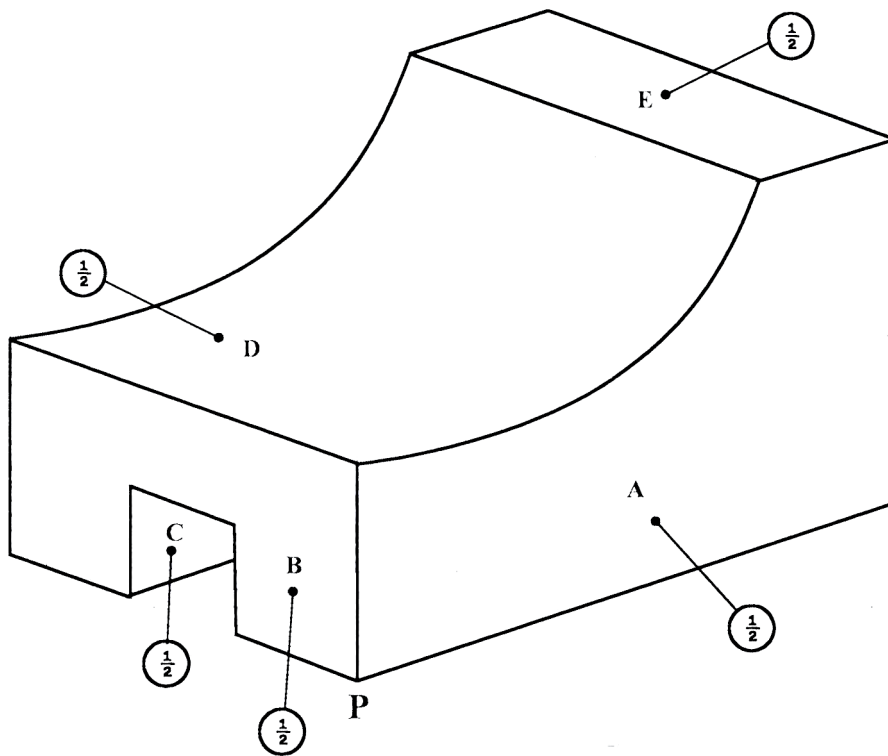
5 marks

(c) (i) Zener diode shorted
- Zero voltage across RL. $\left(\frac{1}{2}\right)$

(ii) Zener diode open
- Increased voltage across RL. $\left(\frac{1}{2}\right)$

2 marks

10.



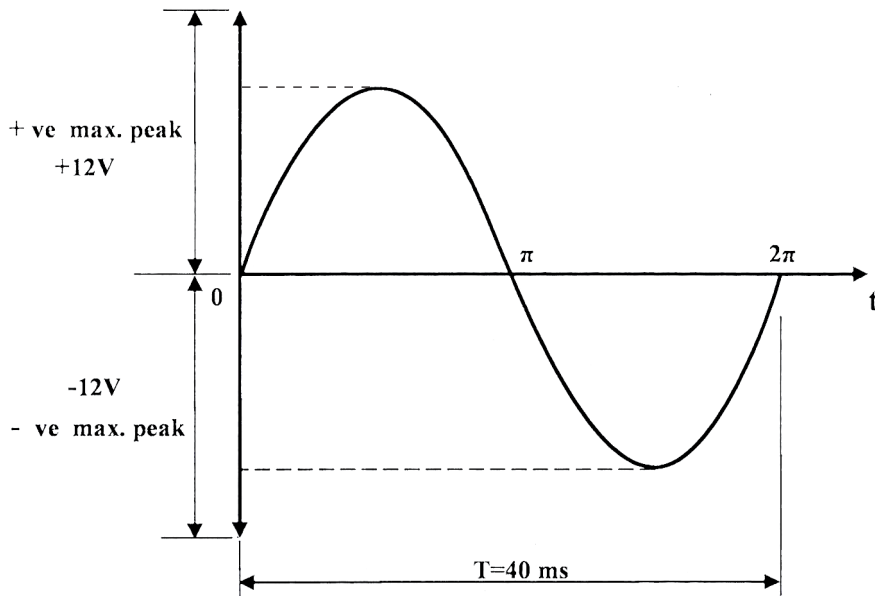
Correct position of P	=	1
Correct faces:		
A	=	$\frac{1}{2}$
B	=	$\frac{1}{2}$
C	=	$\frac{1}{2}$
D	=	$\frac{1}{2}$
E	=	$\frac{1}{2}$
Neatness / proportionality	=	$\frac{1}{2}$
Curves ($2 \times \frac{1}{2}$)	=	1
TOTAL	=	5 marks

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,

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

2 marks

(ii) Average value,

$$\begin{aligned} V_{av} &= 0.637 \times V_{max} \\ &= 0.637 \times 12 \text{ V} \\ &= 7.644 \text{ V} \end{aligned}$$

2 marks

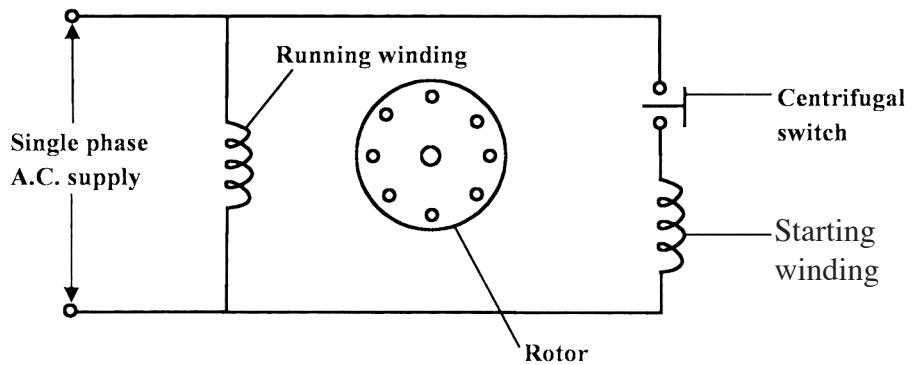
(iii) Rms value, VRMs = $0.707 \times V_{\max}$ (1)

$$0.707 \times 12 = 8.484 \text{ V}$$

2 marks

Total = 13 marks

12.



Correctness = 1 mark

Components $5 \times \frac{1}{2} = 2\frac{1}{2}$ 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 $I_2 = \frac{P}{V}$ (1/2)

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

(ii) For an ideal transformer
Output power = input power (1/2) = $I_2 = \frac{\text{power}}{\text{voltage}}$ (1/2)

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

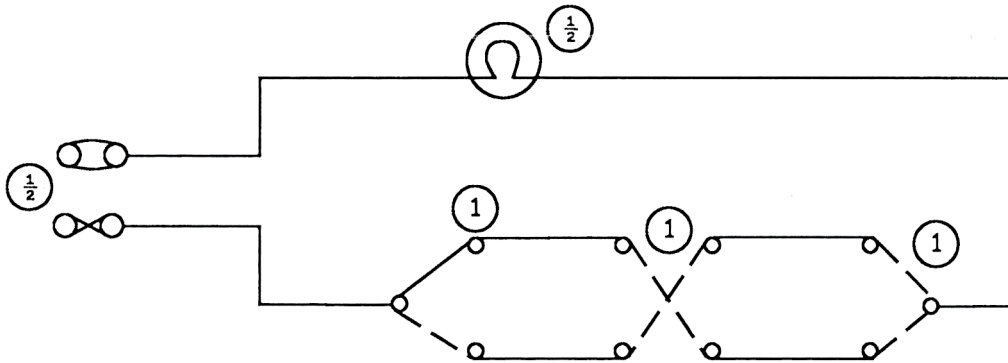
(iii) Transformer ratio

$$\frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{240}{480} = 1:2$$

13 marks

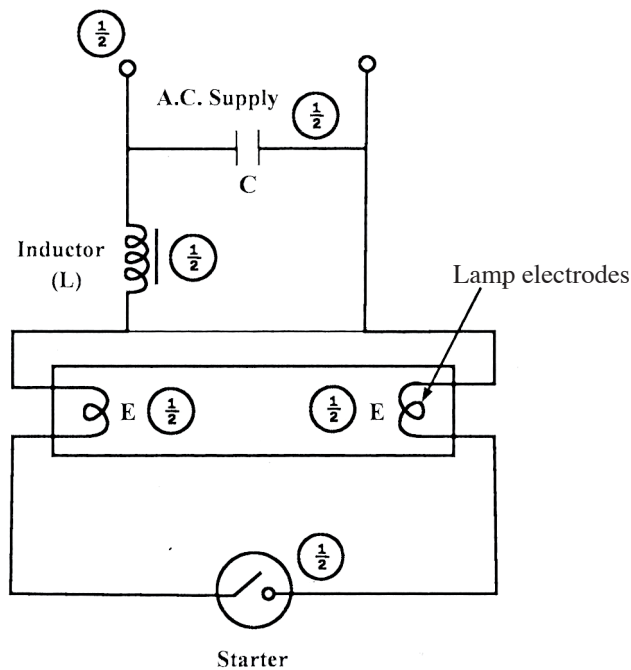
13.

(a)



4 marks

(b)



Six items labelled @ $\frac{1}{2}$	=	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.

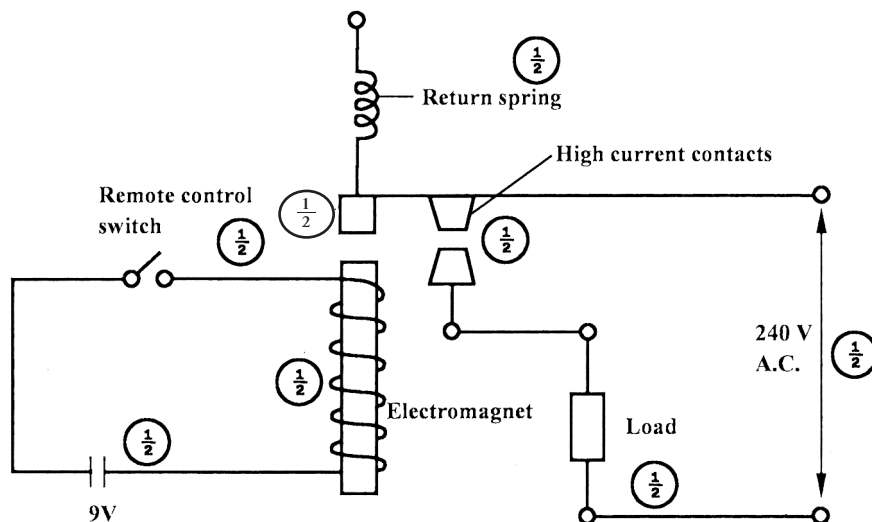
- A ferromagnet metal alloy is heated to bright red hot (1) then allowed to cool in a powerful magnetic field. (1)

(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)

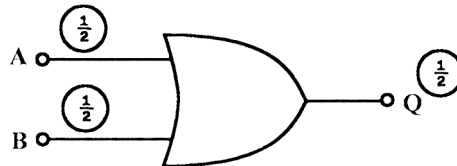


8 parts @ $\frac{1}{2}$ = 4 marks
 Low / high current circuit = 2 marks
 TOTAL = 6 marks

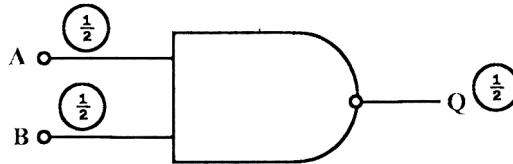
- When the remote switch is closed. Current flows through the coil making it an electromagnet. (1)
- The electromagnet attracts the armature which closes the circuit. (1)
- The load in the controlled circuit then operates and when the switch is opened, the load stops to operate. (1)

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