Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2013

ELECTRICAL TECHNOLOGY MEMORANDUM

MARKS: **200**

This memorandum consists of 11 pages.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY USE AND CARE OF TOOLS AND MEASURING INSTRUMENT

1.1 Safety is the main consideration behind all rules and regulations contained in the CODE of PRACTICE for the wiring of electrical installation. √√ (2)

1.2
- Not wearing safety clothing. √
- Measuring current in series. √
- Working at an unsafe speed. √
- Horseplay in the workshop. √ (Any 2) (2)

1.3 1.3.1 $F = \frac{\text{No of div}}{\text{Time/div}}$ √

$= \frac{8}{2,5 \times 10^{-6}}$ √

= 3,2 MHz √ (3)

1.3.2 RMS value is the amount of DC value that is required for producing the same amount of power as the AC waveform. √ (1)

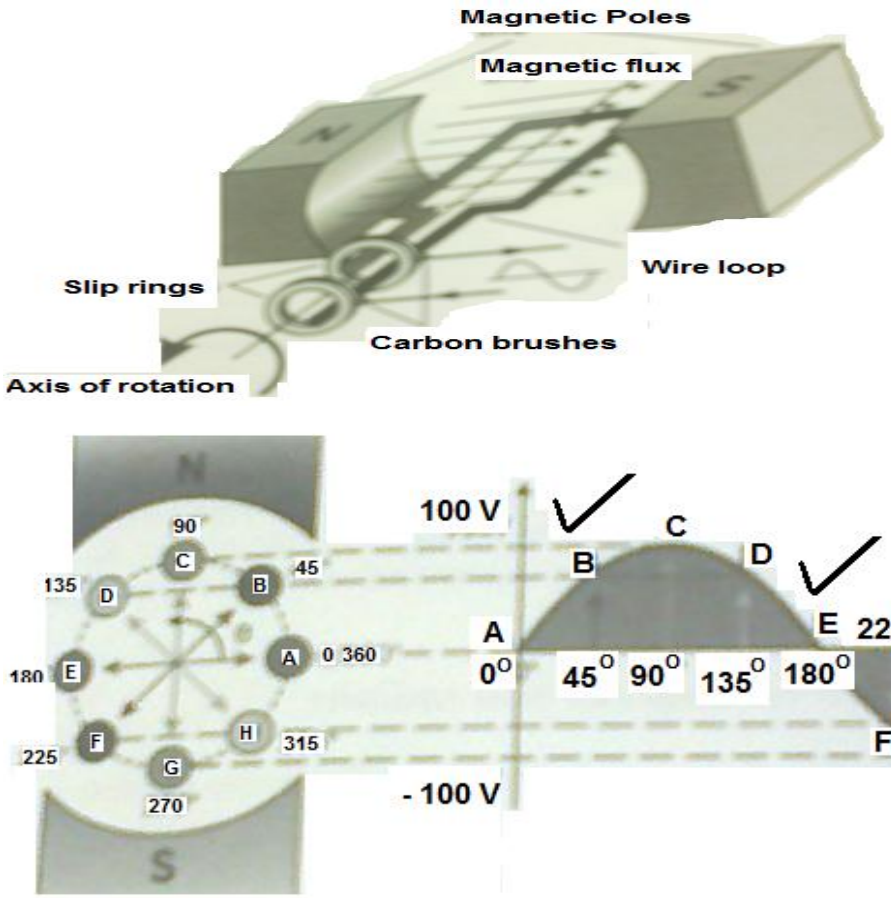
1.3.3 V_{RMS} = 0,707 x volt/div x no of div.
= 0,707 x 5 x 3 √
= 10,61 V √ (2)

[10]

QUESTION 2: SINGLE-PHASE AC GENERATION SINGLE PHASE TRANSFORMERS

2.1 As the conductor loop is rotated through the magnetic field, √ each of the two sides of the loop move through the magnetic field cutting the magnetic lines of flux. √√
This action induces an alternating voltage across the conductor loop. √ (4)

2.2



The mechanical rotation energy is transformed into electrical, √ which is then distributed to the point of consumption. √ (7)

2.3 When the wire loop is perpendicular to the field. √√ (2)

2.4
- The rate of rotation√ i.e. if the rotation is faster, the induced *emf* increases, √ which in turn increases the current in the coil. √ This will be shown by a current detecting instrument called galvanometer. √
- The ends of the coil nearest to the pole become the same polarity as the pole in which direction the coil is rotating. √√ (6)

2.5 2.5.1 $F = \frac{rev}{sec}$ √

$= \frac{1\ 500}{60}$ √

= 25 rev/sec √ (3)

2.5.2 $T = \frac{1}{F}$ √

$= \frac{1}{25}$ √

$= 0{,}004$ sec √ (3)

2.5.3 $Emf = 2\pi BAnN\sin\theta$ √

$= 2.\pi.0{,}05.0{,}004.25.100.\sin 90^{o}$ √

$= 3{,}14$ V √ (3)

2.5.4 $e = E_m \sin\theta$ √

$= 3{,}14.\sin 60^{o}$ √

$= 2{,}72$ V √ (3)

2.5.5 $V_{RMS} = 0{,}707.V_{max}$ √

$= 0{,}707 . 3{,}14$ √

$= 2{,}22$ V √ (3)

2.6 2.6.1 It is used to lower or raise the voltage with the corresponding increase or decrease the current. √√ (2)

2.6.2
- Iron losses √
- Stray losses. √ (2)

2.6.3 $N_s = \frac{V_s N_p}{V_p}$ √

$= \frac{230 . 3\,600}{11\,000}$ √

$= 75{,}27$

$\approx$ 76 turns √ (3)

2.6.4 $I_p = \frac{V_s I_s}{V_p}$ √

$= \frac{230 . 60}{11\,000}$ √

$= 1{,}25$ A √ (3)

2.6.5 $S = VI$ √

$= 230 . 60$ √

$= 13800$ VA

$= 13{,}8$ kVA √ (3)

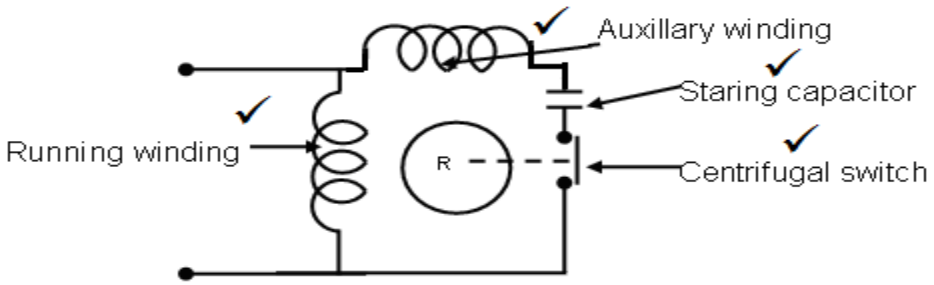
2.7 More insulation is need. √ (1)

2.8 PT-safely measures the voltage in a high voltage power lines. √
CT-safely measures the current in a high current power lines. √ (2)

[50]

QUESTION 3: SINGLE-PHASE MOTORS AND PROTECTION DEVICES

3.1

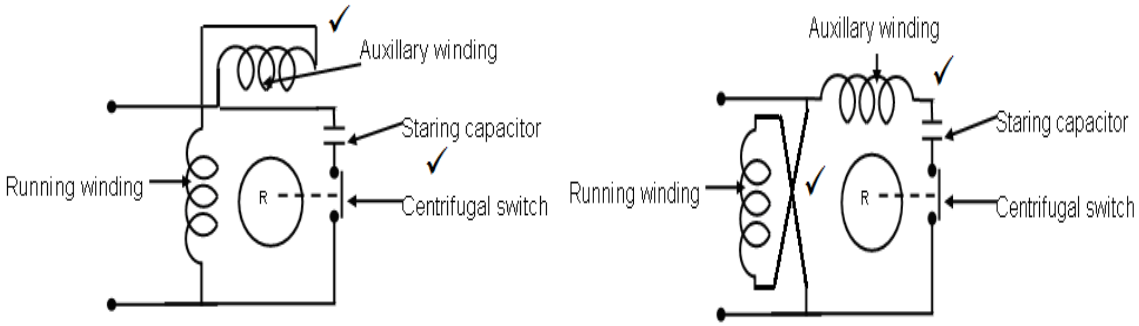


(4)

3.2 To open up at about 75% of operating speed and remove the starting capacitor and starting winding from the supply. √√ (2)

3.3 The motor will not automatically start because the two phase effect has not been created. √√ (2)

3.4



(4)

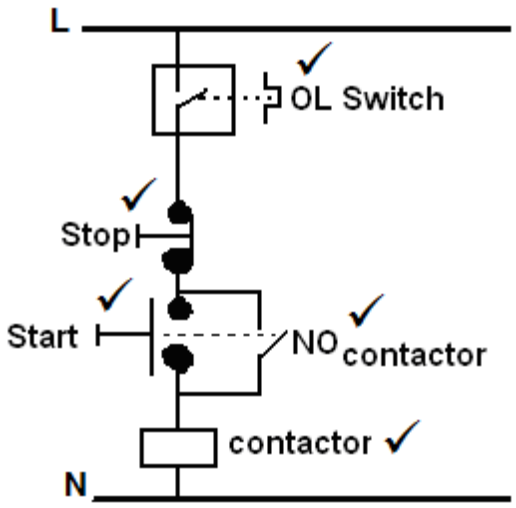
3.5 The two capacitors create a phase shift between the current in the main winding and the current in the starting winding. √√√ (3)

3.6
- Stop button:√ this is used to stop the motor we make use of a similar Spring-loaded push button.√
- Zero-volt coil: √ Starters using magnetic contactors usually derive their power supply for the contactor coil from the same source as the motor supply.√
- Overload protection: √ Overload protection is there to prevent the current drawn by the load from exceeding a certain value. √ Small grinders √ (6)

3.7
- Small grinders √
- Small fans √
- Blowers √
- Washing machine √
- Pumps √
- refrigerator √
- Compressors √ (Any 1) (1)

3.8 The auxiliary winding cannot support high currents for more than a few seconds without being damaged because it is made of fine wire. √√ (2)

3.9



(5)

3.10 To ensure that there is no leakage between the windings and earth. √ (1)

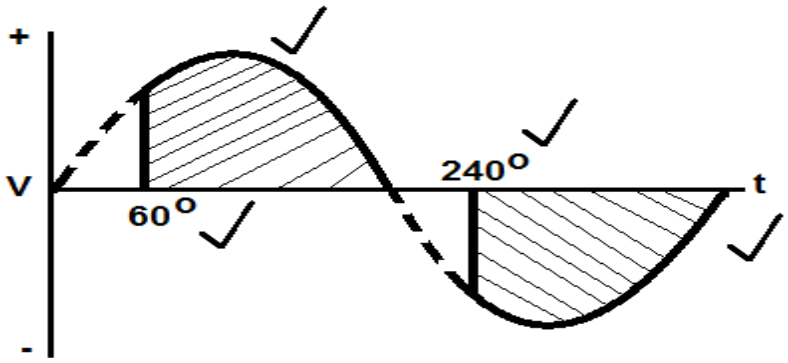
[30]

QUESTION 4: SEMI-CONDUCTOR DEVICES POWER SUPPLIES AMPLIFIERS

4.1
- By increasing the current above the holding current. √
- By applying small voltage to the gate.√
- By applying the pulse to the gate of the SCR. √
- By allowing the supply voltage to exceed the forward-breakover voltage. √ (4)

4.2 Firing angle is the angle when the SCR is turned off. √
Conducting angle is the angle when the SCR is conducting. √ (2)

4.3 4.3.1



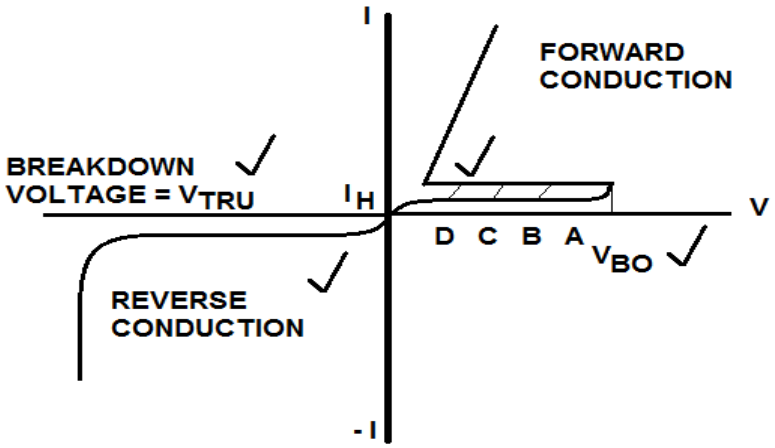
(4)

4.3.2 The capacitor will take longer time to charge and reach the required voltage to trigger the DIAC.√ This means the TRIAC will be triggered later and it will conduct for a shorter period, √ causing the lamp to dim. √ (3)

4.3.3 To limit the current when the value of R_2 is set to its minimum. √ (1)

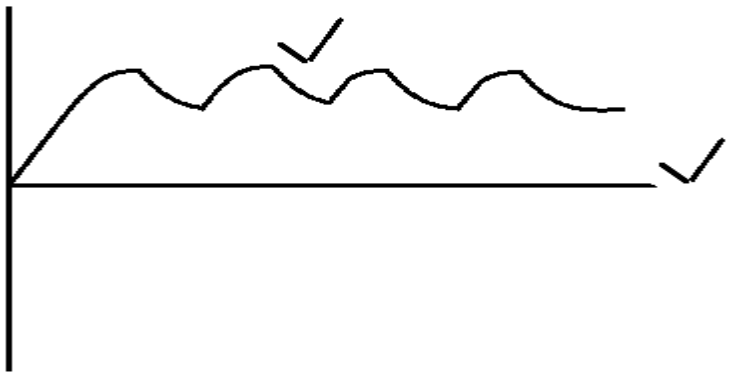
4.4 The physical size of a TRIAC is dependent on the supply voltage it will be connected to as well as the maximum current that will flow through it. √√ (2)

4.5



(4)

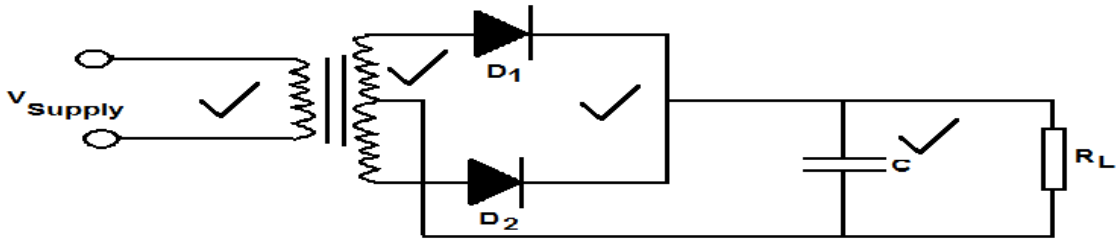
4.6 4.6.1



(2)

4.6.2 To smoothen the ripples to create a clean DC supply by storing the charge and releasing it when needed. √√ (2)

4.7



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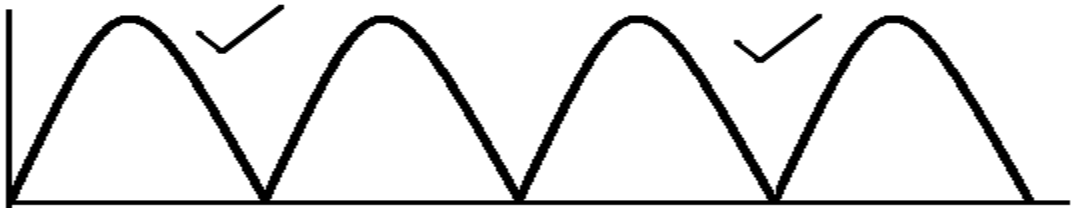
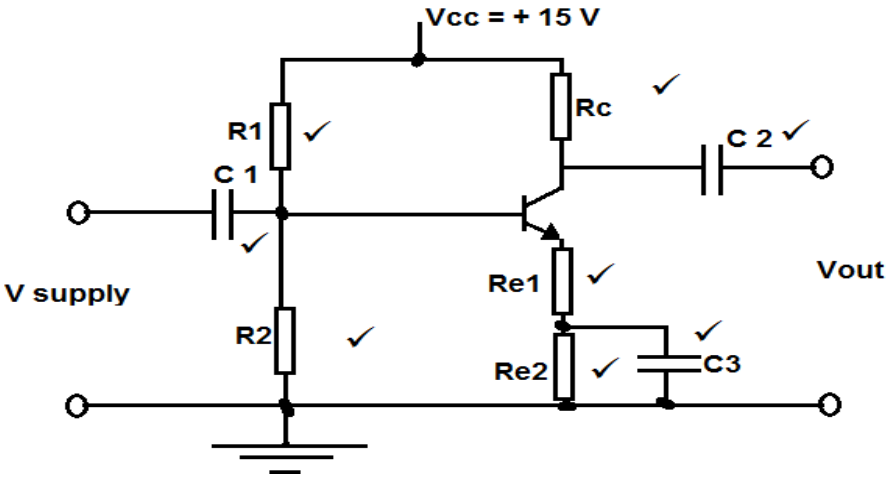
4.8



(2)

4.9 Biasing is the method of establishing predetermined voltage or current at various points of an electronic circuit for the purpose of establishing proper operating conditions in electronic component. √√ (2)

4.10 4.10.1



(8)

4.10.2 Current gain = $\frac{\Delta I_c}{\Delta I_b}$ √

$= \frac{6 \times 10^{-3}}{140 \times 10^{-6}}$ √

= 42,86 √ (3)

4.11
- Common base. √
- Common Collector √
- Common emitter √ (Any 2) (2)

4.12
- The resistor of the LDR is high.√
- Voltage across the LDR is also high.√
- But $V_{be} = V_{LDR}$ so the $V_{be} \geq 0,6$ V√
- Transistor will be switched on like a close switch.√
- Maximum current flows through the LED and the transistor, switching the LED on. √ (5)

[50]

QUESTION 5: RLC SERIES CIRCUITS

5.1 5.1.1 $X_L = 2\pi fL$

$= 2.\pi.50.75.10^{-3}$ √

= 23,56 Ω √

$X_C = \frac{1}{2\pi fC}$

$= \frac{1}{2.\pi.50.220.10^{-6}}$ √

= 14,47 Ω√

$Z = \sqrt{R^2 + (X_L - X_C)^2}$ √

$= \sqrt{22^2 + (23,56 - 14,47)^2}$ √

= 23,8 Ω √ (7)

5.1.2 $I = \frac{V}{Z}$ √

$= \frac{24}{23.8}$ √

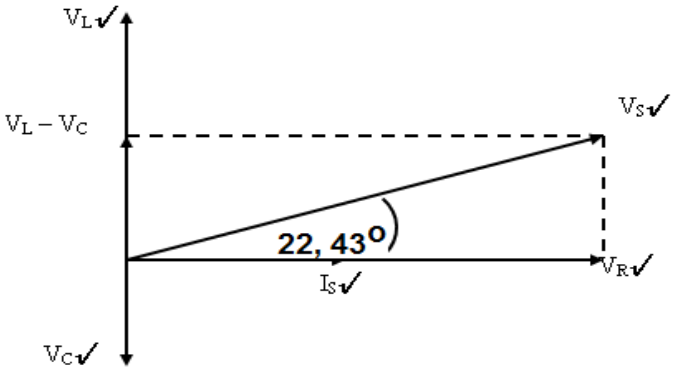
$= 1{,}01$ A √ (3)

5.1.3 $\theta = \cos^{-1}(R/Z)$ √

$= \cos^{-1}(22/23{,}8)$ √

$= 22{,}43^{o}$ √ (3)

5.2



(5)

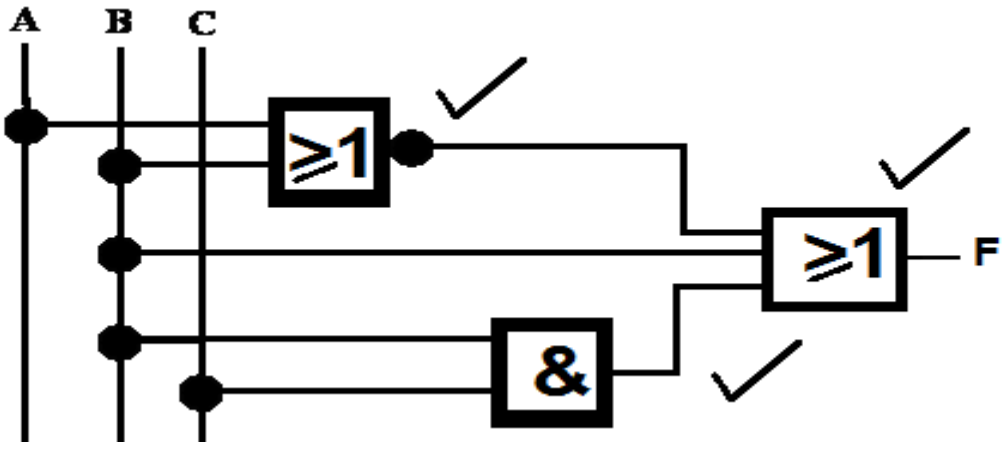
5.3 Impedance of the circuit is the total opposition a circuit offers to the flow of current. It depends entirely to the frequency of the supply when connected to the alternating voltage supply. √√ (2)

[20]

QUESTION 6: LOGIC

6.1 $\left(\overline{(A + B)} \,.\, C\right) + \left(A \,.\, \overline{(B + \overline{C})}\right)$ √√√ (3)

6.2



(3)

6.3 $F = \overline{\overline{A + B + B.C}}$

$= \overline{\overline{A + B}} \cdot \overline{BC}$ √

$= (A + B)(\overline{B} + \overline{C})$ √ (3)

6.4 6.4.1 $Q = \overline{X}YZ + X\overline{Y}Z + XY\overline{Z} + XYZ$ √ √ √ (3)

6.4.2 $Q = \overline{X}YZ + X\overline{Y}Z + XY\overline{Z} + XYZ$

$= YZ(\overline{X} + X) + X\overline{Y}Z + XY\overline{Z}$ √

$= YZ(1) + X\overline{Y}Z + XY\overline{Z}$

$= YZ + X\overline{Y}Z + XY\overline{Z}$

$= Z(Y + X\overline{Y}) + XY\overline{Z}$ √

$= Z(Y + X) + XY\overline{Z}$

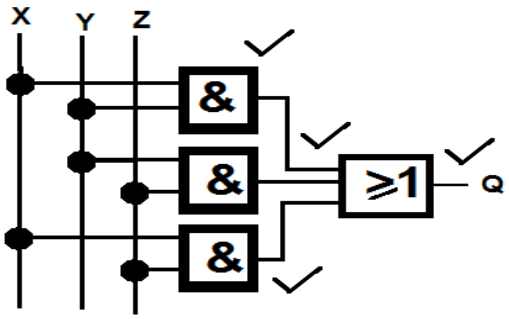
$= YZ + XZ + XY\overline{Z}$

$= YZ + X(Z + Y\overline{Z})$ √

$= YZ + X(Z + Y)$

$= YZ + XZ + XY$ √ (4)

6.4.3

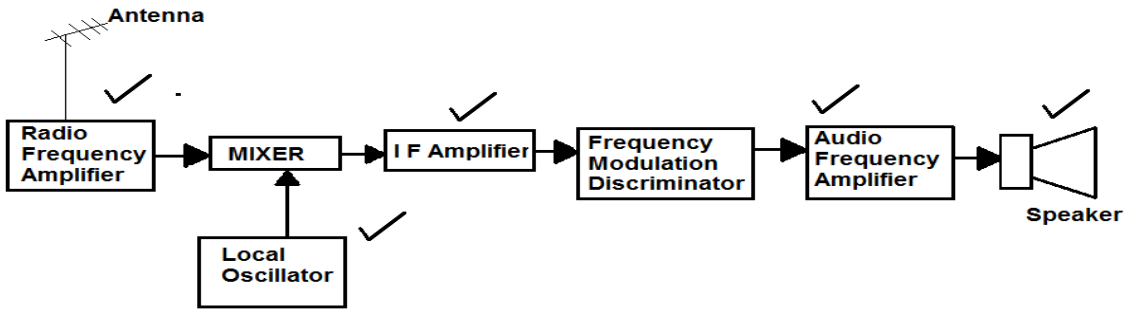


(4)

[20]

QUESTION 7: COMMUNICATIONS

7.1



(5)

7.2
- Forestry agencies and utility services. √
- Police services √
- Ambulance services.√ (3)

7.3 Antenna, as a transmitter, it will produce a large radio frequency current that may be applied to the terminals of the same antenna in order to convert it into an electromagnetic wave radiated into free space. √√ (2)

7.4 7.4.1 AM Transmitter √ (1)

7.4.2 1 – Audio amplifier √
2 – Radio frequency power amplifier √
3 – Antenna √ (3)

7.5 The higher the frequency, the shorter the wavelength. √√ (2)

7.6
- Large coverage area. √
- Reduced interference from other signal. √
- Reduced power use. √
- Increase capacity. √ (Any 2) (2)

7.7 FM transmitter uses FM Modulator. √
AM transmitter uses AM Modulator. √ (2)

[20]

TOTAL: 200