GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

ELECTRICIANS WORK SG

POSSIBLE ANSWERS / MOONTLIKE ANTWOORDE SUPP 2007

QUESTION 1

1.1

1.1.1

$XL = 2 \text{ p } FL$ (1)

$= \frac{2 \times 3{,}14 \times 50 \times 35}{1000}$ (1)

$= 10{,}99 \text{ ohm}$ (1)

$XC = \frac{1}{2 \times \pi \; FC}$ (1)

$= \frac{1}{2} \times 3{,}14 \times 50 \times \frac{180}{1000000}$ (1)

$= 17{,}68 \text{ ohm}$ (1)

$IR = \frac{VT}{R}$ (1)

$= \frac{150}{20}$

$= 7{,}5 \text{ A}$ (1)

$IL = \frac{VT}{XL}$ (1)

$= \frac{150}{10{,}99}$

$= 13{,}65 \text{ A}$ (1)

$IC = \frac{VT}{XC}$ (1)

$= \frac{150}{17{,}68}$

$= 8{,}48 \text{ A}$ (1)

[12]

1.1.2 IT $= \sqrt{IR^2 + (IL - IC)^2}$ (1)

$= \sqrt{7{,}5^2 + (13{,}65 - 8{,}48)^2}$ (1)

$= \sqrt{88{,}148}$

$= 9{,}39$ A (1)

[3]

1.1.3 ZT $= \dfrac{VT}{IT}$ (1)

$= \dfrac{150}{9{,}39}$ (1)

$= 15{,}97$ ohm (1)

[3]

1.2 Iave $= \dfrac{i1 + i2 + i3 + i4 + i5 + i6}{6}$ (1)

$= \dfrac{2 + 5 + 8 + 9 + 6 + 3}{6}$ (1)

$= \dfrac{33}{6}$

$= 5{,}5$ A (1)

R.m.s. value $= \sqrt{\dfrac{i1^2 + i2^2 + i3^2 + ..i6^2}{\text{no of midordinates}}}$ (1)

I rms $= \sqrt{\dfrac{2^2 + 5^2 + 8^2 + 9^2 + 6^2 + 3^2}{6}}$ (1)

$= \sqrt{\dfrac{219}{6}}$

$= \sqrt{36{,}5}$ (1)

$= 6{,}04$ A (1)

Form factor $= \frac{RMS}{AVE}$ (1)

$= \frac{6,04}{5,5}$ (1)

$=$ 0,897 (1)

[10]

1.3 Active current = I cos Ø (1)
Reactive current = I sin Ø (1)

[2]

1.4

1.4.1 XL = 2p FL (1)
= 2p x 100 x 0,2 (1)
= 125,66 ohm (1)

$XC = \frac{1}{2 \times \pi \; FC}$ (1)

$= \frac{1}{2} \times 3,14 \times 100 \times \frac{160}{1\,000\,000}$ (1)

$=$ 9,947 ohm (1)

$Z = \sqrt{R^2 + (XL - XC)^2}$ (1)

$= \sqrt{100^2 + (125,66 - 9,95)^2}$ (1)

$= \sqrt{23\,388,804}$

$=$ 152,93 ohm (1)

$I = \frac{V}{Z}$ (1)

$= \frac{100}{152,93}$ (1)

$=$ 0,65 A (1)

[12]

1.4.2 $\cos Ø = \frac{R}{Z}$ (1)

$\cos Ø = \frac{20}{152,93}$ (1)

cos Ø = 0,13
Ø = $\cos^{-1}$ 0,13
Ø = 82,48° (1)

[3]

1.4.3 $\cos Ø = \frac{R}{Z}$ (1)

$\cos Ø = \frac{20}{152,93}$

$\cos Ø = 0,13 = P.F$ (1)

[2]

1.4.4 I ac = I cos Ø (1)

= 0,85 x 0,13 (1)

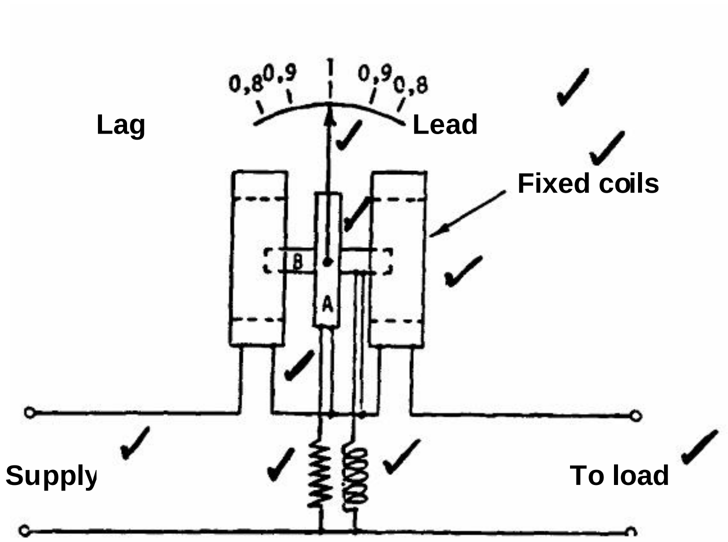
= 0,111 (1)

[3]

[50]

QUESTION 2

2.1



(10)

2.2 In this type of wattmeter the two fixed coils carry the current in the circuit while the moving coil carries a current proportional to the voltage.
Different voltage ranges can be accommodated by means of an external variable resistor, as in the case of a moving-coil voltmeter.
The field strength is proportional to the product of current and voltage, which is the power (instantaneous values during one complete cycle).
Deflection takes place as a result of the interaction between the coils during current flow. (8)

2.3 Wattmeter (1)

2.4 To measure current (1)

[20]

QUESTION 3

3.1 Pin = $\sqrt{3}$ VL IL CosØ (1)

$= \sqrt{3} \times 600 \times 20 \times 0{,}9$ (1)

$= 18{,}706$ kW (1)

Efficiency $= \dfrac{\text{P Output}}{\text{P Input}} \times 100\%$ (1)

$= \dfrac{12}{18{,}706} \times 100\%$ (1)

$= 64\ \%$ (1)

[6]

3.2

3.2.1 Efficiency $= \dfrac{\text{output}}{\text{input}} \times 100\%$ (1)

$P_{input} = \dfrac{\text{P output}}{\text{Efficiency}}$ (1)

$= \dfrac{200\,000}{0{,}9}$ (1)

$= 222{,}222$ kW (1)

Pin = $\sqrt{3}$ VL IL CosØ (1)

IL $= \dfrac{\text{Pin}}{\sqrt{3} \times \text{VL} \times \text{Cos}Ø}$ (1)

$= \dfrac{222\,222}{\sqrt{3} \times 500 \times 0{,}9}$ (1)

$= 285{,}112$ A (1)

[8]

3.2.2 In delta IL $= \sqrt{3} \times$ IPH (1)

$= \sqrt{3} \times 285{,}112$ (1)

$= 493{,}828$ A (1)

[3]

3.3

3.3.1 Pin = $\sqrt{3}$ VL IL CosØ (1)

$= \sqrt{3} \times 380 \times 30 \times 0{,}9$ (1)

$= 17{,}8$ kW (1)

3.3.2 $S = \sqrt{3} \times V_L I_L$ (1)

$= \sqrt{3} \times 380 \times 30$ (1)

$= 19{,}7$ kVA (1)

3.3.3 $I_L = \sqrt{3} \times I_P$ (1)

$I_P = \dfrac{I_L}{\sqrt{3}}$ (1)

$= \dfrac{30}{\sqrt{3}}$ (1)

$= 17{,}3$ A (1)

3.3.4 $\text{Efficiency} = \dfrac{\text{output}}{\text{input}} \times 100\%$ (1)

$= \dfrac{12}{17{,}8} \times 100\%$ (1)

$= 67{,}4\ \%$ (1)

[13]

[30]

QUESTION 4

4.1

- The secondary winding must firs t be short-circuited.
- Dangerously high e.m.f. might be induced in the secondary winding. (3)

4.2 Advantages:

- Less copper is needed.
- It is smaller.
- Different voltages can be obtained from one input.
- More efficient, since the magnetic coupling is better. (Any two) (2)

Disadvantages:

- The primary and secondary turns are electrically connected.
- A dangerous situation could occur if the primary gets into contact with earth.
- Dangerously high current will occur if the secondary is short-circuited.

(Any two) (2)

[4]

4.3

4.3.1 VL2 $= \sqrt{3} \times VPH2$ (1)

$VPH2 = \frac{VL}{\sqrt{3}}$ (1)

$= \frac{380}{\sqrt{3}}$ (1)

$= 219{,}39$ V (1)

[4]

4.3.2 VL1 = VPH1

= 11 000 V (1)

$\frac{VPH1}{VPH2} = \frac{11000}{219{,}39}$ (1)

= 50,13 (1)

Therefore transformation ratio = 50,13:1 (1)

[4]

4.3.3 $N2 = V2 \times \frac{N1}{N2}$ (1)

$= 4000 \times \frac{219{,}39}{11000}$ (1)

= 79,78 windings (1)

[3]

4.3.4 $IPH1 = \frac{IL1}{\sqrt{3}}$ (1)

$= \frac{5}{\sqrt{3}}$ (1)

= 3,46 A (1)

[3]

4.3.5 $P = \sqrt{3} \times VL \times IL \times \cos Ø$ (1)

$= \sqrt{3} \times 11\,000 \times 5 \times 0{,}8$ (1)

= 76,21 023 kW (1)

[3]

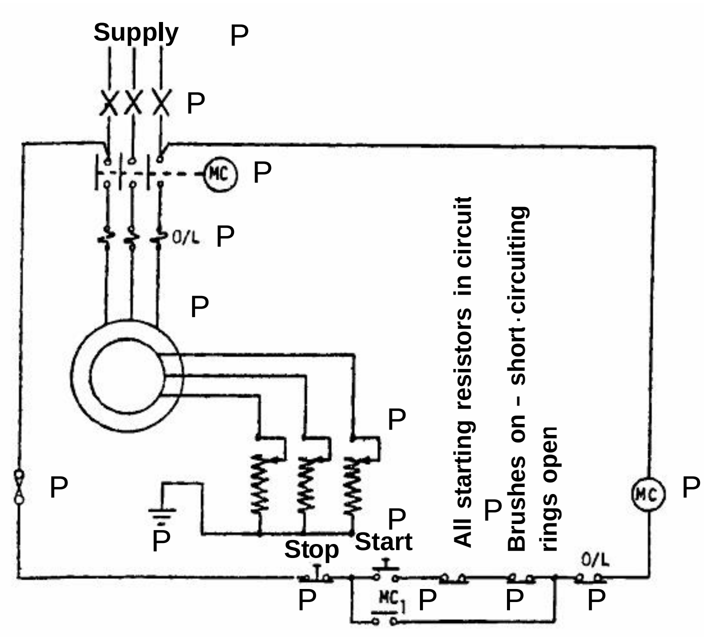
4.4 Its purpose is to dry the air which passes into the transformer tank when the air above the tank contracts. (4)

4.5 Open circuit test
Closed circuit test (2)

[30]

QUESTION 5

5.1



Resistance starter for a slip-ring motor **[15]**

5.2

5.2.1 4 pole = 2 pole pairs (1)

$N = \frac{F \times 60}{2}$ (1)

$= \frac{50 \times 60}{2}$ (1)

= 1 500 r/min (1)

[4]

5.2.2 Rotor speed = N – 5%-slip (1)

= 1 500 – 5%

$= \frac{1500}{100} \times 5$ (1)

= 75

= 1 500 – 75 (1)

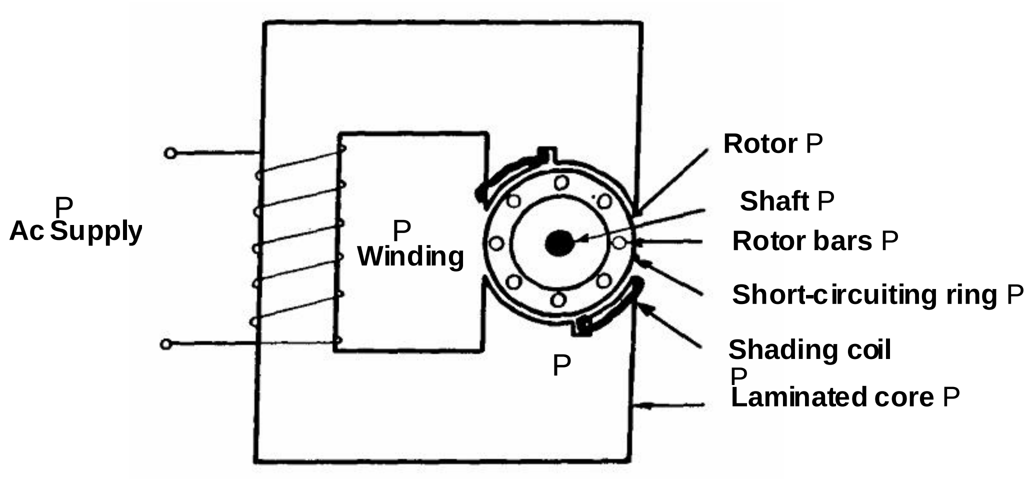
= 1 425 r/min (1)

[4]

5.3
1. Lock-out switches (1)
2. Isolator (1)
3. No-volt coil (1)
4. Overload coil (1)
5. Earth leakage device (1)
6. Isolating link (1)
7. Interlock switches (1)

(any 4) **[4]**

5.4



Shaded-pole induction motor (9)

5.5 Number of poles
frequency (2)

5.6 The speed that the rotor rotates is called the rotor speed and is always less than the synchronous speed. (2)

[40]

QUESTION 6

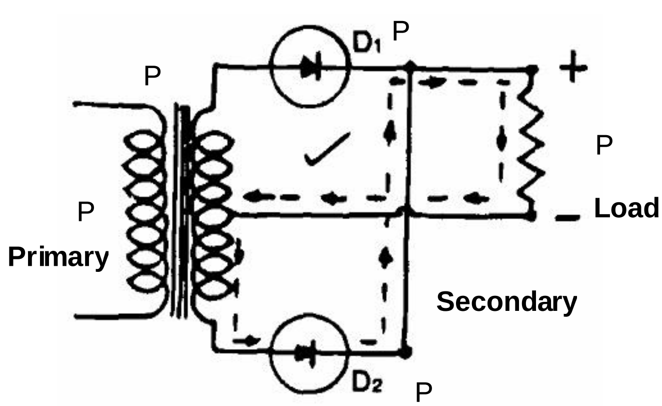
6.1

- Has no heating filament and thus need no heating voltage.
- Takes up little space.
- Cheaper than tube diodes.
- Lower resistance and therefore less voltage drop.
- Works efficient at lower current and voltage.
- Having only two connection points, makes circuit so much simpler.

(Any three answers) **3x1=[3]**

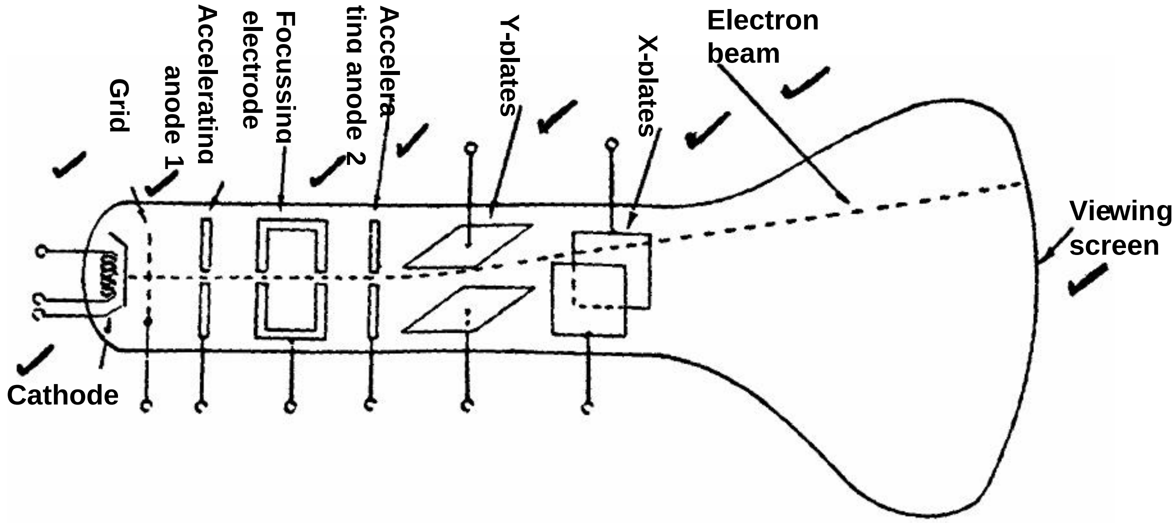
6.2 It is used for studying shapes of alternating currents and voltages as well as for measuring quantities such as voltage, current, power and frequency.
It is also used for diagnostic testing and monitoring of electrical and electronic systems. (2)

6.3



(6)

6.4



(9)

[20]

QUESTION 7

7.1

- Unsafe conditions
- Unsafe acts
- Physical or mental indisposition
- Lack of knowledge and skills
- Incorrect usage of equipment (Any suitable answer) (5)

7.2 Blood transfusion (infected blood)
Sharing of needles for drugs with an infected person
Infected blood entering the body through an injury
Without latex gloves when a person is treated for blood
Having sex with an infected person without protection. (Any suitable answer) (5)

[10]

TOTAL: 200