higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

INDUSTRIAL ELECTRONICS N6

4 APRIL 2013

This marking guideline consists of 9 pages.

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QUESTION 1

1.1 Alpha particles are positively charged and have a low degree of penetration level. Beta particles are negatively charged and have a greater penetration level than Alpha Particles. Gamma particles are neutral but because of their short wavelength, they have very high penetrating abilities. (6)

1.2 Gamma particles because of their high penetration ability. When coming into contact with radio-active material the cellular function of the living tissue will be damaged. Depending on the level of dosage exposure this damage may be temporarily or even permanent. In extreme cases the living tissue may be completely destroyed. (3)

1.3
- Wear approved protective clothing
- Use level exposure indicators
- Premises must be clearly marked with applicable warning signs
- Proper shielding of work stations
- Decontamination of all personnel and equipment after exposure
- Maintain correct storage, transport and waste disposal procedures

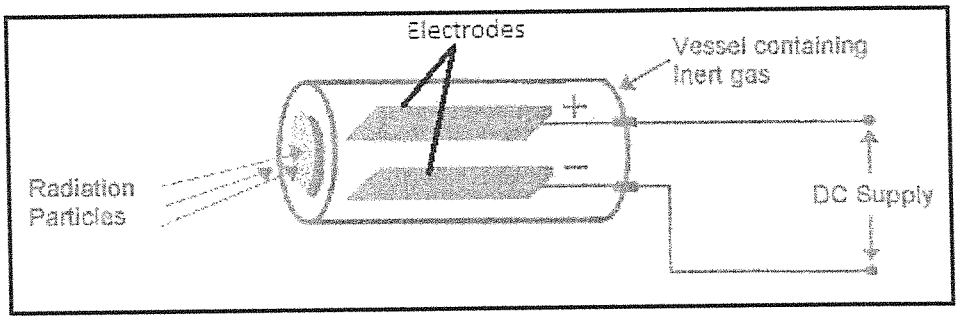
(Any 5 × 1) (5)

1.4 1.4.1 Any ONE of the following detectors, followed by the sketch of that particular detector:

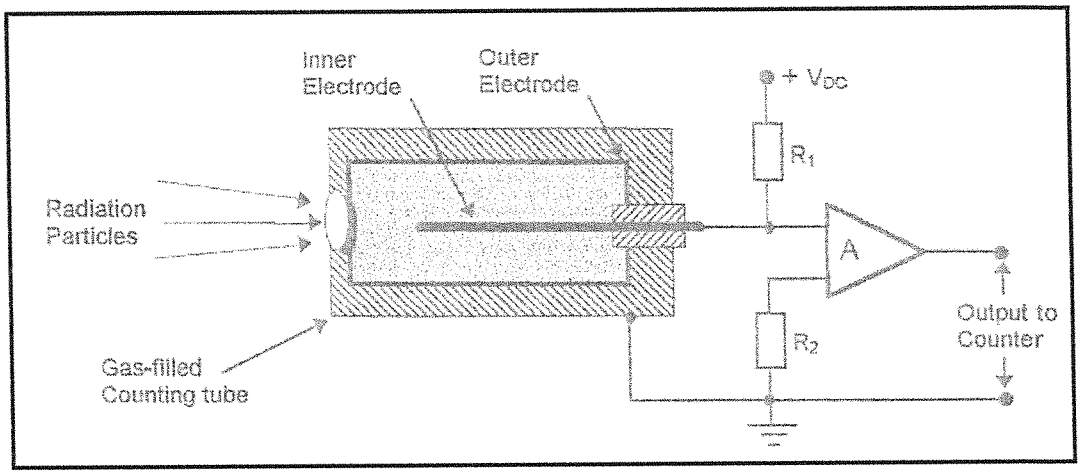
(i) Proportional counter

Sketch of ionisation chamber of Geiger-Muller counter is correct if given, mark accordingly.

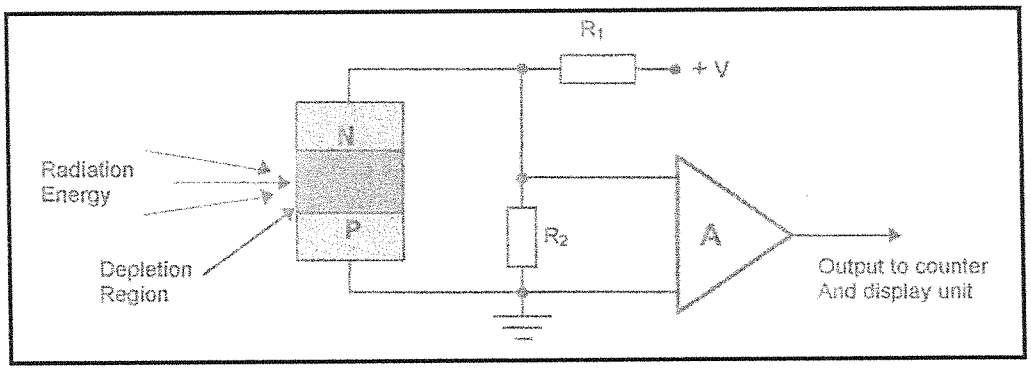
(ii) Ionisation chamber



(iii) Geiger- Müller Counter



(iv) Semi-conductor detector



(3)

1.4.2 Any of the following operation descriptions to match the detector named and sketched by the candidate:

(i) Proportional counter

The applied DC voltage is large enough to accelerate the electrons and ionise other gas atoms in the tube by collision.

The detection of a single radiation particle moving through the counter produces a large current pulse which results in an output voltage pulse, directly proportional to the energy of the ionising particle.

The resultant output from the counter (tube) is fed to either an amplifier and then to a display or directly to the final output stage

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(ii) Ionisation chamber

When ionising particles or radiation enter the chamber they ionise gas between the electrodes. The ions that are thus produced migrate to the electrodes of opposite sign (negatively charged ions move toward the positive electrode, and vice versa), creating a current that may be amplified and measured directly with an electrometer (an electroscope equipped with a scale) or amplified and recorded by means of electronic circuits.

(iii) Geiger- Müller counter

A high voltage is applied between electrodes in the gas-filled tube. Emitted radiation causes ionisation of the gas and conduction follows. An electric discharge is produced when a charged particle enters the tube, and the output is a series of pulses proportional to the amount of radiation admitted.

(iv) Semi-conductor detector

The semiconductor detector consists of a reverse-biased PN junction. When radiant energy is allowed to penetrate the depletion region, electron/hole pairs are generated and momentarily increase the conduction across the junction.

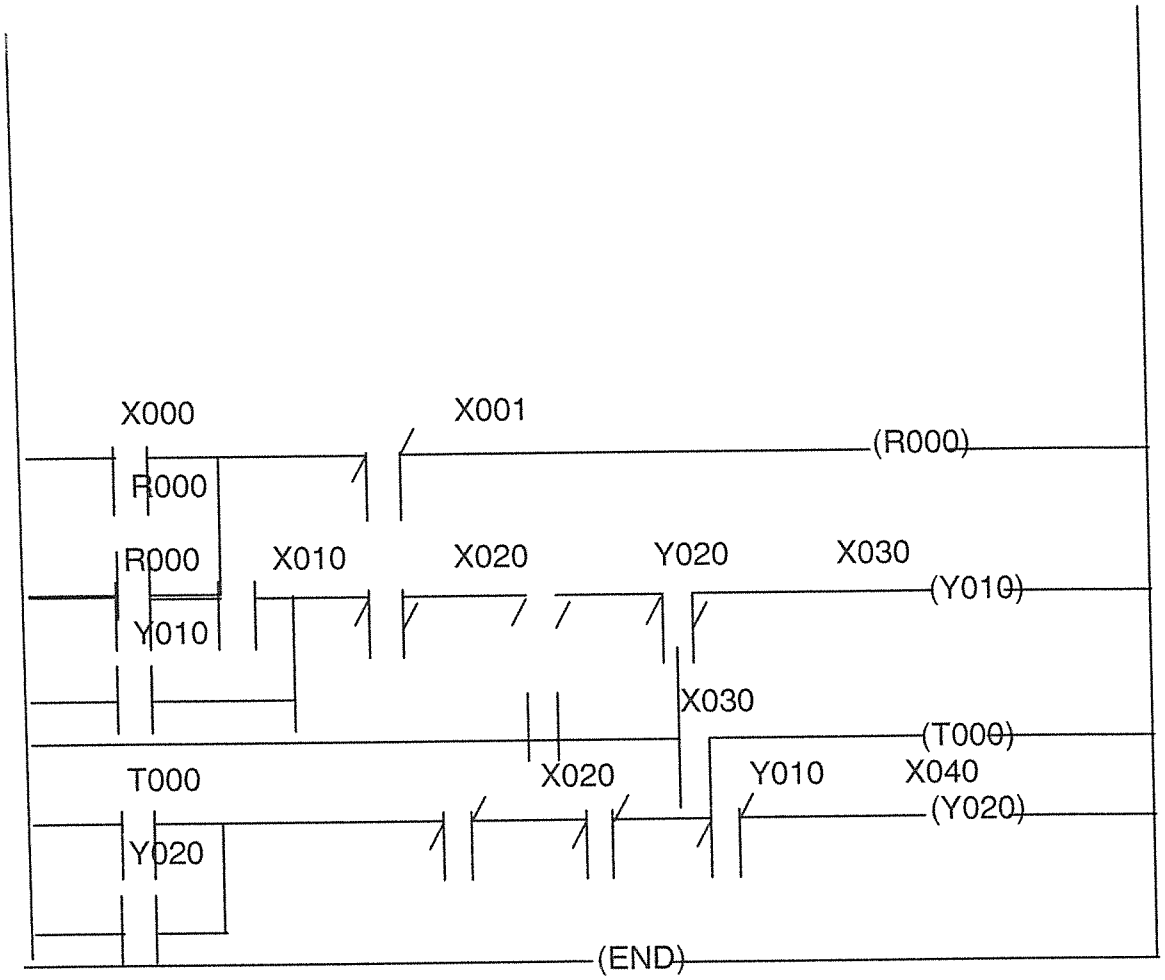
This behaviour of the semiconductor material is similar to that of the gas-filled ionisation chamber in that the semiconductor detector also produces a pulsed output which is amplified and counted. (3)

[20]

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QUESTION 2

2.1

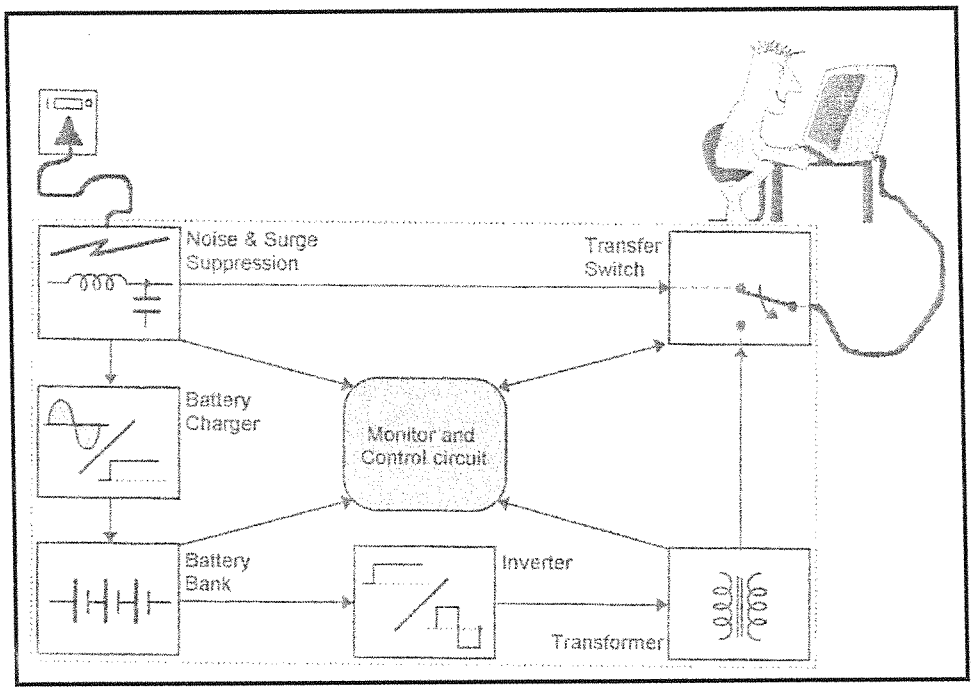


OUTPUTS	INPUTS
R000 - Main Contactor	X000 - Mains Contact ON
Y010 - Motor Up	X001 - Mains control OFF
T000 - 15 seconds delay ON timer	X010 - Remote open
Y020 - Motor down	X020 - Emergency STOP
	X030 - Upper limit switch
	X040 - Bottom limit switch

(10)

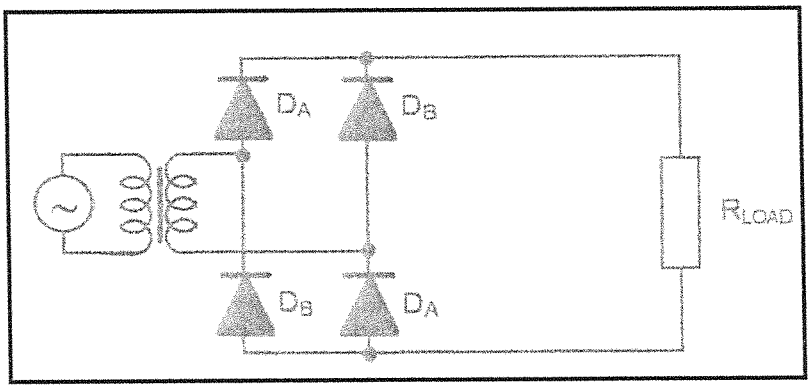
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2.2



(10)

2.3 2.3.1



(4)

2.3.2

$$V_{rms} = \frac{V_{supply} \times N_2}{N_1}$$

$$= \frac{250 \times 1}{16}$$

$$= 15{,}63 \text{ V}$$

OR

$$P = VI$$

$$V_{rms} = \frac{P}{I}$$

$$= \frac{153}{9{,}8}$$

$$= 15{,}61 \text{ V}$$

$$V_{mean} = 0{,}637 \times V_{max} - 2(V_{drop})$$

$$= 0{,}637 \times 22{,}1 - 2(0{,}6)$$

$$= 12{,}86 \text{ V}$$

BUT $V_{max} = \sqrt{2}\, V_{rms}$

$$= \sqrt{2}(15{,}63)$$

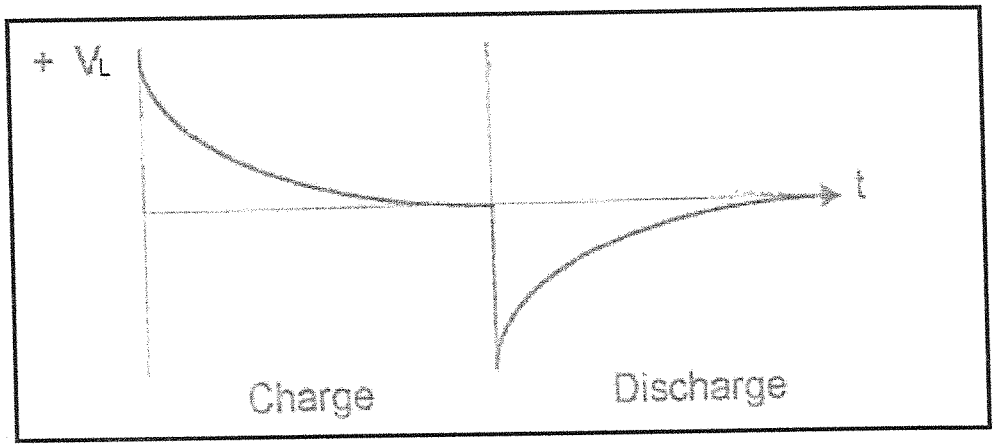
$$= 22{,}1 \text{ V}$$

(6)
[30]

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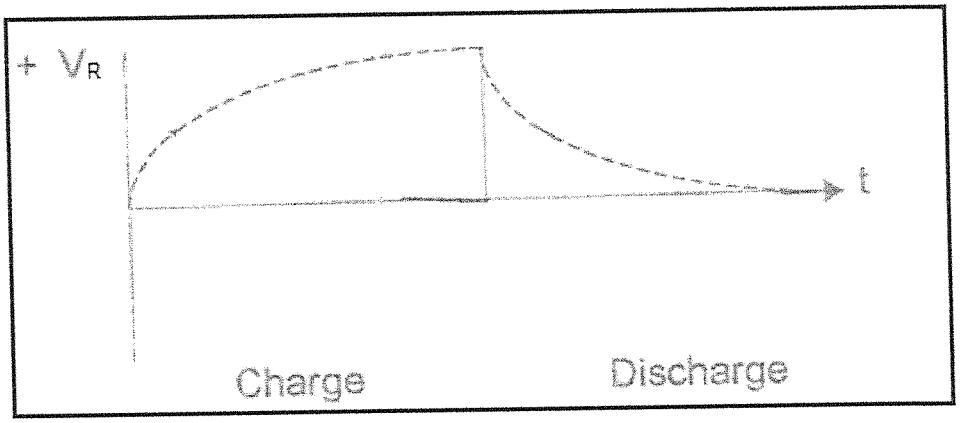
QUESTION 3

3.1 3.1.1



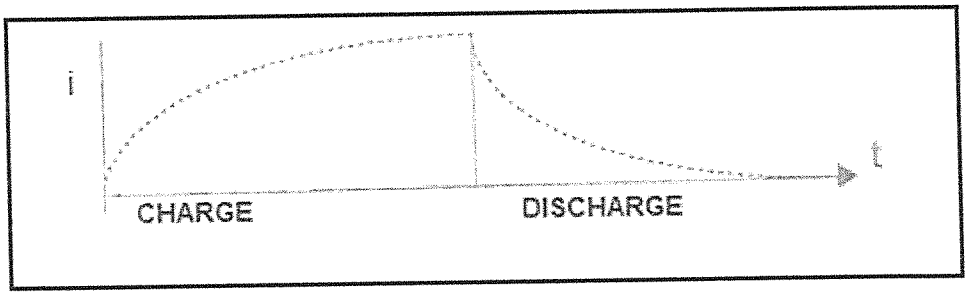
(2)

3.1.2



(2)

3.1.3



(2)

3.2 3.2.1 $i = I_m(1 - e^{\mathrm{T}((-t)/\tau)})$

$175 \times 10^{-3} = I_m(1 - e^{-1})$

$I_m = \underline{276,8\ mA}$ (3)

3.2.2 $R = \frac{V}{I}$

$= \frac{230}{278,8 \times 10^{-3}}$

$= \underline{830,9\ \Omega}$ (3)

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3.2.3 $\tau = \frac{L}{R}$

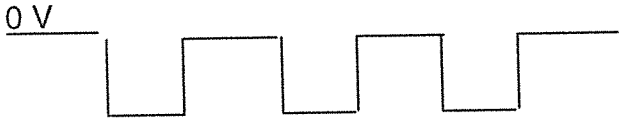
$L = \tau \times R$

$= 0{,}0015 \times 830{,}9$

$= \underline{1{,}25\ H}$ (3)

3.3 3.3.1 Invert amplifier circuit (1)

3.3.2 0 V



-500 mV (3)

3.3.3 The ratio $\frac{R_2}{R_1}$ is the gain of the amplifier.

(a) $R_F = R_m A$

$= 1{,}5 \times 10$

$= \underline{15\ k\Omega}$ (3)

(b) $V_o = -V_i(\frac{R_F}{R_m})$

$= -500 \times 10^{-3}(\frac{15}{1})$

$= \underline{-7{,}5\ V}$ (3)

[25]

QUESTION 4

4.1 4.1.1 frequency – D (2)

4.2 4.2.1 ultrasonic techniques
4.2.2 in phase } - P (3)

4.3 4.3.1 returned (feedback) – C (2)

4.4 4.4.1 simultaneously (at the same time)
4.4.2 logic AND } - K (3)

4.5 4.5.1 normal
4.5.2 abnormal } - R (3)

4.6 4.6.1 device polling
4.6.2 communication organisation } - A (3)

4.7 4.7.1 motor
4.7.2 generator } (3)

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4.8	4.8.1 4.8.2	hardware failure r scan time	(3) **[22]**

QUESTION 5

5.1	A relevant comment	(1)
5.2	1 point of information	(1)
5.3	1 point that clearly counters 5.2	(1) **[3]**

TOTAL: 100

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