Q1.

i). a) Deflection torque;

This is the torque required to move the pointer from its zero position to the deflected position. It is given by

$$T_d = NBiLd = Gi$$

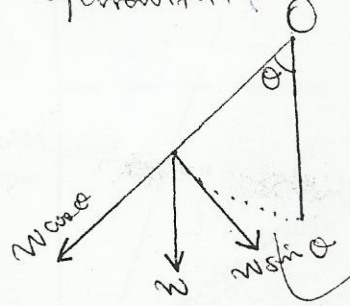
where N = number of turns in the core
B = flux density in the air gap
i = current in the spring
L = vertical distance of the core.
d = horizontal distance of the core.
G = NBLd = Galvanometric constant.

b). Controlling torque.

This is the torque required to avoid the pointer from oscillating about its final deflected position.

Various methods are used eg fluid (liquid or air), and gravity

i) Gravitational control



$T_c \propto W \sin\theta$

ii) fluid control

$$T_c \propto K\theta$$

c) Returning torque - this is the torque required to return the pointer to the zero position when power is switched off.

~~[Definition]~~ There are three methods of damping i.e underdamping, critically damped and overdamped.

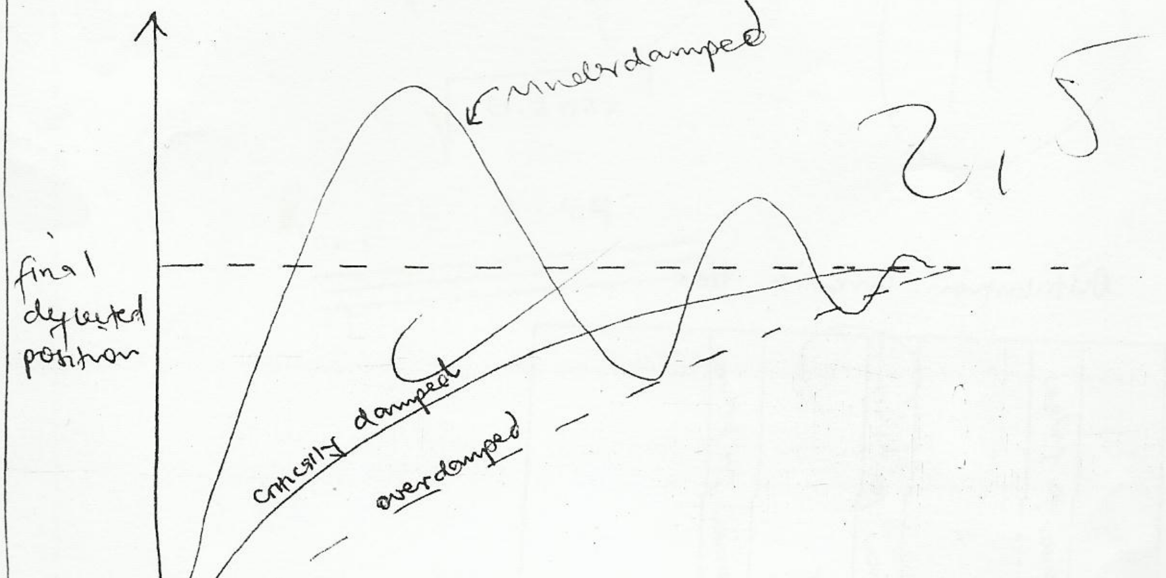
<u>Underdamped</u>, – here the pointer of the measuring instrumental oscillates ~~deflects~~ a lot about the final deflected position.

<u>Critically damped</u> – here the pointer will gradually move to the ~~[final]~~ deflected position.

~~Underdamp~~

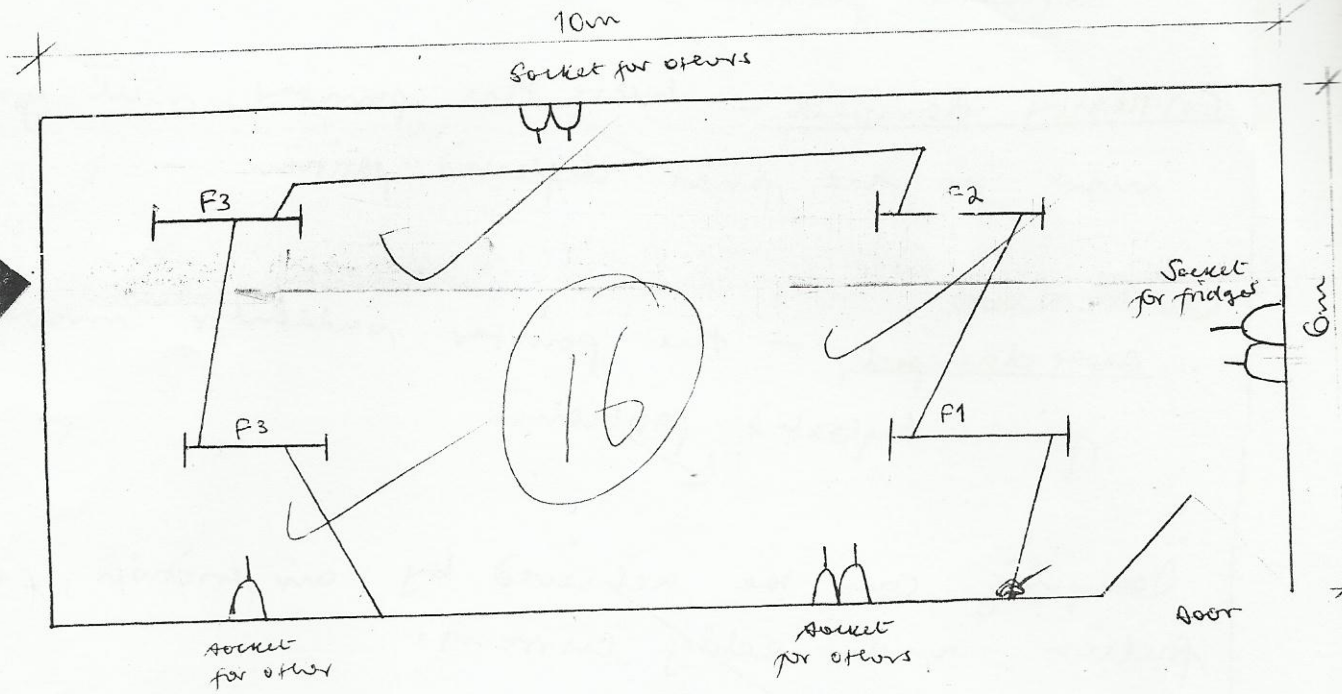
<u>Over damped</u>, – the pointer suddenly moves to the final deflected position.

Damping can be achieved by air friction, fluid (oil) friction and eddy current.



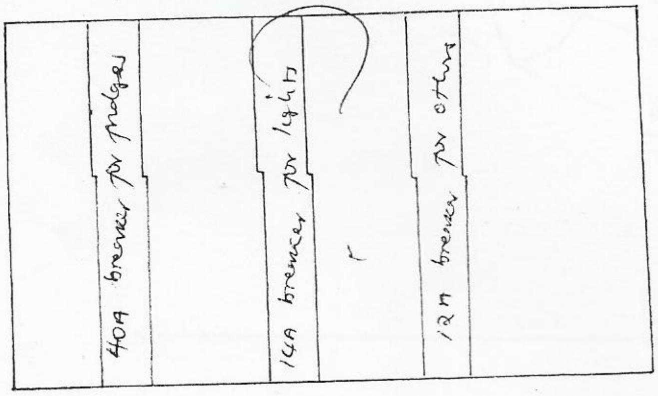
Q2

c) i) A = 10m x 6m = 60m



Distribution circuit box

ii)



Q3

c). $R_1 = 2.5\,kg$, $R_2 = 2.03\,kg$, $R_3 = 2.8\,kg$, $R_4 = 2.45\,kg$

$R_5 = 3.0\,kg$, $R_6 = 2.0\,kg$

Ratio of maximum value to minimum value i.e. Repeatability;

$$R = \frac{R_5}{R_6} = \frac{3.0\,kg}{2.0\,kg} = 1.5 < 2$$

What it mean

actual quartz mass

$$R_{r.m.s} = \sqrt{\frac{\sum_{i=1}^{n} R_i^2}{n}} = \sqrt{\frac{R_1^2 + R_2^2 + R_3^2 + R_4^2 + R_5^2 + R_6^2}{6}}$$

$$= \sqrt{\frac{2.5^2 + 2.03^2 + 2.8^2 + 2.45^2 + 3.0^2 + 2.0^2}{6}}$$

$$= \sqrt{\frac{37.2134}{6}}$$

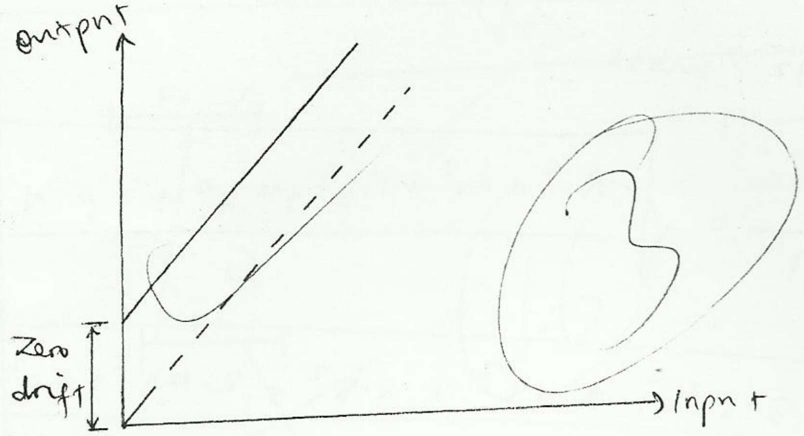
$$= \sqrt{6.2022}$$

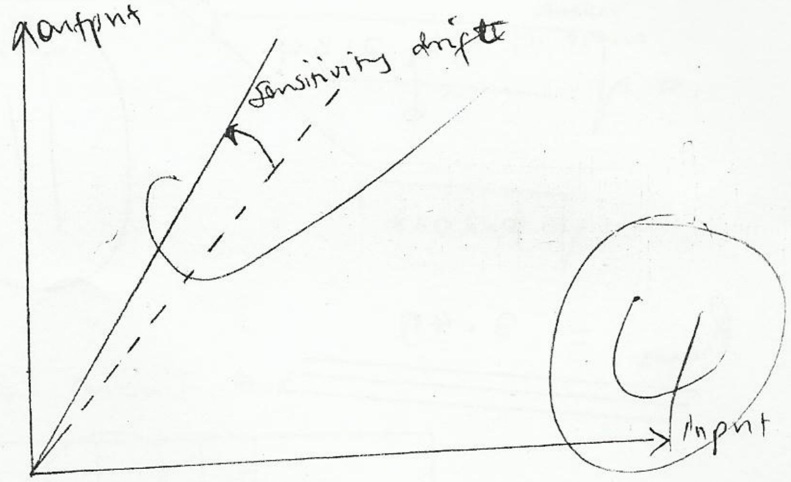
$$R_{rms} = 2.49$$

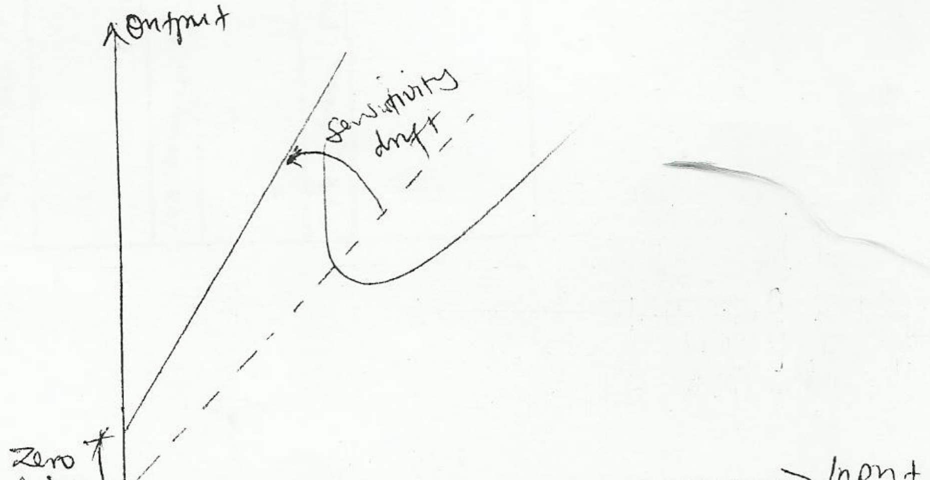
11

ii) <u>Zero drift</u> - This is the measuring instrument's variation in its output which is not caused a change in the input. What causes

<u>Sensitivity drift</u> - this is the variation in sensitivity as a result of ~~ambient~~ change in ambient conditions







Q4.

Part #

1) Cooling fins - these are used to cool the transformers as the transformer heats up during operation. (2)

2) Transformer casing - this is the metal casing which is built around the transformer & is used to protect the inside components of the transformer. (2)

3) Winding casing - this acts as a protective housing for the winding inside. (2)

4) Low voltage brush - this is used as an electrical contact to the low voltage winding. (2)

5) High voltage brush - used as an electrical contact to the high voltage winding. (2)

6) Laminated core - the core is used to link flux between the primary and secondary windings (2)

7) Low voltage winding - this used either as the primary winding for a step up transformer or as the secondary for a step down transformer. (2)

8) High voltage winding - this used either as the secondary for a step up transformer or as the primary for a step down transformer. (2)

9) Oil conservative tank - used to store oil which is used to lubricate and cool the transformer. (4)

Q5

a) Road map of single pole switch circuit troubleshooting;

- turn 'off' electricity by switching the circuit breaker
- use multimeter (dial turned to ohm) or continuity tester.
- Attach the wires to the probes of the multimeter or continuity tester.
- A zero (for multimeter) or a light (for continuity tester) indicates continuity exists.
- A one (for multimeter) or no light (for continuity tester) indicates that there is no continuity.
- If continuity does not exist, the switch is broken and has to be replaced.
- After safely replacing the switch, switch electricity 'on' by switching the breaker 'on.'
- Test the switch if the problem is gone.

9

(b). five causes and maintenance of vibrating motor

1) rotor mis-alligned - rotor has to be removed and alligned properly.

(2) rotor bent - the rotor has bent (not straight) may be due to overloading. The rotor has to be removed and straightened or even replaced.

Same effect

3) ~~stator~~ Stator distorted - the ~~shape~~ shape of the stator may be distorted may be during shipment causes the rotor to be brushing against the stator. The motor has to be disassembled and ~~stator~~ shape of stator corrected.

4) Overloading - the load may be too excessive for the motor. Counter check the load does not exceed the rated load of the motor.

5) Unbalanced load - check that the load is balanced