## SECTION A ANSWER ANY TWO (2) QUESTIONS

### QUESTION 1

(a) A moving –coil millivoltmeter has a resistance of 20Ω and reaches full-scale when the potential difference of 100mV is applied across its terminals. The moving coil has the effective dimensions of 3.1cm x 2.6cm and is wound with 120 turns. The flux density in the gap is $0.15 Wb/m^2$. Determine the control constant of the spring and the cross section area of copper wire for coil winding if 55% of total instrument resistance is due to coil winding. If copper $\rho = 1.73 \cdot 10^{-6} \Omega cm$ . **[10 Marks]**

(i) Explain types instrument drifts and show graphically, **[6 Marks]**

(ii) Explain what is meant by instruments range. **[4 Marks]**

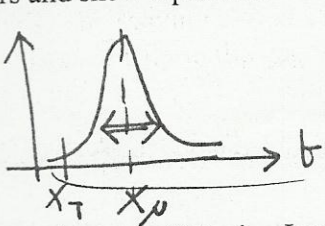
### QUESTION 2

(a) Design a multirange ammeter to give the following ranges 10mA,100mA, 1A, 10A and 100A. If the meter have internal resistance of 10Ω and full scale current of 1mA. **[5Marks]**

(i) Describe what is meant by absolute and secondary instruments, **[3 Marks]**

(ii) Define and state the difference between instrument accuracy and precision. **[6 Marks]**

(iii) State in detail the types of instruments errors and show equations. **[6 Marks]**




### QUESTION 3

(a) Describe in details the principle of operation of both types of Moving Iron Instruments. **[8 Marks]**

(b) Describe with the aid of diagrams the types and process of instrument damping. **[8 Marks]**

(i) If the repeatability of ohmmeter were found to be 2.3 after measuring the same resistor, find the value of X if the measured resistance were; 2.3Ω, 2Ω, 2.1Ω, 1.8 Ω, 3Ω, X Ω and 3.88 Ω. **[4 Marks]**

SECTION B ANSWER ANY **THREE (3)** QUESTIONS

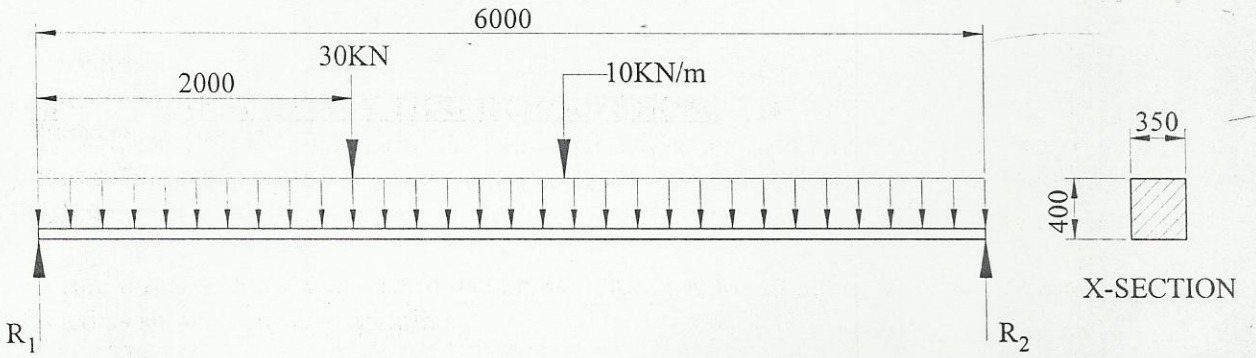
## QUESTION 4

A beam 6 meters long with a solid rectangular cross section of 350mm wide x 400mm deep is loaded as shown below. Determine;

(i) The slope at the end, **[8 Marks]**

(ii) The deflection at the middle. **[12Marks]**

Take E=210GPa.




Figure

## QUESTION 5

A shaft carries four masses in parallel planes A,B,C and D in order along a shaft. The masses at B and C weigh 18 kg and 12.5 kg respectively and each has an eccentricity of 60mm. The masses at A and D have an eccentricity of 80mm. The angle between the masses at B and C is $100^{o}$ and that between the masses at B and A is $190^{0}$ both the angles measured in the same sense. The axial distance between the planes A and B is 100mm and between B and C is 200mm. If the shaft is in complete dynamic balance determine;

(i) The weight of the masses at A and D, **[8 Marks]**

(ii) The distance between plane C and D, **[6 Marks]**

(iii) The angular position of mass at D. **[6 Marks]**

## QUESTION 6

Two closed coiled helical springs are connected in series each having 12 coils at a mean diameter of 25mm. Find the wire diameter of the other given that the stiffness of the composite spring is 700N/m. Calculate the maximum load that can safely be carried by the composite spring and the extension in each spring for a maximum shearing stress of $180N/mm^2$. Take $G=80GN/m^2$.

**[20 Marks]**

## QUESTION 7

The mass of the machine is 100kg. Its vibrations are damped by a viscous dash pot which diminishes amplitude of vibrations from 40mm to 10mm in three complete oscillations. If the machine is mounted on four springs each of stiffness 25kN/m, find;

i) The resistance of the dash pot at unit velocity, **[10 Marks]**

ii) The periodic time of the damped vibrations. **[10 Marks]**

## QUESTION 1:

(i) Describe the types of torques associated with the measuring instruments. **[10 Marks]**

(ii) Define the methods of damping and sketch the graphs **[10 Marks]**

## QUESTION 2:

An electrical wiring diagram is required for given a shop with total luminance of 100lx with maintenance factor 0.6 and coefficient utilization 0.8. The shop has an area of 10x6m. The loading are as follows; fridges 40A, lights 14A and others 12A;

i. Using standard symbols draw the shop plan and indicate the wiring. **[15 Marks]**

ii. Show clearly the distribution supply circuits **[5 Marks]**

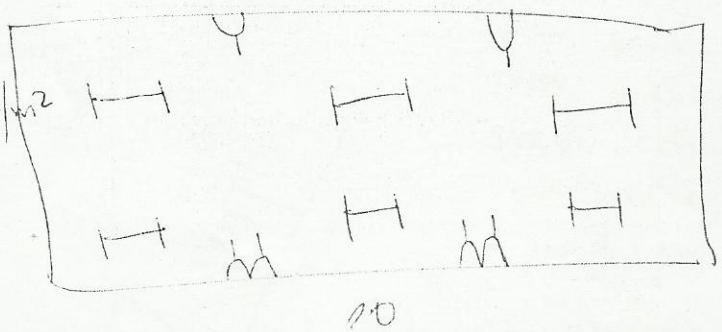
## QUESTION 3:

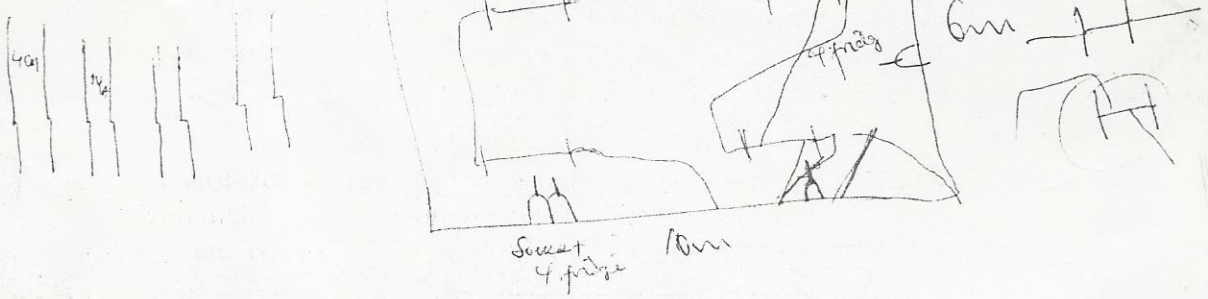
Miss Mutale Chimfwebe was assigned to weigh quartz sample from Kapiri Mposhi for the development of silicon solar cell to determine the exact mass, she carried out measurements of the same quartz and the following results were obtained using the same balance instrument;

2.5kg, 2.03kg, 2.8kg, 2.45kg, 3.0kg and 2.0kg

i. Find the repeatability of the balance instrument and the actual quartz mass. **[12 Marks]**

ii. Describe types of instrument drifts and show graphically. **[8 Marks]**

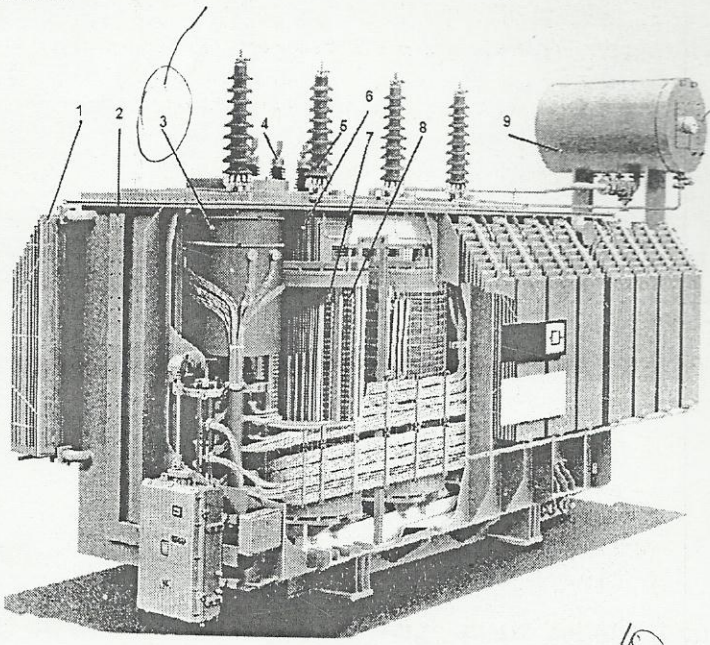




## QUESTION 4:

For the given high voltage transformer diagram below, name the labelled numbers and state the functions

**[20 Marks]**




## QUESTION 5:

(a) Briefly outline the road map of single pole switch circuit troubleshooting

**[10 Marks]**

(b) State five likely causes and maintenance for a vibrating motor

**[10 Marks]**

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