THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION, 1993

SABM. 19.

035 ENGINEERING SCIENCE (SABM

TIME: 3.00 Hours. SHAURI'S PROPERTY

This paper consists of parts I and II.

Part II consists of Sections; A, B and C.

Attempt ALL twenty (20) questions in Part I and any FIVE (5) in Part II. You must attempt at least ONE question from sections; A, B and C.

Part I carries 40%
Part II carries 60%

(Take $g = 9.81\ m/s^2$).

E by Mwalat Mgt (A) (PCB)(PCM)(PGM)

MUSESE PAWA RUSANA (MIPAL)

This paper consists of 6 printed pages.

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PART I

1. Name four fundamental physical quantities in Engineering Science. Give the SI-unit into which each is measured.

2. Give the SI-unit into which each of the following is measured:
   (i) Force (ii) Pressure (iii) Power (iv) Speed.

3. State two conditions for equilibrium of a lever acted upon by parallel forces.

4. Define impulse and give its SI-unit. Force x Secf

5. What is meant by the following terms as applied in Engineering materials?
   (i) Elastic materials (ii) Plastic materials.

6. Define efficiency of a machine.

7. Distinguish between conduction and convection as applied to heat transfer.

8. Define the following terms:
   (i) Specific heat capacity of a substance;
   (ii) Specific latent heat of vapourisation.

9. State the laws of refraction.

10. What is the relationship between the object distance and the image distance when reflection occurs at a plane mirror?

11. What is the difference between reverberation and echo?

12. The sound made by a bouncing ball reaches a distant observer when the ball is well in the air. Explain why.

13. State the fundamental law of electrostatic charges. Like poles —

14. What is an electroscope?

15. Name the three effects of an electric current.

16. Name the instrument used to measure:
   (i) Potential difference, Voltmeter
   (ii) Electrical resistance. Ammeter

17. Define magnetic flux density. Give its SI-unit.

18. Sketch the lines of force associated with a bar magnet.

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20.

19. State Lenz's law of electromagnetic induction.

20. What becomes of excess electrical energy when a transformer is used to step-down a high voltage?

PART II

SECTION A

21. a) Use the polygon of forces to find the resultant of the following concurrent - coplanar forces:

F_1 = 40N, ↑ 270°

F_2 = 60N, ↑ 0°

F_3 = 50N, ↑ 30°

F_4 = 50N, ↑ 90°

200N

(b) Fig: 1 shows a roller which is moved along a slot between two straight parallel guides by a force of 50N exerted on the roller by a link mechanism.

(i) Calculate the force tending to move the roller when the link makes an angle of 40°. 38.7N

(ii) Calculate the reaction force exerted by the guide on the roller. 32.14N

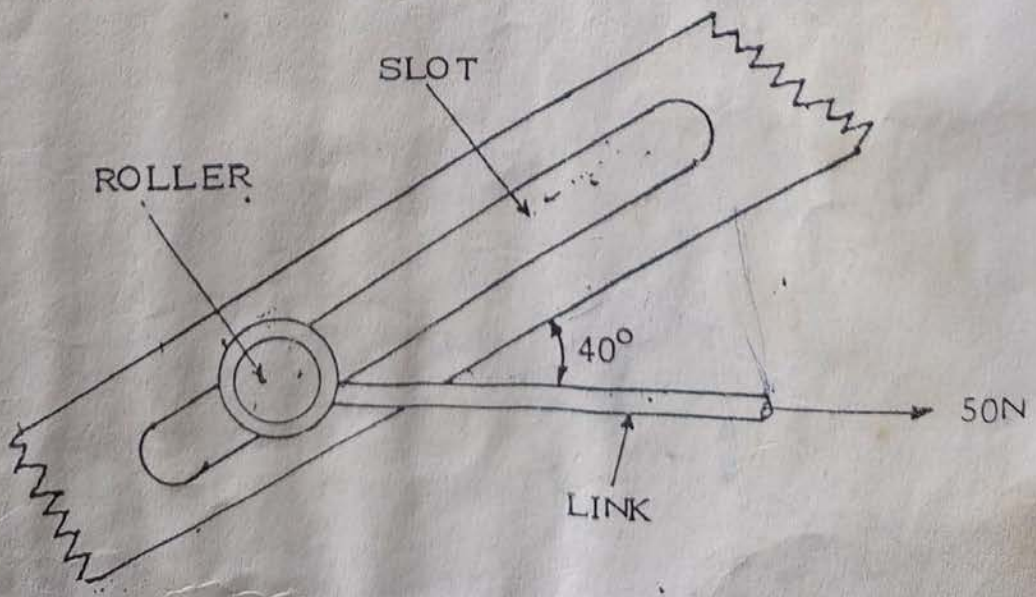


Fig. 1

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22. (a) Define the quantity "factor of safety" as applied to elastic materials.

(b) A bar under tension in a steel structure has a rectangular section of 4 cm by 1.5 cm. The extension measured in a 25 cm length of the bar when load was applied to the structure was 0.005 cm. Calculate:

(i) the tensile stress in the bar

(ii) the tensile force acting on the bar

(iii) the factor of safety used.

Assume that the Young's Modulus of elasticity for steel is $2 \times 10^{11} N/m^2$, and the ultimate tensile stress is $5 \times 10^{8} N/m^2$.

23. (a) Define work and give its SI-unit.

(b) A block of mass 100kg is pushed up an incline of 15° to the horizontal through a distance of 12 m. The coefficient of friction between the block and plane is 0.35. Caculate:

(i) the total work done

(ii) the velocity ratio of the incline.

What becomes of the total work done?

SECTION B

24. (a) Define heat capacity of a substance.

(b) The temperature of some oil was found to rise from $35^{\circ}C$ to $65^{\circ}C$. Express this as a temperature rise in:

(i) degree Fahrenheit (ii) Kelvin.

(c) Calculate the expansion of 15m of a copper pipe when heated from $15^{\circ}C$ to $60^{\circ}C$ if the coefficient of linear expansion of copper is $1.7 \times 10^{-5}/^{\circ}C$.

25. (a) A concave mirror produces a real image of an object placed 0.2m from it. If the distance from mirror to image is 1.50 m, determine the focal length and radius of curvature of the mirror. Show on a ray diagram how the image is formed.

(b) A ray of red light makes an angle of incident of 60° with one face of a prism of refracting angle 60°. Calculate the angle at which the ray emerges from the second face of the prism if the appropriate refractive index of its material is 1.50.

26. (a) Which of the following parameters affect the velocity of sound in air?

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(i) pitch
(ii) loudness
(iii) temperature
(iv) pressure.

(b) Define wavelength of a sound wave in air.

(c) Describe an experiment which demonstrates that sound obeys the laws of reflection.

SECTION C

27. (a) State Ohm's law.

(b) Fig. 2 shows an electric circuit connected to a 230V supply.

(i) Draw its equivalent circuit

(ii) Determine the reading on the voltmeter V

(iii) Determine the reading on the ammeters A_1 and A_2.

(iv) Determine the power in the 30Ω coil.

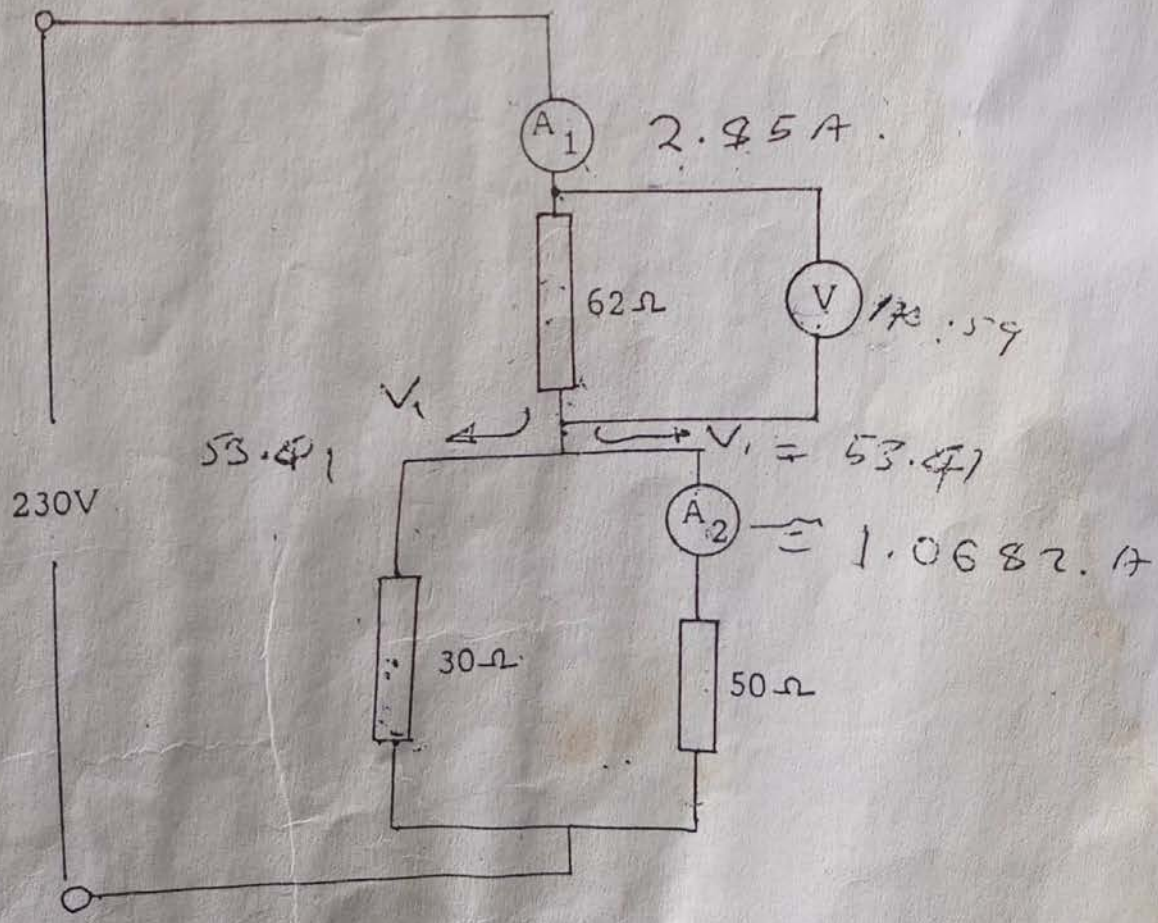


Fig. 2

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28. (a) State Faraday's laws of electrolysis.

(b) Calculate the mass of hydrogen gas liberated during electrolysis of water if a current of 0.4A is passed through the acidulated water electrolyte for a period of one hour.
(Electrochemical equivalent of hydrogen is 1.05×10^{-8} kg/C).

(c) Name two practical uses of electrolysis.

29. (a) A suspended conductor of length 20cm is at right angles to a magnetic field of uniform flux density of 0.5 Wb/m^2. Calculate the magnetic force exerted on the conductor when it carries a current of 3A.

(b) An electron enters normally a uniform magnetic field of 10^{-3}T. If its velocity is 1.04×10^{7} m/s, calculate the radius of its path in the field.

($e/m = 1.8 \times 10^{11}$ C/kg). $(Bev = \frac{mv^2}{r})$

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