THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION, 1991

27.

PROF. SABM.

035 ENGINEERING SCIENCE

SHAURI'S PROPERTY

TIME: 3 Hours.

This paper consists of parts I and II. Part II consists of Sections A, B and C.

Attempt ALL 20 questions in part I and any FIVE 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 $g = 9.81\ m/s^2$ and $\pi = 3.14$)

This paper consists of 6 printed pages.

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PART I

1. (a) What is meant by the equilibrant of a system of forces?
   (b) State the principle of moments.

2. A car started from rest and was accelerated uniformly. It then maintained a constant speed for some time. The brakes were then applied and the vehicle was uniformly retarded to rest. Sketch a graph which describes the motion of the car.

3. (a) State the principle of conservation of energy.
   (b) A stone of mass 5kg is dropped from a height of 5m. What will be its kinetic energy just before hitting the ground?

4. What is a machine?

5. A pulley system has velocity ratio of 4 and an efficiency of 75%. Calculate the effort required to lift a load of 400N at a steady speed.

6. State Archimedes principle and the law of floatation.

7. Mention the appropriate mode of heat transfer for the following:-
   (a) From the sun to the earth.
   (b) From an electric fire to hands held at some distance infront of the fire.
   (c) From the cylinders of a car to the radiator of a car.
   (d) From a hot plate of an electric cooker to the water in a saucepan incontact with the plate.

8. Calculate the heat given out when 0.05kg of iron cools from 45°C to 15°C. Take specific heat capacity of iron to be 460 $Jkg^{-1}\ {}^{o}K^{-1}$.

9. State Charles' law of gases.

10. Give an expression which relates the frequency, wavelength and velocity of a wave.

11. State the laws of refraction.

12. Explain the statement "the refractive index of glass is 1.5".

13. If a bar 3m long is stretched under tension until its length is increased by 0.9mm, find the tensile strain on the bar.

14. Define the magnetic poles.

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15. Draw electric lines of force due to:

(i) a positive charge Q

(ii) two positive charges Q_1 and Q_2 of equal magnitude.

16. A certain length of aluminium wire has a resistance of 28.3 ohm at $20^{\circ}C$. What is its resistance at $60^{\circ}C$?
The temperature coefficient of aluminium is $0.0043/^{\circ}C$ at $20^{\circ}C$.

17. State Faraday's law of electrolysis.

18. What path would be taken by an electron moving perpendicular to:

(i) a uniform electric field

(ii) a uniform magnetic field?

19. A bulb is marked 240 Volts, 100 Watts:
Calculate:

(a) The resistance of the bulb when switched ON.

(b) The cost of using the bulb for 24 hours if a kilowatt hour costs a shilling.

20. What do you understand by an alternating current ?

PART II

SECTION A

21. State Hookes law.

(b) Define : (i) tensile stress

(ii) tensile strain

(iii) Young's modulus of elasticity

(c) A mild - steel rod 4 m long and 30 mm in diameter carries a tensile load of 100 kN. Calculate the extension.
(Take Young's modulus of steel = 200×10^9 Pa)

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22. Fig. 1 is a velocity-time graph for the motion of a body moving in a straight line.

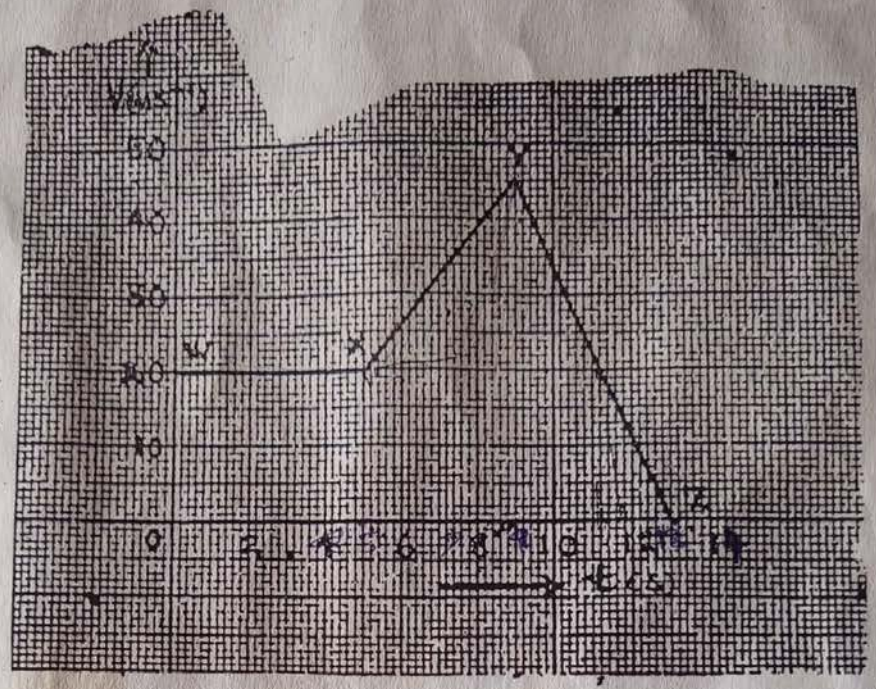


Fig. 1

(i) What was the initial velocity of the body?

(ii) What is the acceleration of the body after the first 4s, 8s and 9s?

(iii) What is the acceleration of the body in the Section YZ of the motion? Comment on your answer.

(iv) What is the total distance covered by the body?

(v) Suppose the body was a car; describe the motion of this car.

23. (a) Explain what is meant by the term centre of gravity.

(b) Fig. 2 below is a section of a composite laminar formed by a square and an isosceles triangle. The material has a uniform density and thickness, so that it has a constant mass per unit area. Determine the centre of gravity of the section.

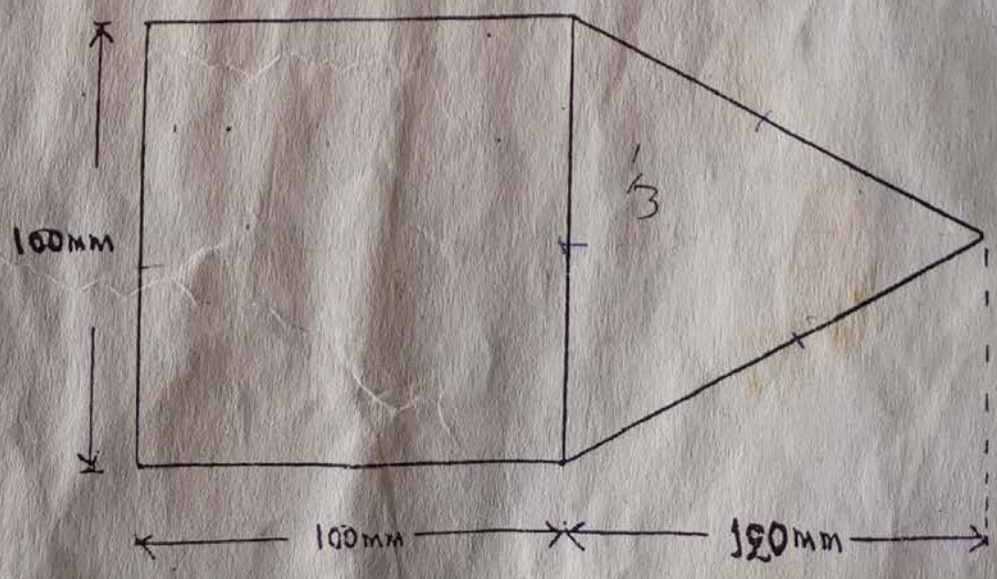


Fig. 2

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20.

SECTION B

24. (a) State two differences between a stationary and a progressive wave.

(b) A plane - progressive wave is represented by the equation $y = 0.1 \sin(200\pi t - \frac{20\pi x}{17})$ where y is the displacement in millimetres, t is in seconds and x is the distance from a fixed origin in metres. Find :

(i) the amplitude.

(ii) wavelength of the wave.

(iii) the speed of the wave.

(iv) the frequency of the wave.

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25. (a) Define the coefficient of linear expansion.

(b) A thick glass bottle cracks when a hot liquid is poured into it. Explain.

(c) A steel tape of correct length at 15°C is used to measure distance on a day when the temperature is 10.0°C. Is the result too large or too small? What is the error on measuring a distance of 20m? (Take coefficient of linear expansion of steel = $1.1 \times 10^{-5}/°C$).

26. (a) What is meant by a focal length of a converging lens ?

(b) An object 10mm tall stands vertically on the principal axis of a converging lens of focal length 10mm at a distance of 17mm from the lens. Find the position, size and nature of the image by graphical construction.

24.3cm.

SECTION C

27. (a) State the laws of electromagnetic induction.

(b) A 10cm long straight conductor moves perpendicularly both to the magnetic field of flux density 0.2T and to its length. If a potential difference of 1V is developed between its ends, calculate the velocity of a conductor resulting to such a voltage.

50m/s

(c) A coil of 1200 turns is wound on an iron former end, with a certain value of current flowing in the circuit. A flux of 0.004Wb is produced. When the circuit is opened the flux falls to its residual value of 0.0015Wb in 0.04s. Calculate the average value of the induced emf.

28. (a) Explain the following terms as related to an alternating voltage (emf)

(i) root mean square (r.m.s.) value

(ii) period

(iii) peak value

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(iv) mean value

(v) form factor.

(b) Calculate the values in (a) above for a 240V, 50Hz sinusoidal supply.

What does the result in (v) imply?

29. (a) State Ohms law.

(b) Calculate the equivalent resistance of the circuit in fig. 3 below.

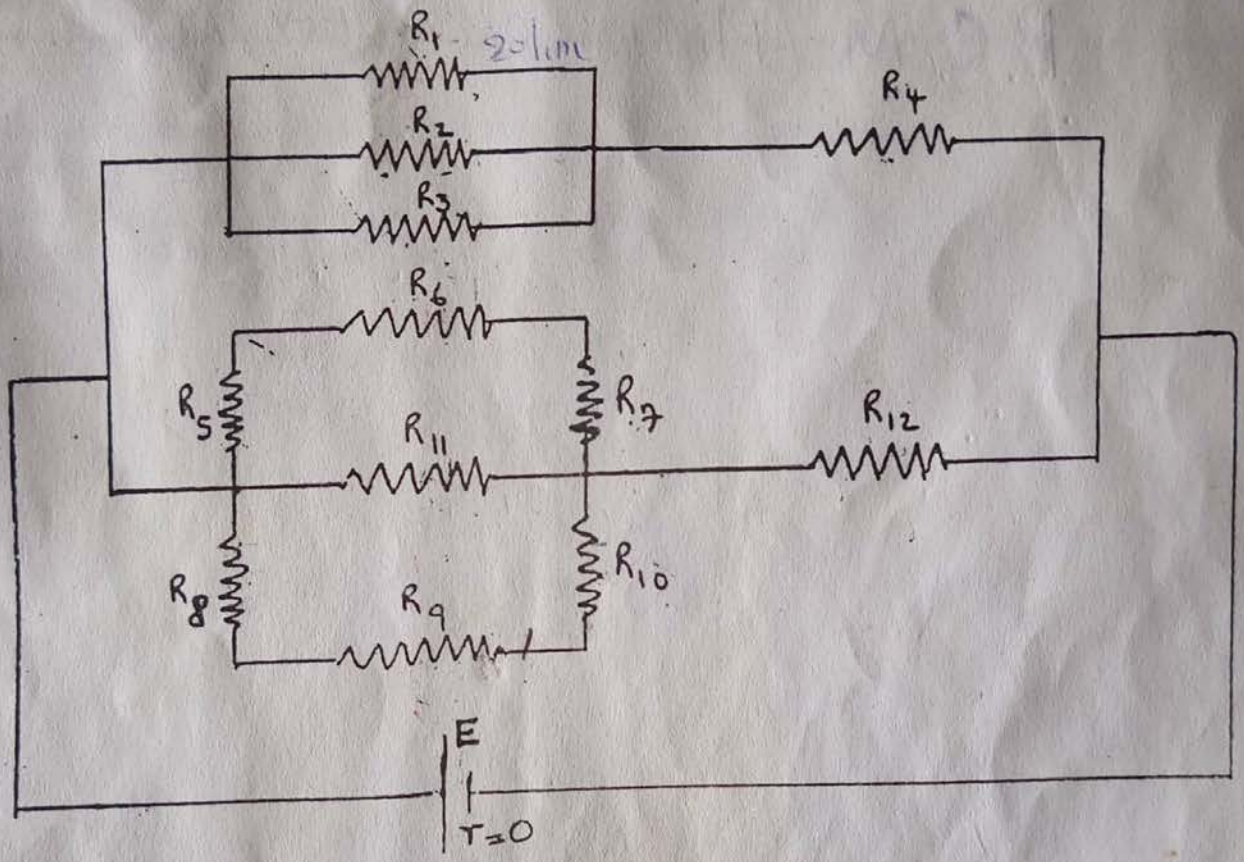


Fig. 3

R_1	=	2 ohm	R_7	=	5 ohm
R_2	=	6 ohm	R_8	=	4 ohm
R_3	=	3 ohm	R_9	=	3 ohm
R_4	=	5 ohm	R_{10}	=	3 ohm
R_5	=	2 ohm	R_{11}	=	2 ohm
R_6	=	3 ohm	R_{12}	=	2 ohm

(c) If the current in the circuit is 0.5A, calculate the value of E.

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