THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION, 1992

035

ENGINEERING SCIENCE

TIME: 3 Hours

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 in part II choosing at least ONE question from each section.

Part I carries 40%

Part II carries 60%

Take: g $10ms^{-2}$

Sp. heat capacity of water = $4200J/Kg^{0}K$

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This paper consists of 5 printed pages.

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PART I

1. Explain what is meant by the term "elastic limit".

2. How high must a waterfall be for the difference in temperature of the water at the bottom and at the top to be 0.5 K?

3. State the principle of the parallelogram of forces.

4. Find the reultant of the following forces acting on a body, 10 N due north, 5N 30^{o} South of West, 12N South-West.

5. Define the term linear "expansivity"

6. State any two laws of friction.

7. Six identical resistors are in parallel. If the equivalent resistance is 12-ohms, what is the resistance of each resistor?

8. What is meant by the term 'electro-chemical equivalent'?

9. Name two deffects of simple cells.

10. Sketch a graph of voltage, v, against time, t, for the output from the coil fitted with two-segment commutator rotating in a uniform magnetic field.

11. What do you understand by the term specific latent heat of fusion?

12. Give two reasons why the efficiency of a machine is never 100 per cent.

13. Find the critical angle of a mediam of a refractive index 1.65.

14. What is meant by the term wavefront?

15. A car starts from rest and uniformly accelerates at a rate of $4ms^{-2}$. What will its velocity be 5 seconds later?

16. A torque of 40 Nm was applied to turn a pulley through 2π radians. Calculate the work done.

17. Using the equation, $1/f = 1/v + 1/u$ and $m = \frac{V}{U}$, show that $m = \frac{v}{f} - 1$

18. A coil made of copper 0.20mm diameter is to have a resistance of 7.5-ohms. What length of wire must be used?

Resistivity of copper = 1.0×10^{-6} ohm-metre.

19. Explain the following fact; a chimney fitted to the place of a boiler induces a draught of air through the burning fuel.

20. State Lenz's law of electromagnetic induction.

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PART II

SECTION A

21. (a) Why is a flywheel usually fitted to an engine?

(b) An engine of a motor car of mass 100kg travelling on a horizontal road at 36 km/hr is switched-off when it reached a hill inclined at 30^0 to the horizontal. If the frictional force opposing its motion is 900N, find;

(i) the distance it travells before coming to rest.

(ii) its increase in potential energy at the end of the hill.

22. (a) State the relationship that exists between 'force' and "momentum" when an elastic material is loaded within the limit of proportionality.

(b) A bar of steel is in tension and it extends 0.05mm due to a load of 10KN.

(i) Find the probable extension due to a load of 12KN if the loading is within the limit of proportionality.

(ii) If the bar is 330mm long and has a cross-sectional area of $330mm^2$, find the value of Young's modulus of elasticity of this material in $\frac{KN}{mm^2}$

23. (a) What is meant by the term "momentum"?

(b) A body of mass, m kg is falling freely from rest under the action of gravity. After it has fallen through a height h metres in a time t seconds, its momentum is 360 $kgms^{-1}$ and its kinetic energy is 2.16KJ.

Determine:-

(i) the velocity after time t seconds

(ii) the height, h fallen by the body

(iii) the mass of the body

(iv) the time of fall t seconds.

SECTION B

24. (a) Define the term 'frequency' and wavelength as applied to wave motion.

(b) A train of plane sound waves propagated at a velocity of $340ms^{-1}$ in air has individual particles of air which excute a periodic motion such that their displacement y from equilibrium position

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at any time t, is given by the expression:

$$y = 5 \times 10^{-6} \sin(680\pi t)$$

Calculate (i) the wavelength of the waves.

(ii) the amplitude of the waves.

25. (a) Define pressure.

(b) Show that when a gas at pressure P is contained in a cylinder fitted with a weight-less frictionless piston of area A, and he is supplied so that the volume changes from V_1 to V_2, the work d W, by the gas is given by the expression; $W = P(V_2 - V_1)$.

26. (a) Light and sound energies are both propagated by waves. State two essential differences in the mode of propagation.

(b) A bus travelleing on a mountainous region had a tyre burst. If 2.5 sec. elapsed between the burst and hearing an echo from the opposite mountain, 450 metres from the bus, calculate

(i) the probable velocity of sound in air.

(ii) , why is this merely a probable velocity?

SECTION C

27. (a) State Ohm's law.

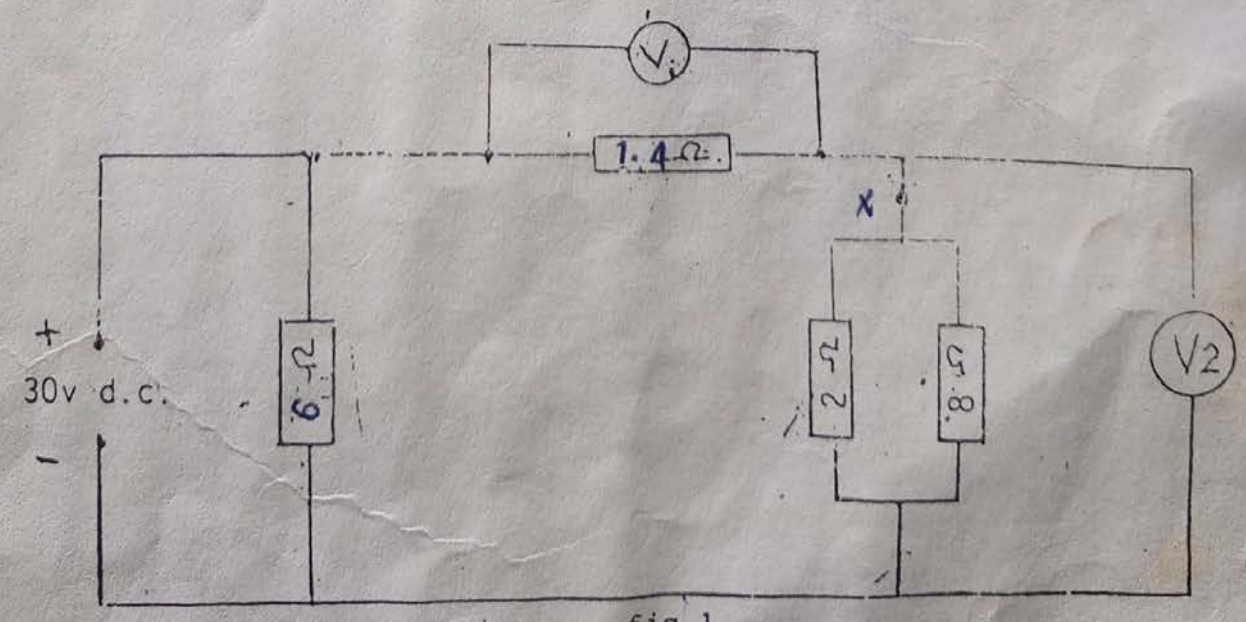


fig.1

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(b) the circuit in figure 1 above is connected to a 30v d.c. supply and has a high resistance voltmeters, V_1 and V_2 connected as shown. Neglecting the current taken by the voltmeters, Calculate:

(i) the total current taken from the supply.
(ii) The reading of the voltmeter V_1
(iii) The reading of the voltmeter V_2.
(iv) the reading on each of the voltmeters if an open-circuit were to occur at point X?

28. (a) What is meant by a 'form factor'?

(b) A rectangular coil of 200 turns rotates at 500 revs per minute between the poles of a horse-shoe magnet which provides a maximum flux through the coil of 10mWb

Determine the emf induced in the coil.

(a) State Flaming's Right Hand Rule of electromagnetic induction.

(b) A rectangular former has a mean width of 15mm and a mean axial length of 20mm. It is wound with 50-turns of wire and is situated in an air-gap of uniform flux density of 0.2T. When the current in the coil is 0.01A, calculate:

(i) the force acting on one side of the coil.
(ii) the maximum torque on the coil
(iii) the work done when the coil turns through an angle of 30°

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