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THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION NOVEMBER 1994

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 questions in part II. You must attempt at least ONE question from Sections A, B and C.

Part I carries 40%

Part II carries 60%.

Inshaalah !!!

This paper consists of 4 printed pages.

PART I

1. Define pressure. Give its SI - units.

2. Give a name of an instrument used to measure
   (a) length - Rulers
   (b) time - Second
   (c) temperature - Kelvin
   (d) mass. Beam balance

3. The frictional force acting on a body of mass 100kg is 196N. Calculate the coefficient of friction.

4. Distinguish between sensible heat and latent heat.

5. Distinguish between the coefficient of superficial expansion and coefficient of cubical expansion.

6. State Archimedes' principle.

7. Calculate the torque produced when a force of 50N acts on a body 2.0m perpendicular from a pivot.

8. Give any two reasons which make mercury a better liquid to be used in a thermometer than water.

9. A hammer is used to drive a nail. If its momentum changes by 10 kgm/sec in 0.1 sec, calculate the driving force.

10. Define work. Give its SI - units.

11. (a) Name two modes of heat transfer.
    (b) What is the necessary conditions for heat to flow ?

12. (a) Define simple Hormonic Motion.
    (b) Give two examples of Simple Hormonic Motion.

13. Calculate the effective value of 15 ohms and 10 ohms resistor connected in:
    (a) series
    (b) parallel

14. The resistance of an aluminium wire 750 cm long and 2mm diameter is 20 ohms. Find the resistivity of the aluminium.

15. The resistance of a conductor is 50 ohms at 10°C and 70 ohms at 25°C. Determine the temperature coefficient of resistance of the conductor.

16. (a) What is capacitance ?
    (b) Calculate the combined capacitance of 2μF and 3μF capacitors in:
    (i) series
    (ii) parallel.

Convection

17. (a) State the fundamental law of magnetism
    (b) Name any two methods of making magnets.

18. What are the units of measure of the following quantities ?
    (a) magnetic flux
    (b) magnetic flux density
    (c) charge
    (d) capacitance

19. How much heat is developed in a resistor with a p.d. of 12 volts across its ends and a current of 20A flowing for 5 minutes ?

20. Write the meanings of the following:
    (a) electron
    (b) ion
    (c) voltmeter
    (d) voltameter.

PART II

SECTION A

21. Distinguish a scalar from a vector quantity. A car runs at a constant speed of 15m/s for 300 seconds and then accelerates uniformly to a speed of 25m/s over a period of 20 seconds. This speed is maintained for 300 seconds before the car is brought to rest with uniform deceleration in 30 seconds.

    Determine:
    (a) the acceleration while the velocity changes from 15m/s to 25m/s.
    (b) the total distance travelled.
    (c) the average speed of the car.

22. What is the centre of gravity of a body ?

    A uniform half-metre rule is freely pivoted at 20cm mark and it balances horizontally when a 10N weight is hung from the 4cm mark. What is the weight of the rule ?

23. (a) Draw a simple labelled diagram of a hydraulic press.
    (b) A hydraulic press has pistons of cross-sectional areas $100cm^2$ and $50,000cm^2$ respectively. The machine is 80% efficient and a force of 10N is applied. What is the load overcome ?

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SECTION B

24. A 1 kg block of copper has its temperature raised by 20 degrees centigrade in 1.9 minutes using an electric immersion heater.

(a) At what rate is heat energy being supplied to the block ?

(b) If the heater takes 2A from a 10V supply, what is the efficiency of the heater ?

Take specific heat capacity for copper to be 380 J/kgK.

25. (a) State Boyle's law as applied to expansion of gases.

(b) 10^{-3} m^3 of air at 27 deg. C and a pressure of 3×10^5 N/m^2 has its volume changed to 1.5×10^{-3} m^3 and its temperature changed to 102 deg. C. What will be its new pressure ?

26. (a) State the laws of refraction.

(b) If a narrow beam of light travelling through air is directed into water, at an angle of incidence of 38^o , what is:

(i) the angle of refraction of the beam

(ii) the speed of light in water ?

The index of refraction of water relative to air is 1.33; speed of light is 3×10^8 m/sec.

SECTION C

27. (a) A milliameter gives a full scale deflection for a current of 0.002A and has a resistance of 40 ohms. What resistance is needed to convert it into an ammeter reading up to 20A ? How must the resistor be connected ?

(b) Explain briefly the principle under which a moving coil meter works.

28. (a) State Faraday's Law of magnetic induction.

(b) A 0.2m straight wire stretched horizontally carries an electric current of 10A from East to West in a magnetic field whose magnetic induction is 0.1 webbers/m^2 directed downwards. What is the magnitude of the magnetic deflecting force on the wire ?

29. (a) Define the term "electrochemical equivalent" as applied to electrolysis.

(b) Calculate the current that flows through copper sulphate contained in a vessel with copper electrodes if 0.45g of copper are deposited in 30 minutes given that the electrochemical equivalent of copper is 3.3×10^{-7} kg/C.