THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION

EXAMINATION - NOVEMBER, 1990

035 ENGINEERING SCIENCE

IME : 3.00 Hours.

This paper consists of part 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%

ALOUCE MUSESE PAWA.

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PART I

1. Distinguish between dynamic and static friction.
2. A body moves with an angular speed of 250 rad/sec. If the radius of rotation is 34m, calculate its linear velocity.
3. Briefly explain the difference between mass and weight.
4. How does a body move in the third second if it starts from rest with a uniform acceleration of $10m/s^2$?
5. Explain what is meant by the term INERTIA, relating it with one of the Newton's laws of motion.
6. A resultant force of 12N acts for 5 seconds on a body of mass 2kg. What is the change in momentum of the body?
7. State the law of conservation of momentum.
8. Define the term centre of gravity of a body.
9. What do you understand by the term Efficiency of a machine?
10. A machine with a velocity ratio of 6 requires 800 J of work to raise a load of 600N through a vertical distance of 1 m. Find the efficiency of the machine.
11. Define the refractive index.
12. An object placed 2cm in front of a convex lens of focal length 5 cm produces a magnified image. Find the position of the image.
13. What is the difference between heat capacity and specific heat capacity ?
14. Define the term linear Expansivity of a solid.
15. What is meant by the temperature of a body?
16. A fixed mass of gas at constant pressure has a volume of $10cm^3$ at 27^oC. Find its volume at 57^oC.
17. What is the frequency of sound with a wave length of 12cm ?
18. State ohm's law and define resistance.
19. What is meant by the e.m.f. of a cell ?
20. Find the internal resistance of a cell of e.m.f. 2 volts if it sends a current of 0.1 ampere through a 19Ω resistance.

PART II

SECTION A

21. A uniform rod AB 2m long of mass 4kg rests on supports C and D wich are placed 5cm from each end. If masses of 2kg, 4kg and 5kg are placed 20cm, 180cm and 130cm respectively from A, find the reactions of the supports.

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22. A wheel and differential axle has the following dimension: effort wheel 300mm diameter, major axle 150mm diameter and minor axle 70mm diameter. To raise a load of 450N an effort of 75N is required. Calculate the force ratio and efficiency of the machine at this load.

23. A torque of 150 Nm is applied to a motor shaft at stand still so that it is made to rotate. The speed of the shaft increases from zero to 250 rev/min. in 15 sec. Find:

(a) the angular velocity of the shaft, in rad/s at the end of the 15sec.

(b) the angular acceleration in rad/s^2

(c) the total angle turned through

(d) the work done by the Torque.

SECTION B

24. (i) From Newton's second law of motion, Force is proportional to the rate of change of momentum i.e. $F \propto m\frac{(v-u)}{t}$

where v = final velocity in m/s

u = initial velocity in m/s

t = time taken in sec.

m = mass of the body.

Mathematically $F = Km\frac{(v-u)}{t}$ where K is a constant.

If F = 0 what can be said about the motion of the body?

(ii) A constant force is applied for a period of 10 seconds to a body of mass 10kg, so that it is accelerated from rest to a speed of 15m/s against opposing frictional force equal to 20N.

Find:

(a) The applied force

(b) The acceleration after the applied force is removed

(c) The total distance travelled before the body again comes to rest.

(d) The total time for which the body is in motion.

25. (a) Explain as to why burns from steam are usually more severe than those from boiling water.

(b) A plastic tray weighing 48 gm and containing 200gm of water at 20°C is put in a refrigerator which abstracts heat at a uniform rate of 2100 J/min.

Calcualte:

(i) The time taken for the tray and water to reach 0°C.

(ii) The total time taken to freeze all the water to ice at 0°C.

Given that specific heat capacity of plastic = 105×10^3 J/kgK

Latent heat of fusion of ice = 335×10^3 J/kg

Latent heat of steam = 2260×10^3 J/kg

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SECTION C

26. (a) A man sits in a chair facing a plane mirror which is 2m away from him and views the image of a chart which faces the mirror, the chart being 60cm behind his head. How far away from his eyes does the chart appear to be? 4.6m.

(b) Yellow light has a wavelength of $\lambda = 6 \times 10^{-5}$cm. Light has a speed of $c = 3 \times 10^{8}$m/s. Find the frequency of yellow light.

27. (a) What is an electrolyte ?

(b) A current of 8A is maintained for 10 minutes through an electrolytic cell containing Cu^{2+} ions. How much copper is deposited ? The charge of an electron is 1.6×10^{-19}C, Avogadros number is 6.02×10^{23} molecules per mole, molecular weight of copper is 63.6gm per mole. 1.6

28. (a) A man stands 750m from a mountain and beats a drum once. How much time will pass before he hears an echo? 2.21

(b) A length of wire has a frequency of 256 Hz when stretched by a force of 48 N. By what force must it be stretched to give a frequency of 320 Hz? =75N.

H.

$T \propto F$

$T_1/T_2 = F_1/F_2$

$\frac{48}{256} = \frac{?}{48}\ \frac{}{320}$

$\frac{320 \times 48}{256}$

$f = \frac{c}{\lambda}$

$\lambda = \frac{c}{f}$

$\lambda f = \frac{c}{\lambda}$

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