THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

NOVEMBER 1995

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 (5) questions in part II. You must attempt at least one question from each of sections A, B and C.

Part I carries 40%

Part II carries 60%

(Take g = 10m/s)

BY MISESE PAWA LUSAN
AKA MIPAL.

PART I

1. (a) What do you understand by the term "relative density" of a substance ?

   (b) The reading of a burette was $20cm^3$. Fifty (50) drawing pins each of average volume $0.1cm^3$ were added to the water. What is the new burette reading ?

2. Calculate the power of a pump which can lift 200kg of water through a vertical height of 6m in 10 seconds.

3. The mass of a piece of cork $0.25g/cm^3$ is 20g. What fraction of the cork is immersed, when it floats in water ?

4. (a) Define a force. is the pull or push.

   (b) Resolve a force of 250N acting at 60° to the horizontal into its horizontal and vertical components.

5. Define reverberation and explain its two important features.

6. A metal rod has a length of 100cm at $200^\circ C$. At which temperature will its length be 99.4cm if the linear expansion of the metal rod is 2×10^{-5} per Kelvin ?

* 7. A certain piece of equipment is made up of 1.5kg of copper, 2.5kg of iron and 1kg of aluminium. If it transmits heat energy to its surroundings at an average rate of 1.9 KJ/min and their Relative specific heat capacities are 0.09 J/gK for copper, 0.12J/gK for iron and 0.21 J/gK for aluminium, calculate:

   (a) the thermal capacity of the equipment 2709 J/°C.

   (b) the time taken for this equipment to cool down from a temperature of $50^\circ C$ to $20^\circ C$. t = 42.8 Min.

* 8. (a) State Archimedes Principle.

   (b) A rectangular metal block of dimensions 200 mm by 100 mm has a hole in the middle. If the metal has a density of 600 kg/cm^3 and the mass of the block is 9kg, calculate the volume of the hole. 0.0005 M^3.

9. Define light.

10. A convex mirror of focal length 18cm produces an image in its axis 6 cm away from the mirror. Use new cartesian, and calculate the position of the object.

11. A torque of 150Nm is applied to a motor shaft at stand still, so that it is made to rotate; the speed of the shaft increases from 0 to 250 rpm in 15 seconds. Find:

11. Cont.

(a) the angular velocity in rad/sec. at the end of the 15 seconds.

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

(c) the total angle turned through.

(d) the workdone by the torque.

BY MISESE PAW

12. Name two types of light sources and give an example for each.

13. An object of mass 1 kg rests on $0.1\ m^2$ of a table. What is the pressure exerted on the table ?

14. Convert the standard pressure of 76 cm of mercury to N/m^2 given that the density of mercury is $13600 kg/m^3$.

15. A flask of water of mass 400g is placed on a 600W electric hot plate. When it reaches boiling point it is left to boil for further 19 seconds and later found to have a mass of 395gm. Find the latent heat of vapourization of water in J/g.

16. A pulley having a diameter of 200mm is driven by a belt. If the effective belt tension tending to turn the pulley is 250N, find the workdone per revolution.

17. A narrow beam of light travels from air into water at an angle of incidence of 40^o. If the refractive index of water relative to air is 1.33, determine

(a) the angle of refraction

(b) the speed of light in water. (Take speed of light in air $= 3 \times 10^8 m/s$

$\sin 40^o = 0.6428$)

18. (a) Define "Critical Angle".

(b) Find the critical angle of a medium with refractive index of 1.65. ($n =$

19. Define:

(a) angular motion

(b) angular acceleration

(c) elastic limit.

20. What is the difference between speed and velocity of a moving object ? Give one example to support your answer.

SECTION A

21. (a) An empty density bottle weighs 22N and 46N when full of water and 43.6N when full of another liquid. Determine the density of the liquid.

(b) A piece of cork of volume $100cm^3$ is floating on water. The density of cork is $0.25g/cm^3$.

(i) Find the volume of cork immersed in water

(ii) What is the force needed to immerse the cork completely ? (take g = 0.01 N).

22. (a) Define a "Wave".

(b) A plane-progressive wave is represented by the equation

$$Y = A \sin\left(200\pi t - \frac{\pi x}{17}\right)$$

Where t is the time in seconds, x is the distance from a fixed origin in centimetres and Y is the displacement in millimetres. Find:

(i) period

(ii) velocity

(iii) frequency

(iv) wavelength

23. (a) Define heat capacity.

(b) A piece of copper having a mass of 0.5kg is heated to 100^oC and is then dropped into a vessel containing 0.75 litres of water at an initial temperature of 15^oC. Find:

(i) The temperature of water which will rise

(ii) The temperature of the copper which will fall.

(Take relative specific heat of copper as 0.09, specific heat capacity of water $4.2KJ/kg^oC$)

SECTION B

24. A tie bar of rectangular cross-section is to carry a load of 75 kN. If the thickness of the bar is 16mm and the tensile stress is to be limited to $120N/mm^2$, determine the necessary width of the bar.

25. Two telegraph poles A and B at the side of a railway track are 50m apart. A train which has a uniform acceleration passes pole A at a speed of 70km/h and passes pole B 2 seconds later.

25. Cont.

(a) What is the acceleration of the train ?

(b) How fast is it moving as it passes B?

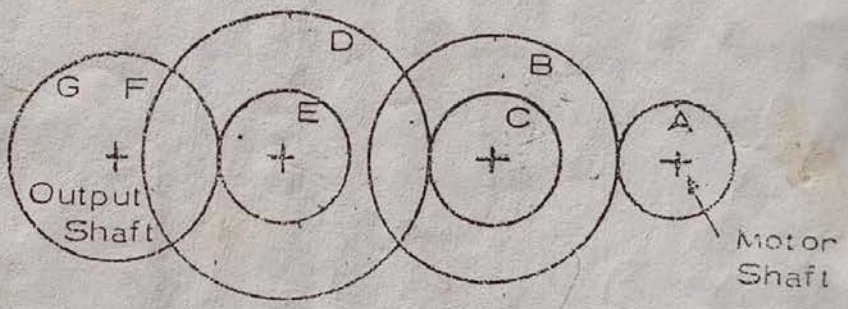
26. (a) State the principle of moments.

(b) A uniform rod AB 2m long of mass 4kg rests on supports C and D which are placed 5cm from each end. If masses of 2kg, 4kg and 5kg are placed 20cm, 180cm and 130cm respectively from A, calculate the reactions at the supports C and D.

SECTION C

27. Gear wheels B, C, D and E are fixed to the same parallel shafts and rotate together; the motor shaft is connected to A and rotates at 975 rpm. The final gear wheel F is fixed to the output shaft G. Determine the speed of the gear wheel E.

Speed of E = ~~52~~ 130 rev/min.



Gear wheel	A	B	C	D	E	F
No of teeth	20	50	25	75	26	65

28. (a) Name two parts of an electricity bill.

(b) A student switches on two electric lamps of 40 Watts every evening for 10 hours.

How much will be paid at the end of a month of 30 days ?

Suppose he had switched on for two full days, how much would be paid ?

(Assume electricity costs 3 shillings per unit and the assessment is 210 shillings).

29. (a) A conductor having an active length of 100mm lies at right angles to magnetic field having uniform flux density of 0.1 T. Find the force exerted on the conductor when it carries a current of 2A.

(b) A portable immersion heater has a resistance of 200 ohms. It is connected to a 240 - volt supply for 2 hours. What will be the cost of the energy consumed at 4 shillings per kilowatt - hour ?