THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

035

ENGINEERING SCIENCE
(For Both School and Private Candidates)

TIME: 3 Hours.

9 November 1999 A.M.

INSTRUCTIONS

1. This paper consists of Parts I and II. Part II consists of sections A, B and C.
2. Attempt question NUMBER ONE in Part I and any FIVE (5) questions in Part II.
3. You must attempt at least ONE (1) question from each of sections A, B and C.
4. Part I carries 40%. Part II carries 60%

(Take $g = 10\ m/sec^2$.

MUSA JOHN
4/4/2014

This paper consists of 4 printed pages

PART I

1. (a) 1000 cm^3 of water of density 1000kg/m^3 are mixed with 800 cm^3 of brine of density 1027 kg/m^3. Find the density of the mixture.

(b) A lever AB is 2m long. If the force applied at end A to lift a load of 420N hung at B is 60N, find the position of the fulcrum from point A.

(c) (i) A submarine is at a depth of 10m below sea-level. If the density of sea water is 1030 kg/m^3 and the atmospheric pressure is 10^5N/m^2, determine the pressure exerted on it.

(ii) A garden roller is being pulled along the ground by a force of 40N acting at an angle of 50° with the ground level. Find the effective force pulling the roller along the ground.

(d) (i) A belt driven pulley has a diameter of 500 mm and its speed is 300 rev/min. The tensions in the two sides of the belt are 1800N and 400N respectively. Calculate the power transmitted by the belt.

(ii) State Newton's second law of motion and use it to show how it leads to the definition of the Newton.

(e) A wheel and axle have an axle of diameter 5cm and a wheel has a diameter of 50cm. What load can be raised by it when an effort of 200N is applied and if its efficiency is 75%?

(f) (i) Express an angle of 87° in radians.

(ii) A point is moving with a constant angular velocity of 20 rad/sec in a circular path of radius 0.25m. What is its linear velocity?

(g) (i) Draw the graph of load against extension for a brittle material.

(ii) A direct tensile force of 50N is applied to a wire of a diameter 2 mm. Find the tensile stress in the wire.

(h) State Charle's and Boyle's laws.

(i) The image in a converging lens is upright and magnified four times. Calculate the object distance if the focal length is 20 cm.

(j) An aluminium conductor has a resistance of 3Ω at 15°C. What is its resistance at 60°C if the temperature coefficient of resistance of aluminium is 0.00403/°C?

(k) Calculate the cost of using a 500W lamp, ten 100W lamps and a 6kW heater at a cost of Tshs 10 per kWh for 20 hours.

(l) An electric generator delivers a load current of 25A at a terminal voltage of 250V. The generator is driven by a motor whose output power is 7.5 kW. What is the efficiency of the generator?

(m) Explain what you understand by the terms: **shunt** and **multiplier**.

(n) (i) State Faraday's laws of electrolysis

(ii) State Faraday's law of electromagnetic induction.

(o) (i) A shaft transmits 18kW when it is rotating at 200 rev/min. What is the torque on the shaft?

(ii) Distinguish between a voltmeter and a voltameter.

(p) What physical quantities are measured by the following units?

(i) Farad

(ii) Henry

(iii) Webber/m^2

PART II

SECTION A

2. (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 100 cm^3 is floating on water. The density of the cork is 0.25g/cm^3

(i) Find the volume of cork immersed in water.

(ii) What force is needed to immerse the cork completely?

3. (a) Define

(i) specific latent heat of fusion, and

(ii) specific latent heat of vaporization.

(b) A copper calorimeter of mass 120gm contains 70gm of water and 10gm. of ice at 0°C. What mass of steam at 100°C must be passed into the calorimeter to raise the temperature of the calorimeter and its contents to 40°C?

Latent heat of ice = 320J/g.

Latent heat of steam = 2200J/g.

Specific heat capacity of water = 4.2J/g.

Specific heat capacity of copper = 0.4J/g.

4. (a) Define pitch as applied to a simple machine.

(b) A screw – jack has a single start thread of 4mm pitch. When an effort is applied to a radius of 112 mm, it is found that an effort of 18.5N is required to lift a mass of 45 kg and an effort of 33.7N is required to lift a mass of 90kg. Determine:

(i) the law of machine in the form of P = aF + b

(ii) the efficiency of the screw – jack.

SECTION B

5. (a) Define the terms:
   (i) Angular velocity, and
   (ii) Angular acceleration

   (b) A flywheel of diameter 360mm increases its speed uniformly from 630 rev/min to 1050 rev/min. in 11 seconds. Calculate:
   (i) the angular acceleration
   (ii) the number of revolutions made during the speed change.
   (iii) the linear acceleration of a point on the rim of the wheel.

6. (a) Define coefficient of linear expansion.

   (b) An iron rod is 100 cm long at 0°. What must be the length of an aluminium rod at 0° if the difference between their lengths of the two rods is to be the same at all temperatures? (Coefficient of linear expansion of iron = 0.000012/°C and coefficient of linear expansion of aluminium = 0.000024/°C).

7. (a) What is meant by the radius of curvature of a concave mirror and how is it related to the focal length?

   (b) A concave mirror produces a real image 1 cm tall of an object 2.5 mm tall placed 5cm from the mirror. Find the position of the image and the focal length of the mirror.

SECTION C

8. (a) Define resistivity of a material and give its unit.

   (b) A factory installation takes 200A at 240V, it is fed from a substation by a twin cable 80m, long. If the cross-sectional area of the conductor is 130mm^2, what voltage is maintained at the substation? (Resistivity of the conductor material = 1.8×10^{-8} Ωm).

9. (a) Define electromotive force of a cell.

   (b) A cell supplies a current of 0.6A through a 2 Ω coil and a current of 0.2 A through a 7 Ω coil. Calculate the e.m.f. and the internal resistance of the cell.

10. An ammeter gives its full-scale reading for a current of 0.1 A and its resistance is 0.5 Ω. Explain how you would adapt it:
    (a) to give a full-scale of 2A, and
    (b) for use as a voltmeter to read up to 100V.