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 **Wednesday, 09th November 2016 a.m.**

Instructions

1. This paper consists of sections A, B and C.
2. Answer **all** questions in sections A and B and **three (3)** questions from section C.
3. Calculators and Cellular phones are **not** allowed in the examination room.
4. Write your **Examination Number** on every page of your answer booklet(s).
5. Where necessary, use $g = 9.81\ m/s^2$

SECTION A (10 Marks)

Answer **all** questions in this section.

1. From each of the items (i) – (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) When an object is placed at the focus of a concave mirror, the image will be formed
A at the infinity B at the focus C at the centre of curvature
D at the pole E at the mirror.

(ii) The ratio of the heaviest load to the original cross-sectional area of the tested piece is called
A elastic limit B yield stress C ultimate stress
D breaking stress E pressure.

(iii) When a mass is rotating in a plane about a fixed point, its angular momentum is directed along the line at an angle of
A 95° to the plane B 45° to the plane C 55° to the plane
D 35° to the plane E 25° to the plane.

(iv) The phenomenon by which the incident light falling on a surface is sent back into the same medium is known as
A Reflected ray B Refraction C Normal
D Incident ray E Reflection.

(v) Which one of the following statement is true?
A The positive charge of an object comes from the transfer of protons.
B The lightning energy comes from the positive charges of protons.
C The unity of measurement for electrical energy is the watt.
D The human body conducts electricity.
E The lightning energy comes from the negative charges of protons.

(vi) Which of the following pairs has the same dimensions?
A Specific heat and latent heat. B Surface tension and force.
C Impulse and momentum. D Mass and force.
E Moment of inertia and torque.

(vii) What happens to flux density, if the cross-sectional area of a magnetic field increases but the magnetic flux remains the same?
A It increases. B It decreases. C It runs zero.
D It doubles. E It remains the same.

(viii) Which of the following quantities can be obtained from the experiment shown in Figure 1?

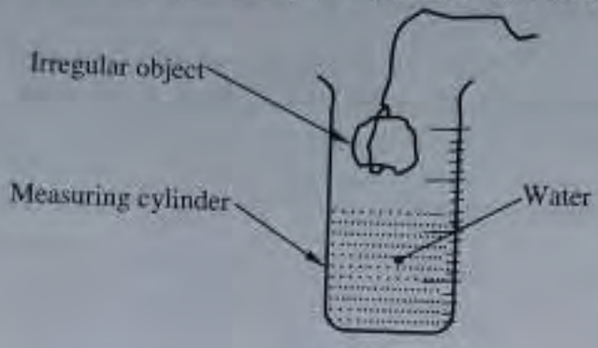


Figure 1

A Volume and density. B Force and density. C Mass and density.
D Volume and force. E Force and mass.

(ix) The current sensitivity of a moving coil galvanometer can be increased by
A reducing the magnetic field of the permanent magnet
B decreasing the number of turns in the coil
C reducing the area of the deflecting coil
D keeping constant the magnetic field of the permanent magnet
E increasing the number of turns in the coil.

(x) Swimming is possible on account of
A first law of motion B second law of motion C Newton's law of gravitation
D third law of motion E Newton's law of energy.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. (a) Define the following terms:
(i) Temperature.
(ii) Thermometer.

(b) What is the function of the constriction in a clinical thermometer?

3. Distinguish Faraday's law from Lenz's law of electromagnetic induction as applied in engineering science.

4. Name six examples of vector quantities.

5. List three applications of the hydraulic press.

6. A column of mercury is 1000 mm high and the area of its base is 4.5.00 cm^2. Find the;
   (a) pressure it exerts
   (b) force it exerts.

7. With respect to simple machine, sketch a sugar tong holding the load in position and label the fulcrum, effort and load.

8. Name six common devices which utilize atmospheric pressure.

9. Draw sketches to represent velocity (v) – time (t) graphs of the following:
   (a) a ball thrown vertically upwards from ground and goes downward after reaching maximum height.
   (b) a car accelerating from zero velocity to maximum velocity and then retarding to zero velocity.
   (c) a car travelling at constant speed.

10. A galvanometer of resistance 10 Ω gives a full scale deflection with a current of 20 mA. How would you convert it into a voltmeter reading 2 volts?

11. Define the following terms:
   (a) Weight. (b) Volume. (c) Measurement.

SECTION C (60 Marks)

Answer **three (3)** questions from this section.

12. (a) (i) Distinguish resistivity from resistance of a wire.
   (ii) The resistance of copper wire is found to be 10 Ω. Calculate the resistance of copper wire of the same length but whose radius is twice that of the first wire. **(09 marks)**

   (b) Find the power wasted as internal energy in the cable when 10 kW is transmitted through a cable of resistance 0.5 Ω and the voltage applied is **(09 marks)**
   (i) 200 V.
   (ii) 20000 V.

   (c) What is your conclusion regarding the results in (b) above? **(02 marks)**

13. (a) (i) Distinguish attraction force from repulsion force.
   (ii) A man who has a mass of 75 kg sits on a chair in such a way that the reaction at each of the four chair legs is the same. If each leg has a cross – sectional area of 650 mm^2, find the compressive stress in each leg of the chair. Assume that none of the force is carried by the man's feet. **(09 marks)**

   (b) (i) What is meant by the term elastic limit of a substance?

(ii) A steel rod, 20 mm diameter carries a pull of 60 kN. Calculate the extension produced in mm on a length of 1 m. (Take E = 210 GPa). **(11 marks)**

14. (a) (i) Define standard atmosphere pressure.

(ii) One end of a U-tube containing oil of relative density 0.8 is connected by rubber tubing to a gas tap. When the gas tap is turned on, the oil rises 6 cm higher in one arm than the other. Find the excess pressure of the gas in N/m^2 and sketch the U-tube before and after the gas tap is turned on. Take g = 9.8 N/kg and density of water as 1000 kg/m^3. **(11 marks)**

(b) (i) Differentiate between mercury and alcohol with respect to laboratory liquids.

(ii) A mercury barometer reads 760 mm Hg at the foot of a mountain 440 m high. What is the barometer reading at the top of the mountain, assuming the average value for the density of air is 1.2 kg/m^3 and for mercury is 13200 kg/m^3. **(09 marks)**

15. (a) A ball is thrown vertically upwards from the ground with a velocity of 20 m/s. Calculate the

(i) maximum height reached

(ii) velocity reached half-way to the maximum height. **(09 marks)**

(b) (i) Distinguish positive acceleration from negative acceleration.

(ii) Two children, James and Maganga standing 24 m apart begin to cycle directly towards each other at the same instant. James starts from rest at a point A, riding with a constant acceleration of 2 m/s^2 and Maganga rides with a constant speed of 2 m/s. What is the time taken before they meet? **(11 marks)**

16. (a) How many pulleys does the system of tackle and pulley system having 5 velocity ratio consists? **(01 mark)**

(b) In a wheel and axle mechanism, the wheel has a diameter of 1m and the axle a diameter of 20 cm. A load of 400 N can be raised by an effort of 120 N. What is the percentage efficiency and how much waste work is done in raising 400 N at height of 9 m? **(19 marks)**