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 **7 November 2001 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. The marks allocated for each section are indicated in parentheses.
4. Write your Examination Number on every page of your answer booklet(s).
5. Acceleration due to gravity, $g = 9.8\ m/s^2$.

This paper consists of 4 printed pages.

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SECTION A (10 marks)

Answer ALL questions in this section.

1. For each of the items (i) – (x) choose the correct answer from among the given alternatives and write its letter beside the item number.

(i) The centre of gravity G of a body can be defined as

A the centre of attraction of the earth
B the focus of the solar system
C the point through which the resultant of the weights of all the particles of the body acts
D the point through which the line of symmetry of a body passes
E the geometrical centre of the body.

(ii) If a body of mass 4.5 kg falls freely from rest for 2.0 seconds before it strikes the round, the maximum kinetic energy it will gain is

A 900 J
B 864.4 J
C 1000 J
D 450 J
E 746 J.

(iii) The property of a material to recover its original shape and size on removal of a distorting force is called

A elasticity
B plasticity
C Hooke's law
D cohessivity
E Young's Modulus.

(iv) If the velocity of sound in a solid is 1.4 km/s, the sound wave of frequency 700 Hz has a wave length of

A 2.0 m
B 0.2 m
C 0.2 km
D 2.0 km
E 3.4 m.

(v) The density of most liquids decreases with increasing temperatures because their volumes

A increase while their masses decrease
B increase more than their masses
C increase while their masses remain constant
D decrease while their masses remain constant
E increase while their masses increase.

(vi) The heat capacity of a body is defined as

A heat required to raise the temperature of a unit mass of the body
B heat required to raise the temperature of the body by 1° K
C heat required to raise the temperature of a unit mass of the body by 100° C or 373° K
D quantity of heat required to raise the temperature of the body from 0° C to 100° C
E quantity of heat required to change it from liquid state to gaseous state.

(vii) If the refractive index of water is $\frac{4}{3}$, the critical angle of water-air interface is

A 48° 35'
B 45°
C 42°
D 36° 51'
E 51° 42'.

(viii) An instrument which consists of a solenoid wound around a soft iron core whose magnetism disappears when the current is switched off is called

A an electromagnet
B an electric bell
C a magnetic relay
D a solenoid
E a generator.

(ix) The area under a velocity - time graph represents

A acceleration
B displacement
C distance
D velocity
E time.

(x) A wheel and axle of efficiency 75 % is used to raise a load of 1500 N. If the radius of the wheel is 40 cm and that of the axle is 4 cm, the effort required to overcome the load is

A 150 N
B 200 N
C 2000 N
D 300 N
E 600.5 N.

SECTION B (30 marks)

Answer ALL questions in this section. All workings for each question must be shown clearly.

2. (a) Define power.

(b) Calculate the power of a pump which can lift 200 kg of water through a height of 6 metres in 10 seconds.

3. The mass of a piece of cork of density 0.25 g/c.c. is 20 g. What fraction of the cork is immersed when it floats in water?

4. A metal rod has a length of 100 cm at 200° C. At what temperature will its length be 100.6 cm if the linear expansion of the metal rod is 2×10^{-5} per Kelvin?

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

6. Define

(a) angular motion
(b) acceleration
(c) elastic limit.

7. Two telegraph poles A and B at the side of a railway track are 50 m apart. A train which has a uniform acceleration passes pole A at a speed of 72 km/h and passes pole B 2 seconds later. Find the acceleration of the train.

8. Find the current taken and the resistance of the filament of a lamp rated at 240 V, 60 W.

9. (a) Define echo as applied in the reflection of sound.
(b) Mention three factors which affect the velocity of sound.

10. (a) What is meant by neutral point in a magnetic field?
(b) Why is repulsion the only sure test for polarity of a magnet?

11. How long will it take to liberate 1.10 g of copper by electrolysis using a current of a 0.5 A?
(e.c.e. of copper = 0.00033 g/c)

SECTION C (60 marks)

Answer THREE (3) questions from this section.

12. (a) 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 1800 N and 400 N respectively. Calculate the power transmitted by the belt.
(b) In a hydraulic press, the radius of a big piston is 8 cm while that of a small piston is 2 cm. Calculate the velocity ratio of the press.

13. A mass of 40 g of aluminium is heated to 200° C and then quickly immersed in 160 g of water contained in a copper vessel having a mass of 24 g, the initial temperature of the water being 12° C. If the final temperature of the water is 21.8° C, calculate the specific heat capacity of aluminium. Assume the specific heat capacity of copper and water to be 390 J/kg °C and 4200 J/kg °C respectively and the loss of heat to be negligible.

14. A moving coil instrument gives full deflection with 15 mA and has a resistance of 5 Ω. Calculate the resistance required

(a) in parallel to enable the instrument to read up to 1 A
(b) in series to enable it to read up to 10 V.

15. (a) A body which moves from rest with uniform acceleration travels 18 m during the third second. What will its velocity be at the end of the eighth second?
(b) A wheel, initially at rest, is subjected to a constant angular acceleration of 2.0 rad/sec^2 for 50 seconds. Calculate the angular velocity attained and the number of revolutions the wheel makes in that time.

16. A mild-steel rod 4 m long and 30 mm in diameter, carries a tensile force of 100 kN. Calculate the extension, assuming Young's Modulus (E) = 200×10^9 N/m^2.