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 ***Thursday 16th October 2008 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. Electronic calculators are **not** allowed in the examination room.
4. Cellular phones are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).

Acceleration due to gravity, $g = 10\ m/s^2$

MAKTABA

This paper consists of 5 printed pages.

SECTION A (10 marks)

Answer **all** questions in this section.

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

(i) The SI unit of energy is
- A Newton metre^2 (Nm^2)
- B joule per second (J/s)
- C joule (J)
- D Newton metre (Nm)
- E watt (W).

(ii) A metre rule is found to balance at 49 cm mark. When a mass of 100 g is suspended at 10 cm mark, it balances at 36 cm mark. The weight of the metre rule is
- A 3.6 N
- B 2 N
- C 2.5 N
- D 3 N
- E 2.9 N.

(iii) If density = A, Volume = P, and Mass = R which of the following is true?
- A $P = \frac{R}{A}$
- B $A = PR$
- C $P = AR$
- D $R = AP$
- E $P = \frac{A}{R}$

(iv) A machine of V.R 5 is used to raise a load whose weight is 200 N. If the effort required is 50 N, the efficiency of the machine is
- A 80 %
- B 50 %
- C 75 %
- D 60 %
- E 85 %.

(v) The heat capacity of a substances is defined as the
- A heat required to raise the temperature of a unit mass of the substance by 100°C or 373K
- B quantity of heat required to raise the temperature of a substance
- C heat required to raise the temperature of a substance by 1 K
- D heat required to raise the temperature of unit mass of a substance
- E heat required to change the state of a substance.

(vii) Two main differences between light and sound waves are that light waves
A are transverse and exhibit interference while sound waves are not
B are transverse and exhibit diffraction while sound waves are not
C undergo interference and diffraction while sound waves do not
D are transverse and electromagnetic while sound waves are not
E are longitudinal and exhibit interference while sound waves are not.

(viii) A body starts from rest and reaches a speed of 5 m/s after traveling with a uniform acceleration in a straight line for 2 sec. The acceleration of the body will be
A $2\ m/s^2$
B $2.5\ m/s^2$
C $1.5\ m/s^2$
D $10\ m/s^2$
E $3\ m/s^2$

(viii) If the charge passing each point in a circuit is 240 C in 2 minutes, the current is
A 120 A
B 4 A
C 20 A
D 480 A
E 2 A.

(ix) Which phenomenon causes the dispersion of white light into a spectrum by a prism?
A Absorption
B Diffraction
C Interference
D Reflection
E Refraction

(x) The fundamental unit of angular displacement is the
A metre
B radian
C degree
D radian per second
E rad/s^2.

SECTION B (30 marks)

Answer **all** questions in this section.

2 A steel rod with a diameter of 20 mm and 1 m long, carried a load of 45 kN which caused an extension of 1.8 mm on the rod. Calculate the stress and strain in the rod.

3. If the resistance of a length of a nickel wire is 53 Ω at 20 °C and 61 Ω at 50 °C; calculate the temperature coefficient of resistance of the nickel from and at 20 °C.

4. An object 2 cm long is erected 8 cm in front of the concave mirror of radius of curvature 10 cm. Determine the position, size and the nature of the image formed.

5. A car is driven round a corner at 50 km/hr. If the radius of the corner is 30 m, what is the angular velocity of the car as it goes round the corner?

6. 2 metre of resistance wire with an area of cross-section 0.5 mm^2 has a resistance of 2.20 Ω. Calculate the
   (a) resistivity of the wire
   (b) length of the wire which when connected in parallel with the 2 metre long wire will give a resistance of 2.00 Ω.

7. (a) Define the coefficient of linear expansion.
   (b) The temperature of 2.5 m long steel rod is raised from 10° C to 90° C. If the coefficient of linear expansion of steel is 0.000012/° C, determine the increase in length.

8. Explain what is meant by the following terms:
   (a) A magnetic field
   (b) A neutral point
   (c) Magnetic declination

9. A uniform pole AB 10 m long weighing 800 N has its centre of gravity 4.0 m from the end A, and is lying on a horizontal ground. The end B is to be lifted by a vertical force applied at B. Calculate the least force required to do this.

10. A sonometer wire whose length is 80 cm has a tension of 40 N. It produces a note of frequency 360 Hz. Calculate the new frequency when the
   (a) length is altered to 100 cm while the tension remains constant
   (b) tension is altered to 90 N while the length remains constant.

11. Define the following concepts:
   (a) Work
   (b) Energy
   (c) Power

SECTION C (60 marks)

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

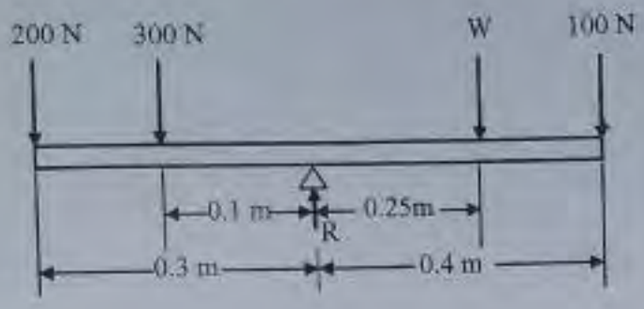
12. (a) A Flask of volume 500 cm^3 has a mass of 76 g when empty. Calculate the mass of the flask when it is full of sea water. (The density of sea-water is 1025 kg/m^3).
   (b) A fixed mass of a gas at constant temperature has a volume of 500 cm^3 at a pressure of 1 atm. Calculate the volume of the gas at a pressure of 4 atm.

13. (a) State the two conditions for an equilibrium to occur when a body is under action of a number of parallel forces.

(b) A uniform horizontal lever is supported on a fulcrum and loaded as shown in the figure below. Calculate the magnitude of the

(i) load W required to maintain equilibrium

(ii) reaction R at the support. (Neglect the mass of the lever).



14. An engine has a mass of 150 kg and is suspended from a crane by a sling 4 m above ground level.

(a) Determine the potential energy of the engine due to its position above the ground.

(b) Due to a fault in the sling, the engine falls freely to the ground from that height. Calculate the

(i) velocity at the point of impact with the ground.

(ii) kinetic energy at the point of impact with the ground.

(iii) potential energy of the engine after falling 3 m.

(Take g = 10 m/s^2 and neglect air resistance).

15. A lifting machine has a velocity ratio of 50. When tests were carried out on the machine, it was found that an effort of 180 N lifted a load of 2000 N while an effort of 300 N lifted a load of 5000 N. Determine the

(a) law of machine, assuming it is linear

(b) effort, mechanical advantage and efficiency when lifting the maximum safe load of 10,000 N.

(c) limiting efficiency of the machine.

16. An accumulator of e.m.f 2 V and negligible internal resistance is connected to two resistors of value 4 Ω which are joined in parallel. Find the total current taken from the accumulator and the current in each resistor.