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 *Friday*, **October 14, 2005 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, $g = 9.8\ m/s^2$

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 the letter besides the item number.

(i) The SI units of linear momentum is

A NS
B Kg m/s
C Kg/ms
D Js
E N/m.

(ii) Potential and kinetic energies are similar in the fact that

A both produce heat
B both are measured in watts
C one is a substitute of the other
D both are forms of mechanical energy
E both can be destroyed.

(iii) The difference between a scalar and a vector quantity is that a

A scalar has magnitude only
B vector has direction only
C scalar has magnitude and direction while a vector has magnitude only
D scalar has magnitude only while a vector has both magnitude and direction
E scalar has energy.

(iv) The area under velocity against time graph represents

A displacement
B velocity
C distance
D acceleration
E average velocity.

(v) When two notes of nearly the same frequencies are sounded together they are called

A notes
B nodes
C beats
D resonance
E frequency.

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

A $48^{\circ}\ 35'$
B 45°
C 42°
D $36^{\circ}51'$
E 30°.

(vii) 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 an electroscope.

(viii) An instrument which can detect an electric charge is called

A ammeter
B electroscope
C ohmmeter
D electrometer
E galvanometer.

(ix) The property which distinguishes longitudinal waves from transverse waves is the

A wavelength
B velocity
C ability to be refracted
D relative directions of oscillations and propagation
E amplitude.

(x) The weight of an object is

A the same as its mass when at the poles
B measured in grammes and kilogrammes
C greater at poles than at the equator
D greater at the equator than at the poles
E the same at the poles and at the equator.

SECTION B (30 marks)

Answer **all** questions in this section.

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

3. Name the instruments used to measure the following physical quantities.

(a) Pressure. (b) Humidity. (c) Temperature. (d) Potential difference.

4. A piece of wood of density 0.9 g/cm^3 and volume 30 cm^3 floats in a liquid of density 1.2 g/cm^3.

(a) Calculate the mass of liquid displaced.

(b) What fraction of the volume of wood is under the liquid?

5. What do you understand by the term "anomalous expansion of water"?

6. At a temperature of 30° and 740 mm of mercury the volume of a gas is 300 cm^3. Calculate the volume of the gas at s.t.p.

7. State **three (3)** factors which affect the velocity of sound.

8. (a) Calculate the value of a single resistance which could be used instead of three resistances 2, 3 and 4 ohms connected in parallel.

   (b) Calculate the current through a 4 Ω resistor, if the total current in the circuit in 8.(a) above is 2.6 A.

9. What is polarization and how is it prevented in the Leclanché cell?

10. Distinguish between resistivity and temperature coefficient of resistance of a material.

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

SECTION C (60 marks)

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

* 12. A square hole whose side is 12 mm long has to be punched out of a metal plate 1.6 mm thick. The shear stress required to cause the fracture is 350 N/mm^2.

   (a) Calculate the force which must be applied to the punching die?

   (b) What would be the compressive stress in the punch?

13. (a) State the law of flotation.

   (b) What volume of brass of density 8.5 g/cm^3 must be attached to a piece of wood of mass 100 g and density 0.2 g/cm^3 so that the two together will just submerge under water?

* 14. (a) Define the coefficient of linear expansion.

   (b) An iron tyre of diameter 50 cm at 15° is to be shrunk on to a wheel of diameter 50.35 cm. To what temperature must the tyre be heated so that it will slip over the wheel with a radial gap of 0.5 mm?

   Coefficient of linear expansion of iron = 0.000012/°C.

15. A concave mirror produces a real image 1 cm tall of an object 2.5 mm tall placed 5 cm from the mirror. Using Real-is-positive convention, find the position of the image and the focal length of the mirror.

16. A cell supplies a current of 0.6 A 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.