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, 15th October 2009 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).
6. Acceleration due to gravity: $g = 9.8\ m/sec^2$.

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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 from the given alternatives and write its letter beside the item number.

(i) "Every particle of matter in the universe attracts every other particle with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them". This statement refers to the

A First Newton's law of motion
B Second Newton's law of motion
C Third Newton's law of motion
D Faraday's universal gravitational law
E Newton's universal gravitational law.

(ii) The principal focus of a convex mirror is

A real
B virtual
C converging
D diverging
E imaginary.

(iii) Which of the following is a statement of Lenz's law of electromagnetic induction?

A The magnitude of the induced e.m.f is proportional to the rate of change of flux.
B The ratio of the number of the turns of a coil in the primary to those of secondary equals the ratio of primary voltage to secondary voltage.
C The direction of the induced e.m.f is such as to oppose the motion producing it.
D The induced e.m.f is produced in a straight conduct when the conductor cuts the magnetic flux.
E The direction of the induced e.m.f is in the same direction as that of the magnetic flux density.

(iv) An aluminium rod of 1 m and cross section area of 500 mm^2 is used to support a load of 5 kN which causes the rod to contract by 100 micrometres. Calculate the Young's modulus.

A 100 mPa B 0.01 mPa

C 10 kPa D 100 GPa E 100 kPa.

(v) On very hot days, sounds are not heard over as long distances as on cooler days because
A waves at ground level travel slower than those higher up since the temperature is higher, and so refraction of sound occurs away from the ground.
B waves at ground level travel faster than those higher up since the temperature is higher, and so refraction of sound occurs away from the ground.
C waves at ground level produce vibrations more than those higher up since the temperature is higher and so reflection of sound occurs away from the ground.
D waves at ground level acquire more kinetic energy than those higher up since the temperature is higher.
E waves at ground level gain more potential energy than those higher up since the temperature is higher, and so reflection of sound occurs away from the ground.

(vi) The heat energy required to change 1 kg of a substance from a liquid to a gaseous state at the same temperature is called
A specific heat capacity
B specific latent heat of vaporization
C sensible heat
D specific latent heat of fusion
E heat capacity.

(vii) 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.

(viii) The density of most liquids decrease with increasing temperatures because their volumes
A increase while their masses decrease
B increase more than their masses
C decrease while their masses remain constant
D decrease while their masses increase
E increase while their masses remain constant.

(ix) Three common methods of magnetization are
A natural, electrical and chemical
B electrical, magnetic and chemical
C electrical, magnetic and induction
D stroking, induction and electrical
E stroking, chemical and natural.

(x) Viscosity means

A measurement of parallel forces in Liquid
B forces acting on a beam immersed in water
C transmission of forces counter clockwise of a beam in Liquid
D a measure of the force required to move a body within air
E a measure of the force required to move a body within a Liquid.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. Calculate the cost of using a 500 W lamp, ten 100 W lamps and a 6 kW heater at a cost of Tsh. 10/= per kWh for 20 hours.

3. A motor vehicle of mass 2 tonnes is travelling at a speed of 50.4 km/hr. Determine the Kinetic energy of the vehicle at this speed.

4. (a) Express an angle 87° in radians.

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

5. State Charles' and Boyle's laws.

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

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

8. 1000 cm^3 of density 1000 kg/m^3 are mixed with 800 cm^3 of brine of density 1027 kg/m^3. Find the density of the mixture.

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

10. A uniform metre rule 100cm is balanced horizontally on a wedge placed under the 40 cm mark by a weight of 0.5 N hanging from the 20 cm mark. What is the weight of the metre rule?

11. Distinguish between a voltameter and voltmeter.

SECTION C (60 Marks)

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

12. (a) Differentiate between heat and temperature.

(b) A metal vessel and its water content are together equivalent to 6 kg and their temperature is 8°C. If 5 kg of water at 35 °C are added, what will the resulting temperature be?

13. A wheel initially at rest is subjected to a constant angular acceleration of 2.0 rad/sec^2 for 50 seconds.

(a) Calculate the angular velocity of revolutions the wheel makes in that time.

(b) If the angular velocity attained was maintained for 50 second and then the wheel decelerates for 20 second to rest. Calculate the
(i) Deceleration.
(ii) Number of revolutions attained by the wheel (give the answer in Revolutions).

14. (a) Define acceleration.

(b) Find the acceleration of a body of mass 10 kg when it is subjected to a horizontal force of 100 N if it moves along a
(i) smooth horizontal surface.
(ii) horizontal surface which produces a frictional force of 80N.

15. (a) Define:
(i) Mechanical advantage.
(ii) Velocity ratio.
(iii) Efficiency as applied to a machine.

(b) A load of 500 N is raised through 5 metres by a machine when its effort E moves simultaneously through a distance of 25 metres along its direction. If the machine has an efficiency of 80 %, calculate:
(i) The total work done by the machine.
(ii) The value of the effort.

16. An ammeter gives its full-scale reading for a current of 0.1A and its resistance is 0.5 Ω. Explain how you would adapt it
(a) to give a full scale of 2 A and

(b) for use as a voltmeter to read up to 100 V.