

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, 15<sup>th</sup> 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:  $g = 9.8 \text{ m/sec}^2$ .



This paper consists of 5 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 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  $500 \text{ mm}^2$  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  $87^\circ$  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  $3\ \Omega$  at  $15^\circ\text{C}$ . What is its resistance at  $60^\circ\text{C}$  if the temperature coefficient of resistance of aluminium is  $0.00403/^\circ\text{C}$ ?
8.  $1000\text{ cm}^3$  of density  $1000\text{ kg/m}^3$  are mixed with  $800\text{ cm}^3$  of brine of density  $1027\text{ kg/m}^3$ . 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  $8^{\circ}\text{C}$ . If 5 kg of water at  $35^{\circ}\text{C}$  are added, what will the resulting temperature be?
13. A wheel initially at rest is subjected to a constant angular acceleration of  $2.0 \text{ rad/sec}^2$  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 0.1 A and its resistance is  $0.5 \Omega$ . 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.