THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

035

ENGINEERING SCIENCE
(For Both School and Private Candidates)

Time: 3 Hours **Friday, 09th November 2018 a.m.**

Instructions

1. This paper consists of sections A, B and C with a total of **sixteen (16)** questions.
2. Answer **all** questions in sections A and B and **three (3)** questions from section C.
3. Calculators, Cellular phones and any unauthorized materials are **not** allowed in the examination room.
4. Write your **Examination Number** on every page of your answer booklet(s).

SECTION A (10 Marks)

Answer **all** questions in this section.

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

(i) What is the angles of incidence and reflection in the construction of simple periscope?

A 30^0 B 40^0 C 45^0
D 60^0 E 90^0.

(ii) When simple machine applies force on a body and a body moves in the same direction to that of simple machine, then one of the following is likely to happen;

A power is done on the body. B work is done on a body.
C energy is done on the body. D work is done by a body.
E work is done on a machine.

(iii) The rate of working when a joule of work is done in one second is called

A Work B Joule C Energy
D Power E Watt.

(iv) Which of the following list represents examples of the first class levers?

A Scissors, claw hammer, pliers B Pincers, claw, hammer, spade.
C Pliers, broom, spade. D Spade, Bottle opener, wheelbarrow
E Space, tweezers, wheelbarrow

(v) Which of the following quantities expresses the ratio of weight of a substance to the weight of an equal volume of water?

A Density of the substance B Density of the water
C Relative density of the substance D Relative density of water
E An upthrust

(vi) In a distance-time graph for the motion of a body, the slope of the line usually represent

A displacement. B uniform retardation.
C uniform acceleration. D acceleration or retardation.
E velocity or speed.

(vii) Figure 1 represent bimetallic strip. What will happen if its temperature will be lowered and then raised?

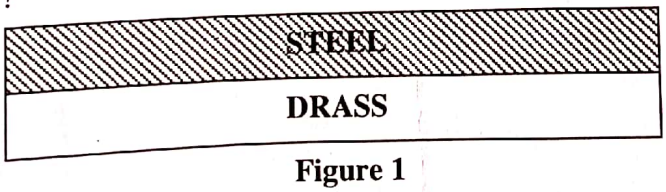

Figure 1

A It will bend down and then up
B It will bend up and then down
C It will bend to the left and then to the right side
D It will bend to the right and then to the left side
E It will put on and then off an electric iron

(viii) The quality or timbre of a musical note is determined by

A pitch. B loudness. C overtones.
D actaves. E intensity.

(ix) Which among the following represents vector quantities?

A Weight, velocity and acceleration B Mass, density, volume
C Speed, acceleration and weight D Pressure, density and volume
E Joule, pressure and force

(x) The change in angle per second is called

A angular velocity. B angular acceleration.
C angular motion. D period of angular motion.
E speed of angular motion.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. A screw jack has 5 threads per centimetre. If the length of the turning lever is 20 cm; determine the velocity ratio of the screw jack.

3. Name the effect of an electric current which is the basis for the successful operation of the following electrical devices:
(a) An electric iron. (b) An electric motor. (c) An electric bell.
(d) A filament lamp. (e) A fuse.

4. List four fundamental and two derived physical quantities. In each case, mention the apparatus used to measure them.

5. Differentiate between work from energy.

6. Calculate a torque which has to be applied to a flywheel with a moment of inertial of 60 kgm^2 to give it an angular acceleration of 0.5 rad/s^2.

7. How does solar and lunar eclipses occur?

8. Why the volume of a bubble increases as it rises from bottom of water to the surface? Briefly explain.

9. Why efficiency of a car's screw jack is always smaller and less than 50%?

10. Briefly explain the following with regard to energies:
(a) Chemical energy.
(b) Nuclear energy.

11. Why is it dangerous to replace an electric fuse with an iron nail?

SECTION C (60 Marks)

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

(a) A certain transparent liquid is poured in a measuring cylinder to a depth of 24 cm. If a stone at the bottom of the cylinder appears to be raised 6 cm as viewed by an observer from the top; determine the refractive index of the liquid. (Give the answer in two decimal places). **(04 marks)**

(b) A ray of light is incident on the air-glass boundary as shown in Figure 2. If the refractive index of the glass is 1.5; determine the angle of incidence 'i'. **(10 marks)**

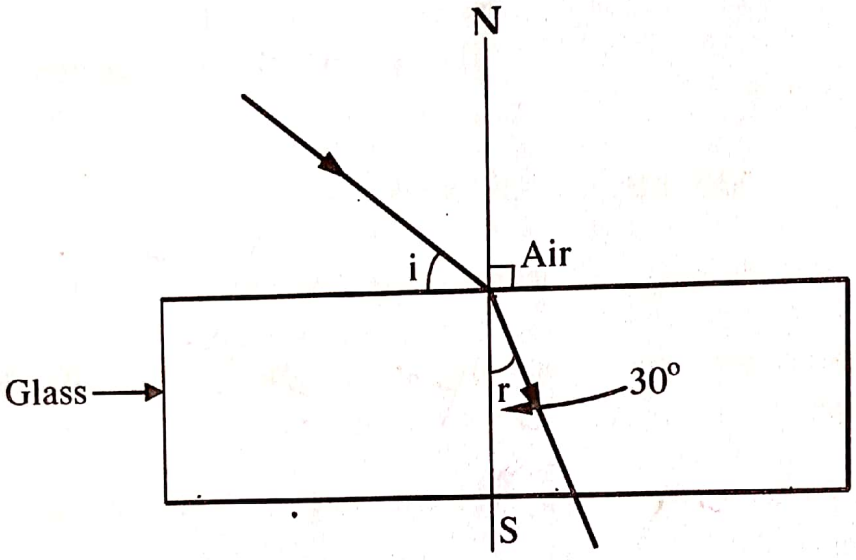

Figure 2

(c) An object is placed 10 cm from a concave lens of focal length 15 cm. Using the lens formula and 'real is positive sign' convention, determine;

(i) The nature of the image.

(ii) The position of the image formed. **(06 marks)**

(a) Define the following terms:

(i) Constant angular velocity

(ii) Constant angular acceleration **(02 marks)**

(b) What is the peripheral velocity of a point on the rim of a wheel of radius 200 mm when rotating at 3 rev/sec? **(07 marks)**

(c) The wheels of a car with a diameter of 700 mm is rotating when the car moves along a horizontal road. If the rate of rotation increases from 50 rev/min to 1100 rev/min in 40 seconds, calculate;

(i) the angular acceleration of the wheels.

(ii) the linear acceleration of a point on the tyre thread. **(11 marks)**

14. A machine which consist of a wheel of 300 mm diameter and an axle of 75 mm diameter has efficiency of 75% at a load of 120 N. Determine;
(a) the movement ratio of this machine. **(05 marks)**
(b) the effort required to raise the 120 N load. **(07 marks)**
(c) the effort required for this load if the machines efficiency was raised to 85% by lubrication of the bearings. **(05 marks)**
(d) the ideal effort for this load on this machine. **(03 marks)**

15. (a) A step-up transformer has 1000 turns in the secondary coil and 100 turns in the primary coil. An alternating current of 5.0 A flows in the primary circuit when connected to a 12.0 V a.c. supply.
(i) Calculate the voltage across the secondary coil.
(ii) If the transformer has an efficiency of 90%, what is the current in the secondary coil? **(10 marks)**

(b) The heating element of a 250 V electric cooker has effective resistance between terminals of 10 ☒ when the cooker is switched to maximum heat. If electrical energy costs 80 shillings per kWh, how much does it cost to operate the cooker at maximum heat for half an hour? **(06 marks)**

(c) A generator supplies a load current of 20 A at a p.d of 200V. Determine the power output of the generator. **(04 marks)**

16. (a) Define the following terms as used in sound waves:
(i) Echo **(02 marks)**
(ii) Reverberation

(b) A ship using an echo – sounding device receives an echo from a wreck 0.8 second after the sound is transmitted. If the velocity of sound in sea-water is 1500 m/sec, determine the depth of wreck. **(06 marks)**

(c) A pipe open at both ends is dipped in water with one end open over the water. A radio producing a music of frequency 512Hz is brought very close to the mouth of the pipe. If the radio and the pipe are then raised, find the length of the air column in the pipe for the first resonance, and when next resonance occurs.
Note: End correction is neglected. Velocity of sound in air = 340m/sec. **(12 marks)**