



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 November 07, 2003 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. Read the questions carefully before you start answering them.
4. Cellular phones are **not** allowed in the examination room.
5. Electronic calculators are **not** allowed in the examination room.
6. Write your Examination Number on every page of your answer booklet(s).
7. Acceleration due to gravity, $g = 9.8 \text{ m/s}^2$

This paper consists of 4 printed pages

SECTION A (10 Marks)

Answer ALL questions in this section.

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

- (i) If a body of mass 4.5 kg falls freely from rest for 2 seconds before it strikes the ground, the maximum kinetic energy it will gain is
- A 900 J B 864.4 J C 1000 J D 746 J E 450 J.
- (ii) Velocity ratio means
- A the velocity at which the load moves when acted upon by a force
B the ratio between the distance moved by effort to the distance moved by the load
C the ratio between the distance moved by load to the distance moved by effort
D the distance moved by both the effort and load
E efficiency over mechanical advantage.
- (iii) The property of a material to recover its original shape and size on removal of a distorting force is known as
- A elasticity
B cohesivity
C plasticity
D Hooke's law
E Young's modulus.
- (iv) The direction of the induced current when a straight conductor moves through a magnetic field can be determined by applying
- A Fleming's left hand rule
B Fleming's right hand rule
C Maxwell's cork screw rule
D Ampere's swimming rule
E Right hand grip rule.
- (v) The temperature of a body expresses
- A the quantity of heat energy in joules it contains
B the degree of heat contained in the body measured in centigrade
C the degree of hotness or coldness of that body
D the scale of temperature measured in Fahrenheit or centigrade
E how much energy can be extracted from the body when it cools down.
- (vi) The steam at 100 °C has a more burning effect than water at 100 °C because
- A steam is at higher temperature than water at 100 °C
B the molecules of water in steam have more kinetic energy than those of water at 100 °C
C steam is more penetrative than water at 100 °C
D the latent heat of steam is higher than the specific heat capacity of water at 100 °C
E steam is less dense than water.

(vii) The wavelength of sound waves moving at a velocity of 340 m/s and a frequency of 1000 Hz is

- A 0.43 km B 34 m C 34 km D 43 km E 0.43 m.

(viii) A given mass of gas has a volume of 100 cm^3 at 75 mm Hg pressure. What will the pressure of the gas be when its volume is 60 cm^3 ?

- A 120 mm Hg
B 130 mm Hg
C 135 mm Hg
D 140 mm Hg
E 125 mm Hg.

(ix) A couple is produced when two

- A parallel forces act on it
B equal and opposite forces act on a point with a distance x between them
C parallel and unlike forces act on a point at a distance x metres apart
D parallel and like forces act on a point at a distance x metres apart
E equal forces act on a point with a distance x apart.

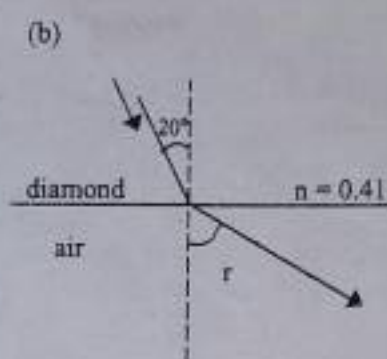
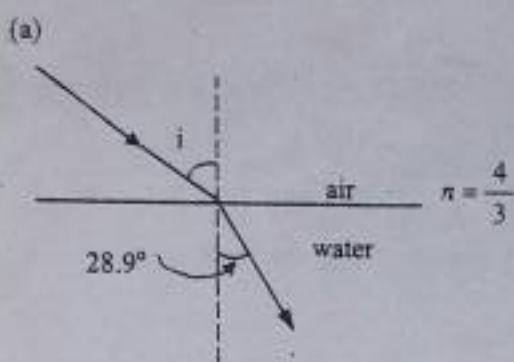
(x) Which of the following is not appropriate for use in the construction of a mercury barometer?

- A A glass tube 1700 mm long
B A glass tube having a bore of 5 mm
C A glass tube having walls 3 mm thick
D A glass tube sealed at one end
E A supply of distilled mercury.

SECTION B (30 marks)

Answer ALL questions in this section. All workings must be shown clearly.

2. Find the horizontal and vertical components of a force of 20 N acting at 60° to the horizontal.
3. A direct tensile force of 100 N is applied to a wire of diameter 2 mm. Find the tensile stress in the wire.
4. (a) A bicycle's wheel has an angular velocity of 25 rad/s. If the diameter of the wheel is 0.8 m, what is the speed of the bicycle?
(b) If the bicycle in 4.(a) above reaches a speed of 8 m/s from rest in 4 seconds, what is the angular acceleration of the wheels?
5. A mild steel rod 4 m long and 30 mm in diameter, carries a tensile force of 100 kN. Calculate the extension, assuming Young's modulus, $E = 200 \times 10^9 \text{ N/m}^2$.
6. (a) Distinguish between "heat" and "temperature".
(b) What is the name given to a change in state from solid to vapour?
7. (a) Define density and give its SI - units.
(b) Calculate the density of an object whose mass is 10 kg and its volume is 0.05 m^3 .
8. What is the difference between a "projectile" and a "trajectory"?



Calculate the angle of incidence in (a) and the angle of refraction in (b).

A body of mass 3 kg describes a circle of radius 0.5 m at $\frac{10}{\pi}$ revolutions per second. Find the force causing this circular motion.

Calculate the torque produced by a vertical force of 50 N on a body placed 2.0 m from the point of action of the force and perpendicular to the direction of the force.

SECTION C (60 marks)

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

In a test on a machine an effort of 20 N was required to raise a load of 200 N. If the effort moves through 125 mm to raise the load by 10 mm, find the force ratio for this load

- work done in raising this load by 30 mm
- distance moved by the effort in raising this load by 30 mm
- work done by the effort while the load is raised by 30 mm
- efficiency of the machine.

(a) What do you understand by "momentum of a body"?

(b) State Newton's second law of motion

(c) A car of mass 2000 kg travelling at 72 km/h is brought to rest over a distance of 40 m. Find the average braking force in Newtons.

An ordinary hydrometer of mass 28 g floats with 3 cm of its stem out of water. The area of cross section of the stem is 0.75 cm^2 . Find the total volume of the hydrometer and the length of the stem above the surface when it floats in a liquid of relative density 1.4.

A piece of copper of mass 250 g is heated to 100°C and then transferred to a well lagged aluminium can of mass 10.0 g containing 120 g of methylated spirit at 10.0°C . Calculate the final steady temperature after the spirit has been well stirred.

Specific heat capacity of copper = $400 \text{ J/kg } ^\circ\text{C}$; Specific heat capacity of spirit = $2400 \text{ J/kg } ^\circ\text{C}$; and Specific heat capacity of aluminium = $900 \text{ J/kg } ^\circ\text{C}$.

A cell supplies a current of 0.6 A through a 2Ω coil and a current of 0.2 A through a 7Ω coil. Calculate the e.m.f. and the internal resistance of the cell.