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, $g = 9.8\ m/s^2$

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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 cohessivity
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.

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(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, $E = 200 \times 10^9$ 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"?

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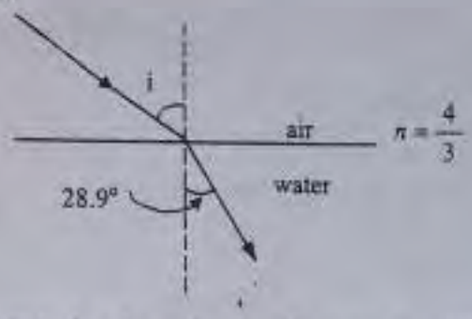
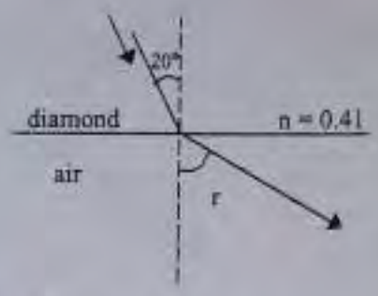
(a)



(b)



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 theforce ratio for this load

(a) work done in raising this load by 30 mm

(b) distance moved by the effort in raising this load by 30 mm

(c) work done by the effort while the load is raised by 30 mm

(d) 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 J/kg °C; Specific heat capacity of spirit = 2400 J/kg °C; and Specific heat capacity of aluminium = 900 J/kg °C.

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.

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