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 morning 19/10/2007***

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. Slide rules and mathematical tables may be used when necessary.
4. Electronic calculators are not allowed in the examination room.
5. Cellular phones are not allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. Where necessary use: acceleration due to gravity, $g = 9.8\ m/sec.^2$

This paper consists of 5 printed pages.

S45

SECTION A (10 marks)

Answer **all** questions in this section.

1. 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) To raise a load of 280 N through a vertical distance of 1 m a machine required 600 J. What is the efficiency of the machine?
- A 21.4 %.
- B 46.7 %.
- C 4.67 %.
- D 2.14 %.
- E 0.467 %.

(ii) If a uniform rod 1.0 m long of mass 100 g is supported horizontally on two knife edges placed 10.0 cm, from its ends, the reaction at the support when a 150 g mass is placed at the midpoint of the rod will be
- A 250 g
- B 125 g
- C 125 dynes
- D 1.225 N
- E 2 N.

(iii) The relation between volume and temperature at constant pressure is known as
- A pressure law
- B Boyle's law
- C Charle's law
- D avogadro's law
- E gas law.

(iv) Thunder is heard 5 seconds after the lighting flash is seen. How far away is the centre of the electrical storm? (velocity of sound = 330 m/sec) .
- A 1650 m
- B 1700 m
- C 1600 m
- D 1550 mm
- E 1800 m.

(v) In a simple electric motor, the commutor
- A changes the current direction in the coil
- B reverses the battery poles
- C connects the brushes together
- D reverses the current in the battery
- E changes the current strength in the coil.

(vi) Liquid x needs 2000 J to be heated through 5 °C. An equal mass of water with specific heat 4200 J/kg °C needs 6000 J to be heated through 10 °C. The specific heat capacity of x in J/kg °C is

A 2800
B 1400
C 1000
D 700
E 420.

(vii) The property of a material to recover its original shape and size on removal of distorting force is called

A elasticity
B plasticity
C Hooke's law
D cohessivity
E Young's modulus.

(viii) If the e.m.f. and internal resistance of a battery is 1.5 V and 0.4 Ω respectively, the current supplied through a 14.6 Ω is

A 15 A
B 10 A
C 1 A
D 0.1 A
E 2.0 A.

(ix) A boy whose weight is 600 N runs up a flight of stairs 10 m high in 12 sec. The average power he develops in watts, is

A 72
B 720
C 7200
D 500
E 1000.

(x) Under constant tension, the note produced by a plucked string is 180 Hz when the length is 90 cm. At what length is the frequency 120 Hz?

A 13.5 cm.
B 1.35 m.
C 1.35 cm.
D 60 cm.
E 60 m.

SECTION B (30 marks)

Answer **all** questions in this section. All working for each question must be shown clearly.

2. A barge, 180 cm long and 70 cm broad whose sides are vertical, floats in water when partially loaded. If 37800 g of cargo is added, what height will it sink?

3. Convert the standard pressure of 76 cm of mercury to N/m^2 given that the density of mercury is 13600 kg/m^3.

4. How many kilograms of copper can be raised from 15 °C to 60 °C by the absorption of 80 kJ of heat assuming the specific heat of copper is 390J/kg °C?

5. A direct tensile force of 50 N is applied to a wire of diameter 2 mm. Find the tensile stress of the wire.

6. Distinguish between a voltmeter and a voltameter.

7. What physical quantities are measured by the following units?

   (a) Farad.

   (b) Henry.

   (c) Webber/m^2.

8. An aluminium rod is 20 m at 15 °C. At what temperature will its length be 20.096 m? (coefficient of linear expansion of aluminium = 2.4 x 10^{-5}/ °K).

9. A coil of a very fine copper wire is found to take a current of 0.75 A when a p.d. of 4.5 V is applied. If a wire has a resistance of 1.5 Ω per metre, what length of the wire is in the coil?

10. Distinguish between sensible heat and latent heat.

11. The tension that occurs on a piano is AN when the frequency is 400 kHz. Calculate the tension needed to produce a note of frequency 600 kHz.

SECTION C (60 marks)

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

12. Dry steam is passed into a well-lagged copper can of mass 250 g containing 400 g of water and 50 g of ice at 0 °C. The mixture is well stirred and the steam supply cut off when the temperature of the can and its contents reaches 20 °C. Neglecting heat loss, find the mass of steam condensed.

Specific heat capacities:	water = 4.2 J/g °C
	copper = 0.4 J/g °C
Specific latent heats:	steam = 2260 J/g
	ice = 336 J/g.

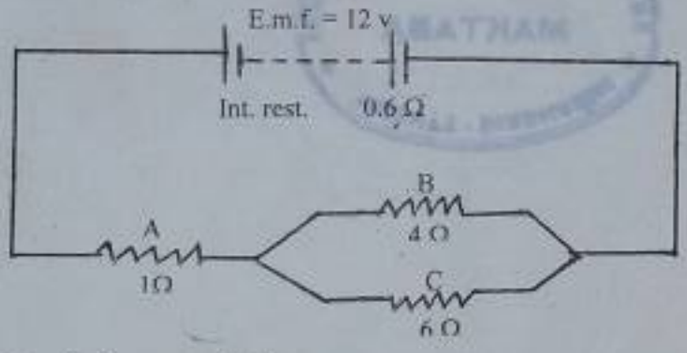
13. An object is placed

(a) 20 cm.

(b) 5 cm from a converging lens of focal length 15 cm.

Find the nature, position and magnification of the image in each case. (Use Real – is – positive convention).

14. The circuit below shows a 12 V battery of internal resistance 0.6 Ω connected to three resistors A, B and C. Find the current in each resistor.



15. (a) Define magnetic flux.

(b) A coil of 2000 turns gives rise to a magnetic flux of 4 m Wb when carrying a current of 5 A. What will be the average e.m.f. induced in the coil, if a current of 5A in it is reversed in direction in one-tenth of a second?

16. (a) Draw a diagram of a single pulley system with a velocity ratio of 6.

(b) (i) Calculate the efficiency of the pulley in 16(a) above if an effort of 1000 N is required to raise a load of 4500 N.

(ii) Find the energy wasted when a mass of 500 kg. is lifted by the pulley in 16(a) above through 2 m.