THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION, 1989

035

ENGINEERING SCIENCE

TIME: 3 Hours.

This paper consists of Parts: I and II. Part II consists of Sections; A, B and C.

Attempt ALL 20 questions in Part I and any FIVE in Part II. You must attempt at least ONE question from Section A, B and C.

Part I carries 40%

Part II carries 60%.

(Take $g = 9.81\ m/s^2$ and $\pi = 3.14$)

Graph papers are provided.

This paper consists of 5 printed pages.

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PART I

1. Resolve a force of 250N acting at 60° to the horizontal into its horizontal and vertical components.

2. A man sees lighting and hears the thunder 6 seconds later. How far away is the storm?

3. Calculate the power of a pump which can lift 200kg of water through a vertical height of 6m in 10s.

4. An object of mass 2kg falls from a height of 20m above the ground. Find the loss of potential energy just before the mass strikes the ground.

5. Give one advantage of a convex mirror as a driving mirror over a plane mirror. In each case illustrate by a diagram.

6. (a) State the law of floatation.
   (b) Explain why a block of 500g of iron sinks in water while an iron ship of 1000 tons floats in water.

7. Mention three means by which the heat energy may be transferred from one point to another.

8. Define the specific latent heat of fusion.

9. A 50 Watts heating coil is used for 2 minutes to heat a metal block of 0.5 kg and specific heat capacity 1000 $J\,kg^{-1}\,{}^{o}K^{-1}$. Find the temperature rise.

10. Calculate the wavelength of a note of 400 Hz when the velocity of sound in air is 330 ms^{-1}.

11. Explain with the aid of a diagram, what is meant by refraction of light.

12. Mention the three factors affecting the velocity of sound in air.

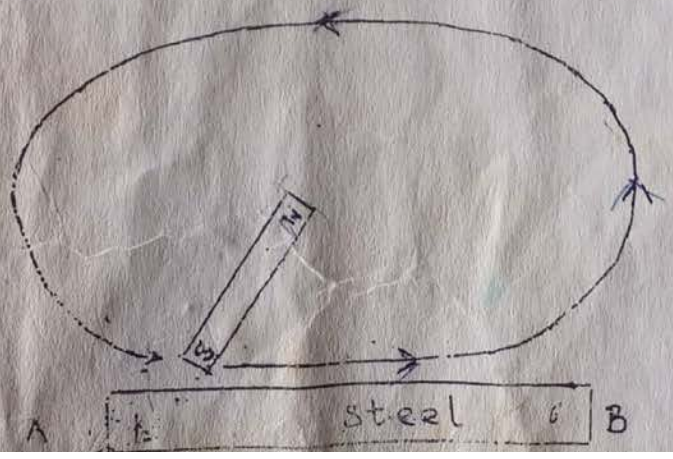
13. Calculate the frequency of a radio wave of wavelength 160m. The velocity of all electromagnetic waves in free space is $4 \times 10^{8}\,ms^{-1}$.

$$\frac{4 \times 10^{8}}{16 \times 10^{1}}$$

$$\frac{4 \times 10^{8} \times 10^{-1}}{16}$$

$$0.25 \times 10^{7}\ Hz$$

14.



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14. Contd....

Fig. 1 above shows a piece of steel which has become magnetized after being stroked several times by the pole of a bar magnet in the manner shown. Name the magnetic pole which appears at end A of the steel.

15. Draw a diagram to show the shape of the resulting magnetic field when a direct current is passed through a solenoid. Indicate by arrows the directions of the current and the field.

16. 2 metre of resistance wire, area of cross-section $0.5mm^2$ has a resistance of 2.2Ω. Calculate the resistivity of the metal.

17. A copper voltameter connected in a circuit has 1.2×10^{-3}kg of copper deposited on the cathode in 20 minutes. If electrochemical equivalent of copper is 3295×10^{-10}kg/C, find the current flowing. 3.0349A

18.

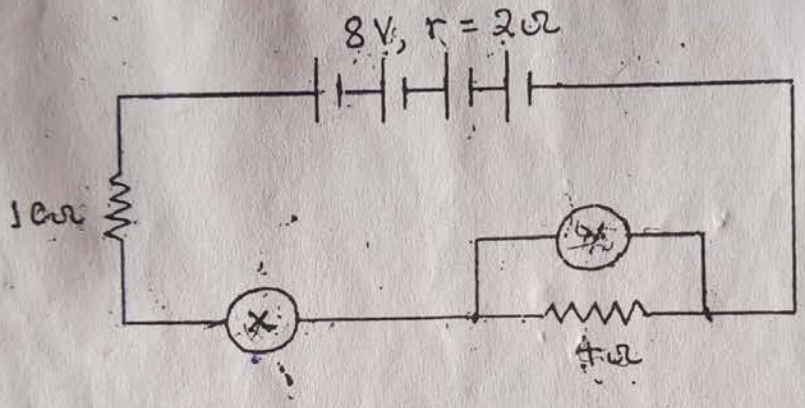


Fig. 2

From the circuit in fig. 2:

(a) Name the instrument marked X and Y

(b) Calculate the reading of. (i) X and (ii) Y.

19. Name the physical quantity measured in Farad.

20. What is meant by Electro-chemical equivalent of a substance?

PART II

Section A

21. A system of pulleys consists of an upper block fitted with three pulleys and a lower block fitted with two pulleys. An effort of 240N is required to raise a body having a mass of 85kg. Sketch the arrangement and calculate:

(a) the velocity ratio

(b) the mechanical advantage

(c) the efficiency

(d) the workdone in lifting the body 50mm, and

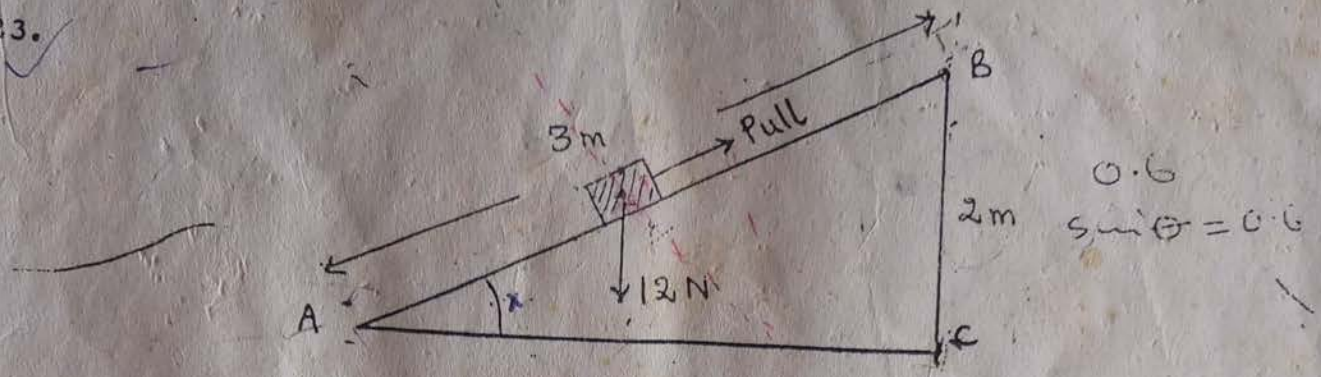
(e) the corresponding workdone by the effort.

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22. (a) State Archimedes' principle

(b) A loaded rod floats upright in water with a length of 10cm below the water surface. When a small piece of glass is placed on top of the rod, the rod floats with 15cm immersed. If the glass is fastened to the bottom of the rod, the length immersed becomes 13cm. What is the density of the glass? The density of water is 1g/cc.

23.



0.6
$\sin\theta = 0.6$

In the figure above, a weight of 12N is pulled steadily up a rough inclined plane from the bottom A to the top B. The frictional force along the plane is 2N. Calculate:

(a) the component of the 12N weight normal to the inclined plane — 4N

(b) the magnitude of the force, F, pulling the weight up the plane — 8N

(c) the work done in moving the weight from A to B. — 24J

Section B

24. A tie bar of rectangular cross-section is to carry a load of 75kN. If the thickness of the bar is 15mm and the tensile stress is to be limited to $120N/mm^2$, determine the necessary width of the bar. Supposing it is found that the bar extends 0.06mm over 100mm length. Determine the value of the modulus of elasticity.

25. (a) What is meant by a wave motion?

(b) Explain what is meant by the statement that "sound is propagated in air as longitudinal progressive wave".

(c) A sonometer wire of length 5.0×10^{-1} m and mass per unit length 10^{-3} kg m^{-1} is stretched by a load of 4.0kg. If it is plucked at its mid-point, what will be:

(i) the wavelength of the note emitted

(ii) the frequency of the note emitted.

26. (a) Distinguish between virtual and real images

(b) Draw a ray diagram to show how a concave mirror can produce a virtual image.

(c) An object 2cm long is placed 40cm in front of a concave mirror of focal length 15cm so that it is perpendicular to, and has one end resting on the exis of the mirror. Find by means of a ray diagram, drawn to a suitable scale, the size and position of the object.

(Hint: Use the provided graph paper).

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