THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION
NOVEMBER 1996

031/1 PHYSICS PAPER 1
(For both School and Private Candidates)

TIME: 3 Hours.

INSTRUCTIONS

1. This paper consists of Sections A, B and C.
2. Answer ALL questions in Section A, any NINE (9) questions from Section B and any FOUR (4) questions from Section C in the answer booklet provided.
3. Read the instructions given under each section very carefully.
4. The marks intended for each section and/or question are indicated in brackets.
5. Where calculations are involved you are expected to show clearly all the steps of your work in a systematic manner.
6. The following constants may be useful.

Acceleration due to gravity	g	=	$10.0 m/s^2$
	π	=	$\frac{22}{7}$
Electrochemical equivalent of copper		=	0.00000033kg/C
Density of Mercury		=	13.6 g/c.c.
Density of air		=	0.0012g/c.c.
Density of water		=	1.0g/c.c.
One tonne		=	1000 kg

This paper consists of 10 printed pages.

SECTION A (15 MARKS)

Answer ALL questions in this Section.

You are advised to spend not more than 45 minutes.

1. For each question or statement choose and write the letter of the best answer in the answer booklet provided.

(i) The greatest difference in pressure exerted on a smooth horizontal surface by the surfaces of a regular block of wood of dimensions 3.0cm by 4.0cm by 5.0cm and density 0.75g/c.c. is:-

A. 225 N/m^2 B. 300 N/m^2
C. 150 N/m^2 D. 375 N/m^2

(ii) If 0.35 litres of water is mixed with 0.15 litres of mercury, then the density of the mixture will be:-

A. 14.6g/c.c. B. 7.3g/c.c.
C. 4.78g/l D. 4.78g/c.c.

(iii) The effect of weightlessness is experienced by a person when aboard an elevator (lift) which is;

A. ascending at a constant speed
B. descending at a constant speed
C. ascending at the acceleration of gravity
D. descending at the acceleration of gravity

(iv) Mercury drops are spherical when sprinkled on a clean glass surface and therefore this liquid does not wet glass. The reason for this behaviour is that:-

A. The force of adhesion between the molecules of mercury is greater than the force of cohesion between glass molecules and mercury molecules.
B. The force of cohesion between the molecules of mercury is greater than the force of adhesion between glass molecules and mercury molecules.
C. The force of cohesion between the molecules of mercury is less than the force of adhesion between glass molecules and mercury molecules.
D. The force of adhesion between the molecules of mercury is less than the force of cohesion between glass molecules and mercury molecules.

(v) Viscosity can be defined as:-

A. Liquid friction
B. The opposition force in a moving gas
C. The force which opposes the relative velocity between the layers of a fluid in motion.
D. The opposite of solid friction.

(vi) If a solid weighs 1960N in air, 1568N when totally immersed in water and 1176N when totally immersed in liquid X, then the density of liquid X is:

A. 4.0 g/c.c. B. 2.0 g/c.c.
C. 5.0 g/c.c. D. 3.0 g/c.c.

(vii) The bright haze seen in the sky just after sunset and just before sun rise is called:-

A. Constellation light B. Meteorites
C. Zodiacal light D. The milky way

(viii) In thermometry, the ice point and steam point are respectively referred to as:-

A. Minimum and Maximum points
B. Freezing and Boiling points
C. Standard and Fundamental temperatures
D. Lower and Upper fixed points.

(ix) A compound strip of brass and iron is straight at room temperature (28°C). Identify the diagram which shows the shape taken by the strip when cooled to 0°C, given that the linear expansivity of brass is greater than that of iron.

A.



B.



C.



D.



(x) Define specific latent heat of a substance

A. It is the amount of heat required to change a substance from one state to another, at constant temperature.
B. It is the amount of heat required to change a unit mass of a substance from one state to another at constant temperature
C. It is the heat required to change a solid to its liquid state.
D. It is the heat required to change a liquid into its gaseous state at the boiling point.

(xi) The branch of physics which deals with the study of heat as a form of energy is:

A. Thermometry
B. Thermodynamics
C. Calorimetry
D. Kinetic theory

(xii) The normal body temperature of a healthy human being is 36.9°C. In the absolute temperature scale, this temperature is equivalent to:

A. 309.9K B. 309.9°K
C. 309.9°C D. 309.9C

(xiii) The diagram which follows (Figure 1) shows a side view of plane water waves travelling in a ripple tank from P towards Q. If the crest at P takes 4.0 seconds to reach Q, then the velocity of the wave is:-

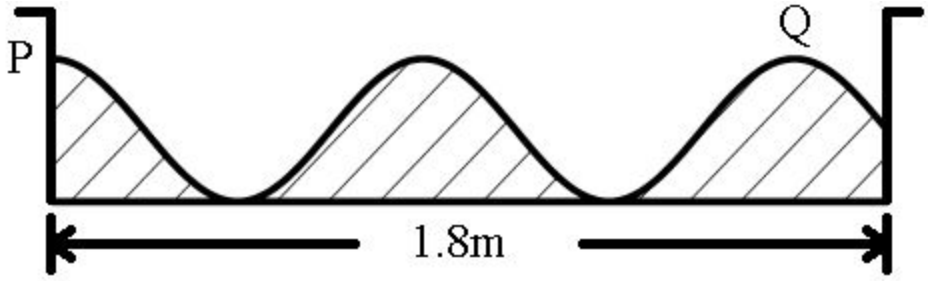


Figure 1

A. 4.0m/s B. 4.5m/s
C. 0.45m/s D. 0.4m/s

(xiv) Two close sources of waves which are vibrating in step produce interference effect. Such sources are called:

A. Resonant sources B. Coherent sources
C. Young's double slit D. Simultaneous sources.

(xv) The distance from a pin hole to the film in a pin hole camera is 200mm. If this camera is used to take a photograph of a block of flats 40m high and 100m away then the length of the image in the film will be:-

A. 80mm B. 8.0mm
C. 0.8mm D. 0.08m

(xvi) An object 10mm high is placed 0.20m infront of a convex mirror of focal length 0.15m. Which one of the following best explains the position, orientation and type of image formed?

A. The image is found to be located 0.08m behind the mirror, erect and real.
B. The image is found to be located 0.08m behind the mirror, inverted and virtual.
C. The image is found to be located 0.08m behind the mirror, inverted and real.
D. The image is found to be located 0.08m behind the mirror, erect and virtual.

(xvii) How can a converging lens be used as a simple microscope?

A. By placing the object at infinity and viewing it through an eye piece.
B. By placing the object closer to the converging lens than its focal length.
C. By placing the object exactly at the centre C of curvature of the lens.
D. By squeezing the object between two converging lenses and viewing it through one of them.

(xviii) The colours which add together to produce white light are called complementary colours. which of the following are complementary colours?

A. Red and Cyan B. Magenta and Blue
C. Red and Green D. Yellow and Red

(xix) The magnetic field pattern produced by arrangement of magnetic pole pieces shown in figure 2 suggests that the letter R stands for:-

(xix) Cont.

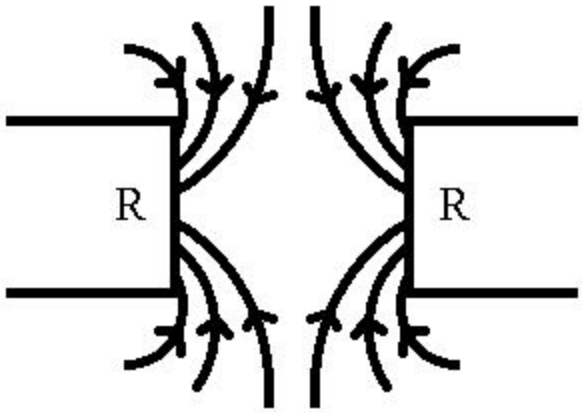


Figure 2

A. N pole B. S pole
C. Dipole D. Neutral point

(xx) Three common methods of magnetization are:-

A. Natural, Electrical and Chemical
B. Electrical, Magnetic and Induction
C. Stroking, Induction and Electrical
D. Stroking, Chemical and Natural

(xxi) A milliammeter can be converted to an ammeter by connecting its coil to a suitable resistor called a:-

A. Multiplier in series
B. Shunt in series
C. Multiplier in parallel
D. Shunt in parallel

(xxii) If the plastic cap of a ball pen is rubbed against hair it tends to attract small pieces of paper. This effect is observed because the cap has been charged by:-

A. removal of electrons
B. addition of electrons
C. induction
D. contact

(xxiii) Electrostatic charges are measured in terms of:-

A. Amperes B. Farads
C. Electrons D. Coulombs

(xxiv) The time taken to deposit 99mg of copper in a copper voltameter which carries a current of 3.0 A is equal to:-

A. 10.0 seconds B. 100.0 seconds
C. 100,000.0 seconds D. 10,000.0 seconds

(xxv) The metal which emits electrons by thermionic emission in the triode tube is called a:-

A. hot cathode B. cold cathode
C. cathode ray emitter D. filament

(xxvi) Select the incorrect statement from the following:-

A. Elements with the same atomic number have the same chemical properties
B. Elements with the same atomic number and different atomic masses are called isotopes.
C. The atoms of a given element do not necessarily have the same mass.
D. The atomic number of an element is equal to the sum of its mass number and its number of neutrons.

(xxvii) A Geiger Muller Tube sealed into a radioactive source and connected to a decade counter records a count of 3200 per second for the source at 11.00 a.m. on Tuesday the 29th of October 1996 and 40 per second at 2.00 p.m. on the next day. From this observation it can be deduced that the half life of the source is:-

A. 9.0 hours B. 6.0 hours
C. 3.0 hours D. 1.0 hour.

(xxviii) A transformer having 1000 turns in the primary coil and 250 turns in the secondary coil is supplied with 240 volts d.c. from a battery. Which of the following is the output voltage in the secondary?

A. 60 volts a.c. B. 60 volts d.c.
C. 960 volts a.c. D. 0 volts.

(xxix) Which of the following is a statement of Lenz's law of electromagnetic induction?

A. The magnitude of the induced e.m.f. is proportional to the rate of change of flux.
B. The direction of the induced e.m.f. is such as to oppose the motion producing it.
C. The ratio of number of turns of coil in the primary to those of the secondary equals the ratio of primary voltage to secondary voltage.
D. The induced e.m.f. is produced in a straight conductor when the conductor cuts the magnetic flux.

(xxx) A gas cylinder contains 5.0kg of gas at a pressure of 10 atmospheres. If the tap is opened then the total mass of the gas that can escape, assuming that temperature remains constant is:-

A. 4.5 kg B. 4.0 kg
C. 5.0 kg D. 2.5 kg

SECTION B (45 MARKS)

Attempt nine (9) questions only.
You are advised to spend not more than 1 hour and 15 minutes in this Section.
ALL WORKING for each question attempted must be shown clearly.

2. (a) Draw a simple pulley machine whose velocity ratio is 3. (2 marks)
(b) If the efficiency of this machine is 80%, what load can be raised by an effort of 200 N? (3 marks)

3. Is it possible for a balloon of volume 2000m^3 filled with hydrogen of density 0.09 kg/m^3 to float in air, if the mass of its canvas is 100 kg, that of the pilot is 70 kg and if it carries an extra load of 1500 kg? Explain your answer. (5 marks)

4. (a) What is limiting friction? (1 mark)
(b) A loaded trailer weighing 25 tonnes is being towed at constant speed across a level roadway whose coefficient of dynamic friction is 0.25. Determine the frictional force in the trailer? (4 marks)

5. Explain how you would show in the Laboratory that water is a bad conductor of heat. (5 marks)

6. (a) What is electromagnetic radiation? (1 mark)
(b) Why are refrigerators painted white? (2 marks)
(c) Name two domestic utensils or appliances which are painted black and explain why they are painted so? (2 marks)

7. Classify the following as "real" or "virtual" images:-
   (i) The image formed in a convex mirror
   (ii) The image formed in a plane mirror
   (iii) The image formed in a concave mirror when the object is positioned between the focal point and the pole point.
   (iv) The image formed in a concave mirror when the object is positioned outside the focal length.
   (v) The image formed by a pin hole camera. (5 marks)

8. (a) Define e.m.f. and internal resistance of a cell. (2 marks)
   (b) A battery of e.m.f. 12.0V and internal resistance of 0.5Ω is connected to a parallel combination of resistors valued 15Ω and 30Ω. What current passes through each resistor? (3 marks)

9. (a) State the factors which determine the resistance of a conductor. (2 marks)
   (b) Find the length of nichrome wire of diameter 0.56 mm which will provide a resistance of 100 Ω given that its resistivity is 10^{-6} Ωm. (3 marks)

10. (a) Write down two ways in which a.c. power produces similar effects as d.c. power. (2 marks)
    (b) Write one process which can be performed by d.c. power but not a.c. power. (1 mark)
    (c) Write down two main advantages of usage of a.c. power over d.c. power for domestic and industrial purposes. (1 mark)

11. (a) Draw a fully labelled standard symbol of a p-n-p transistor. (3 marks)
    (b) What is the main function of a transistor in an electronic circuit? (1 mark)
    (c) Name one of the two common semiconductor materials used in solid state electronics. (1 mark)

12. (a) A plane wave travelling at a speed of 250m/s meets a plane boundary with a medium where the speed of the wave becomes 300m/s. If the angle made by the wave front from the boundary while the wave is in the first medium is 30°, find the angle it will make when in the second medium. (4 marks)
    (b) What law governs the phenomenon described in part (a) above? (1 mark)

SECTION C (40 MARKS)

Attempt any FOUR (4) questions from this section.
ALL WORKING for each question attempted must be shown clearly.
You are advised to spend not more than 1 hour in this section.

13. (a) Give two differences that exist between linear momentum and kinetic energy. (2 marks)

(b) An eight tonne loaded truck travelling at 45 km/hr collides and sticks to two connected empty trucks each of mass 3.5 tonnes.

(i) Find the initial speed of the three trucks if frictional effects are negligible. (3 marks)

(ii) How much energy is lost at impact? (3 marks)

(iii) How can you account for this lost energy? (1 mark

(iv) Does this particular example support the conservation laws of momentum and energy? (1 mark)

14. (a) Write the names of each of the three states of water. (3 marks)

(b) Determine the amount of heat required to vapourize completely 100 grammes of ice initially at -10°C, given that the specific heat capacity of water is 4200J/kgK and the latent heat of vapourisation of water is 2,268,000 J/kg. (7 marks)

15. (a) Define focal point and pole point of a converging lens. (2 marks)

(b) Draw ray diagrams showing how a converging lens produces:-

(i) a real inverted image larger than the object. (2 marks)

(ii) a virtual image larger than the object. (2 marks)

(c) An object is placed 20cm form a converging lens of focal length 8.0cm. By a drawing or otherwise find the distance of the image from the lens. (3 marks)

What is the magnification? (1 mark)

16. A Laboratory technician has enough stock of standard resistors of values 100Ω and 1000Ω.

(a) Illustrate how he can prepare standard resistors of values 50Ω, 150Ω, 250Ω, 300Ω and 500Ω using combinations of not more than four resistors.

(b) For each of the five resistors prepared by the technician in (a) above find the current that will pass through the effective resistor if a 6.0 volts battery of negligible internal resistance is connected across its ends. (5 marks)

17. (a) Define the terms isotopes and isobars. (2 marks)

(b) Uranium $^{238}_{92}\text{U}$ decays to Polonium $^{222}_{84}\text{P}$ by α emission (at each stage) via $^{234}_{x}\text{Th}$, $^{230}_{y}\text{Ra}$ and $^{226}_{z}\text{Rn}$. Following this process, $^{222}_{84}\text{P}$ decays to $^{q}_{86}\text{Rn}$ by β emission only. Write balanced equations of the stage by stage decay process from $^{238}_{92}\text{U}$ to $^{q}_{86}\text{Rn}$ and hence determine the values of x, y, z and q. (6 marks)

(c) Name the isotopes and isobars obtained in the decay process shown in (b) above. (2 marks)

18. (a) Under what conditions are eddy currents formed? (2 marks)

(b) State two advantages and two disadvantages of eddy currents. (4 marks)

(c) What practical steps are taken in order to minimize eddy currents in the core of a transformer? (2 marks)

(d) Is it possible to construct a transformer with 100% efficiency? Why? (2 marks)