Physics I

010

03/Nov/2011 08.30am – 11.30am

REPUBLIC OF RWANDA

RWANDA EDUCATION BOARD

ORDINARY LEVEL NATIONAL EXAMINATIONS 2011

SUBJECT : **PHYSICS I**

DURATION : **3 HOURS**

INSTRUCTIONS:

This paper consists **THREE** sections A, B and C.

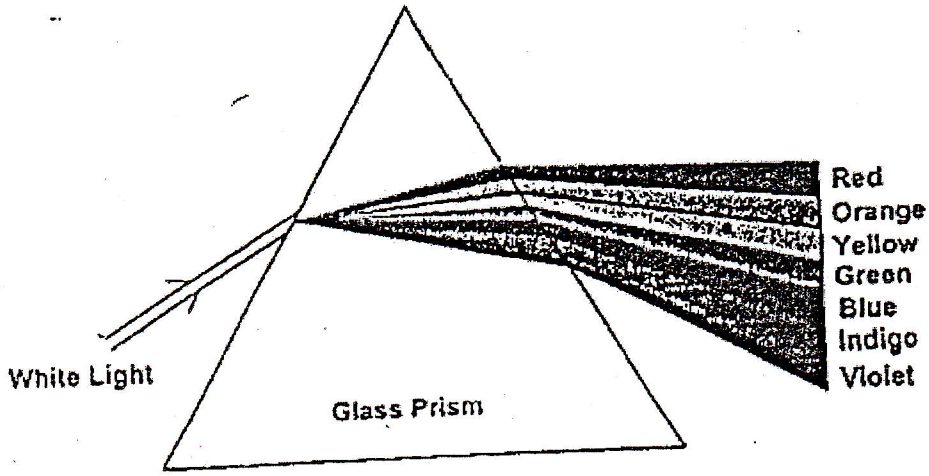
Attempt **all** questions in section A. **(55 marks)**

Answer **any three** questions in section B. **(30 marks)**

Answer **only one** question in section C. **(15 marks)**

You may use a calculator and a mathematical instrument.

c)



SECTION C

21. a) Teacher's guidance

b) Rate of change of temperature or slope

$$= \frac{\Delta R}{\Delta L} = \frac{3.2\Omega - 2.4\Omega}{8m - 6m} = \frac{0.8\Omega}{2m} = 0.4\Omega/m$$

c) $p = \frac{R}{L} = 0.4\Omega/\text{m} \times 0.5 \times 10^{-6}\text{m}^2 = 2 \times 10^{-7}\Omega\text{m}$

$\therefore$ resistivity of the wire $= 2 \times 10^{-7}\Omega\text{m}$

22. a) Teacher's guidance

b) $\text{Slope} = \frac{\text{change in R}}{\text{change in L}} = \frac{3.9 - 2.2}{9.5 - 5.5} = \frac{1.7}{4} = 0.425\Omega/\text{m}$

therefore, slope $= 0.43\ \Omega/\text{m}$

c) $R = \frac{\rho L}{A}$

$A = \frac{0.50}{1000000} = 5.0 \times 10^{-7}\text{m}^2$

From b above, $R = 1.7\Omega$ and $L = 4\text{m}$

From $R = \frac{\rho L}{A} = 1.7 = \frac{\rho 4}{5.0 \times 10^{-7}}$

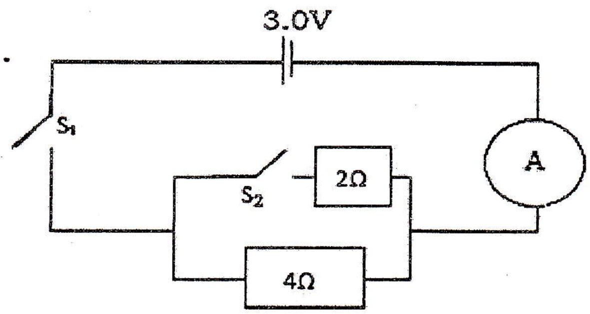
$4\rho = \frac{1.7 \times 5.0 \times 10^{-7}}{4}$

Resistivity of the wire $= 2.125 \times 10^{-7}\Omega\text{m}$

END

SECTION A. ATTEMPT ALL QUESTIONS IN THIS SECTION (55 marks)

1. a) What is meant by the term resistivity? **(2 marks)**
   b) Write an equation for resistivity of a resistor. **(1 mark)**
2. State the effects of an electric current and give an example each effect. **(4 marks)**
3. Draw a labeled diagram of a periscope and use light rays to explain how it functions. **(4 marks)**
4. What is the difference between a vector quantity and a scalar quantity? Give an example of each quantity. **(4 marks)**
5. a) Sketch a distance -time graph showing
   (i) motion of a body moving with uniform velocity. **(2 marks)**
   (ii) a body moving with uniform velocity. **(2 marks)**
   b) A car starts from rest and is accelerated uniformly at the rate of $3m/s^2$ for 8s. Find the distance travelled. **(2 marks)**
6. a) Explain the term induced magnetism. **(2 marks)**
   b) Mention one method of demagnetizing a magnet. **(1 mark)**
7. Why is a tall person more likely to fall down while climbing a mountain? **(4 marks)**
8. Identify the interchange of energy between potential energy and kinetic energy for a swinging pendulum bob. **(3 marks)**
9. a) Friction is useful to our daily lives. Mention two examples to justify this statement. **(2 marks)**
   b) What causes friction and how can it be prevented? **(2 marks)**
10. What do you understand by each of the following terms:
    (a) angular velocity. **(1 mark)**
    (b) a period of swinging pendulum bob. **(1 mark)**
    (c) frequency of a swinging pendulum bob. **(1 mark)**
11. a) State factors influencing pressure in a liquid at a point in a liquid in equilibrium. **(2 marks)**
    b) With the aid of a diagram, show that water finds its own level. **(2 marks)**
12. a) A load of 600N is raised 0.3 m by a machine. If the effort applied is 200N and it moves 1.0m, find the efficiency of the machine. **(2 marks)**
    b) Why is the efficiency of a machine not a hundred percent? **(2 marks)**
13. Why does an iron left outside at night feel colder than a piece of dry wood? **(4 marks)**
14. In an electric circuit below, what will be the reading of the ammeter if S_2 is:
    (a) open and S_1 closed? **(2 marks)**
    (b) closed and S_1 closed? **(3 marks)**



SECTION B: ANSWER ONLY THREE QUESTIONS. **(30 marks)**

15. (a) What is meant by the term real image as applied to optics. **(2 marks)**
    (b) Distinguish between a concave mirror and a convex mirror. Give one application of each type of mirror. **(3 marks)**
    (c) An object is placed vertically at the centre of curvature of a concave mirror.
        i) Use rays and draw a diagram to show how the image of this object is formed. **(3 marks)**
        ii) State the characteristics of this image. **(2 marks)**

16. a) What effect does increase in pressure have on the melting point of ice? **(2 marks)**
    b) State two physical properties of water which change with temperature. **(2 marks)**
    c) How much heat is needed to raise the temperature of a body with mass 4kg by 8° C? The specific heat capacity of the body is 300J/Kg. **(2 marks)**
    d) Find the amount of heat required to melt 100g of lead initially at 25°C if the melting point of lead is 327°C. Specific heat capacity of lead is 140J/kg. Specific latent heat of fusion is 2.7×10^5 J/kg. **(4 marks)**

17. a) Describe how you would use a gold leaf electroscope to determine the sign of the charges on a given charged body. **(4 marks)**
    b) Explain how an insulator gets charged. **(2 marks)**
    c) Describe how a lightning conductor safeguards a tall building from being struck by lightning. **(4 marks)**

18. a) What is inertia? **(2 marks)**
    b) With aid of a diagram, explain how you can demonstrate inertia effect. **(4 marks)**
    c) State Newton's second law of motion. **(1 mark)**
    d) A block of mass 5000g is pulled from rest on a horizontal frictionless surface by a constant force F. If the block travels 8m in 2s, find:
        i. the acceleration **(1.5 marks)**
        ii. the force F **(1.5 marks)**

19. a) Differentiate between primary cells and secondary cells. **(2 marks)**
    b) What are the components of a simple direct electric motor? **(3 marks)**
    c) Explain the term back e.m.f (electromotive force) of a battery. **(2 marks)**
    d) What is the difference between a practical d.c motor and a simple d.c motor? **(3 marks)**

SECTION C: Answer one question from this section.

20. Describe how you can verify the law of refraction of light (SNELL'S LAW) using the following apparatus: rectangular glass block, optical pins, plain paper, drawing pins, a ruler and protractor. Illustrate your methods with aid of a diagram and show how you come to your conclusion. **(15 marks)**

21. Describe how you can determine the density of an irregular stone using the following apparatus:
    Eureka can, a small irregular stone, a thread, beam balance, measuring cylinder and a beaker.
    State the sources of errors and all precautions you take to avoid errors in your experiment.
    (15 marks)

END

ANSWERS TO ORDINARY LEVEL PHYSICS PAPER 2011

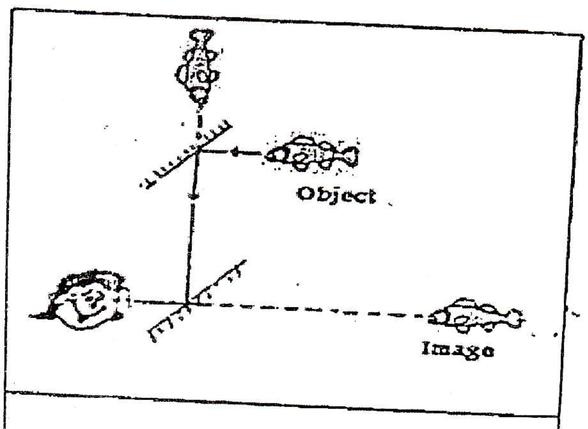
SECTION A:

1. a) Resistivity is the ability of a conductor to oppose the flow of current in a resistor.
   Or it is numerically equal to the resistance of 1 m length of it of cross section area 1 m^2.
   Or it is a constant characterizing the nature of an electric conductor.
   Or it is a specific resistance of a material conductor.

   b) $p = \frac{RA}{L}$

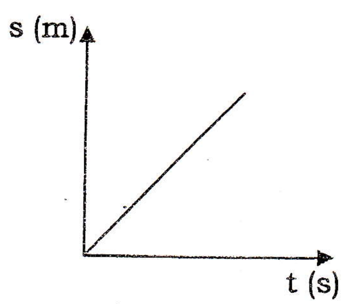
2. Heat effect: electric iron, electric kettle, filament, immersion heater.
   Light effect: electric bulb, florescent tubes.
   Magnetic effect: electric motor, electric bell, loudspeaker
   Chemical effect: electrolysis during electroplating
   Physical effect: electrocution

3. A simple periscope consists of a tune containing two plane mirrors, fixed parallel to and facing one another. Each makes an angle of 45° with the line joining them. Light form the object behind a tall obstacle is turned through 90° at each reflection and on observer is able to see over the top of an obstacle.

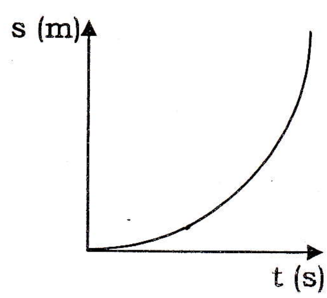


4. A scalar quantity is defined by its magnitude only. It is non-directional in nature. Thus area is a scalar quantity because when stating an area, we do not have to state the direction of an area. Other examples of scalars are mass, length, time, density, volume, speed etc. All quantities that have both the magnitude and direction of measurement are called vector quantities. Examples of vectors include: weight, velocity, acceleration etc.

5. a) i)



ii)



b) $S = \frac{1}{2}at^2 + ut = \frac{1}{2}(3)(8)^2 + (0)(8) = 96m.$

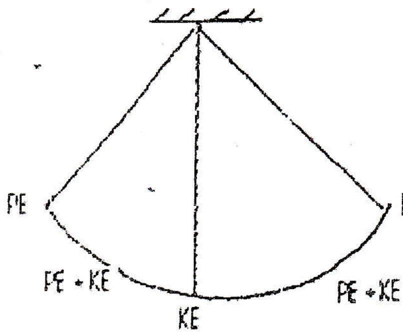
6. a) When a piece of unmagnetized steel or other ferromagnetic body is placed either near to or in contact with a pole of a magnet and then removed it is found to be magnetized. i.e. it becomes a magnet itself. This is called induced magnetism. The material is said to have induced magnetism in it. Tests with a compass needle show that the induced pole nearest to the magnet is of opposite sign to that of the inducing pole.

b) Heating, placing it inside a solenoid through which AC is flowing, hammering the magnet when pointing E-W direction, keeping like poles together for a long time.

7. The center of gravity of a tall person is high and makes him to be unstable; hence he is therefore likely to fall down.

Or the center of gravity of a tall person is high. A slight force would exert a turning force out of the body of a tall person and hence fall down.

8. **Simple pendulum**



9. a) Friction is very important because it enables us to move, to write, to make fire etc.

b) Causes of friction: Rough surfaces

Prevention: The moving machine parts are always oiled or greased. This helps one to slip more easily over the other. The liquid is usually oil, which we refer to as a lubricant (reduce friction by separating two contacting surfaces with an intermediate layer of softer material) and we call the effect lubrication.

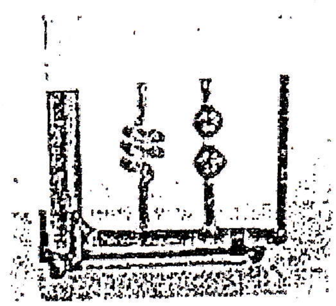
10. a) Angular velocity describes the rate of rotation. It is defined as the ratio of the angular displacement to the time interval: $w = \frac{\Delta\theta}{\Delta t}$. Or angular coordinate per unit time

b) The period T of an object revolving in a circle is the time required for one complete revolution.

c) Frequency f is the number of revolutions per second $f = \frac{1}{T} = \frac{w}{2\pi}$

11. a) Density and depth

b) Pascal's vases



12. a) Work done by loads: $W_L = Ld_L = 600 \times 0.30 = 180\text{J}$

Work done by effort: $W_E = Ed_E = 200 \times 1 = 200\text{J}$

Efficiency: $\eta = \frac{W_L}{W_E} = \frac{180}{200} = 90\%$.

b) Because of friction and weight of the moving parts of the machine.

13. Iron is a good conductor of heat so heat will be conducted quickly from the hand conductor of heat, so there is no conduction of heat from the hand to wood.

Or iron is a good conductor of heat and it can also lose heat fast to the cold surrounding so at night the iron feels colder. Or dry wood is a poor conductor of heat so wood cannot lose heat or gain it, so it does not feel cold as the iron.

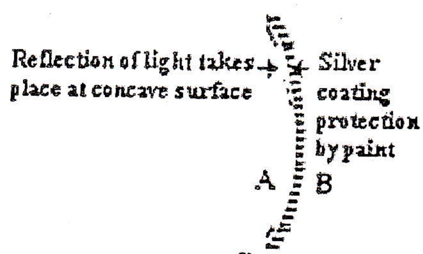
14. a) $I = \frac{U}{R} = \frac{3}{4} = 0.75A$

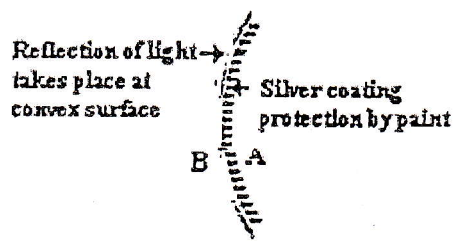
b) $\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{4} = \frac{3}{4} \Rightarrow R_e = \frac{4}{3}\,\Omega$ and hence $I = \frac{U}{R} = \frac{3 \times 3}{4} = 2.25A$

SECTION B

15. a) Real image is made from "real" light rays that converge at a real focal point. It can be projected onto a screen because light actually passes through the point where the image appears.

b) If the mirror coating is in the inside of the spherical surface, then the mirror is called a **convex mirror** (curves outwards)

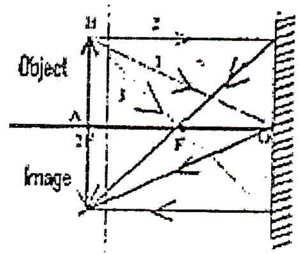




Concave Convex

Concave: terrestrial reflecting telescope; projectors, shaving mirrors, car head lights, solar concentration
Convex: driving mirrors, security mirrors in shops and supermarkets. (vigilant mirrors)

c) i)



ii) Nature of image: real, inverted, the same size as object, formed at the center of the curvature.

16. a) When the pressure increases, the melting point of ice decreases.

b) Volume, density and change of state

c) Heat: $Q = mC\Delta T = 4 \times 300 \times 8 = 9600J$

d) $Q = mC\Delta T + mL = 0.1 \times (327 - 25) \times 140 + 0.1 \times 27 \times 10^5 = 31228J$

17. a) Charge electroscope by transferring a known charge to the cap of electroscope, the gold leaf diverge. Bring the charged body near the cap of the electroscope:

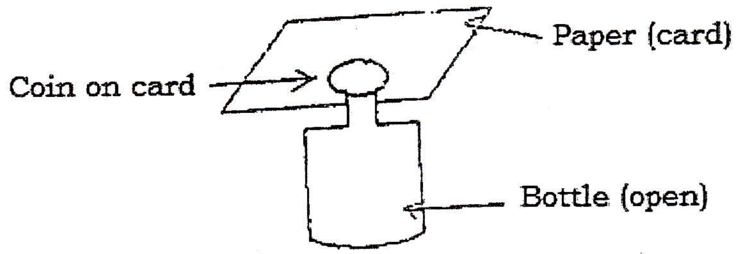
- If the gold leaf diverges more, the charge on the gold leaf is the same as that on the body.
- If the gold leaf decreases in divergence (collapses), the sign of the charge on the body is opposite to that on the gold leaf.

b) An insulator gets charged by rubbing. E.g. when an ebonite rod (polythene) is rubbed with fur it becomes negatively charged. When a glass rod is rubbed with silk (nylon) it becomes positively charged.

c) A negatively charged cloud high above the tall building induced positively charge on the spike and the negative charges (electrons) are repelled to earth through the copper strip to the ground.

18. a) Inertia is the tendency of an object to resist to changes in its state of rest or motion in the absence of any net forces acting.

b) Coin experiment



A small coin is placed on a card. The card and the coin are placed over the mouth of a bottle. The card is horizontally flicked away with a finger. The coin drops into the bottle.

c) The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object:

$a = \frac{F_{net}}{m}$

Or the rate change of momentum of a body is directly proportional to the force applied and it takes place in the direction in which the force acts.

d) i) $S = \frac{1}{2}at^2 + ut \Leftrightarrow 8 = \frac{1}{2}(a)(2)^2 + (0)(2) \Leftrightarrow a = 4m/s^2$

ii) $F = ma = 5 \times 4 = 20N$

19. a)

Primary cell	Secondary cell
Cannot be rechargeable	Can be rechargeable
High internal resistance	Low internal resistance
Have short life	Have a long life
Have a small e.m.f. of 1.5V	Have a large e.m.f of 2V
Use disposable batteries	Use ordinary batteries
Irreversible chemical reaction generates electric current	Reversible chemical reactions generates electric current.

b) Rectangular coil, spindle, commutator, battery and rheostat, a U-shaped magnet.

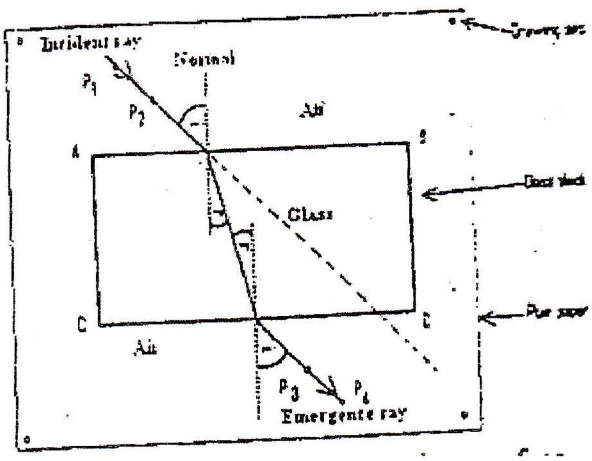
c) Bemf is the counter electromotive force that sets its self against the current that induces it.
Or Bemf is the electromotive force that opposes to the applied voltage.

d)

Practical DC motor	Simple DC motor
Several coils are wound in evenly spaced states in a soft iron cylinder	One coil field pole which are stationary armature turns in the space between the N pole and S pole.
Powerful and efficient	Less powerful and less efficient.

SCETION C.

20. Experiment to verify Snell's law.



- Place a soft board on a table or a plane surface.
- Place a plane (white) paper on the soft board and fix it with drawing pins.
- Draw a straight line AB on the paper and place a glass block on the paper so that one edge is in contact with the ruler along line AB.
- The ruler is then transferred to the other edge of the glass block and line CD is drawn.
- Draw a normal through point O.
- Draw several oblique straight lines through point O at different angles of incidence from the normal. These lines represent incident rays.
- Fix pins P1 and P2 apart on one of the incident rays.
- Looking through the other side CD of the glass block with the images of P1 and P2
- Remove the pins and replace them with pencil crosses.
- Draw a line through P3 and P4 so that it touches the side CD at point P.
- Join points O and P with a straight line to form a refracted ray.
- Using a protractor, measure the angle of incidence I and the angle of refraction and record them in a table.

  Make five more angles of incidence and their corresponding angles of refraction.

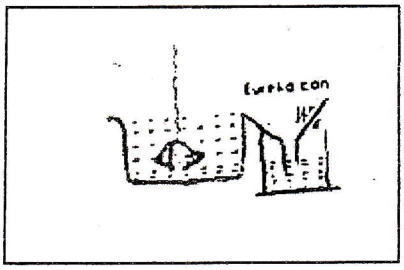
i	r	Sin (i)	Sin (r)	$\frac{\sin i}{\sin r}$

The ratio $\frac{\sin i}{\sin r}$ is found. This ratio is constant.

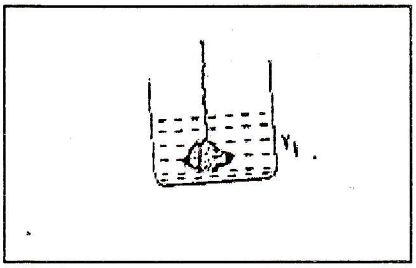
Conclusion: for any given pair of media, the ratio of $\frac{\sin i}{\sin r}$ is constant.

21. Experiment to determine density of an irregular stone

- Measure the mass of the stone using a beam balance
- Take at least 3 measurements and find the average mass (m) of the stone.
- Measure the volume.



or



- Pour some water into the Eureka can placed on a level surface until the water starts running out of the Eureka can and collect into the beaker put under the outlet.
  Wait until the water stops running out of the toilet. Tie a stone with a thread. Place a measuring cylinder under the outlet of the eureka can. Carefully lower the stone into the eureka can. Wait again until all displaced water is collected in the measuring cylinder and stops dropping out of the outlet.
  Read the volume of the displaced water in the measuring cylinder.
  Repeat the experiment two more times and find the average volume (V)
- Or pour some water in a measuring cylinder to get an initial volume (V_1)
  Tie a stone with a thread.
  Slowly lower the stone into the measuring cylinder until it is completely submerged.
  The water level in the measuring cylinder rises to the volume (V_2)
  The volume of the stone: $V = V_2 - V_1$)
  Repeat the above step at least two more times to find the average volume
  Calculate the density: $p = \frac{m}{v}$

Sources of errors.

- The beam balance may be inaccurate.
- Wrong reading of the beam balance scale
- Wrong reading of the volume of displaced water.

Precaution

- Avoid splashing water when lowering the stone into the eureka can
- Avoid the parallax error when reading water volume and the mass of the stone.
- Avoid reading the volume of displaced water before the water stops dropping out of the outlet.

END.