Physics I **010** 16th Nov. 2012 8.30 am 11.30am

REPUBLIC OF RWANDA

RWANDA EDUCATION BOARD (REB)

ORDINARY LEVEL NATIONAL EXAMINATIONS 2012

SUBJECT : **PHYSICS I**

DURATION : **3 HOURS**

INSTRUCTIONS:

This paper consists of 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.

Use a blue pen only for writing and a pencil for only for drawing.
No other ink is allowed.

SECTION A: ATTEMPT ALLL QUESTIONS (55 MARKS)

1. State three characteristics of magnetic fields lines. **(3 marks)**
2. Find the magnetic force which produces a moment of 200Nm about a fulcrum at a distance of 5.0 m from the line of action of the force. **(3 marks)**
3. Why is a stool made with outwards slanting legs? **(3 marks)**
4. Why is a convex mirror used as a side mirror on motor cars? **(3 marks)**
5. A man lifts a weight of 300N through a vertical height of 5m in 10 seconds. Determine the man's power. **(3 marks)**
6. Explain, using the kinetic theory, why the pressure of air inside a car tyre increases on a hot day. **(4 marks)**
7. a) Why is the density of rain water less than that of ocean water? **(2marks)**
   b) Calculate the density of a substance whose mass is 180g and volume 200cm^3. **(2 marks)**
8. a) What is meant by the term force? **(2 marks)**
   b) A force of 80N acts on a body and produces an acceleration of 2m/s^2. What is the mass of the body? **(2 marks)**
9. a) What happens to water when it is heated;
   (i) from 0° to 4°C? **(1 mark)**
   (ii) from 4°C to 100°C? **(1 mark)**
   b) At what temperature does water have maximum density? Explain your answer. **(2 marks)**
10. A battery of e.m.f 1.5V and internal resistance, r, is connected in series with a 4Ω resistor. The current in the circuit is 0.3A, sketch a diagram to show this connection and calculate the internal resistance, r, of the battery. **(4 marks)**
11. a) State the principle of floatation. **(1 mark)**
    b) Why does a balloon full of hydrogen gas rise when released? **(3 marks)**
12. The table below shows speeds of a car acceleration on a straight road.

Time/s	0	1	2	3	4
Speed//ms^{-1}	0	6	12	18	24

    a) What is the acceleration of the car? **(1 mark)**
    b) Is the acceleration non-uniform? **(1 mark)**
    c) What distance does the car travel in 5 seconds? **(2 marks)**
13. a) Why is water used to cool engines and radiators of vehicles? **(2 marks)**
    b) How much heat is needed to raise the temperature by 20°C of 4kg of a substance of specific heat capacity 300J/kg° C? **(2 marks)**
14. a) What is the coulomb? **(2 marks)**
    b) The current through a conductor is 6A. What is the charge which passes in 2 seconds? **(2 marks)**
15. With aid of a diagram explain why it is possible to drink fanta from a fanta bottle using a drinking straw? **(4 marks)**

SECTION B: ATTEMPT ANY THREE QUESTIONS. **(30 marks)**

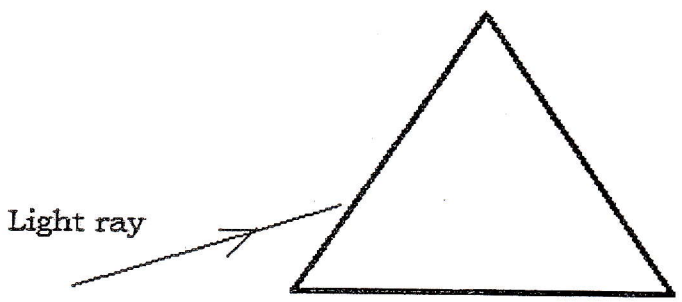
16. a) What is meant by specific latent heat of vaporization? **(2 marks)**
    b) State two factors which affect the boiling point of water. **(2 marks)**
    c) Calculate the heat required to convert 0.9 kg of water at 100°C to steam. Specific latent heat of vaporization of water = 2.26×10^6 J/Kg. **(3 marks)**
    d) What is the difference between boiling and evaporation? **(3 marks)**

17. a) Differentiate a concave lens from a convex lens. **(3 marks)**
    b) What is meant by the principle axis of a lens? **(2 marks)**
    c) An object is placed between the principal focus of a convex screen. Sketch a diagram to show the image formed and state the characteristics of this image. **(5 marks)**

18. a) Which property of transmission of pressure in liquids is used in hydraulic press and hydraulic car breaks? **(1 mark)**
    b) What is the other unit of pressure that is the same as $1N/m^2$? **(1 mark)**
    c) Name the instrument that is used to measure the pressure of the atmosphere and which does not contain a liquid? **(1 mark)**
    d) A hydraulic press has a large circular piston of radius 80cm and a circular plunger of radius 10cm. A force of 200N is exerted by the plunger.
    (i) Find the force exerted on the piston **(6 marks)**
    (ii) State one reason why the weight of the load just raised by the piston is less than the force obtained. **(1 mark)**

19. a) What is the use of a fuse in an electric circuit? **(3 marks)**
    b) Draw a diagram showing an electric circuit consisting of one battery of voltage 1.5V, two parallel lamps and an ammeter to read the total current flow in the circuit. Calculate the current if the resistance of each lamp is 3Ω. **(7 marks)**

20. a) What is meant by dispersion of light? **(2 marks)**
    b) Explain how a rainbow is formed. **(3 marks)**
    c) The diagram below is a glass prism. A beam of white light strikes the face of a prism as shown. Copy the diagram below and show how the white light splits into its component colors. **(5 marks)**



SECTION C: ATTEMPT ONLY ONE QUESTION. **(15 marks)**

21. A student carried out an experiment to determine the electrical resistance, R, of six lengths, L, of a wire. R is measured in Ohms and L is measured in meters. Below are the results obtained.

L/M	5.0	6.0	7.0	8.0	9.0	10.0
R/Ω	2.0	2.4	2.8	3.2	3.8	4.0

(a) Plot the graph of R against L (plot R along the y-axis and L along the x-axis). **(9 marks)**

(b) Determine the slope (gradient) of the graph. Show on the graph how you determine the slope. **(4 marks)**

(c) Use the results from (b) above to calculate resistivity of the wire, P, given that; $R = \frac{pL}{A}$ and cross section area of the wire L = 0.50mm². **(2 marks)**

22. A student heated 5.0kg of water in a copper calorimeter. The student recorded the time and corresponding temperature. The table below shows the results obtained.

Time/Minutes	4	5	6	7	8	9
Temperature/°C	36	40	45	49	54	57

(a) Plot a graph of temperature (along the y-axis) against time (along the x-axis) **(9 marks)**

(b) From the graph, determine the room temperature. **(1 mark)**

(c) Use the graph to determine the rate of temperature change. **(5 marks)**

END.

ANSWERS TO ORDINARY LEVEL PHYSICS PAPER 2012

SECTION A:

1. - Never cross each other
   - Are close together where magnetic field is strong.
   - Are far apart where magnetic field is weak
   - Are parallel where the field is uniform
   - Come from N-pole and converge to S-pole.

2. Moment P = F × d, 200 Nm = F×50m, $F = \frac{200\,Nm}{50m} = 40N.$

3. - To increase the area of the base.
   - To lower the gravity
   - Makes the stool more stable.

4. - It produces erect images
   - It has a wide view of the road
   - It gives a virtual image

5. Power: $= \frac{work\ done}{time\ taken} = \frac{300N \times 5m}{10s} = 150$ watts.

6. - Air molecules and the pressure increases. On a hot day, molecules gain energy and makes them vibrate faster.
   - The collision with the walls increases, the pressing force increases and air molecules expand when the temperature increases and the volume is constant.

7. a) Rain water does not contain dissolved salts or mad in it. Ocean water has a lot of dissolved salts.

   b) m = 180g, v = 200cm³ ⇒ $D = \frac{m}{v} = \frac{150g}{200cm^3}$

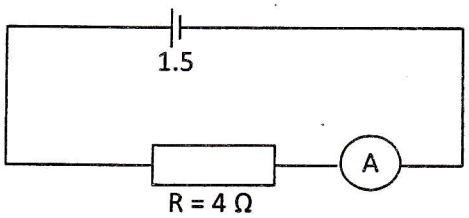
8. a) Force is any cause (external agent) which changes the state of the rest or motion or can deform the shape of a body.

   b) F = m.a ⇒ $m = \frac{F}{a} = \frac{80}{2} = 40$kg.

9. a) i) When water is heated from 0°C to 4°C, it contracts (its volume decreases)
ii) When water is heated from 4°C to 100°C, it expands (increases in volume)

b) Water has maximum density at 4°C, at 4°C water has minimum density since its volume contracts from 0°C to 4°C and then the volume increases from 4°C to 100°C.

10.



$E = I(R + r)$

$r = \frac{E}{I} - R$

$r = \frac{1.5}{0.3} - 4 = 5 - 4 = 1\Omega$

11. a) Floating displaces its own weight of fluid or up thrust is equal to the weight of the floating body.
b) Hydrogen gas is less dense than normal air or weight of hydrogen balloon is less than that of air displaced or up thrust is greater than its weight.

12. a) $\text{acceleration} = \frac{change\ of\ velocity}{change\ in\ time} = \frac{12-6}{2-1} = \frac{6m/s}{1s} = 6m/s^2$

b) Acceleration is uniform.

c) $S = vt + \frac{1}{2}at^2 \Rightarrow S = 0m/s + \frac{1}{2}6.5^2 = 75m.$

13. a) Water is easily available and cheap to obtain, water has a high specific heat capacity of 4200J/kg°C.
b) Heat needed: $Q = mC\Delta t$
$= 4kg \times 300 \times 20 = 24000J.$

14. a) A coulomb is the quantity of charge passing a point in a circuit when a steady current of 1 Ampere flows for 1 second.

b) $Q = IE\frac{1}{2} = 6A \times 25 \times \frac{1}{3} = 12C$

15. When one sucks a soda, the atmospheric pressure pushes down on the surface of the fluid in the bottle becomes greater than the pressure of the air inside the straw. The atmospheric pressure pushes up the fanta into the mouth.

SECTION B

16. a) Specific latent heat of vaporization of a substance is the quantity of heat required to change a unit of mass of the substance from its liquid to its vapor at constant temperature.
b) The pressure of the atmosphere, the impurities.
c) Given $m = 0.9kg$
$Lv = 2.26 \times 10^6\ J/Kg$
$\text{Heat required} = mLv = 0.9 \times 2.26 \times 10^6\ J/Kg = 2034000J$

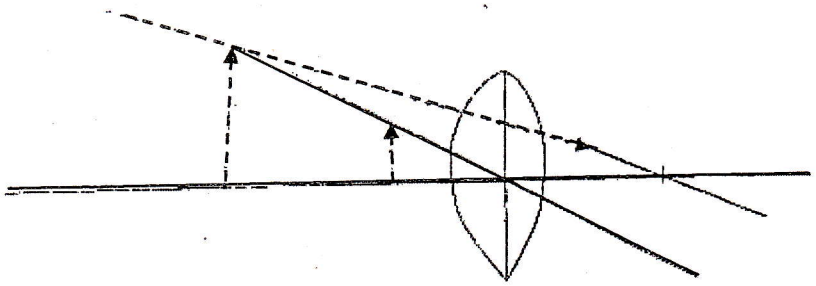
d)

Boiling	Evaporation
Rapid vaporization	Low vaporization
Takes place inside the liquid and on the surface	Takes place at the surface of the liquid
Happens at a specific temperature	May change at any temperature.
Provides bubbles	Do not provide bubbles.

17. a) A concave lens is thinner in the middle and larger at the end. It always forms a virtual image and it is diverging.
A convex lens is thickest in the middle. It forms virtual or real image. It is converging.

b) The principle axis of a lens is a line passing through the focal center of the lens, this line passes through the principle focus.

c)



Characteristics:
The image is behind the object, The image is virtual, The image is erect, The image is larger than the object.

18. a) Pressure in liquids is transmitted equally in all directions

b) Pa

c) Aneroid barometer

d) i) Area of the circular plunger $= \pi r^2$

Pressure due to the plunger $= \frac{Force}{Area} = \frac{200N/m^2}{\pi \times (10)^2}$

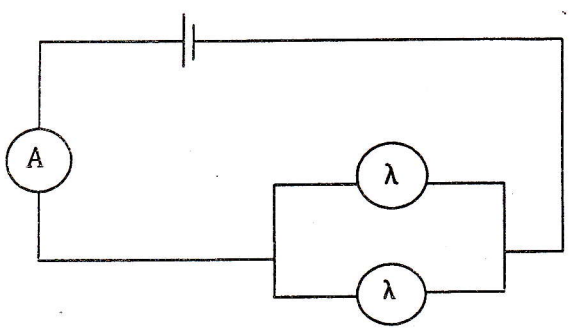
This pressure is transmitted to the pistol area $= \pi \times (0.8)^2$
Force on piston = pressure × area.

$\frac{200 \times 0.8^2}{1} = 200 \times 64 = 12800N.$

ii) The load raised by the piston is much less than 12800N because of frictional forces.

19. a) When a large current flows through the fuse, it becomes hot and then it melts hence breaking or stopping the flow of electric current.

b)



$R = 3\Omega$

$I = \frac{i}{r} = \frac{i}{r_1} + \frac{i}{r_2}$

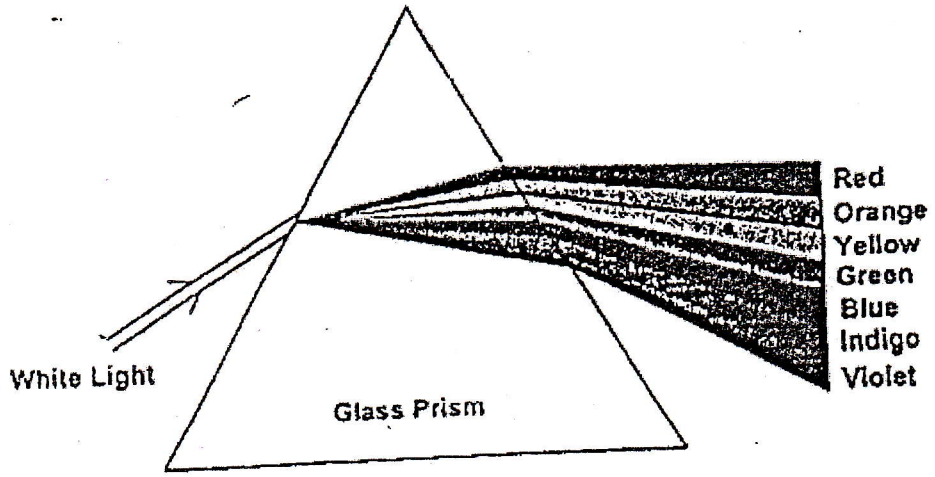
$R = \frac{R_1 R_2}{R^1 + R_2} = \frac{3 \times 3}{3+3} = \frac{3}{2}\Omega$

$I = \frac{V}{R} = 1.5\,v \times \frac{2}{3} = 1.0\,A$

20. a) Dispersion of light is the separation of white light into different components.

b) Light rays from the sun strike rain drops. The rain drops act as a prism so they separate the white light into its component colors.

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

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

22. a) Teacher's guidance

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

therefore, slope $= 0.43\ \Omega/m$

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

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

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

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 $= 2.125 \times 10^{-7}\Omega m$

END