Physics I

010

03/Nov/2009 08.30am – 11.30am

REPUBLIC OF RWANDA

RWANDA EDUCATION BOARD

ORDINARY LEVEL NATIONAL EXAMINATIONS 2009

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.

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

1. a) Why is the density of ocean water greater than the density of rain water? (2 marks)
   b) 5000cm³ of paint has a mass of 6.5kg. Calculate the density of the paint. (2 marks)
2. a) What is force? (1 mark)
   b) Name two types of forces. (2 marks)
3. Give a molecular explanation as to why the viscosity of some fluids increases when the temperature of liquids increases. (2 marks)
4. The hind tyres of a tractor are larger than those of a car. Give a scientific explanation for this difference. (4 marks)
5. The pressure in a water pipe at a mouth of a tap is 3×10^3 Pa. What is the height of the water pipe? ($g = 10m/s^2$ and the density of water is 1000kg/m³). (4 marks)
6. A train increases its speed steadily from 10m/s to 20m/s in 1 minute. Find:
   a) The average speed of the train during this time in m/s. (2 marks)
   b) The distance the train travels while increasing its speed. (2 marks)
7. A tall person is more likely to fall while climbing a mountain than a short person. Why is this possible? (2 marks)
8. a) How much work is transferred when a load of 5000N is lifted through a distance of 300m? (2 marks)
   b) What is the power of a person weighing 600N who runs upstairs in 2s? The stairs are made of 10 steps each 15cm high. (2 marks)
9. a) Calculate the kinetic energy for a car of mass 900kg travelling at a speed of 30m/s. (2 marks)
   b) Calculate the potential energy of a mass 900kg that has been lifted through a distance of 20m. (g = 10N/kg) (2 marks)
10. a) State any two methods of heat transfer. (2 marks)
    b) Explain why on a cold day the metal handle bars of a bicycle feel cold than the rubber grips. (3 marks)
11. a) What is the difference between boiling and evaporation? (2 marks)
    b) What mass of cold water at 10°C should be added to 50kg of hot water at 90°C so that the final temperature of water is 58°C? The specific heat capacity of water is 4200J/kg. (2 marks)
12. a) Which are the types of electric charges? (2 marks)
    b) Find the charge when a current of 4A flows for 5 minutes. (2 marks)
13. a) Write the equation linking resistance, potential difference and current. (2 marks)
    b) Find the potential difference across a 20Ω resistor if a current of 0.5A flows. (2 marks)
    c) Why might a filament lamp blow at the moment you switch it on? (1 mark)
14. What is the use of soft iron pieces called keepers? (2 marks)
15. a) What is the difference between reflection of light and refraction of light? (2 marks)
    b) Differentiate between regular reflection of light and diffuse reflection. (2 marks)

SECTION B: Answer any three questions (30 marks)

16. a) Differentiate between a vector quantity and a scalar quantity and give two examples of each quantity. (4 marks)
    b) What is meant by a non uniform velocity? (1 mark)
    c) A car moving a velocity of 10m/s accelerates uniformly at the rate of 3m/s² to reach 34m/s Find:

i. The time taken. **(2 marks)**
ii. The distance travelled in this time. **(3 marks)**

17. a) What is meant by:
i. e.m.f of a battery **(2 marks)**
ii. internal resistance of a battery? **(2 marks)**
b) A battery of e.m.f 1.50V has a terminal p.d of 1.2V when a resistor of 25Ω is joined it. Calculate the current flowing, the internal resistance and the terminal p.d when a resistor of 10Ohms replaces the 25Ω resistor. **(6 marks)**

18. a) How can you distinguish between a converging lens and a diverging lens? **(4 marks)**
b) Explain the meaning of the focal length of a lens. **(2 marks)**
c) Draw a diagram showing how a converging lens can form a real image the same size as the object. **(2 marks)**
d) State two characteristics of the image formed by a diverging lens. **(2 marks)**

19. a) What is meant by the term heat capacity of a substance? State the unit of heat capacity. **(3 marks)**
b) 9.9×10^{5}J of heat is required to change 3 kg of ice at 0°C to water at 0°C. Find the specific latent heat of fusion of ice. **(2 marks)**

20. a) Why is electricity transmitted at high voltages? **(2 marks)**
b) Mains electricity supply is dangerous. How is it made safe to use? **(3 marks)**

SECTION C: Answer only one question. **(15 marks)**

21. The table represents the variation of time with velocity of a moving body.

Time (s)	Velocity(m/s)
0	0
2	5
4	10
6	15
8	20

a) Plot a velocity-time graph (velocity along the Y-axis and time along the X-axis) using the data in the table. **(9 marks)**
b) Show on the graph how you determine the gradient of the graph. **(3 marks)**
c) Calculate the gradient. **(2 marks)**
d) What does this gradient represent? **(1 mark)**

22. A student heated some water and recorded temperature, *0*°C, and the corresponding time, *t* minutes. See the table below.

Time ,t, (minutes)	Temperature 0(°C)
2	35
4	44
8	65
12	86
14	95
16	95

a) Plot a graph of temperature, 0°C (along y axis-axis) and time t, minutes (along the x-axis). Use data in the table. **(9 marks)**
b) Draw the best fit line and show how you determine the gradient of the graph. **(3 marks)**
c) Calculate the gradient. **(2 marks)**
d) What is the initial temperature of the water? **(1 mark)**

END

ANSWERS TO ORDINARY LEVEL PHYSICS PAPER 2009.

SECTION A:

1. a) Ocean water contains minerals which have greater density than the density of rain water which is pure.

   b) Density: $p = \frac{m}{v} = \frac{6.5}{0.005} = 1300 kg/m^3$.

2. a) Force is something which tries or tends to change an object's state of rest (static effect) or that of uniform motion (dynamic static) in a straight line. It is also defined as a push or a pull on a body. Whenever there is an interaction between two objects, there is a force upon each of the objects.

   b) Friction force, gravitational force, spring force, nuclear forces, electrical forces, magnetic forces.

3. As the temperature increases, the particles gain more energy and the vibration between them becomes more rapid.

4. A bus or truck is heavy. It may have large tires, so that its weight is spread over a large area. This means that the pressure on the ground is reduced; so it is less likely to sink in soft ground.

5. Height: $P = pgh \Leftrightarrow h = \frac{p}{pg} = \frac{3000}{1000 \times 10} = 0.3m$

6. a) The average speed of the train during this time $V = \frac{10+20}{2} = 15m/s$

   b) The distance the train travels while increasing its speed: $S = Vt = 15 \times 1 = 15m$

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 of a tall person and hence fall down.

8. a) Work transferred: $W = Fd = 500 \times 300 = 150KJ$.

   b) The power of a person $P = \frac{Wd}{t} = \frac{600 \times 10 \times 0.15}{2} = 450W$.

9. a) K.E for this car $= \frac{1}{2} mv^2 = \frac{1}{2} \times 900 \times 30 = 13500J$

   b) The potential energy of that mass: $PE = mgh = 900 \times 10 \times 20 = 180000J$

10. a) Due to conduction, convection and radiation

    b) The metal handle bar of a bicycle is a good conductor of heat and it can also lose heat fast to the cold surrounding so on a cold day the metal handle bar of a bicycle feels colder. Or the rubber grip is a poor conductor of heat so the metal handle bar of a bicycle cannot lose heat or gain it so it does not feel cold as the metal handle bar of a bicycle.

11. a)

Boiling (vaporization)	Evaporation
Occurs at the surface and inside the liquid	Occurs only at the surface
Occurs when the liquid attains its boiling point due to pressure.	Takes all temperature below the boiling point.
Temperature does not change during boiling.	Temperature may change during evaporation.

   b) $m_1C(t_f - t_1) = 0 \Leftrightarrow m_1 = \frac{m^2(t^2 - t_f)}{t_{f-t_1}} = \frac{50(90-58)}{58-10} = 50kg$

12. a) Positive charges and negative charges.

    b) $Q = it = 4 \times 5 \times 60 = 1200C$.

13. a) Ohm's law: U = IR

b) U = IR = 0.5 × 20 = 10V

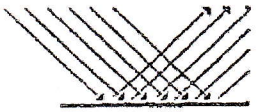
c) The electrons which light the bulb in a flashlight do not have to first travel from the switch to the filament. Rather, the electrons which light the bulb immediately after the switch is turned on are the electrons which are present in the filament itself. As the switch is flipped, all mobile electrons everywhere begin marching; and it is the mobile electrons present in the filament whose motion are immediately responsible for the lightening of its bulb. As those electrons have the filament, new electrons enter and become the ones which are responsible for lightening the bulb.

14. The keepers become strong induced magnets, and the opposite induced poles at their ends neutralize the poles of the bar magnets. In other words the magnetic dipoles in domains of both magnets and keepers form closed loops with no free poles. Consequently the demagnetizing effect disappears.

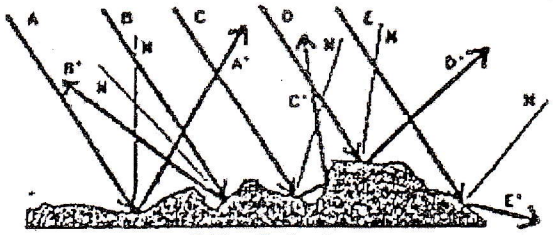
15. a) The change of direction or bending of light passes from one material or medium to another is called refraction while when light rays hit the smooth surface of a mirror, they bounce off in a straight line.

b) If a parallel beam of light falls on a plane mirror it is reflected as a parallel beam and regular reflection (specular reflection) is said to occur. Most surfaces however reflect light irregularly and the rays in an incident parallel beam are reflected in many directions. Reflection by a rough surface such as paper of the book is irregular and is called irregular of diffuse reflection.

The diagram below depicts two beams of light incident upon a rough and smooth surface



Specular Reflection
(smooth surfaces)



Diffuse Reflection
(rough surfaces)

SECTION B:

16. a) A scalar quantity is defined by its magnitude only. It is non-directional in nature. Thus area is a scalar quantity because when starting an area, we do not have to state the direction of the area. Other examples of shares 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 are weight, velocity, acceleration etc.

b) A body is said to move with non-uniform velocity if its rate of change of distance moved with time in a specific direction is not constant.

c) i) Time taken: $t = \frac{v-u}{a} = \frac{34-10}{3} = 8s.$

ii) The distance travelled: $S = \frac{1}{2}at^2 + ut = \frac{1}{2} \times 3 \times 8^2 + 10 \times 8 = 176m.$

17. a) i) The e.m.f. of a generator is the potential difference across the terminals of the generator (battery or cell) in an open circuit.

ii) The internal resistance of an active receptor is the measure of its capacity to absorb heat energy by the joule effect when a current is flowing through it.

b) $U = Ri \Leftrightarrow i = \frac{U}{R} = \frac{1.25}{25} = 0.05A.$

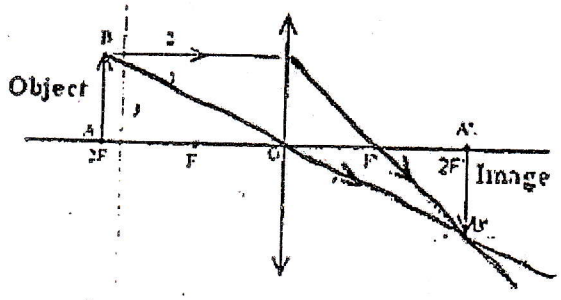
Internal resistance: $r = \frac{e-u}{t} = \frac{1.50-1.25}{0.05} = 5\Omega$

Electric current: $i = \frac{U}{R} = \frac{U}{10} \Rightarrow$ The terminal p.d $U = e - \frac{r \times u}{10} \Leftrightarrow U = 1.5 - \frac{5 \times u}{10} \Rightarrow U = 1V$

18. a) Parallel incident rays to the converging lens meet at a point while parallel incident rays to the diverging lens diverge as they emerge out of the lens.

b) Focal length of a lens is the distance between the focal point and the optical center of the lens.

c)



d) Inverted or erect, virtual or real, enlarged or reduced.

19. a) The heat capacity of a body is the heat required to rise its temperature by 1K. The SI unit of heat capacity is J/K. The heat capacity μ of an object is the proportionality constant between the heat Q the object absorbs or loses and the resulting temperature change ΔT of the object. That is;

$Q = \mu\Delta T = \mu(T_1 - T_f)$

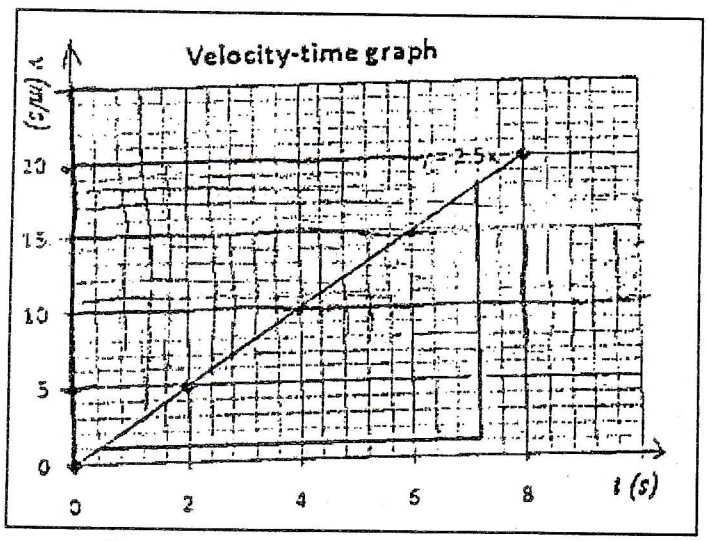
b) The specific latent heat of fusion of ice: $L_f = \frac{Q}{m} = \frac{990000}{3} = 330000 J/Kg.$

20. a) The power delivered to the factory is P = IU. The economy requires the waste power, to be small but it also requires the cables to be thin and therefore cheap to buy and connect, so the economical way to transmit the power is to make current I as small as possible, this means making the potential difference U as high as possible.

b) Each circuit has a fuse or cutout which opens it automatically when current is higher than some defined value. The neutral wire is earthed by the electricity supplier company; the current is again closed with help of a switch.

SECTION C:

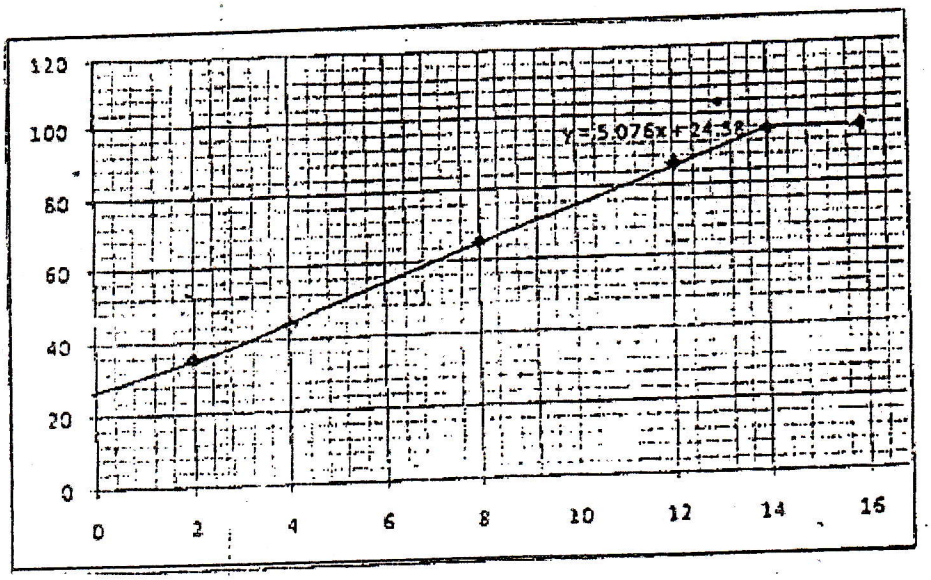
21. (a) and (b)



c) Gradient: $\text{grad} = \frac{\Delta v}{\Delta t} = \frac{18}{7.2} = 2.5$

d) It represents the acceleration.

22. (a) and (b)



c) The gradient is; grad = 5.077

d) $\theta = 24.38°C$

END