Physics I

011

31st/10/2014   08.30am-11.30am

REB

Rwanda Education Board
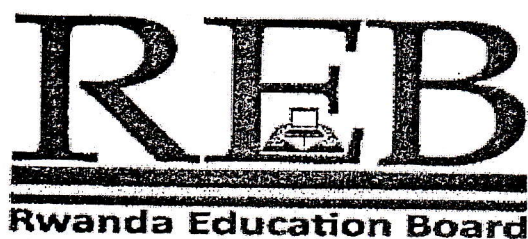
ORDINARY LEVEL NATIONAL EXAMINATIONS 2014

SUBJECT : PHYSICS I

DURATION   : 3 HOURS

INSTRUCTIONS:

1. Do not open this question paper until you are told to do so.
2. Write your names and index number as they appear on your registration form.
3. This paper has **THREE** sections **A, B** and **C.**

   SECTION A: This question is compulsory.   **(55 marks)**

   SECTION B: Attempt any **three** questions   **(30 marks)**

   SECTION C: Attempt **Only one** question.   **(15 marks)**

4. Calculators and mathematical instruments may be used.

5. **Use only a blue or black pen and pencil.**

SECTION A: ATTEMPT ALL QUESTIONS.   (55 marks)

1. The following are quantities common in Physics, mass, weight, density, force, velocity and speed. Which quantities are:

   (a) Vectors?   **(1.5 marks)**

   (b) Scalars?   **(1.5 marks)**

2. Why is the density of sea water not the same as the density of distilled water?   **(3 marks)**

3. Explain why solids have a fixed shape. Use the kinetic nature of molecules in solids to explain your answer.   **(3 marks)**

4. Why is the sharp edge of a knife thin?   **(3 marks)**

5. (a) What is the unit of power?   **(1 mark)**

   (b) A man lifts 50kg of sugar through a vertical distance of 1.5m. Calculate the work done. Take g = 10N/kg.   **(2 marks)**

6. (a) What is the difference between displacement and distance?   **(2 marks)**

   (b) A car has a velocity of 60km/hr. How far does it travel in 20 minutes?   **(2 marks)**

7. (a) Explain why water has maximum density at about 4°C.   **(2 marks)**

   (b) Give two reasons to explain why mercury is a good liquid for use in a thermometer.   **(2 marks)**

8. (a) Explain why a pencil that is partly immersed in a liquid, appears bent at the surface.   **(2 marks)**

   (b) The figure below slows a ray of light travelling towards the face of a plane mirror. Copy the diagram and complete its path after leaving the surface of the mirror. Label your diagram.   **(2 marks)**
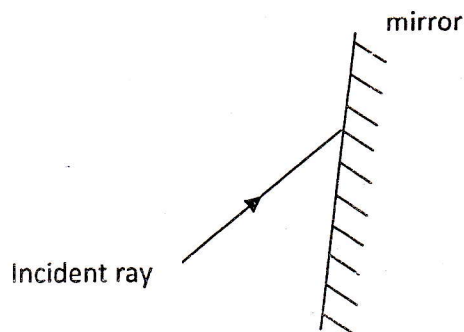
9. (a) What factors does conduction of heat in solids depend on?   **(2 marks)**

   (b) Although the earth absorbs a lot of heat from the sun during the day, its temperature does not continue to rise every day. Explain this phenomenon.   **(2 marks)**

10. Explain each of the following:

   (a) Experiments on electrostatics do not work well on humid days. **(2 marks)**

   (b) An uncharged metal rod causes the leaf of a charged electroscope to collapse. **(2 marks)**

11. A 1.5V cell has an internal resistance of 0.25Ω. It is connected in series with a 0.35Ω resistor, what current flows? **(4 marks)**

12. (a) Which of the following materials are strongly attracted by a magnet: wood, iron, glass and nickel? **(1 mark)**

   (b) Explain why two steel pins hang from the end of a vertical bar magnet do not hang vertically. **(3 marks)**
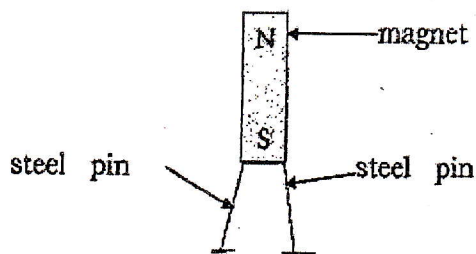
13. (a) Explain why, when a stone is thrown upwards it rises and then falls to the ground again. **(3 marks)**

   (b) A student of mass 60kg runs with a velocity of 2m/s. Calculate the kinetic energy. **(1 mark)**

14. (a) Explain why, in houses electric lamps are connected in parallel. **(2 marks)**

   (b) A circuit consists of 6.0Ω and 3.0Ω in parallel arrangement and a p.d of 12V is connected across the whole circuit. Calculate the current in the circuit. **(2 marks)**

15. (a) Explain why in a pin-hole camera, the size of the hole must not be too large. **(1 mark)**

   (b) State the properties of an image formed in a pin-hole camera. **(3 marks)**

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

16. (a) Give an example of (i) a luminous object. **(1 mark)**

               (ii) a non-luminous object. **(2 marks)**

   (b) Why are translucent glasses used in toilet windows? **(2 marks)**

   (c) What is the difference between the principal focus of a converging lens and the principal focus of a diverging lens? Illustrate your answer using diagrams of these lenses. **(5 marks)**

   (d) Give an application of a diverging lens. **(2 marks)**

17. (a) Why do corrugated iron roofs make cracking noises as a day gets hotter and as the day gets colder? **(3 marks)**

   (b) Why are immersion heaters placed at the bottom of hot water tanks? **(3 marks)**

   (c) Why does milk in a bottle keep cool when the bottle stands in water in a porous pot in dry weather days? **(2 marks)**

   (d) How much heat is needed to raise the temperature by 10°C of 5kg of a substance of specific heat capacity 300J/kg° C? **(2 marks)**

18. (a) State any two effects of an electric current. **(2 marks)**

   (b) Why does a voltmeter have a high resistance while an ammeter has a low resistance? **(2 marks)**

   (c)
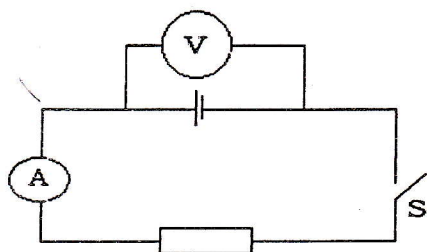
The voltmeter, V and the ammeter, A readings in the circuit above when switch S is open are 3.0V and 0.0A and when the switch is closed are 2.4V and 2.0A. Calculate the internal resistance of the cell. **(3 marks)**

(d) The diagram below shows a lamp, a battery, a switch and a copper wire.

Copper wire

Lamp   Switch
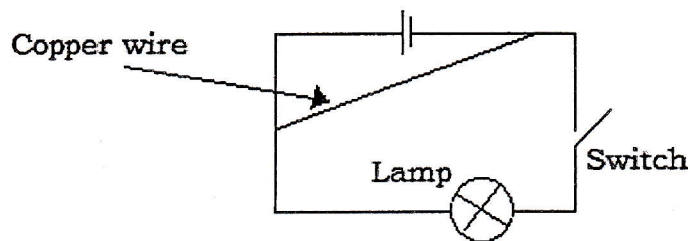
      i) When the switch is on, the lamp does not give light. Explain why.   **(2 marks)**
     ii) What is this effect called?   **(1 mark)**

19. (a) Calculate the pressure exerted on a level ground by a man whose mass is 70kg and the area of his both feet is 250cm³. Give the answer in Pascals (Pa). Take g = 10N/kg.   **(2 marks)**

    (b) Explain why water is not suitable as a barometer liquid.   **(3 marks)**

    (c) Explain how it is possible to drink a fanta drink using a straw.   **(3 marks)**

    (d) Why is an aneroid barometer better for measuring pressure at various altitudes?   **(2 marks)**

20. (a) What is meant by the term "**inertia**" of a body?   **(2 marks)**

    (b) What is the relation between force F, mass m and the acceleration produced a of a moving body?   **(1 mark)**

    (c) The force in a rope pulling a body is 100N. The mass of the body is 40kg and the frictional force is 20N. i) Find the resultant force.   **(1 mark)**
                                   ii) Calculate the acceleration.   **(2 marks)**

    (d) State Newton's third law.   **(2 marks)**

    (e) Why does one feel pain when he/she boxes or hits a hard surface with a fist?   **(2 marks)**

SECTION C: ANSWER ONLY ONE QUESTION   **(15 marks)**

21. Describe an experiment you can carry out to determine the density of a very small piece of dry wood which has irregular shape. The piece of wood does not sink into water.   **(15 marks)**

22. (a) With aid of a labeled diagram, describe an experiment to show how the heat radiated from a hot object depends on the nature of the surface.   **(12 marks)**

    (b) State three applications of this effect.   **(3 marks)**

END

ANSWERS TO ORDINARY LEVEL PHYSICS PAPER 2014

SECTION A:

1. a) Vectors: Weight, Force, Velocity
   b) Scalars: Mass, Density, speed.

2. Sea water contains impurities that change its density.

3. Solids have a fixed shape because their molecules are closely packed to one another and are held by strong intermolecular forces.

4. The sharp edge of a knife is thin so as to exert a greater pressure onto whatever the knife is cutting thereby easing the cutting.

5. a) The unit of power is Watts(W) or Joules per second (J/S).

   b) m = 50kg, d = 1.5m

      F = ma = 50 × 10 = 500N.

      ∴ Work done = F × d = 500 × 1.5 = 750J.

6. a) Displacement is a vector quantity while distance is a scalar quantity.
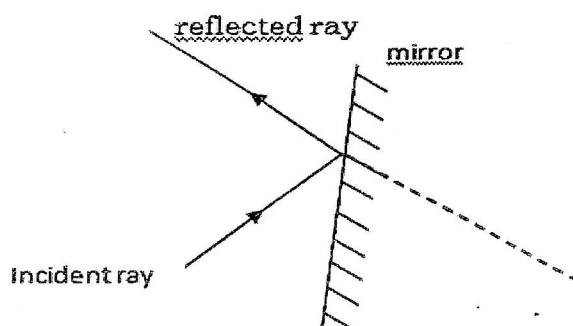   b) $v = 60km/h = \dfrac{60 \times 1000}{3600} = 16.7m/s$

      t = 20 × 60 = 1200s

      d = v × t = 16.7 × 1200

         = 20040m or 20.04km

7. a) At about 4°C, water has the least (or minimum) volume yet volume varies inversely with density.

   b) - Mercury is opaque so it can easily be seen.
      - Mercury is a good conductor of heat.
   - Mercury does not stick to the walls of the glass.

8. a) It appears bent due to refraction of light as it passes from air to water

   b)

9. a) Temperature difference, Nature of the solid, solid of the liquid
   b) The earth absorbs heat from the sun during the day but also loses (emits) the same to the atmosphere.

10. a) - Because the medium or dielectric is different from the vacuum or air.
       - The moisture causes charge leakage.

    b) Because some electric strength will be lost (or wasted) in charges trying to repel like charges in the neutral rod towards the leaf.

11.
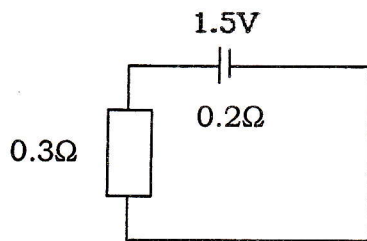
Total resistance = 0.275 + 0.35 = 0.60Ω

Current, $I = \dfrac{1.5}{0.6} = 2.5A$

12. a) iron, nickel

  b) - The upper part of the pin in contact with the south pole of the magnet is the north and this happens to the two pins, meaning that the two lower ends of the pins will be south which repel each other.
  - The lower ends acquire the same polarity by induction so they repel each other.

13. a) The stone thrown upwards rises and then falls to the ground because it is acted upon by a force of gravity.
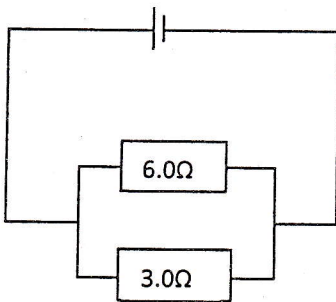
  b) m = 60kg, V = 2m/s

  Kinetic energy $= \dfrac{1}{2}mv^2 = \dfrac{1}{2} \times 60 \times 2^2 = 30 \times 4 = 120J$

14. a) - So that when one lamp is broken, the other lamps can still work or produce light.
  - So as to lower their effective resistance and hence increase their brightness.

  b)

Total resistance, $R = \dfrac{6 \times 3}{6+3} = \dfrac{18}{9}$

Current, $I = \dfrac{V}{R} = \dfrac{12}{2} = 6A.$

15. a) A small hole enables a fairly sharp image to be formed on the screen.
  b) inverted, diminished, real

SECTION B

16. a) i) The sun
   ii) The moon
  b) Because they allow little light to pass through them.
  c) The principal focus of a converging lens is real while the principal focus of a diverging lens is virtual.
  d) used in spectacles that correct long sight.

17. a) As the day gets hotter, they do expand and as the day gets colder, they contract. The noise is as a result of expansion and contraction respectively.
  b) To be able to set up convection currents within the water. This is because if the water is heated from the bottom, it becomes less dense and then rises to the top.
  c) The water being a poor conductor of heat doesn't allow heat from out to reach the milk
  d) $\Delta \theta = 10°C$, m = 5kg , c = 300J/Kg/k

  $q = mc\Delta\theta$

  $= 5 \times 300 \times 10 = 15000J$

18. a) - It causes heating of the component through which it passes.
   - It induces a magnetic field into a wire through which it passes
   - It causes lighting e.g. in a filament bulb.
   - It also has a chemical effect e.g. bubbles of gas are evolved at wires (plates) in the acid due to a chemical reaction of t of the current.

   b) The voltmeter has a high resistance so that very little current flows through it to make it work. An ammeter has a low resistance to allow much current to pass through it.

   c) $E = 3.0V$, $V = 2.4V$, $I = 2.0A$, $r = ?$
   lost p.d $= 3 - 2.4 = 0.6V$
   Using $V = IR$, lost p.d $= Ir$

   $$\frac{0.6}{2} = \frac{2r}{r} \Rightarrow 0.3 = r \Rightarrow r = 0.3\Omega$$

   d) i) Much of the current will flow through the copper wire and very little current will flow through the bulb yet it's not sufficient enough to light it.
   ii) Short circuiting

19. a) mass, $m = 70kg$, $A = \left(\frac{250}{10,000}\right)$ m² $= 0.025m^2$

   $F = mg = 70 \times 10 = 70N.$

   Pressure, $P = \dfrac{Force}{Area} = \dfrac{700}{0.025} = 28000$ Pa

   b) Water has a narrow density thus it would call for a longer narrow tube to be used.
   c) When the drink is sucked through the straw, the pressure inside the straw reduces. Thus the atmospheric pressure at the surface of the Fanta bottle pushes the fanta up the straw.
   d) Because its much smaller and can record a week's worth of data.

20. a) Inertia is the tendency of a body to remain at rest of continue moving in a straight line as long as no external force acts upon it.
   b) Force is the product of mass and acceleration, $F = ma$

   c) From $F = ma$, $a = \dfrac{F}{m} = \dfrac{80}{40} = 2m/s^2$

   d) For every action, there is an equal but opposite reaction.
   e) The hard surface exerts an equal force onto someone thus the pain.

SECTION C

21. An experiment to determine the density of a very small piece of wood with an irregular shape and does not sink in water:

   Apparatus: Measuring cylinder, a sinker (object that can sink), a beam balance, a piece of wood, water, a string.

   - Weigh the sinker in air to determine its mass. Weigh the sinker with the wood fixed onto it to determine the mass of the sinker and the wood.

   - Pour a reasonable amount of water in a measuring cylinder. Note the initial level of the water in the cylinder.

- Gently dip the sinker into the cylinder containing water and note the new level of water. Again dip the sinker with the wood fixed into the cylinder. Note the level of water when the sinker and the wood are dipped into water.
- Note the results as indicated below:
  - Mass of the sinker in air = M_1
  - Mass of the sinker and the wood in air = M_2
  - Initial level of water in the cylinder = V_0
  - Level of water when sinker is dipped = V_1
  - Level of water when sinker and wood are wood are dipped = V_2
  - Determine the mass of the wood, $M_w = M_2 - M_1$.
  - Determine the volume of the sinker, $V_S = V_1 - V_0$
  - Determine the volume of the wood, $V_w = V_{ow} - V_S$
  - Calculate the density of the wood from:

$$\text{Density of wood} = \frac{Mass\ of\ wood}{Volume\ of\ wood} = \frac{M_w}{V_w}$$

22. a) An experiment to show that heat radiated from a hot object depends on the nature of the surface.
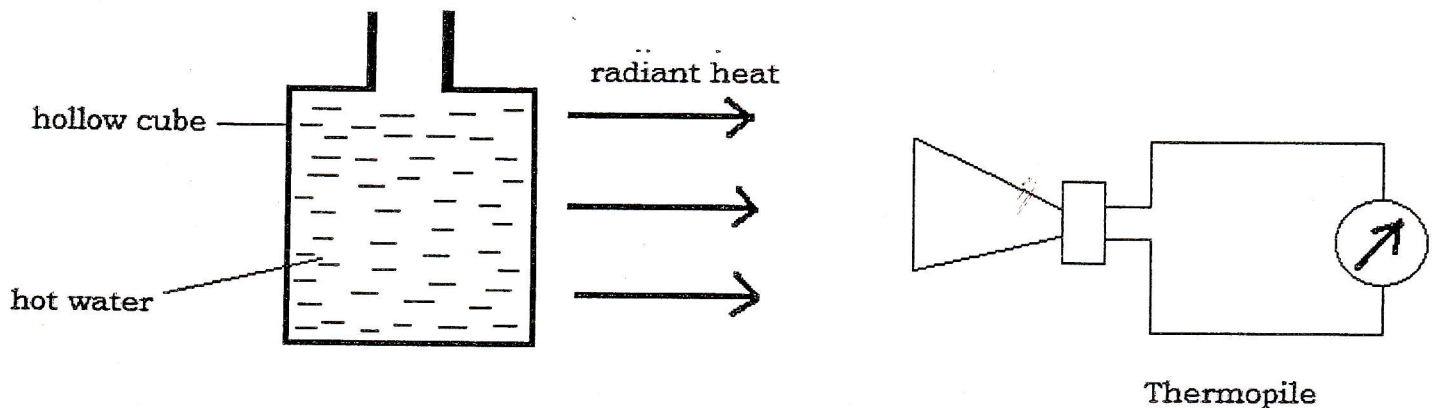
Thermopile

- Get a hollow cube and paint its sides with different colors dull black, highly polished silvery bright, grey and white.
- Turn the cube each of the four faces of the cube is in front of the thermopile. Note the deflection in the galvanometer caused by each face.
- It will be observed that the dull black surface produces the largest deflection followed by grey. White will be third and the highly polished will produce the least deflection. Therefore, radiation from a body depends on the nature of its surface.

b) - Used to determine the choice of dress

  - Used in a green house effect
  - Used in thermos flasks and other utensils like teapots. A tea pot painted with a silverly surface keeps the water hot for some time.

END