

Physics I

010

03/Nov/2003 08.30am - 11.30am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD

ORDINARY LEVEL NATIONAL EXAMINATIONS 2003/2004

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)**

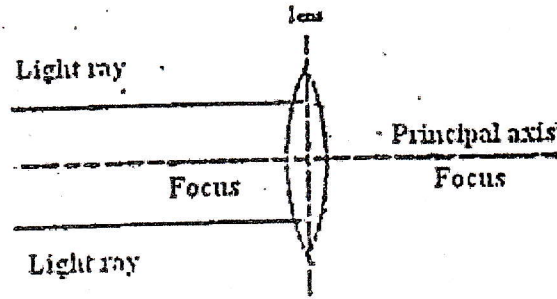
Answer **only one** question in section C. **(15 marks)**

You may use a calculator and mathematical instruments.

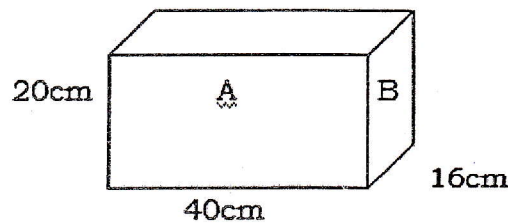
Show all your working.

SECTION A: Answer all questions.**(55 marks)**

1. Name two instruments which can be used, accurately to measure the diameter of a small metal sphere. **(2 marks)**
2. a) Copy the diagram below and complete it. **(2 marks)**



- b) A person sees only far objects clearly.
- i) Which vision defect could cause this? **(1 mark)**
- ii) Which type of lens could correct this defect? **(1 mark)**
3. A body has mass and weight. Which of the two quantities:
- a) is a vector? **(1 mark)**
- b) is measured in newtons? **(1 mark)**
- c) remains the same at any place? **(1 mark)**
4. The mass of a body is 0.026 kg and its density is 1.3 kg/m^3 . Calculate the volume of the body. Express the answer in standard form. **(2 marks)**
5. A uniform meter rule is pivoted at the 45 cm mark. A mass of 5g is placed at the 5cm and it balances the meter rule horizontally. Calculate the mass of the meter rule. **(2.5 marks)**
6. a) Define the term pressure. **(1 mark)**
- b) What effect does lower air pressure have on the boiling point of water? **(1 mark)**
- c) The mass of the rectangular block below is 16kg.
- i) Calculate the pressure exerted on the ground by each of the surfaces A and B. Take $g = 10\text{N/kg}$ **(2 marks)**

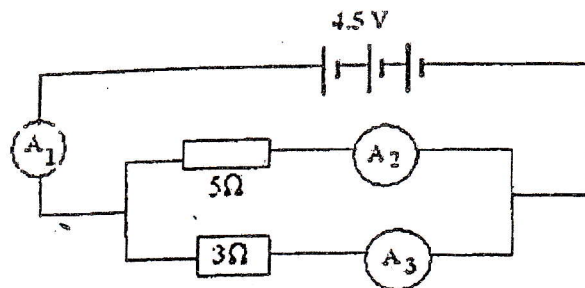


- ii. What conclusion can you make from your answers about the area in contact with the surface and the pressure exerted? **(1 mark)**
7. a) State 3 methods of heat transfer. **(3 marks)**
- b) A girl boils water in a source pan on a stove. Identify the methods of heat transfer that take place. **(1 mark)**
8. Copy the bar magnets below and show the magnetic field lines of force around them. Label the neutral point. **(2.5 marks)**

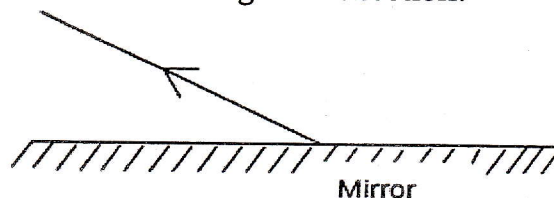


9. a) Identify the differences between distance and displacement of a moving body. **(2 marks)**
- b) A man walks 4 km away from his home and then returns to his home. Determine:
- i) the displacement and distance of this movement. **(1 mark)**
- ii) the average speed if the whole journey takes 2 hours. **(1 mark)**

10. a) State the unit of power. (1 mark)
 b) In loading a lorry, a boy lifts a 25 kg bag of sugar through a height of 2m. Calculate;
 i) The work done. Take $g = 10\text{N/kg}$ (2 marks)
 ii) The power developed if the boy takes 2 seconds to load the lorry. (2 marks)
11. a) State the laws of electrostatic charges. (2 marks)
 b) A current of 2A flows for 3 seconds. Calculate the charge passing a point. (2 marks)
12. a) What is the difference between speed and velocity? (1 mark)
 b) The initial speed of a car is 20km/h. After 30 minutes the speed of the car is 50km/h, calculate the acceleration. (2 marks)
13. a) An electric current flows through a high resistance conductor. What effect does the current have on the resistance? (1 mark)
 b)



- From the electric circuit above, calculate the current recorded by ammeters A_1 , A_2 and A_3 .
- c) Calculate the cost of running three 100 W lamps and six 60 W lamps for 10 hours if electric energy costs 50 Frw per Kwh. (2 marks)
14. a) Which is the source of energy that enables plants to make food in their green leaves? (1 mark)
 b) A child picks up a stone and then releases it. List three energy changes that occur. (3 marks)
15. a) Copy and complete the diagram below showing clearly the incident ray, the normal ray, angle of incidence and angle of reflection. (2 marks)



- b) State the relation between the angle of incidence and angle of reflection. (1 mark)

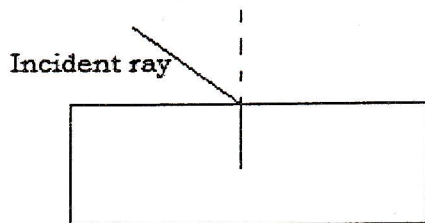
Section B: Answer only three questions.

(30 marks)

16. a) State the three states of water and explain the differences between them. (3 marks)
 b) A mass of air can have different volumes without changing its mass. Why? (1 mark)
 c) A bottle of milk remains cool when it stands in water in a clay pot in warm surroundings. Why? (4 marks)
 d) Explain what is meant by diffusion of liquids. (2 marks)
17. i) State and explain the factors which affect resistance of a conductor wire at constant temperature. (4.5 marks)
 ii) What is meant by the resistivity of a conductor material? (1.5 marks)
 iii) A resistance of 20Ω is needed from a long resistance wire of radius 0.7 mm and resistivity $1.0 \times 10^{-6} \Omega\text{m}$. How long is the resistance wire needed? (2 marks)

18. a) i) Copy the diagram in your answer book and complete it.

(2 marks)



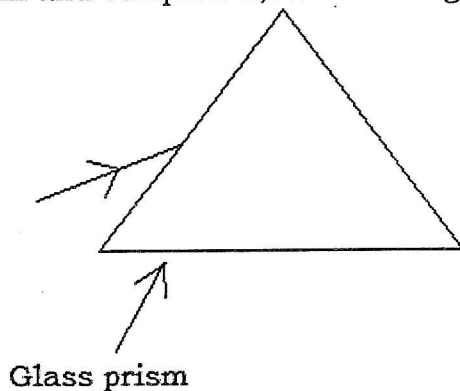
ii) On the diagram label the refracted ray and emergent ray.

(2 marks)

iii) What can you say about the incident ray and emergent ray?

(2 marks)

b) Copy the diagram and complete it, label the angle of deviation.



c) A light ray incident to a triangular glass prism is separated into different colors.

i) What is the process called?

(1 mark)

ii) What causes the separation of colors?

(1 mark)

iii) Which color is bent most?

(1 mark)

iv) Which color is bent least?

(1 mark)

19. a) i) With aid of a diagram, show how pressure in a liquid increases with depth of the liquid.

(3 marks)

ii) Name another quantity, besides depth of a liquid, on which variation of pressure in liquids depends.

(1 mark)

b) The density of lake water is 1000kg/m^3 . The pressure at a point A below the surface of lake water is 45000Pa . Calculate the depth of the point A under the surface.

(2 marks)

c) It is better to use a liquid in hydraulic machines than a gas. Why?

(2 marks)

d) Give two examples where transmission of pressure in liquids is applied.

(2 marks)

20. a) Define the term specific heat capacity.

(2 marks)

b) Determine the heat given out when an iron ball of mass 3 kgs and specific heat capacity of 440J/kg cools from 200°C to 100°C .

(2 marks)

c) Water is used to cool car engines and in the radiators of central heating systems. Why is water a better liquid to use in cooling engines?

(2 marks)

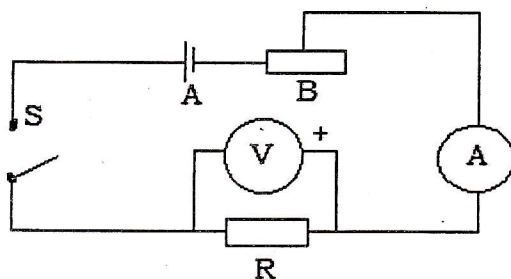
d) A shiny object and a black object are left in the sun. Which of the two objects becomes hot? Explain your answer.

(3 marks)

SECTION C: Answer only one question.

(/15 marks)

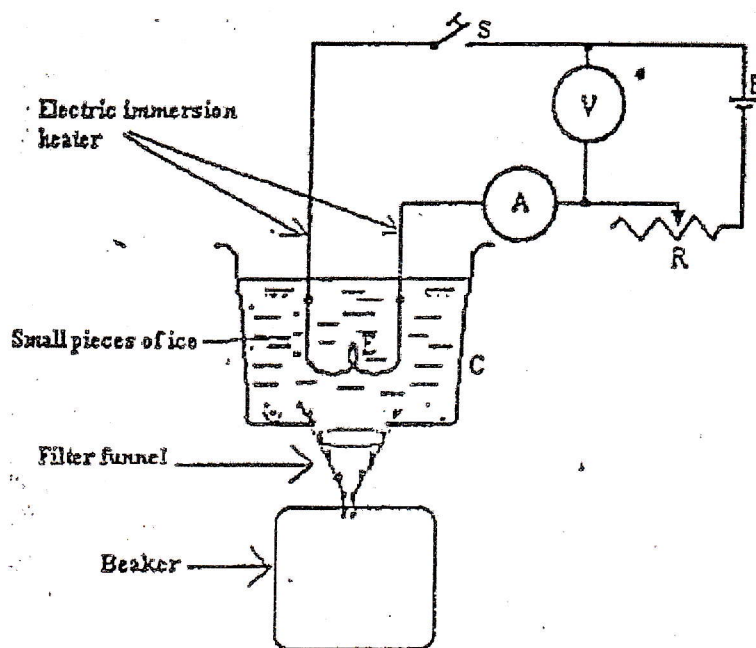
21. The electric circuit below may be used to determine the unknown resistance of a conductor.



- What is the use of part A (1 mark)
- Name part B and state its function. (2 marks)
- The ammeter has a low resistance. Why? (2 marks)
 - Name the instrument labeled and state its function. Explain why it has a high resistance. (3 marks)
- Small currents should be used in this experiment. Why? (2 marks)
- Results below were obtained from this type of experiment. Copy the table in your answer book and complete it. Calculate the mean resistance. (4 marks)

Voltmeter reading (V)	Ammeter reading (A)	Resistance (Ω)
1	0.5	
2	1.1	
3	1.6	
4	2.0	
5	2.6	
6	3.0	

22. You are provided with a clock, electric immersion heater of known power, small pieces of ice, a beaker and a funnel. See the apparatus below. A beam balance is provided to determine the mass of water.



- State what is meant by specific latent heat of fusion of a substance. (2 marks)

- b) Describe how you would use the apparatus above to determine the specific latent heat of fusion of ice. (9 marks)
- c) Why is the immersion heater better than a bunsen burner flame in this experiment? (1 mark)
- d) Mention a possible cause of error in the experiment (1 mark)

23. a) You are provided with a beam balance, a beaker, a measuring cylinder (250cm³), water, test tube and a thin thread. Describe how you may determine the density of the test tube. Show clearly how you arrive at the final results. All necessary calculations should be shown. Mention any precautions you take. (ignore the mass of air in the test tube). (11 marks)

b) A pupil carried out the experiment above and obtained the following results.

- Mass of test tube = 26g
- Volume of water in tube = 40 cm³
- First level of water in the measuring cylinder = 20cm³
- Level of water in the measuring cylinder + test tube full of water = 70cm³

Calculate the density of the test tube and express the answer in kilograms per cubic meter. (4 marks)

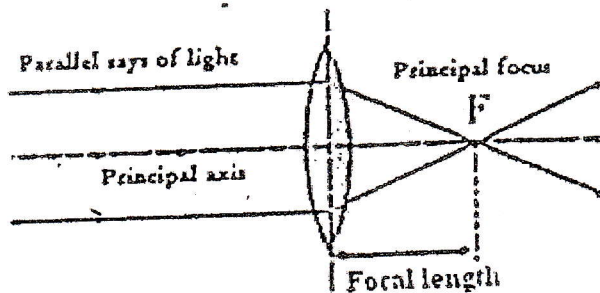
END.

ANSWERS TO ORDINARY LEVEL PHYSICS PAPER 2003/2004

SECTION A:

1. Vernier caliper, micrometer screw gauge.

2. a)

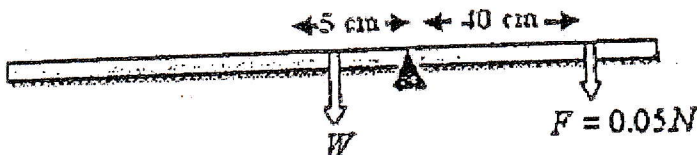


- b) i) Farsightedness (hyperopia) or presbyopia
 ii) The farsighted eye is assisted by the use of a converging lens

3. a) Weight, b) Weight, c) Mass

4. Volume: $p = \frac{m}{v} \Rightarrow V = \frac{m}{p} = \frac{0.026}{1.3} = 2 \times 10^{-2} \text{m}^3$

5.



6. a) Pressure (symbol "p") is the force acting normally per unit area applied in a direction perpendicular to the surface of an object
 b) It decreases the boiling point

c) i) pressure exerted on the ground by area A: $p = \frac{F}{A} = \frac{16 \times 10}{0.2 \times 0.4} = 2000 Pa.$

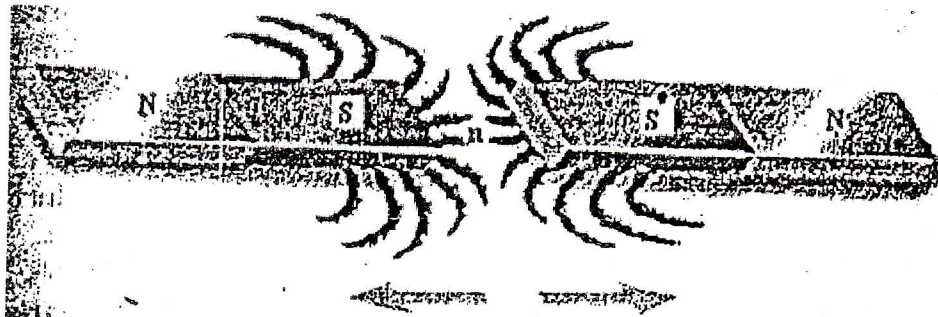
pressure exerted on the ground by area B: $p = \frac{F}{A} = \frac{16 \times 10}{0.16 \times 0.2} = 5000 Pa.$

ii) If the force is concentrated on a small area, it will exert a higher pressure than if the same force is distributed over a large surface area.

7. a) Conduction, Convection and Radiation

b) Conduction and convection

8.



9. a) Distance is a scalar quantity describing the length of the path between two points along which the particle has travelled while displacement is a vector quantity; defined as distance moved in specified direction or the change from its initial position to its final position.

b) i) Displacement is zero, distance = 8km.

ii) Average speed: $= \frac{\Delta S}{\Delta t} = \frac{8 \text{ km}}{2 \text{ hrs}} = 4 \text{ km/hr}$

10. a) The unit of power is a Watt. (W)

b) i) Work done: $W = Fh = mgh = 25 \times 10 \times 2 = 500 \text{ J}$

ii) Power: $P = \frac{W}{t} = \frac{500}{2} = 250 \text{ W}$

11. a) Like charges repel and unlike charges attract each other. This is called the basic law of electrostatic charges.

b) Using $i = \frac{Q}{t} \Rightarrow Q = it = 2 \times 3 = 6 \text{ C.}$

12. a) Speed describes how fast something is moving; it is a scalar quantity while velocity describes how fast something is moving in a specific direction. It is a vector quantity.

b) Acceleration: $a = \frac{\Delta v}{t} = \frac{50 - 20}{0.5} = 60 \text{ km/hr}^2 = 0.00453 \text{ m/s}^2$

13. a) Heat effect or joule effect.

b) Equivalent resistance: $\frac{1}{R} = \frac{1}{Rc} = \frac{1}{Rb} \Leftrightarrow R = \frac{RcRb}{Rc+Rb} = \frac{5 \times 3}{5+3} = \frac{15}{8} \Omega$

Electric current: $i_1 = \frac{U}{R} = \frac{4.5 \times 8}{15} = 2.4 \text{ A};$ Electric current: $i_2 = \frac{U}{R_2} = \frac{4.5}{3} = 1.5 \text{ A}$

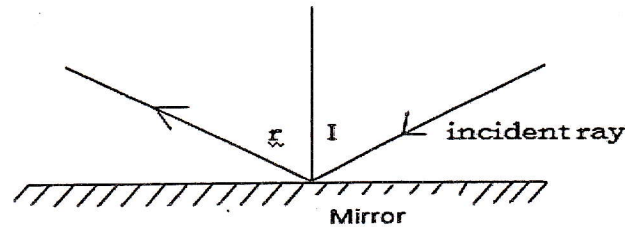
Electric current: $i_3 = \frac{U}{R_3} = \frac{4.5}{5} = 0.9 \text{ A}$

c) Energy: $E = p \times t = [(100 \times 3) + (60 \times 6)] 10 = 6.6 \text{ KW} \Rightarrow \text{Cost} = 50 \times 6.6 = 330 \text{ Rfw}$

14. a) The sun

b) Potential energy in his muscles - kinetic energy - calorific energy - sound energy and light energy.

15. a)



b) The angle between the reflected ray and the normal is the same as that between the incident ray and the normal.

SECTION B

16. a)

Solids	Liquids	Gases
Particles are very closely packed thus rigid	Particles are loosely packed thus can flow	Particles are very packed and can flow.
Voids are extremely small thus incompressible	Voids are relatively larger thus slightly compressible	Voids are very large and so highly compressible
Particle motion is restricted to vibratory motion about a fixed position	Particle motion is very slow	Particle motion is very random. These random movements enable gases to diffuse.
Inter-particle force is very large thus very dense	Inter - particle forces are intermediate resulting in low density	Inter-particle forces are negligible thus imparting low density.
Solids have a "definite" of "fixed" shape, and size they. They resist a change of that shape. They also occupy a definite volume	A liquid "deforms" and takes the shape of its container. It has little resistance to shear forces that would change the form it takes, but they have a definite volume	Gases have no definite shape and expand to fill all the available space.

b) Gases have no definite shape and expand to fill the available space.

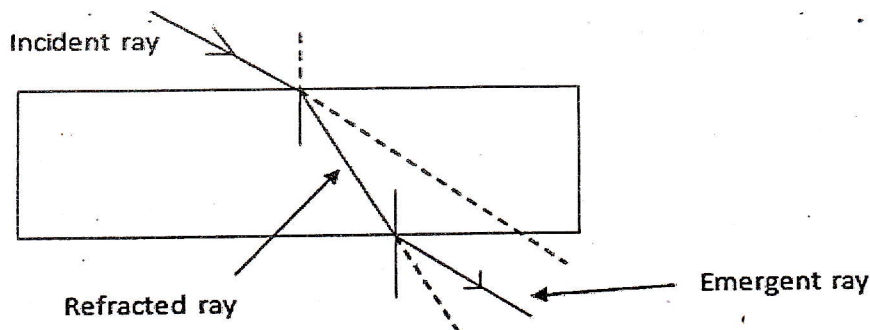
c) The clay pot and water are bad conductors of heat.

d) Diffusion is the natural tendency of molecules to flow from higher concentrations to low concentration.

17. i) - The length of the wire (in m). The longer the wire; the more resistance that there will be.
 - The cross sectional area of the wire (in m²); the wider the wire is, the less resistance that there will be to the flow of electric charge. When all other variables are the same, the charge will flow at higher rates through wider wires with greater cross-sectional areas than through thinner wires
- ii) The resistivity of the material (in Ω m). Some materials are better conductors than others and offer less resistance to the flow of charge. Silver is one of the best conductors but is never used in wires of households due to its cost. Copper and aluminum are among the least expensive material with suitable conducting ability to permit their use in wires of households.

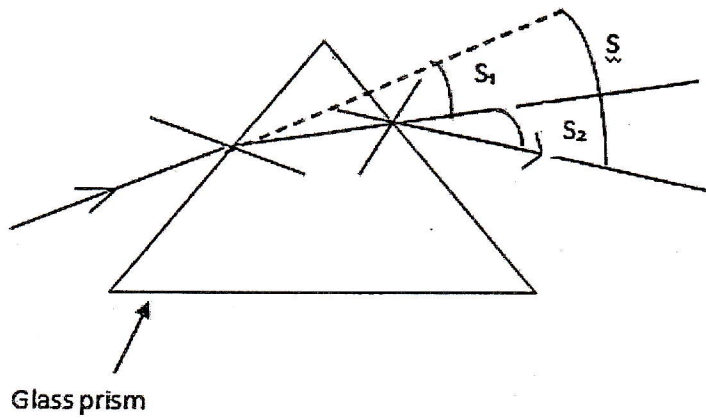
$$\text{iii) } R = \rho \frac{L}{A} \Leftrightarrow L = R \frac{A}{\rho} = \frac{20 \times \pi (0.7 \times 10^{-3})^2}{10^{-6}} = 30.77\text{m}$$

18. a) i) and ii)



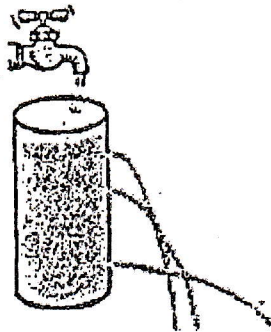
- iii) The change in angle of light ray is the same when it enters and leaves the glass. The direction of incident ray is parallel to the direction of emergent ray. The two rays are parallel.

b)



- c) i) Dispersion (the separation of white light into its component colors by a prism)
 ii) The index of refraction is different for each color.
 iii) Violet (deviated most)
 iv) Red (deviated least)

19. a) i)



ii) Density.

$$b) p = \rho gh \Rightarrow h = \frac{p}{\rho g} = \frac{45000}{10 \times 1000} = 4.5 \text{ m}$$

- c) Liquids are incompressible, communication integrals
 d) Hydraulic press (brake), elevators etc.

20. a) Specific heat capacity, often shortened to specific heat, is the measure of the heat energy required to increase the temperature of a unit quantity of a substance by a unit of temperature.
 b) Heat given out: $Q = m\Delta T = 3 \times 440(200-100) = 132000 \text{ J}$.
 c) Because water has a higher specific heat capacity and is less expensive.
 d) The black object becomes hot because it absorbs more heat energy.

SECTION C

21. a) Part A is used in producing electricity.
 b) B: Rheostat for adjusting the amperage and varying resistance.
 c) i) Not to diminish the intensity in the circuit.
 ii) A voltmeter is an instrument used to measure electrical potential difference between two points in an electric circuit.
 d) To avoid too much heat which would distort the results.

e)

Voltmeter reading (V)	Ammeter reading (A)	Resistance (Ω)
1	0.5	2.0
2	1.1	1.8
3	1.6	1.9
4	2.0	2.0
5	2.6	1.9
6	3.0	2.0
Mean resistance: $R = \frac{2.0+1.8+1.9+2+1.9+2}{6} = 1.9\Omega$		

22. a) Specific latent heat of fusion is the amount of energy required to convert 1 kg of a substance from solid to liquid without a change in the temperature of the surroundings, all absorbed energy goes into the phase change.

b) To find the specific latent heat of fusion of ice:

- Weigh the empty beaker, m_1
- Connect the heater
- Stop watch triggers the onset of the 1st drop
- Stop the clock when we have a measurable quantity and it determines the duration t .
- Weigh the beaker containing the liquid base, m_2
- Calculate:
 - o The mass of the liquid: $m = m_2 - m_1$
 - o Quantity of heat provided by the water heater: $Q = Pt$
 - o Heat absorbed by water: $Q = mLf$
 - o Heat absorbed by water = quantity of heat provided by the water heater i.e. $mLf = Pt \Rightarrow Lf = \frac{Pt}{m}$

c) It is easy if we know the power to calculate the amount of heat.

d) Read error and loss of heat

23. a) Determination of test tube density by direct measurement of volume and mass.

- i. Using the beam balance, determine and record the mass of the test tube m
- ii. Determine the initial volume of the measuring cylinder: V_1
- iii. Fill the test tube with water and use the measuring cylinder to measure the volume of that water.
- iv. Holding the string, lower the test tube containing water into the water until it is completely submerged. Record the new water level: V_2
- v. Determine the volume of the test tube: $V_2 = V_1 + (V+V_1) \Rightarrow V = V_2 - (V_1+V_1)$
- vi. Calculate the density using this volume and the mass: $\rho = \frac{M}{V}$

b) Volume of test tube: $V_2 = V_1 + (V+V_1) \Rightarrow V = 70 - (20+40) = 10\text{cm}^3$

$$\text{Density: } \rho = \frac{m}{v} = \frac{26}{10} = 2.6\text{g/cm}^3 = 2600\text{kg/m}^3$$

END