REPUBLIC OF RWANDA

RWANDA EDUCATION BOARD

ORDINARY LEVEL NATIONAL EXAMINATIONS 2005

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. a) Explain why a piece of iron sinks in water but an iron ship floats on water.   (2 marks)
   b) Calculate the mass of cement of 0.4cm³ and a density of 3000kg/m³.   (1 mark)

2. a) State the difference between mass and weight.   (2 marks)
   b) The weight of a body on the moon is less than the weight of a body on earth. Why? (1 mark)

3.   Why are gasses squeezed more easily than liquids?   (2 marks)

4. a) The figure below is a uniform meter rule and O is its center of gravity A. Identify quantity A.   (1 mark)
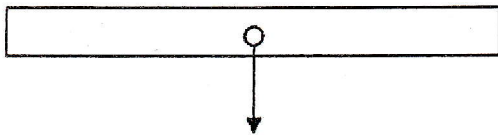
   b) The meter rule below is supported at its center. Calculate the distance X if the meter rule is uniform and the weights are balancing.
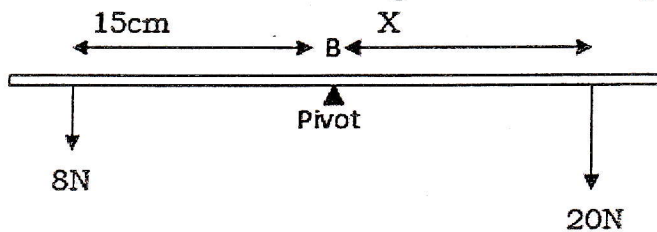
5. The formation of the food we eat depends on the sun. Explain.   (3 marks)

6. The diagram below shows a box with openings at M and N. A lighted candle is placed in the box shown.
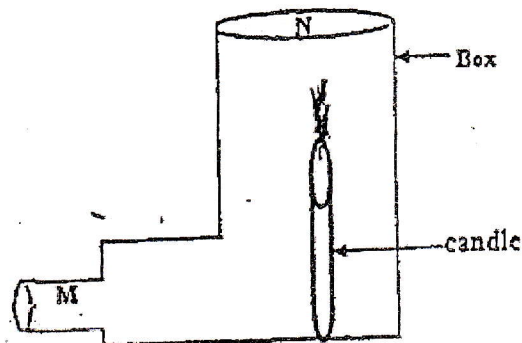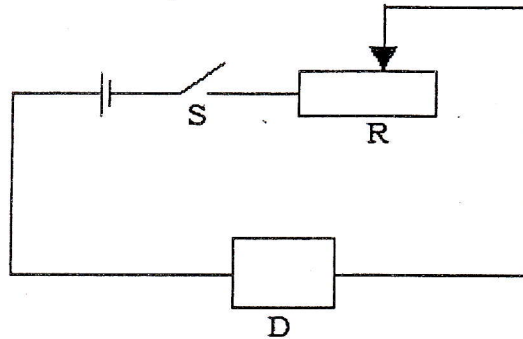

   a) Copy the diagram and label arrows to indicate the direction of hot air and cool air.   (2 marks)
   b) Name the process of air movement being illustrated in the diagram.   (1 mark)
   c) On a hot day, it feels better when a person is near a lake. Why?   (1 mark)

7. a) State the laws of reflection of light.   (2 marks)
   b) Copy the diagram in your answer book. Using ray construction, show the position of the image of point A in the mirror.

8. a) Mention the main heat effects when objects are heated. **(3 marks)**
   b) A piece of wood is burnt completely and becomes ash. What is this heat effect? **(1 mark)**

9. The diagram shows a bar magnet and one magnetic field line.

   a) Copy the diagram and draw two more magnetic field lines. **(2 marks)**
   b) Which of the poles A or B is
      i) A north pole? **(1 mark)**
      ii) A south pole? **(1 mark)**

10. a) Copy the diagram and complete the circuit to show how you would connect; **(2 marks)**

   - a voltmeter to measure the potential difference across resistor D
   - an ammeter to measure the current through D.
   b) Why are components R and S used in the above electric circuit? **(2 marks)**

11. a) What is meant by specific heat of a substance? **(2 marks)**
   b) A mass of water is heated and its temperature rises from 45°C to 55°C.
   Calculate the mass of water if the heat energy supplied is 21,000J.
   Specific heat capacity of water = 4200J/kg. **(2 marks)**

12. a) Name the unit of pressure. **(1 mark)**
   b) What is the pressure on a surface when a force of 200N acts on an area of 0.5m²? **(1 mark)**
   c) Explain why knife edges are sharp. **(2 marks)**

13. a) State what is meant by friction. **(2 marks)**
   b) How does friction help us to walk on land? **(1 mark)**
   c) Friction can damage parts of engines in vehicles. How is the friction reduced? **(1 mark)**

14. a) John's weight is 600N and he runs 10 m in 12 s. Mary weighs 700N and runs
      the same distance as John in 4s. Calculate the power developed by each person. **(2 marks)**
   b) Who of the two is more powerful? Give a reason to explain your answer. **(1 mark)**

**Section B: Answer any three questions.** **(/30 marks)**

16. a) The diagrams below show the paths of rays of light through the blocks of glass.
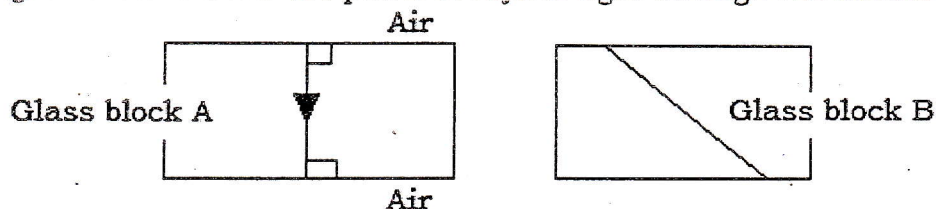

   i. Copy the diagram and show paths of rays of light through the air before and
      after passing through the blocks of glass. **(2 marks)**
   ii. On glass block B, label equal angles A and B, and the second pair X and Y. **(2 marks)**

b) i) Copy the diagram and use ray diagrams construction to show the formation of the image of object X in the converging lens.
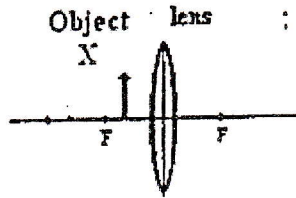
ii) State the relation between the size of the image formed and the size of the object X. **(1 mark)**

c) Name an optical instrument where a converging lens is used. **(2 marks)**

17. a) What is meant by specific latent heat of fusion of a substance? **(2 marks)**

b) The graph below shows a cooling curve of a hot liquid.
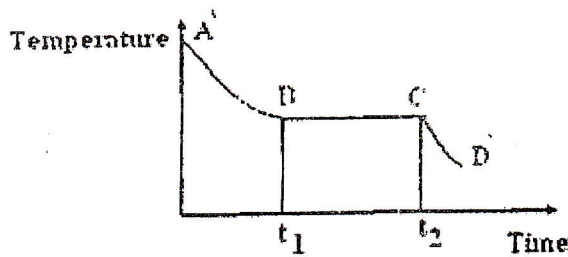
Use the idea of particles to explain what is happening from:

i. A to B **(2 marks)**
ii. B to C **(2 marks)**
iii. C to D **(2 marks)**

c) What is the heat lost between B and C called? **(1 mark)**

18. a) Which property of light do shadows rely on to occur? **(1 mark)**

b) Draw a diagram to show umbra and penumbra shadows formed at the same time. **(3 marks)**

c) State the condition for an eclipse to occur. **(1 mark)**

d) A pinhole camera consists of a box with a small hole in a metal plate at one end and a screen of frosted glass at the other end. What is the use of:

i) The small hole? **(1 mark)**
ii) The box? **(1 mark)**
iii) The frosted glass? **(1 mark)**

c) The height of the image of an object observed on the screen of a pinhole camera is 3cm and the distance from the screen to the pinhole is 15cm away from the pinhole. Calculate the height of the object if the object is 30cm away from the pinhole camera. **(2 marks)**

19. a) List in order, energy conversions taking place when a torch bulb is lit. **(2 marks)**

b) What advantage and disadvantage does a torch bulb have over a car battery? **(2 marks)**

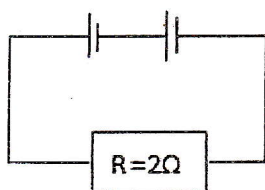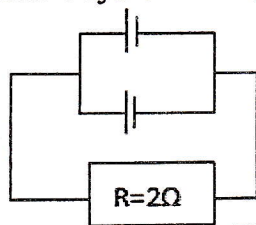c) Circuits below show different ways of arranging batteries in a circuit.

i. Identify each type of battery arrangement. **(2 marks)**
ii. If the batteries are identical and each has a potential difference of 1.5V, calculate the current through resistance R in each circuit. **(2 marks)**
iii. What advantage does the arrangement in Fig. B have over Fig A? **(1 mark)**

20. a) Name the states of equilibrium. **(3 marks)**
    b) State how a body can be made more stable. **(2 marks)**
    c) The diagram below is an equilateral triangle cardboard. Copy it and label with an O the centre of gravity. Explain how you determine the position of O. **(2 marks)**
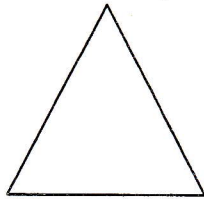
    d) Explain how passengers make the vehicles more likely to roll over. **(2 marks)**

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

21. A student did an experiment to find out how the length of a spring increases when different weights are added. The table below shows the results.

Weight (N)	1	2	3	4	5	6	7
Length(mm)	23	26	29	32	35	49	66

    a) Draw a graph of length against weight using these results. **(12 marks)**
    b) What is the original length of the spring? **(1 mark)**
    c) By how many millimeters did the 1.7N weight cause the spring to stretch? **(1 mark)**
    d) What is the length of the spring when the spring reaches its elastic unit? **(1 mark)**

22. The table below shows how the speed of a moving body changes with time.

Time (s)	5	10	15	20	25	30	40
Speed(m/s)	20	30	40	50	50	60	70

    a) Plot the graph of speed against time using these results. **(12 marks)**
    b) Estimate the initial velocity of the moving body. **(1 mark)**
    c) Put letter A on any part of the graph where the velocity is constant. **(1 mark)**
    d) For how long is the speed constant? **(1 mark)**

23. A student did an experiment to find out how the pressure of a gas varies with its volume at constant temperature. The table below shows the results obtained.

P (units)	3	4	6	12
V(units)	23	26	29	32
I/V				

a) Copy and complete the table above. **(4 marks)**

b) What happens to the volume of the gas as the pressure increases? **(1 mark)**

c) Plot the graph of pressure against $\dfrac{1}{volume}$. **(8 marks)**

d) Estimate the volume of the gas when the pressure is 9 units. **(2 marks)**

END

ANSWERS TO ORDINARY LEVEL PHYSICS PAPER 2005

SECTION A:

1. a) The density of a bar of iron is greater than that of water so it sinks in water. The boat has an iron hollow form that makes the average density of the whole boat less than the density of water where it floats.

   b) Mass: $p = \dfrac{m}{v} \Rightarrow m = pv = 3000 \times 0.4 = 1200kg$

2. a)

Mass	Weight
A measure of the amount of matter in an object	The force of gravity exerted on an object
A scalar quantity	A vector quantity
Measured in kg by using a beam balance	Measured in Newton by using a dynamometer
Stays the same wherever you are	Changes from place to place

   b) The acceleration due to gravity on the moon is less than that on the earth.
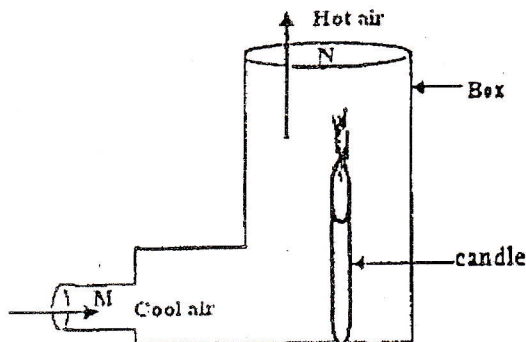
3. Intermolecular distance of solids is larger than that of liquids.

4. a) Weight

   b) Condition of equilibrium: $8 \times 15 = 20 \times x \Rightarrow x = 6cm$

5. The sun is the source of energy for Photosynthesis in green plants:

6. a)

   b) Convection

   c) Near a lake on a hot day, cool air moves towards the ground or evaporates and creates a convection current of fresh air to the ground or sea breeze.

7. a) The incident ray, the reflected ray and the normal at the point of incidence all lie in the same plane. The angle between the reflected ray and the surface normal is the same as that between the incident ray and the normal.
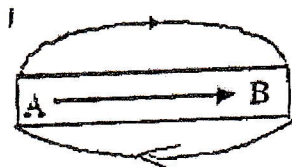
b)
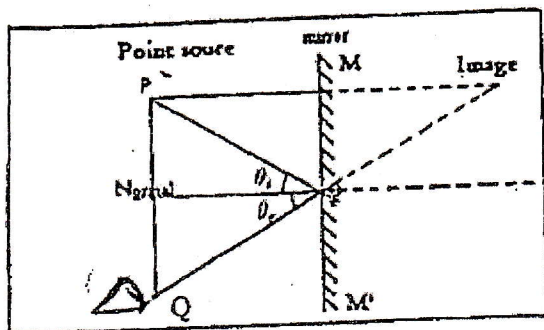
8. a) Expansion, physical change of its state or chemical change (combustion), light effect, heat energy and increasing of temperature.
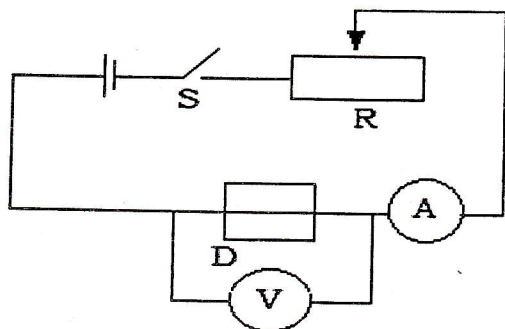
   b) Combustion

9. a)

   b) A: North, B: South

10. a)

   b) R: Rheostat; to vary the amperage, S: Switch; to open or close the electrical circuit.

11. a) The heat capacity of a body is the heat required to raise its temperature by 1K. The SI unit of heat is J/K. The heat capacity of an object is the proportionality constant between the heat Q that the object absorbs or loses and the resulting temperature change of the object. That is; $Q = \mu\Delta T = \mu(T_f - T_i)$

   b) Mass of water: $Q = mC\Delta T \Longleftrightarrow m = \dfrac{Q}{C(T_f - T_i)} = \dfrac{2100}{4200 \times 10} = 0.05 kg$

12. a) The SI unit for pressure is pa

   b) Pressure: $p = \dfrac{F}{A} = \dfrac{200}{0.5} = 400 Pa$

   c) The reason is, the flat side has a greater surface area (less pressure) and so it does not cut the fruit. When we take the thin side, the surface area is reduced and so it cuts the fruit easily and quickly.

13. a) Friction is the force exerted by a surface as an object moves across it or makes effort to move across it. The friction force often opposes the motion of an object.

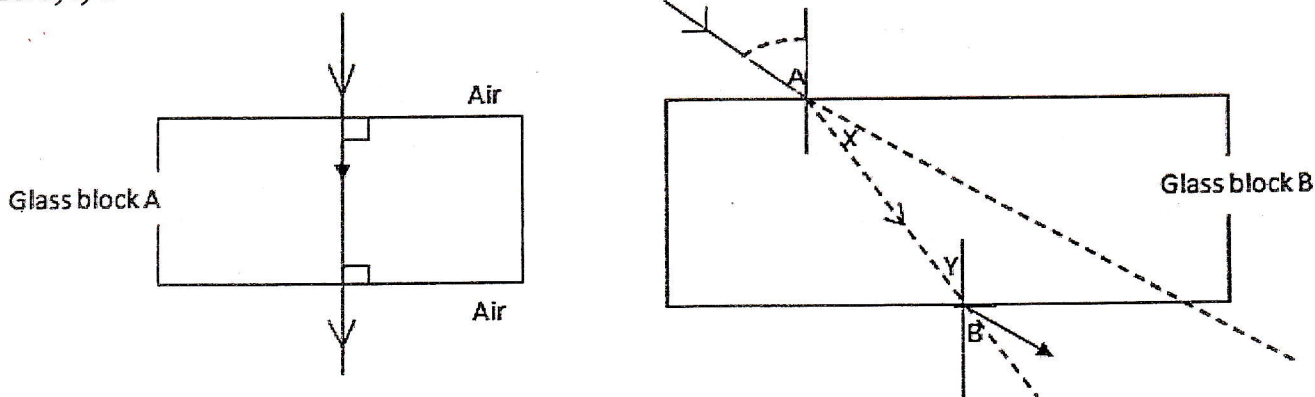   b) it helps us to avoid slipping.

   c) By lubrication

14. a) Mary's power: $\dfrac{Fd}{t} = \dfrac{700 \times 10}{14} = 500 W$;   John's power: $\dfrac{Fd}{t} = \dfrac{600 \times 10}{12} = 500 W$
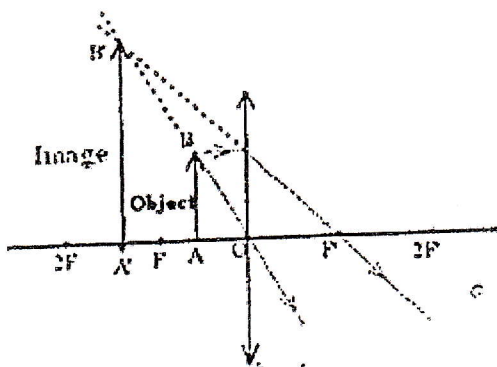
b) Mary is as powerful as John, since they have the same power.

SECTION B

16. a) i) ii

Air

Glass block A

Air

Glass block B

b) i)

ii) The object is located in front the focal point (F), object between the lens and (F), the image behind the object, virtual, erect and larger than object.

c) Eye telescope, microscope, camera, magnifying glass etc.

17. a) The specific latent heat of fusion (melting) of a substance 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. The SI unit is J/kg.

b) i) From A to B: the particles lose energy and become increasingly tight and reduced vibration (disturbances) and hence lower temperature.

ii) B to C: Particles lose more energy and the liquid solidifies at constant temperature.

iii) C to D: The body becomes stronger still, loses energy and intensity of vibration of particles continues to decrease until it reaches room temperature.

c) The heat lost between B and C is called the latent heat if solidification.

18. a) Shadows are formed because light travels in straight lines.

b)

Penumbra   Umbra

Source of light   Obstacle
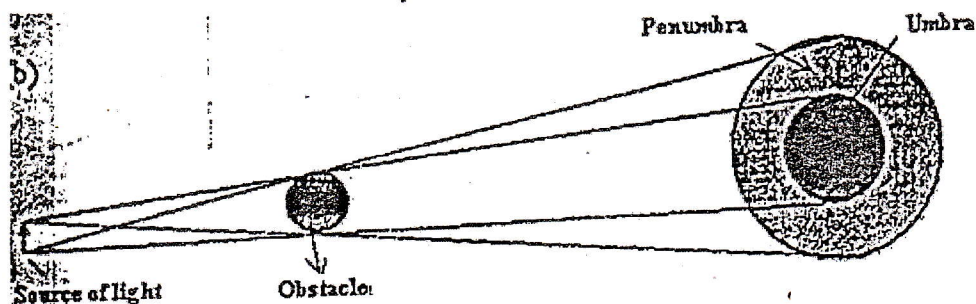
c) An eclipse occurs when the moon is between the sun and the earth or when the earth is between the sun and the moon and all are aligned.

d) i) The small hole is used to create a point source to have a clear image.

ii) The box darkroom is used to prevent entry of unwanted light.

iii) The frosted glass receives the image (screen) or allows observing the image.

e) The height of the object: $y = \dfrac{h^1}{h} = \dfrac{q}{p} \Rightarrow h = \dfrac{h^1 p}{p} = \dfrac{3 \times 30}{15} = 6\text{cm}$.

19. a) Chemical energy – electrical energy – heat energy – light energy (radiation)

b)

Advantage	Disadvantage
Cheap	Lower intensity
Not heavy	With polarized light (short term)

c) i) Fig A: Series connection and Fig B: parallel connection
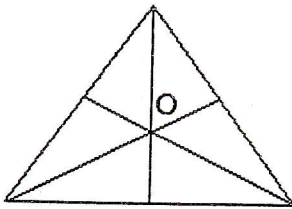
ii) In circuit of Fig A: $i = \dfrac{E}{R} = \dfrac{1.5 \times 2}{2} = 1.5$ A, In circuit of Fig B: $i = \dfrac{E}{R} = \dfrac{1.5}{2} = 0.75$ A

iii) The circuit in Fig. B consumes less energy and if one battery is defective, the circuit can operate without problems.

20. a) Stable equilibrium, unstable equilibrium and neutral equilibrium.

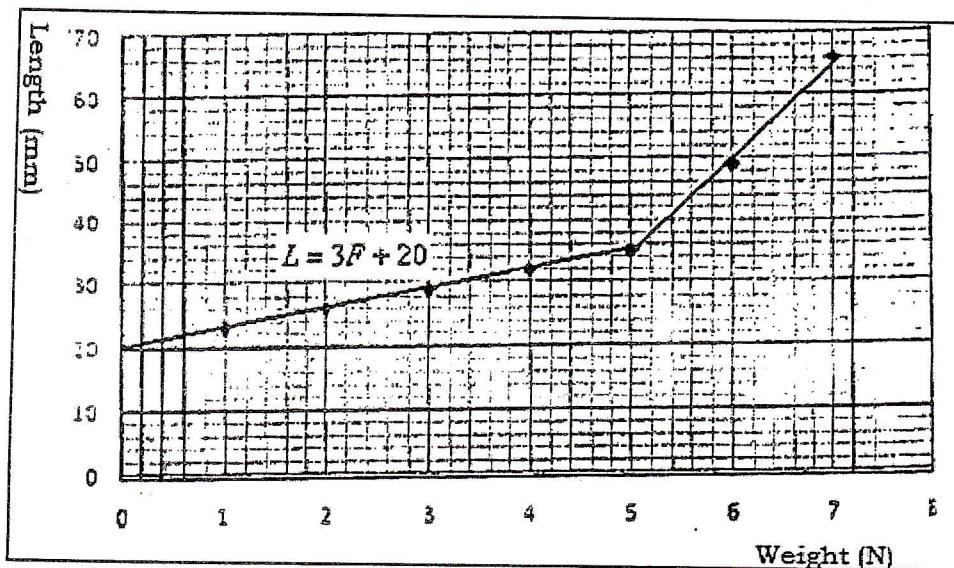b) By increasing the support base; lower center of gravity.

c)

d) When the centre of gravity of vehicle-passengers is high, the vehicle may be at an angle.
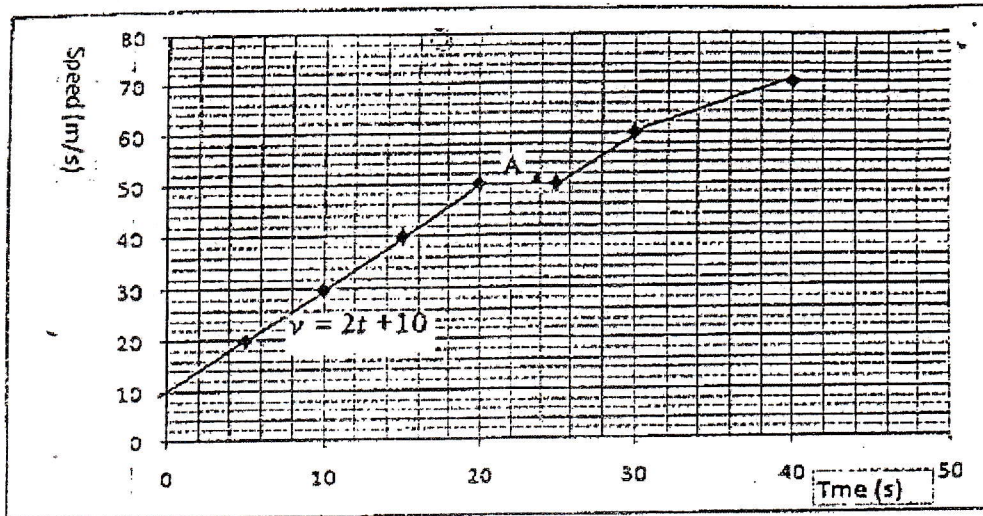
SECTION C:

21. a)

b) The original length of the spring is 20mm.

c) From the equation: $L = 3F + 20 \Rightarrow L = 3 \times 1.7 + 20 = 25.1$ mm, and hence the spring stretched by: $25.1 - 20 = 5.1$mm.

d) When the spring reaches its elasticity limit, its length is 35mm.

22. (a) and (c)

Graph of Speed (m/s) versus Time (s) showing line $v = 2t + 10$ with point A marked.

b) Initial velocity of the moving body: 10m/s.

d) The speed is constant for 25s - 20s = 5s.

23. a)

Pressure (units)	3	4	6	12
Volume(units)	4	3	2	1
1/V	0.25	0.33	0.5	1

b) The pressure is inversely proportional to the volume or when pressure increases, volume decreases

c)

Graph of Pressure versus $1/V$ showing line $P = 11.97x + 0.021$.
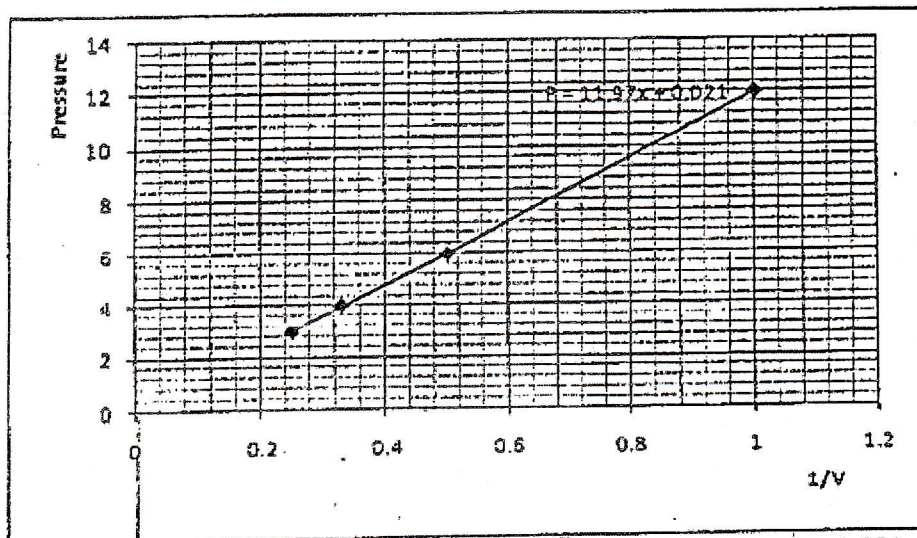
d) From the equation of that graph: $P = 11.97x + 0.021$, if $P = 9 \Rightarrow x = \dfrac{9 - 0.021}{11.97} = 0.750$ and hence

$x = \dfrac{1}{V} = V = 1.33$

END.