COMPETENCE BASED ASSESSMENT PHYSICS ITEMS WORK BOOK

SENIOR ONE TO SENIOR FOUR

BASED ON THE NEW LOWER SECONDARY CURRICULUM

By

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SCHOOL:_____ **YEAR:**_____

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Preface

This learner's topical items book has been written in line with the revised physics syllabus for the new lower secondary curriculum.

This is a topical based trial items book designed to tackle major topics in the current syllabus.

The items are graded in each topic and the main objective is to present the material in a manner for easy comprehension and understanding.

The book aims to develop both an understanding of the important concepts of physics and some analytical skill in the solutions of problems.

The main reason for the designing of this book is to provide enough items for the students' revision in order to perfect in the subject and also provide confidence in the students after being exposed to a number of items in this book.

It is hoped that the book will be found useful for students' revision items at New Ordinary level ***and it will be more useful to a learner if he or she has the " Lwanga William Physics Learner's Research Book (detailed physics new curriculum notes)" by the same company.***

This learner's items work book is one of the materials which are to be used to support the teaching and learning process of the new lower secondary curriculum.

Lwanga Books Ltd feels confident that this Book will be of immense value to both the learners and the teachers.

Any suggestions for improvement of this book are most welcomed, thanks.

"It is not what We do for you but what We will teach you to do for and by yourselves that will eventually make you successful beings in the society"

Acknowledgement

Lwanga Books Limited is deeply indebted to all those who participated in the development of **Lwanga William S1-S4 Competence Based Assessment Physics Items Work Book.**

Special thanks go to **Mr. Lwanga William**, the CEO Lwanga Books Ltd for his valuable insights and advice on all publishing matters.

We would like to express our sincere appreciation to all those who worked tirelessly towards the production of this learner's physics items workbook.

First and foremost, we would like to thank our families and friends for supporting all our initiatives both financially and spiritually, Lwanga William's parents; **Mr. William Lwanga** and **Mrs. Harriet Lwanga,** his brother; Mr. Nsubuga Grace.

The initiative and guidance of the publishing partners, Ministry of Education and Sports (MoES) and National Curriculum Development Centre (NCDC) in development and implementation of the New Lower Secondary Curriculum are highly appreciated.

We thank God for the wisdom He has given us to produce this volume of work.

May the Almighty God bless all the students that will use this book with knowledge to encounter and comprehend all the CBA Scenario Items incorporated in this CBA Physics Items Book……..**AMEN**.

We welcome any suggestions for improvement to continue making our service delivery better.

NB: "Search" {lwanga william} on youtube and subscribe (also tap on the notification bell) to that you-tube channel and watch the subject based project lessons that are on-going. " subscription is for free"

INTRODUCTION TO PHYSICS

Introduction to physics as a natural science

Item:

In a certain community, physics is identified as fundamental in understaning the world around us and has numerous applications in the society. One of the garages in that community decided to give a monthly test to all its workers so as to keep them updated.

A penalty was attached " *any worker that fails the all test, will not be given his or her monthly pay".* This has put all workers on tension.

Task:

Using your knowledge of physics, help the workers to understand;

1. (a) What physics is?.

It is the study of matter in relation to energy (Defines matter and energy).

(b) branches of natural sciences.

- Physics.
- Biology.
- Agriculture.
- Chemistry.

(c) career opportunities in physics:

- Engineering.
- Agriculture.
- Radiography.
- Medicine.
- Astronomy.
- Teaching/lecturing
- Geology etc.

2. (a) steps involved in scientific approach.

- Experimentation.
- Measurements.
- Analysis.
- Conclusion where necessary.

(b) branches of physics.

- Mechanics: deals with forces under various conditions.
- Properties of matter.
- Optics

(a) Geometrical optics (light)

(b) Physical optics (waves)

- Heat: Energy in motion due to temperature difference.
- Sound: Due to vibration of objects.
- Electricity:

(a) Static electricity (electrostatics)

(b) Current electricity

- Magnetism.
- Electromagnetic induction

(Relationship between magnetismand electricity).

- Modern physics:

(a) Atomic physics

(b) Nuclear physics

(c) Electronics.

(c) reasons why physics studied?

- To help society understand why certain things behave the way theydo. Example

(a) Why the sky appears blue;

(b) The behaviour of planetary systems (sun, moon, etc.) to mention but a few.

- Provides skills to people who in turn provide services to others inthe community.
- To discover new things that have not been discovered yet.
- Helps us to acquire jobs e.g. doctors, teachers to mention but a few.
- Helps the society to understand phenomenon; natural or artificial.

Laboratory rules and precautions

Item:

In a cetain village, quality control inspection involves testing products and materials using the knowledge of safety protocols, proper equipment usage and emergency procedures to ensure accurate results and safety.

Task:

As a physics student;

1. (a) Advise the village inspectors about the basic laboratory rules:

- Strictly adhere to instructions as given by your teacher (the instructor).
- Do not eat, drink or smoke whilein a laboratory.
- Inform your teacher at once about any accident.
- While in a laboratory do not run,play or throw things.
- Do not touch live open electricalcircuits.
- Be punctual.
- Read or listen carefully to the experiment instructions to avoid wastage during the experiment.

(b) A good laboratory must have a fire extinguisher and first aid kit. List down items that make up a first aid kit.

- A pair of scissors
- Bandages
- Adhesive plaster
- Sterilised cotton wool and gauze
- Dilute antiseptic solution
- Safety pins
- Forceps
- Gloves.

Item:

The importance of physics in our lives and the country at large is highlighted by the many applications that physics has made possible in people's lives, however most people are not aware of this significance especially our old generation.

Task:

Using the knowledge of physics, help the old generation to understand;

1. How physics is important inagriculture.

2. How physics can be used to boost the economy of a country.

3. Instances where physics relates to history and business.

4. The laboratory rules by grouping them under the following headlines.

(a) Electricity.

(b) Heat.

(c)General rules.

5. The first step(s) to do when you smell unusual gas in the labarotory.

FORCES

Meaning and effects of a force

Item:

In a certain town, people are concerned about car safety. They raised this issue to the concerned(LC1) who directed the car manufacturing companies to do the needful. A town scientist was invited to analyse the case and after her analysis, she quoted *" undrestanding the forces involved in collisions (inertia, friction, momentum) will help car manufacturers design safer vehicles and safety features like airbags and seatbelts"* and this left the chairman LC1 confused.

Task:

As a physics student, help the chairman to understand;

1.(a)(i) The term force and its SI unit.

(ii) Briefly seven types of a force.

(iii) Briefly three effects of a force.

Realtionship between mass and weight

Item:

During Aviation in Uganda, a pilot instructor said that pilots need to consider the weight and mass of their aircraft, fuel, and cargo to ensure safe takeoff, landing, and flight dynamics. This statement left most of the ministers confused and wanted to know more about the two concepts used in the instructor's statement.

Task:

Using your knowledge of physics, help the ministers to briefly know;

1. (a) The following terms:

(i)Mass.

(ii)Weight.

(b) Any three differences between mass and weight.

(c) The weight of the following masses.

(i) 2 kg.

(ii) 26 500.25 g.

(iii) 0.0731 kg.

(iv) 430 mg.

(d) How mass and weight of a body is measured.

Mass of a body is the quantity (amount)of matter in the body. The mass of a bodyis measured by balancing it against a known mass.

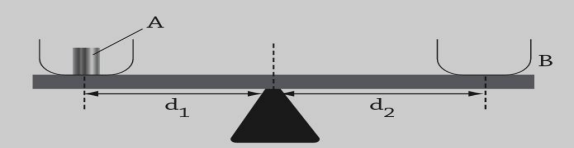


Fig.2.1 : Lever balance

The mass of a body A can be known if thatof B is known.Note that $d_1 = d_2$.
(Principle of movements).
The instruments that use this principleare scalepan, Tripple balance and lever balance.
Weight of the body is measured directly using a spring balance. It uses the principle that extension of loaded spring is proportional to the load.
The scale on this type of balance has to be calibrated by attaching known masses or applying a known force on a beam balance.

Fig. 2.2 : A spring balance

(e) The weight of a 60 kg girl on planet Y if the acceleration due to gravity on planet Y is a fifth that of the earth.(acceleration due to gravity g on earth = 10 N/kg)

Item:

During physics engineering in any country, scalar and vector calculations are essential for designing and optimizing systems like engines, gears and transmissions.

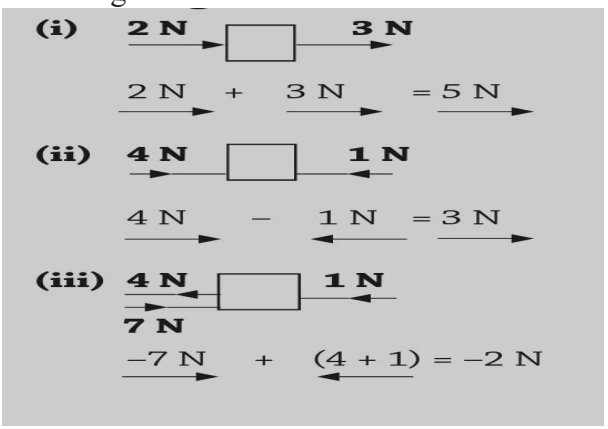
Task:

As a learner of physics;

1. (a) Distinguish with examples between scalar and vector quantities.

Scalar quantities are quantities with only magnitude (size) e.g. Density, area,mass, time, pressure, work, energy, volume, distance and speed.
A vector quantity is that with both magnitude (value) and direction e.g. momentum, force, impulse, accelerationand velocity.

(b) Determine the resultant force on the following.



(c) (i)Two forces of 3 N and 4 N act at right angle at the same point on an object in Fig 2.3.

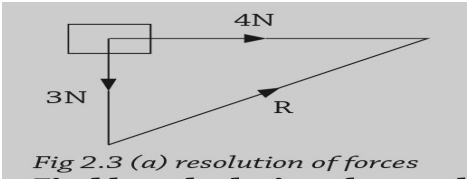


Fig 2.3 (a) resolution of forces

Find by calculation the resultant force which is equal in magnitude and direction to the two forces.

(ii) If two forces of 5 N and 12 N act on a body of mass 2 kg at right angle to each other, find the resultant on the body.

Frictional force

Item:

Understanding frictional forces is vital in various fields, from vehicle safety and machine designing to sports equipment and medical devices, to ensure efficiency, safety, and performance. Engineers consider frictional forces to optimize gear trains, bearings and other mechanical systems for efficiency and durability.

Task:

Therefore as a learner of physics;

1. (a) (i)Define friction as used in forces.

Friction is a force that opposes relative motion of any two surfaces incontact.

(ii) State and explain two types of friction.

(b)(i) Give at least four advantages of frictional force.

(ii) Give atleast four disadvantages of frictional force in our everydaylives.

(c) State ways of:

(i) increasing friction.

(ii) minimizing friction.

2. (a) State laws of friction.

- Friction depend on the nature ofsurface and materials in contact.
- Friction is acting parallel to surface and opposite to the direction of motion caused by force.

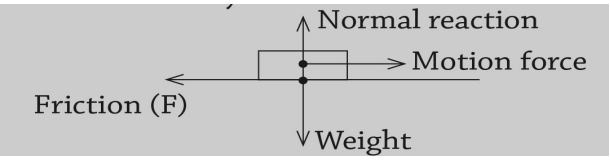


Fig 2.4 : Forces on moving block

- Friction is proportional to the pressing force (normal reaction) i.e. F =μR.
- Friction is independent of the speed.

(b) An object of mass 0.5 kg rests on a horizontal surface and a force of 4.0 N is required to make it move.

(i) Sketch a diagram showing all theforces acting on this body .

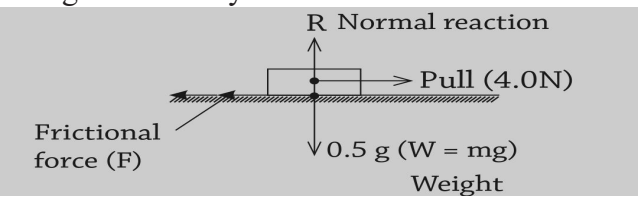


Fig 2.5 : Forces acting on moving object

(ii) Calculate the coefficient of static friction.

(c) A block of mass 250 kg is pulled on a lavelled ground. The coefficient of sliding friction between the block and the ground is 0.4. If the block hasa uniform acceleration. Determine theforce pulling it?

(d) Describe an experiment, you would use to determine the coefficient of static friction.

- Static friction exists upto a point when motion just starts. So its value can be determined by adding known weights to a pan shown as in the Fig 2.6.

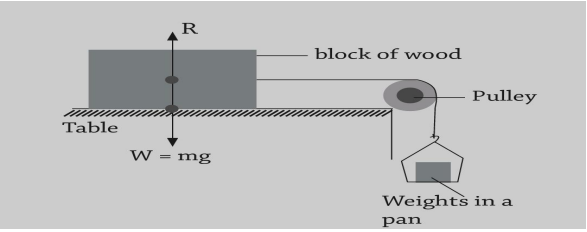


Fig 2.6 : Determining the coefficient of static friction

- A block of wood of known mass is connected to a pan using a string which passes over a pulley. Known weights (mass) are added unto the pan until the wood just begins to move. (The masses or weights including that of thepan, F is recorded).
- The value of F is the static friction acting on the wooden block.

From $\mu = \frac{\text{Frictional force}}{\text{Normal reaction}}$

$\mu = \frac{F}{R}$;

where R is the normal reaction (R = mg).

Hence, the coefficient μ, of static friction can be determined.

Fluid flow

Item:

Most of the developed countries use fluid flow to design flood control systems like dams, levees, and stormwater management systems. So, understanding fluid flow is essential in various fields, from energy generation and transportation to medical applications and environmental management, to optimize performance, efficiency, and safety.

Task:

Therefore, as a physics learner;

1. (a) Throw some light on the term a fluid.

A fluid is any substance that flows freely e.g. gases and liquids.

(b) Write short notes about the following terms :

(i) Viscosity.

Viscosity is the resistance offered by fluid to oppose the motion of a body influids.

(ii) Streamline flow.

Streamline flow is the type of fluid flow where fluid layers are equidistant from each other and the layers move with the same velocity in the same direction.

(iii) Turbulent flow.

Turbulent flow is the type of fluid flow,where fluid layers move with different velocity in different directions.

(c) List down applications of streamlineflow.

2. (a) Explain the meaning of fluid friction?

Fluid friction is the resistance to the motion of a body passing through a fluid.

At times called viscous drug. The more viscous a fluid is e.g. glycerine, the greaterthe fluid friction.

(b) State factors that affect viscosity.

(c) Describe the motion of a ball bearing when dropped in a transparent jar filled with glycerine.

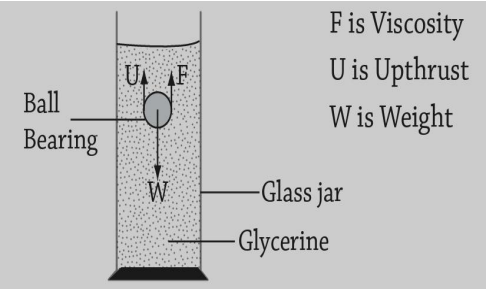
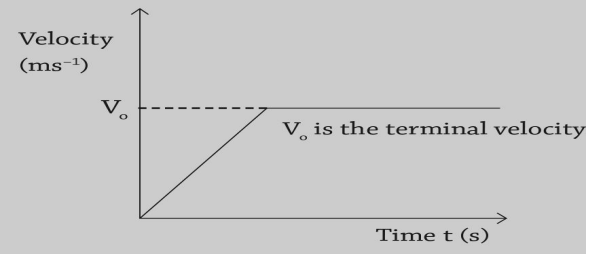


Fig 2.7 : Motion of body in fluid

A ball bearing is dropped into a glass jar containing glycerine (clear viscous liquid) and its motion observed.
The ball bearing at first accelerate and attains a constant maximum velocity. The ball accelerates because the weight is greater than the upthrust (U) and the fluid friction (F).
Since viscosity increases with motion, there reaches a time when the weight equals the sum of the upward force., i.e.W = U + F.
At this point, a constant maximumvelocity called terminal velocity is reached, i.e. there is no acceleration.
(d) Explain the term terminal velocity using a graph.
Terminal velocity is the constant maximum velocity which a body attainsin a fluid when the resultant force on it is zero.
i.e. Weight = Viscosity + upthrust

$$W = F + U$$

A graph of velocity against of a body in a fluid



Item:

Understanding weight is essential in various fields, from aviation and engineering to medicine and space exploration to ensure safety, efficiency, and accuracy. During space exploration, weight is a critical factor in spacecraft design, fuel calculation, and astronaut safety.

Task:

Therefore, having studied physics;

1. Calculate:

(a) the weight of:

(i) 2 kg of water,

(ii) 400 g of onion.

(b) the tension developed in a string supporting a mass of 120 g.

2. Give an explanation to the following;

(a) A steel cable of about 3 cm diameter is able to lift a heavy load like a lorry or a truck.

(b) Antiseptics used for cuts and other wounds have a low surface tension.

(c) A gardener is advised to loosen the soil for healthy growth of the plants.

Item:

A small ball bearing is allowed to fall freely through a liquid of high viscosity. The ball bearing accelerates for 0.2 s and acquires 'terminal velocity' after 1.0 s.

Task:

Using your knowledge of physics;

1. (a) Define the term "terminal velocity".

(b) Explain, in terms of the various forces acting, how the ball bearing acquires

terminal velocity.

(c) Sketch a graph of velocity (y-axis) against time and label the axes.

Item:

In a certain community, during pipe flow and river flow, engineers use streamline flow in designing pipelines for efficient fluid transportation and turbulent flow to understand river flow, sediment transport, and flood dynamics. So, understanding streamline and turbulent flow is crucial in various fields, from aerodynamics and pipe flow to medical applications and environmental remediation, to optimize performance, efficiency, and safety.

Task:

Using your knowledge of physics;

1. (a) Distinguish between a streamline flow and a turbulent flow.

(b) Explain why cars are made narrow at the front.

2. Explain the following statements:

(a) An air flow over the wings of an aircraft causes a lift.

(b) Flags flutter in a breeze.

(c) It is dangerous to stand near the edge of a platform in a railway station, when a train passes without stopping.

(d) A spinning ball curves during its flight.

(e) It is difficult to push a table tennis ball completely out of the funnel, held upright, by blowing air from underneath through `the narrow end of the funnel.

(f) In a strong wind, the thatched roof of a hut can be completely lifted off although the walls are not appreciably damaged.

MOMENT OF A FORCE

Principle of moments

Item:

Rock company is a prominent company in uganda. During construction and architecture, its engineers use moments to calculate the stress and stability of buildings, bridges, and other structures. Therefore, the principle of moments is essential in various fields, from construction and mechanical engineering to sports equipment design and medical devices, to ensure stability, efficiency, and safety.

Task:

Having studied physics;

1.(a) Define the following terms:

(i) Moment of a force.

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(ii) a couple of force.

A couple of force is a pair of equal parallel but opposite forces acting on a rigid body whose only effect is to turn the body.

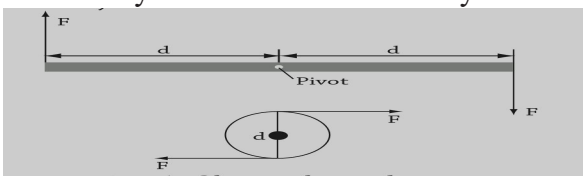

Fig 3.1 : Object under couples

(iii) Torque of a force

A torque is a moment of couple which is equal to the product of one of the force and perpendicular distance between theforces.

Torque = F × d

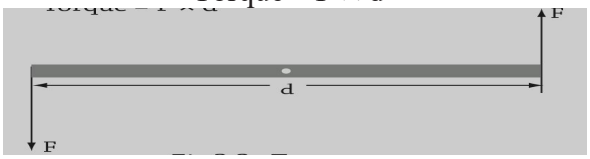

Fig 3.2 : Torque

(b) (i) State the principle of moments.

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(ii) Describe an experiment to verify the principle of moments.

Balance a metre rule on a knife-edge and note the balancing point P as shown in Fig 3.1.

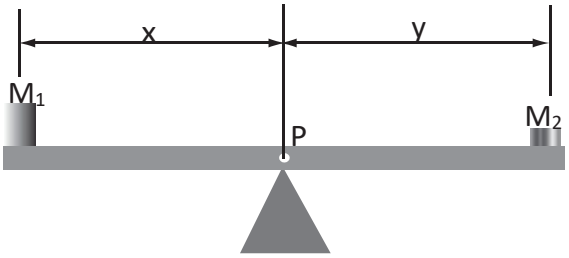

Fig 3.3 : See Saw

- Place a mass M_1 at a distance x from the balance point P and place another massM_2 on the opposite side of P. Move the mass M_2 until the metre rule balances again. Note the distance y of M_2 from P.
- Repeat the procedure using other masses M_2. Tabulate results including M_1gx and M_2gy, where g is the acceleration due to gravity.
- It will be observed from the result that $M_1gx = M_2gy$ hence verifying the principleof moments.
- The moment of the weight of mass M_1 about P is always equal to the moment ofthe weight of mass M_2 about P when the metre rule is in equilibrium.

(c)(i) State how one can increase themoment of a force.

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(ii) Give two examples where moment of a force is increased considerably in practical life.

- When closing a door or window, more force has to be applied to make the door close easily a higher speed.
- Cutting wires using pliers or bottle top openers. The handles have to be aslong as possible.

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2.(i)Explain why the handle of car door is placed away from the hinges.

A force is applied at a greater possible distance from the hinges (pivot or fulcrum). This gives the maximum moment and a force applied to open thewill be reduced.

(ii) If the handle is 80 cm from the hinges and a force of 65 N is applied to open the door. Calculate the moment of a force.

(iii) State and explain the best direction for the force when the door is being opened.

At right angle to the plane of the door. Moment is the product of perpendicular distance and force.

In order for moment to be maximum, force should be applied at a right angle tothe plane of the door.

(iv) State two applications of theprinciple of moments.

3.(a) Give any effect of both moment and couple of a force.

Causes turning effect on a body about a fixed point called a pivot.

(b) Give any three applications of moments or couple of a force.

4.(a) A uniform beam of mass 8 kg and length 5 m is balanced at point 2 m as shown in the Fig. 3.4. (Take **g = 10 N/kg)**

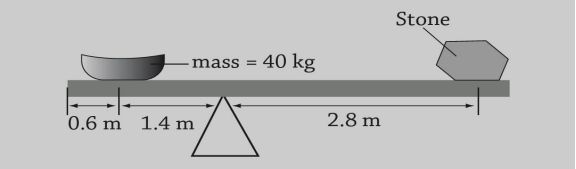

Fig. 3.4: Beam balance

If the system is in equilibrium, determine the weight of the stone.

(b) Figure 3.5 shows a system in equilibrium where T and S are bar magnets. (Hint: Unlike poles attracts,while like poles repel).

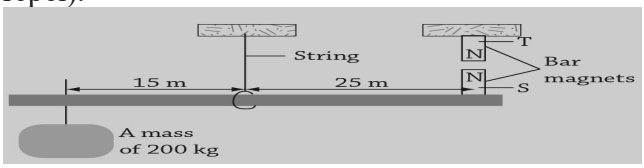

Fig. 3.5: System in equilibrium

Determine the magnetic forcebetween the bar magnets.

5. A uniform pole PQ of length 2 m and mass 6 kg carries a load of 4 kg as shownin Fig 3.6 (a), and is resting on a horizontal surface.

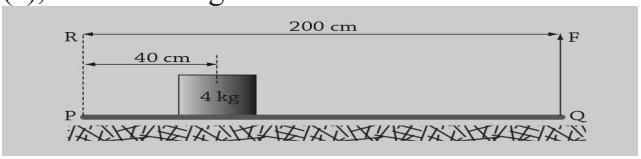

Fig. 3.6 (a) Load on a pole

(i) Calculate the minimum force F applied, to lift the beam at the end Q.

(ii) Find the reaction at P when end Q has just got lifted.

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Centre of gravity

Item:

In the world of work, centre of gravity is essential in calculating the stability and lifting capacity of cranes and hoists. Therefore, understsanding the centre of gravity is vital in various fields, from aircraft design and shipbuilding to sports equipment design and medical equipment, to ensure stability, balance, and safety.

Task:

Having studied physics;

1. (a) (i)Define the term centre of gravity.

Centre of gravity of a body is thepoint through which the whole weight of the body seems to act.

Is the point in the body which weight appears to be concentrated.

(ii) Describe an experiment to determine the centre of gravityof an irregular object e.g. a lamina.

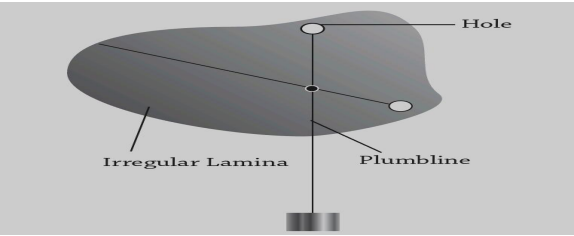

Fig. 3.7 : Centre of gravity of a lamina

- Drill at least two holes near the edge ofa lamina (sheet).
- The lamina is suspended by means of a nail through one of the holes. A plumbline is suspended at the nail.
- A line is drawn along the string of the plumbline. The lamina is then hung at another hole and the plumb line is suspended again at this hole. A second line is drawn along the thread of the plumb line. Where the two drawn lines intersect, is the centre of gravity of the lamina.

Stability and equilibrium

Item:

1. Understanding stability and equilibrium is crucial when designing furniture. Furniture designers must consider stability and equilibrium when creating tables, chairs, and other pieces. Ensuring that furniture is sturdy and balanced can prevent accidents and injuries.

Task:

Having studied physics, help furniture designers in understanding;

(a) T h e conditions necessary for a body to be in a state of mechanical equilibrium.

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(b) With one example each, describe the following states of equilibrium :

(i) Stable equilibrium.

Stable equilibrium is the state of a body where when it is slightly displaced(tilted), it moves back to its original position when released. This is because tilting it raises the centre of gravity and by moving back to original position, islowering the centre of gravity.

Example of stable equilibrium is a book resting on its largest surface area.

(ii) Unstable equilibrium.

Unstable equilibrium is the state of a body where when it is slightly displaced(tilted), it moves further away from its original position when it is released.

This is because tilting it lowers thecentre of gravity and by moving further, it is lowering the centre of gravity and becoming more stable in anew position.

An example is a bottle standing upsidedown.

(iii) Neutral equilibrium.

Neutral equilibrium is the state of a body where when it is slightly displaced(tilted), it just stays in the new positionwhen it is released. Tilting it does not affect the

height of the centre of gravity and stability remains the same.
An example is a ball on a horizontal plane (surface).

Item:

1. Fig. 3.8 shows pool balls P, Q and R. P is placed on a flat surface, while Q and R are placed on and inside a dish, respectively.

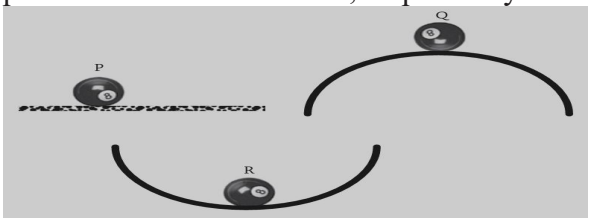

Fig. 3.8: Types of equilibrium

Task:

Name and explain the state of equilibrium in each of the cases in Fig 3.8.

Item:

2. (a) The Fig 3.9 shows an old type of a bus carrying a lot of luggage on top.

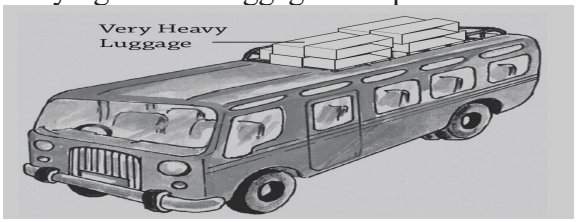

Fig. 3.9 : An overloaded bus

(i) Which state of equilibrium is the bus in?

(ii) Explain two factors that determine the stability of this bus.

(b) Explain why a half-filled jerry can of water is more stable than an empty jerry can of same dimensions and material, when standing upright.

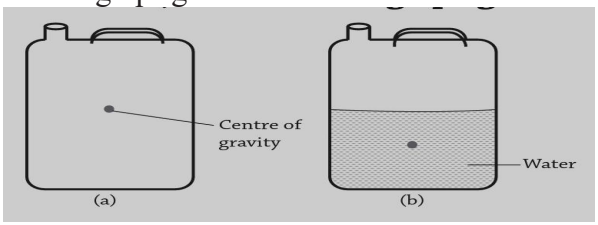

Fig. 3.10 (a) Empty jerrican (b) Half filled jerrican

When the jerry can is empty its centre of gravity is near the mid-point of the jerry can. When the jerry can is half-filled with water the centre of gravity is lowered due to the weight of water in lower half.

This makes the half-filled jerry can more stable than the empty one.

(c) State the measures taken to increase stability of a double-decker bus.

(i) during its construction

- The engine and chassis of the bus are placed as low as possible.
- The upper deck and seats are made of light material.
- The bus is constructed with a wide base area.
- Luggage compartments are placedunder the seats.

(ii) when it is operating on the road.
Standing passengers may be allowed in the lower deck but not the upper one i.e the passengers are advised to always be seated.

Item:

3. A force of 20 N is applied to open the gate of a fence at a distance of 1.4 m from the

pivot. Calculate the moment of force about the hinges.

Item:

4. A person applies a force of 500 N and produces a moment of force of 300 Nm about the wheels of a wheel cart (Figure 3.11). Calculate the perpendicular distance x from the line of action of the force to the wheels.

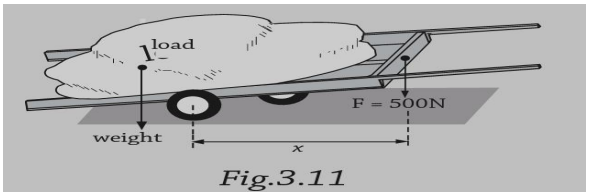

Fig.3.11

Item:

5. A uniform metre rule is balanced horizontally at its centre. When a mass of 5 g is suspended at the 4 cm mark, the rule balances horizontally if a mass M is suspended at the 60 cm mark. Calculate M.

Item:

In Figure 3.12, calculate the value of the unknown mass M, when the uniform plank is balanced horizontally.

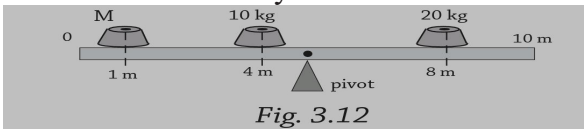

Fig. 3.12

Item:

Figure 3.13 shows a uniform meter rule of mass 100 g that is balanced over a pivot using a spring and a force of 3 N. Calculate the tension in the spring.

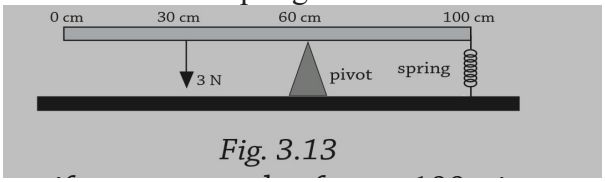

Fig. 3.13

Item:

A uniform metre rule of mass 100 g is supported using a spring X at its centre of gravity. Determine the tension in each spring when the arrangement is as shown in figure 3.14.

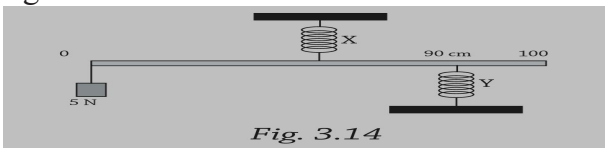

Fig. 3.14

Item:

A weightlifter supports with one hand a 15 kg iron bar 3 m long, while masses of 90 kg and 75 kg hang from the two ends of the bar. Sketch a diagram of the set up andcalculate;
(a) the force applied by the weightlifter to support the bar horizontally,

(b) the distance from the centre of gravity of the bar where the force is being applied.

Item:

A long heavy uniform plank AB of length 10m is pivoted at a point X, 4 m from B. A load is attached at the end A to support the weight of a stone of mass 45 kg stands at the end B. The load is adjusted when it is moved towards the pivot X to keep the system in equilibrium (Figure 3.15).

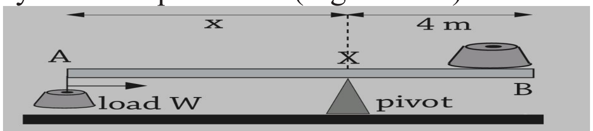

Fig. 3.15

Table 3.1 shows the load W, when the distance x is adjusted to keep the plank horizontal. The value of $(1/x)$ also has been included.

W (N)	267	320	400	560	640	800	
x (m)	6.0	5.0	4.0	2.9	2.5	2.0	
1 (m^{-1})	0.17	0.20	0.25	0.35	0.40	0.50	x

Table 3.1

(a) Plot a graph of W (y-axis) against $1/x$.

(b) Determine the gradient of the line. What does the gradient represent?

(c) Use your value of the gradient and the moment produced to determine the weight of the plank.

PROPERTIES OF MATTER

Molecular properties of matter

Item:

Environmental scientists study the molecular properties of matter in air, water, and soil to analyse pollution levels and their impacts on human health and ecosystems. Understanding how pollutants like heavy metals or pesticides interact and disperse in the environment can help in developing effective mitigation strategies.

Task:

Therefore, having studied physics;

1. (a) (i)What is matter?

(ii) Give states in which matterexists.

(b) Explain the meaning of the term microscopic and macroscopic in relation to matter.

In microscopic arrangement, we deal with the study of an individual atom of matter i.e. what an atom is made of.

Inmacroscopic arrangement, we deal with the matter as a whole i.e. what matter is made of.

(c) Explain why density of a gas is much less than that of a solid.

(d) Explain why it is easier to compress agas than a solid.

(e) (i) Distinguish between melting and boiling.

Melting is a process of changing a solid to a liquid at constant temperature.

Boiling is a process of changing a liquid to gas at constant temperature.

(ii) Give the melting point of pure ice and the boiling point of pure water.

Kinetic theory and Brownian motion

Item:

Understanding kinetic theory and brownian motion helps in thermal engineering and pollution control. Engineers use kinetic theory in designing heating and cooling systems, like refrigeration and air condition.

Task:

Therefore, having studied physics;

1. (a) State the kinetic theory of matter.

(b) With aid of diagrams, describe the arrangement of particles in solids, liquids and gases.

Solids

The particles are held tightly together and cannot move relative to each other, but they can vibrate at fixed position. As a result, solids cannot flow. A solid has a definite shape and volume. Due to this, solids cannot be compressed very much. The solid has a high density because particles are much closer to each other.

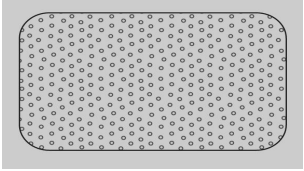

Fig 4.1 : Molecules in a solid

Liquids

The particles are a little further apart than in a solid. Particles vibrate and are also free to move about in constant motion. Liquids cannot be compressed very much. They have no definite shape and they can flow. They take the shape of the container in which they are placed.

The forces of attraction between liquid particles are weaker than those between solid particles.

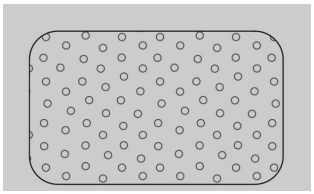

Fig 4.2 : Molecules in liquid

Gases

Particles are widely separated and can move independent of one another.

Gases can be compressed and they have no definite shape or volume. Particles move freely and faster than those in liquids.

Forces of attraction between the particles of a gas are much weaker than those between liquid and solid particles. The density of a gas is very much less than that of solid and liquid.

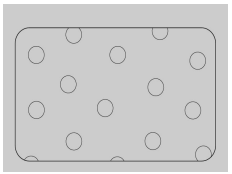

Fig 4.3 : Molecules in gases

(c) Use the kinetic theory of matter to explain melting and evaporation.

When a solid is heated, the strong intermolecular forces between its particles are weakened, making the particles to break loose from their positions hence melting.

When a liquid is heated, the weak intermolecular forces between its particles are weakened further and the more energetic particles keep escaping from the liquid surface, hence evaporation. The liquid cools because less energetic particles are left.

(d) (i) Explain the term Brownian motion?

Brownian motion is the demonstration that liquid and gas particles are in constant random motion.

(ii) With a labelled diagram explain how you can demonstrate Brownian motion in gases and liquids.

In gases

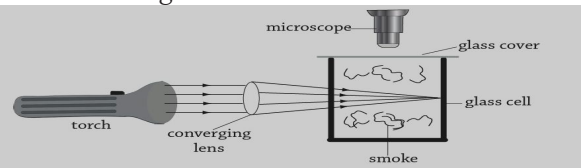

Fig 4.4 : A Smoke cell

Smoke is trapped in a glass cell and theglass properly shone by light from a bulb.

With the smoke viewed directly from above using a microscope the molecules of air collide with that of smoke producing the constant randommotion.

In liquids

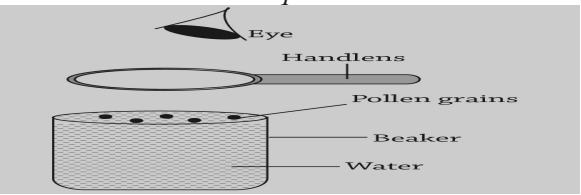

Fig 4.5 Pollen grains onwater

Pollen grains are sprinkled on the water surface contained in a glass and viewed through a microscope. The pollen grains are observed to be in a constant random motion. This is because the invisible water molecules in constant random motion continuously collide with the pollen grains.

(iii) Explain factors that affect Brownian motion.

(iv) Explain what is observed when a smoke cell containing smoke is placed on ice blocks and viewed by a microscope.

Surface tension

1.(a) Define the term surface tension.
Surface tension is the tendency of a liquid surface to behave as if it is a stretched thin elastic skin in a state of tension. This is the reason why an insect (pond skater)is able to walk on a water surface; a needlecan float on water.

(b) (i) Describe an experiment to prove the existence of surfacetension in liquids.
Place a blotting paper on the surface ofthe water in a beaker. Place an office pin on the blotting paper and leave theset up for sometime. The blotting paper eventually sinksleaving the pin floating.

(ii) State any two factors that affect surface tension in liquids.

(c) (i) State applications of surface tension.

(ii) Explain why camphor darts on the water surface.
Camphor is a hydrophobic substance which does not easily dissolve in water.When a small piece of camphor is placed on the water surface, it moves inan irregular path (darts). This is due to the camphor dissolving slightly and reducing on surface tension on

its one side. The camphor does not dissolve equallyall round the piece and alteration in surface tension is not balanced. The unequal forces acting around the piece will cause it to move in an irregularpath, hence darting. Small light boats or ducks can be madeto sail by attaching small pieces of camphor on them.

Diffusion and Osmosis

Items:

1. A carbonated beverage is left open overnight. Explain how the carbon dioxide gas diffuses out of the solution, resulting in a flat drink. Discuss the factors that affect the diffusion rate and provide examples.

2. A patient is receiving intravenous fluids to treat dehydration. Describe the process of osmosis that occurs as the fluids enter the patient's cells. Explain how osmosis helps restore cellular balance and discuss the importance of proper fluid balance in the body.

3. A perfume diffuser releases fragrance into the air. Compare and contrast the diffusion process in gases (perfume) and liquids (fragrance oil). Explain the similarities and differences in the diffusion processes and provide examples of each.

4. A farmer uses a fertilizer that relies on osmosis to deliver nutrients to plant roots. Explain how osmosis regulates the movement of nutrients into the plant cells. Describe the importance of osmosis in plant nutrition and provide examples of its applications in agriculture.

5. A medical device uses diffusion to deliver medication through a patch on the skin. Design an experiment to investigate the effect of patch size on diffusion rates. Describe the materials and procedures used and discuss the expected results. Explain how the experiment demonstrates the relationship between surface area and diffusion.

Cohesive and adhesive forces.

Items:

1. Drops of liquids A and B are put ona clean glass surface and appear asshown in Fig 4.7 a and b.

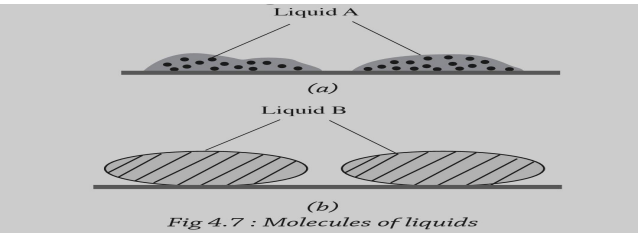

Fig 4.7 : Molecules of liquids

(i) What liquids could A and B be?

A is water.

B is mercury.

(ii) Explain why they appear as shown in Fig 4.7.

In A, adhesive force is greater than cohesive force, so the liquid spreadsand wets the glass. In B, cohesive force is greater than adhesion, so the liquid forms a spherical droplet and does not wet theglass.

2. A water droplet forms on a leaf surface. Explain the cohesive forces acting within the water droplet and the adhesive forces acting between the water and leaf surfaces. Discuss how these forces combine to create the droplet's shape and stability.

3. A gecko's feet can stick to walls and ceilings. Describe the adhesive forces involved in this phenomenon, including the role of van der Waals forces and electrostatic attraction. Explain how the gecko's foot structure enhances these forces, allowing it to defy gravity.

4. Compare and contrast the cohesive properties of liquids and solids. Explain how cohesive forces affect the surface tension of liquids and the strength of solids. Provide examples of how these properties are utilized in everyday applications, such as fluid dynamics and materials engineering.

5. A painter uses a specialized adhesive to bond two materials together. Explain the adhesive forces involved in this process, including the role of intermolecular forces and surface roughness. Describe how the adhesive's properties are tailored to specific applications, such as bonding metal or glass.

6. Design an experiment to investigate the effect of surface roughness on adhesive forces. Describe the materials and procedures used and discuss the expected results. Explain how the experiment demonstrates the relationship between surface roughness and adhesion.

Capillarity in liquids

Items:

1. A paper towel absorbs a spilled glass of water. Explain the capillary action that occurs in the paper towel, allowing it to draw up the water. Discuss the role of adhesive and cohesive forces in this process.

2. A tree root system is able to transport water and nutrients from the soil to the leaves. Describe the capillary action that occurs in the xylem vessels, allowing them to defy gravity and transport fluids. Explain the importance of capillarity in plant physiology.

3. Compare and contrast the capillary action in hydrophobic and hydrophilic materials. Explain how the contact angle and surface tension affect the capillary action in each type of material. Provide examples of applications in everyday life, such as waterproof fabrics and medical devices.

4. A laboratory technician uses a capillary tube to measure the viscosity of a liquid. Explain the principles of capillarity that allow the technician to determine the viscosity. Describe the importance of viscosity in fluid dynamics and engineering applications.

5. Design an experiment to investigate the effect of surface tension on capillary action. Describe the materials and procedures used and discuss the expected results. Explain how the experiment demonstrates the relationship between surface tension and capillary action.

Growing a crystal

1. **(i) Explain the term crystal cleavage?**

Crystals are solids with straight edges, flat sides and hard. Crystals of the same substance have the same shape. Cleavage is the line along which a crystalis split. So crystal cleavage is simply splitting of a crystal to form other crystals. Cleavage proves that Crystals are made up of small particles which are arranged in planes in an ordinary manner.Particles of crystals are held together by strong forces. Large crystals are made by adding layers of particles in a regular way.

(ii) Describe an experiment to show the growing of crystals.

Pour some warm water in a glass jar. Bit by bit, pour some sugar into the jar as youstir. Continue this process until the watercan dissolve no more sugar.

The solution is said to be saturated. Place a cardboard with several pieces ofthread protruding from it on top of thejar such that the threads are hanging in the solution. Leave the jar in undisturbedstate at least one day. When the threads are pulled out, some crumbs/crystals of sugar will be seen lined up on the threads.The experiment can be repeated with salt or copper sulphate.

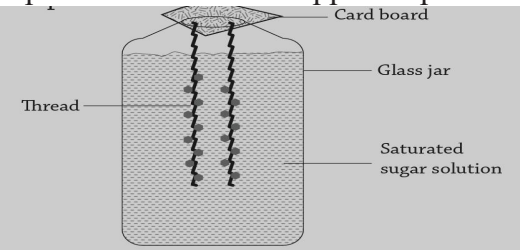

Fig 4.12 : Growing crystals

Items:

1. Having studied physics, Explain why;

(a) the density of a gas is much less than that of a solid or a liquid.

(b) a bottle of perfume sprayed at one end of a room can be detected shortly afterwards at the other end.

(c) diffusion takes place faster in gases than in liquids.

2. A smoke cell contains a mixture of trappedair and smoke. The cell is strongly illuminated by a powerful bulb and viewed through a microscope. Small bright specksare seen dancing in a random manner.
(a) What are these bright specks?

(b) Why do they move in the manner described above?

3. In an experiment to determine the thickness of an oil molecule, the following readings were obtained. The volume of the drop is 1×10^{-10} m^3 and the diameter of the circular film formed is 0.2 m. Calculate the diameter of the oil molecule, stating the assumption made.

4. If in item 3 above, instead of one drop, 5 such oil drops were used, what could be the
(a) thickness of the oil molecule and

(b) radius of the film formed on water.

5. An oil drop of volume 9×10^{-12} m^3 when allowed to spread on the surface of waterforms a circular patch of area 5×10^{-3} m^2. Calculate the diameter of the oil molecule.

MECHANICAL PROPERTIES

Properties of matter

Items:

1. A chef uses different materials (metal, wood, plastic) to cook and prepare food. Explain how the thermal conductivity of each material affects the cooking process. Discuss the importance of thermal conductivity in everyday life.

2. A engineer designs a new building material that must withstand extreme temperatures and pressures. Describe the properties of matter (density, specific heat capacity, elasticity) that are crucial for this material. Explain how these properties are related to the material's atomic structure.

3. Compare and contrast the properties of solids, liquids, and gases. Explain how the arrangement of particles and intermolecular forces affect the physical properties of each state of matter. Provide examples of how these properties are utilized in everyday applications.

4. A medical researcher develops a new drug that must be delivered through a specific medium (air, water, tissue). Explain how the properties of matter (solubility, diffusivity, viscosity) affect the drug's delivery and efficacy. Discuss the importance of understanding these properties in medical research.

5. Design an experiment to investigate the effect of pressure on the volume of a gas. Describe the materials and procedures used and discuss the expected results. Explain how the experiment demonstrates the relationship between pressure and volume, and relate it to the properties of gases.

Hooke's Law

Items:

1. A civil engineer designs a suspension bridge that must withstand various loads and stresses. Explain how Hooke's Law is applied to determine the stretch and tension in the suspension cables. Discuss the importance of understanding elastic potential energy in this context.

2. A materials scientist develops a new alloy for aerospace applications. Describe how Hooke's Law is used to characterize the alloy's elastic properties, such as Young's modulus and spring constant. Explain the significance of these properties in designing aircraft structures.

3. Compare and contrast the elastic behavior of different materials (metals, polymers, composites). Explain how Hooke's Law relates to the atomic structure and bonding of each material. Provide examples of how these materials are used in various applications due to their elastic properties.

4. A biomechanical engineer designs a prosthetic limb that must mimic the elastic properties of human tissue. Explain how Hooke's Law is applied to model the stress-strain relationship in the prosthetic materials. Discuss the importance of reproducing the elastic behavior of natural tissues in prosthetic design.

5. Design an experiment to investigate the effect of temperature on the elastic properties of a material. Describe the materials and procedures used and discuss the expected results. Explain how the experiment demonstrates the relationship between temperature and elastic behavior, and relate it to Hooke's Law.

Items:

1. The length of an unstretched spring is 6 cm. When a mass of 100 g is attached to it, the new length is 8.5 cm. Calculate the spring constant of the spring in newtons per metre.

2. Calculate the force required to produce an extension of 6 cm in a spiral spring of springconstant 50 N/m

3. A vertical spiral spring of unstretched length11 cm has a stone attached to its lowerend. When a 100 g mass is added, the new length is 17 cm. When a 300 g is added again, its length is 26 cm. Calculate the mass of the stone.

4. The sketch graph in Figure 5.9 shows the relationship between the force, *F*, applied to a spiral spring and the extension, *e*, produced. Calculate the spring constant ofthe spring in newtons per metre.

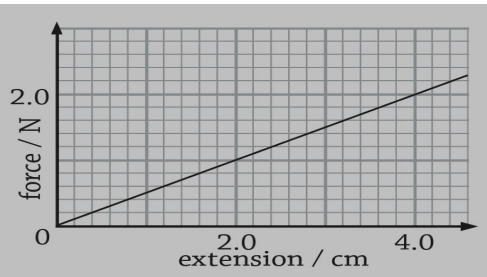

Fig. 5.9

5. Figure 5.10 shows graphs obtained when twospiral springs X and Y are stretched in two different experiments.

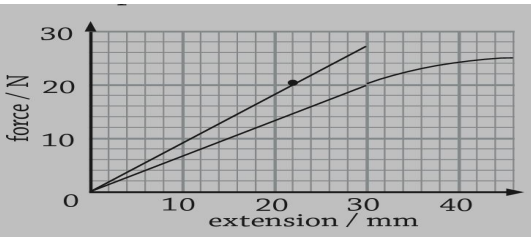

Fig. 5.10

(a) Use the values from the graph to state which spring is more stiff.

(b) Calculate the difference in the extensions of the two springs when a force of 20 N is applied to each spring.

MEASUREMENTS

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