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PHYSICS 5054

MEASUREMENTS

1. **Identify basic units and derived units.**

Answer:

International System of Units (SI)

Quantity	SI unit	symbol
Time	second	s
Length	metre	m
Mass	kilogram	kg
Electric current	ampere	A
Temperature	kelvin	K
Light intensity	candela	cd
Amount of substance	mole	mol

Derived units

QUANTITY	SI UNIT	SYMBOL
Area	square metre	m^2
Acceleration	$(m \cdot s^{-2})$	
Frequency	hertz	Hz
Energy	joule	J
Power	watt	W
Force	newton	N
Pressure	Pascal	Pa
Electric charge	coulomb	C
Potential difference	volt	V

2. **Recognise prefixes, multiples and submultiples of fundamental and derived units.**

Answer:

The names of metric units are formed by adding a prefix to the basic unit of measurement.

To tell how large or small a unit is, you look at the prefix.

To tell whether the unit is measuring length, mass, or volume, you look at the base.

Prefixes in the Metric System						
kilo-	*hecto-*	*deka-*	meter gram liter	*deci-*	*centi-*	*milli-*
1,000 times **larger** than base unit	100 times **larger** than base unit	10 times **larger** than base unit	base units	10 times **smaller** than base unit	100 times **smaller** than base unit	1,000 times **smaller** than base unit

The most commonly used metric prefixes

PREFIX	**SYMBOL**	**FACTOR**	**NUMERICALLY**	**NAME**
giga	G	10^{9}	1 000 000 000	Billion
mega	M	10^{6}	1 000 000	Million
kilo	k	10^{3}	1 000	Thousand
centi	c	10^{-2}	0.01	Hundredth
milli	m	10^{-3}	0.001	Thousandth
Micro	μ	10^{-6}	0.000 001	Millionth
Nano	n	10^{-9}	0.000 000 001	Billionth

3. Use scientific notation

Answer:

- Helps to make it easy to read large or small numbers which are inconveniencing when they are not converted to scientific notation. Scientific notation is the use of power in writing numbers in a form of Z x 10^{n}
- Z is the non-zero figure on either the left or right hand side of the decimal point.
- n is the positive or negative exponent
- Determine Z by shifting the decimal point in the original number to either the right or the left until a non-zero digit is on its left.

- n is determined by counting the number of places the decimal point has been moved. It is positive if it is moved to the left and negative if it moves to the right.
  Example 1 **.00000031** in scientific notation.
- Move the decimal place to the *right* to create a new number from 1 up to 10.
  So, $Z = 3.1$.
- Determine the exponent, which is the number of times you moved the decimal.
- In this example, you moved the decimal 7 times; also, because you moved the decimal to the right, the exponent is negative. Therefore, $n = -7$, and so you get
- Put the number in the correct form for scientific notation is 3.1×10^{-7}
- Example 2. 300 000 000 in scientific notation
- Z = 3
- n = 8
- scientific notation = 3×10^{8}

Significant figures

- Use of significant figures is one way of indicating the accuracy of measurements
- They are figures in numbers known with certainty plus the first digit that is uncertain

Rules/examples

- All non-zero figures are significant e.g. 449.5 has 4 sig. figures
- All zeros in between non zeros are significant e.g. 103. 006 has 6 sig. figures
- All zeros to the right hand side of the decimal point are not e.g. 0.00753 has 3 significant figure i.e. 753.
- Zeros to the right of the decimal point following a non-zero figure are significant e.g. 0.07020 has 4 sig. figures i.e. 7020

Length and time

4. **Demonstratetheuseofrules todeterminelength**

Answer:

- Rules come in various forms. These include metre rule, measuring tape, etc.
- A meter rule is used to measure medium lengths i.e. 0 to 1m. It has an accuracy of 0.1cm.
- A measuring tape measures long lengths i.e. 0 to 100m .It has an accuracy of 0.1 cm
- A metre rule is the most commonly used to measure length in the laboratory.

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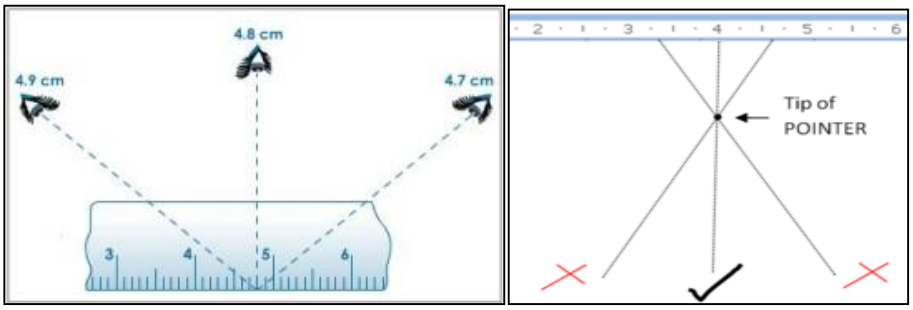
Useofrules todeterminelength:

- Study the markings on the rule (cm and mm)
- Align the rule to the object to be measured.
- Take the reading by placing the eye correctly as shown in the diagram to prevent error by parallax. Parallax error is the error caused due to reading from the side of the Tape or the Rule. For accurate measurement, the eye must always be placed vertically above the mark being read.



5. **Demonstratetheuseofa mechanicalmethodforthe measurementofasmall distance:**

Answer:

Vernier Caliper

- Used to measure short lengths i.e. 0 to 15 **cm.**
- It is accurate to 0.01 **cm** or 0.1mm
- Consists of a Main Scale and a Vernier Scale.
- The outside jaws, are used to measure the outer dimensions of an object.
- The inner jaws for the inner ones.
- The stem is used to measure the depth.

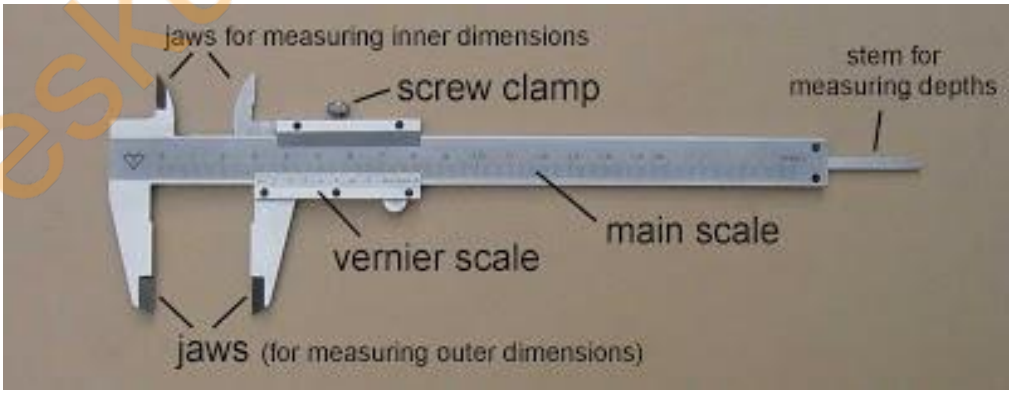


Figure 1: Major Parts of the Vernier Calipers

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- To measure gently grip the object with the straight edges of outside or inside jaws.

How to take reading

- First read the main scale, and note down the reading **before** the 0 on the **Vernier scale**, as shown in the diagram below.
- The reading on it is 2.8 cm, as the .8 after the 2 on the main scale is before the 0 on the Vernier scale.
- For the second place of decimal, look at the Vernier scale. Find a marking on the Vernier scale that coincides exactly with the reading on the main scale.
- In the diagram below, the 6 on the Vernier scale coincides exactly with a line on the main scale (it does not matter with which line on the main scale this line coincides). So the second place of the decimal would 6, i e .06.
- To get the total reading, add the two readings i-e 2.8+.06. The final reading is 2.86cm or 286mm.

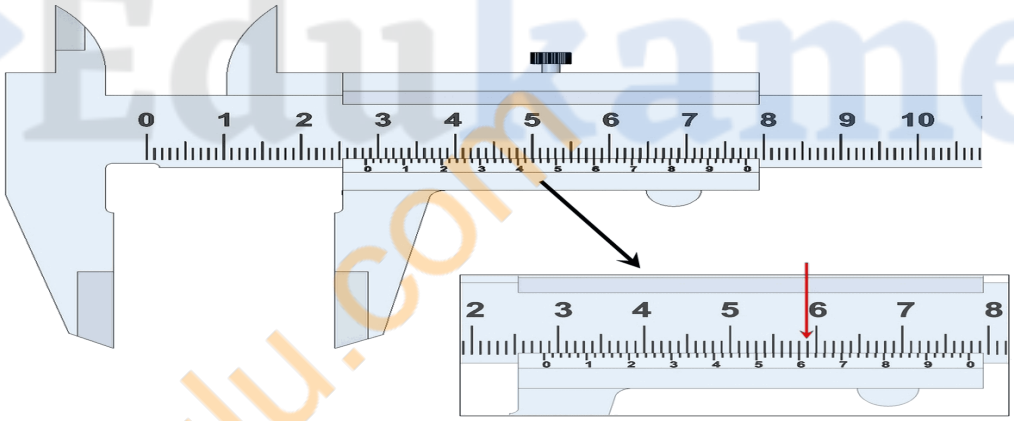

Figure 2: How to Read the Vernier Calipers

Error in a Vernier caliper

- Negative zero error: Occurs when the zero of the Vernier scale is to the left of the Vernier scale when the two jaws are in contact.
- To take the precise value for the measurement we are taking, we have to add the value of the negative zero error to the obtained measurement.
- No zero error is the precise arrangement of the meter scale and the Vernier scale so that the zeros of both scales fit each other.

Precautions

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i. Zero the instrument before taking measurements

ii. Lubricate moving part

iii. Do not store the instrument in a dump place to avoid rusting

2 Micrometer

- Used to measure very short readings i.e. 0 to 2.5**cm**.
- It has an accuracy of 0.001**cm or** 0.01 **mm**.
- It has two scales; main scale (on the sleeve) and the circular scale (on the thimble).
- Each division on the main scale represents 1 mm.
- Each division on the thimble represents a distance of 0.01mm.

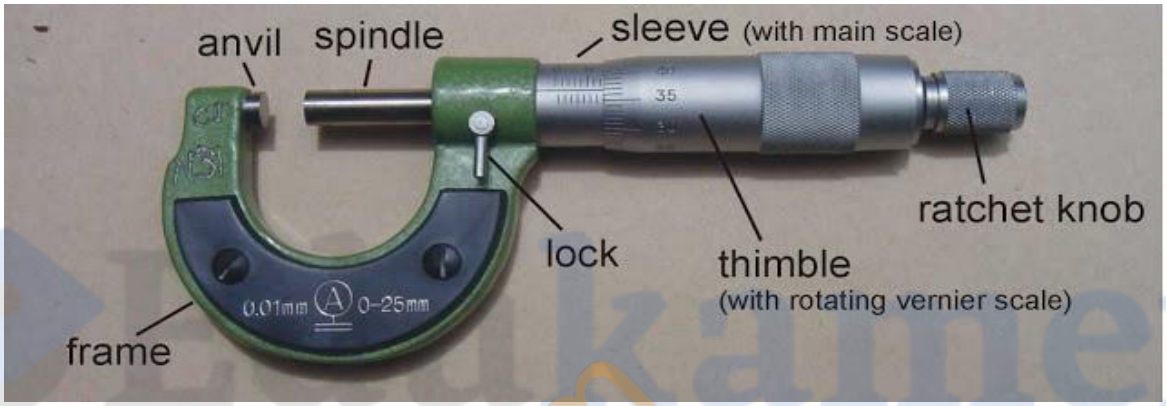

Figure 3: Main parts of a Micrometer Screw Gauge

How to take reading

- Turn the thimble until the object is gripped gently.
- Read the main scale on the sleeve. This reading would be in millimeters.
- In the diagram below, the reading is 5.5mm.
- Then read the line on the circular scale that coincides with the line on the main scale.
- In the diagram below, the 28th line on the circular scale coincides with the line.
- So, the reading would be 0.28mm.
- Then add 5.5 with 0.28 and you will obtain your answer in millimeters.

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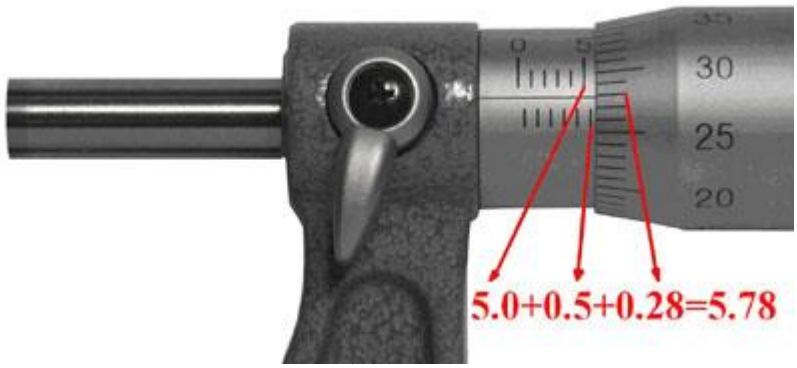
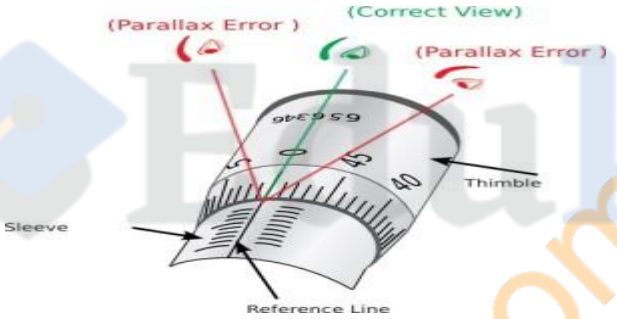


Parallax Error

- Parallax errors affects the accuracy of the measurement.
- Consistently using the incorrect angle to view the markings, measurements will be displaced from the true values by the same amount. This is called **systematic error**.
- If different angles are used to view the markings, measurements will be displaced from the true values by different amounts. This is called **random error**.



Precautions

i. Zero the instrument before taking measurements
ii. Lubricate moving part for easy sliding.
iii. Do not store the instrument in a dump place to avoid rusting.
iv. Clean the anvil and the spindle to remove dust particle because it can take the measurement of even dust particles.

6. Demonstratetheuseof clocksand other devicesfor measuringanintervalof time

Answer:

Clocks

- A unit of time is any particular time interval, used as a standard way of measuring or expressing duration.
- The International System of Units (SI), is the second (s).
- It is calculated in a variety of ways such as seconds, minutes, hours, days, weeks, and etc.

TYPE OF CLOCK/WATCH	USE AND ACCURACY
Atomic clock	Used to measure very shorty time intervals of about 10^{-10} seconds
Digital stopwatch	Used to measure short time intervals of minutes and seconds to an accuracy of ±0.01 s±0.01 s
Analogue stopwatch	Used to measure short time intervals of minutes and seconds to an accuracy of ±0.1s±0.1s
Ticker-tape timer	Used to measure short time intervals of 0.02 s
Watch	Used to measure longer time intervals of hours, minutes and seconds
Pendulum clock	Used to measure longer time intervals of hours, minutes and seconds
Radioactive decay clock	Used to measure LONG time intervals of years to thousands of years

Analogue/Digital Clocks

- Can be read in hours, minutes and seconds.

How to use:

- The clock is set to commence at a particular time or the start time is noted.
- The time event is then allowed to occur, and at the end of the event, the end time is noted. The difference provides the required time interval.
- Accuracy: ± 1 s

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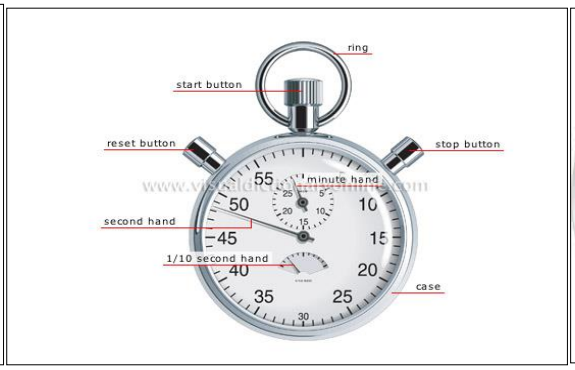
Stopwatch and Stopclock

- A **stopwatch** is a handheld timepiece designed to measure the amount of time elapsed from a particular time when it is activated to the time when the piece is deactivated.
- A large digital version of a stopwatch designed for viewing at a distance, as in a sports stadium, is called a **stopclock**.



- In **manual timing**, the clock is started and stopped by a person pressing a button.
- In fully automatic time, both starting and stopping are triggered automatically, by sensors.
- The timing functions are mostly controlled by two buttons.
- Pressing the top button starts the timer running, and pressing the button a second time stops it, leaving the elapsed time displayed.
- A press of the second button then resets the stopwatch to zero. The second button is also used to record *split times* or *lap times*.
- When the split time button is pressed while the watch is running, the display freezes, allowing the elapsed time to that point to be read, but the watch mechanism continues running to record total elapsed time.
- Pressing the split button a second time allows the watch to resume display of total time.

Precautions

- Inaccurate reading of the time when using an analogue stop watch (stop clock), parallax error should be avoided.
- Repeat the experiment to get an accurate reading by taking an average of the readings.

- **Human reaction error** can also generate a difference in the time recorded and original time.

Ticker Tape Timer

A ticker tape timer produce a dot on a tape at a fixed time interval.

How to use: The tape is attached to an object and the state of motion of the object can be deduced from the dots on the tape.

Reading the tape from ticker tape timer

The procedure to deducing the state of motion from the resulting tape is best explained using an example. The 3 tapes, X, Y and Z, have a length of 1 m from the first dot to the last dot. The dots are made by a ticker tape timer with a time interval of 0.1 seconds.

For X, the dots are evenly spaced. Since the length is 1 m, the spacing between each dots is 0.2 m. We can calculate the speed of the object using

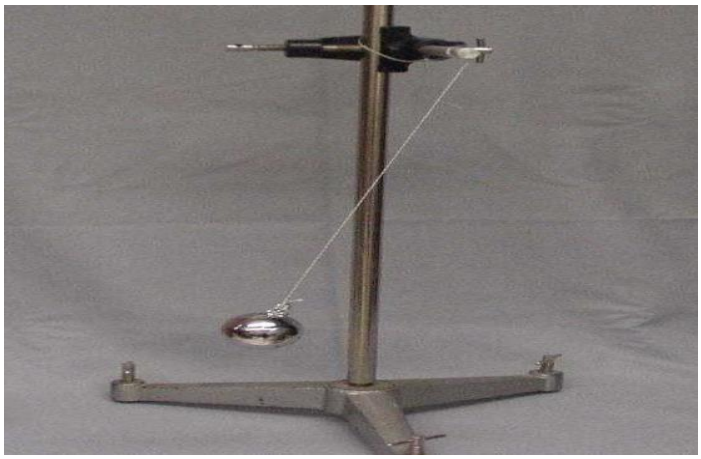
Speed=Distance X time=0.20s X 1m =2m/s

Hence, X represent the tape from an object that is moving at **constant speed**.

For Y, the spacing between the dots increases as time passes. Since the dots are made with a fixed time interval, the time in the formula above is fixed. We will get an increasing speed as the distance between the dots increases. Hence, Y represent the tape from an object that is **accelerating**.

For Z, the spacing between the dots decreases as time passes. Using the same reasoning as above, Z represent the tape from an object that is **decelerating**.

Periodofa Pendulum(T=t/n)

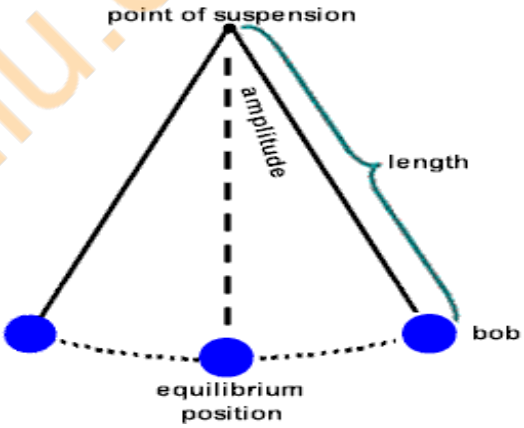


A simple pendulum makes use of a swing (**oscillation**) of the metallic bob to measure time period.

Note:

The **oscillation** refers to a swing of bob from left to right and back to the starting position.

The **Time period** of the pendulum is the time taken for one complete oscillation.



Frequency is the number of oscillations of the pendulum in one second.

Answer:

How to find time period using a Simple pendulum.

- First measure time for 20 complete oscillations using a stop watch or a stop clock (remember measuring time period of just one oscillation will not be accurate and can introduce errors)
- Find T1 (time period 1) using formula **total time for 20 oscillations/20 ($\frac{n}{t}$)**
- Once you have found T1 repeat the experiment for next four times to find T2 T3 T4 T5
- To get an accurate reading of time period take average of the 5 time periods i.e. **T1+T2+T3+T4+T5/5**

6. Identifyfactorsthataffect theperiodofasimple pendulum

- The period is affected the **length of the pendulum** (i.e. distance from fixed point to the middle of the bob). When the length increases time period increases.
- It is also affected by the **gravitational force**. When gravitational force increases time period decreases.

N.B. Massofthebob and amplitude have no effect on the periodic time

MASS AND, WEIGHT

7. Distinguish between mass and weight

Answer:

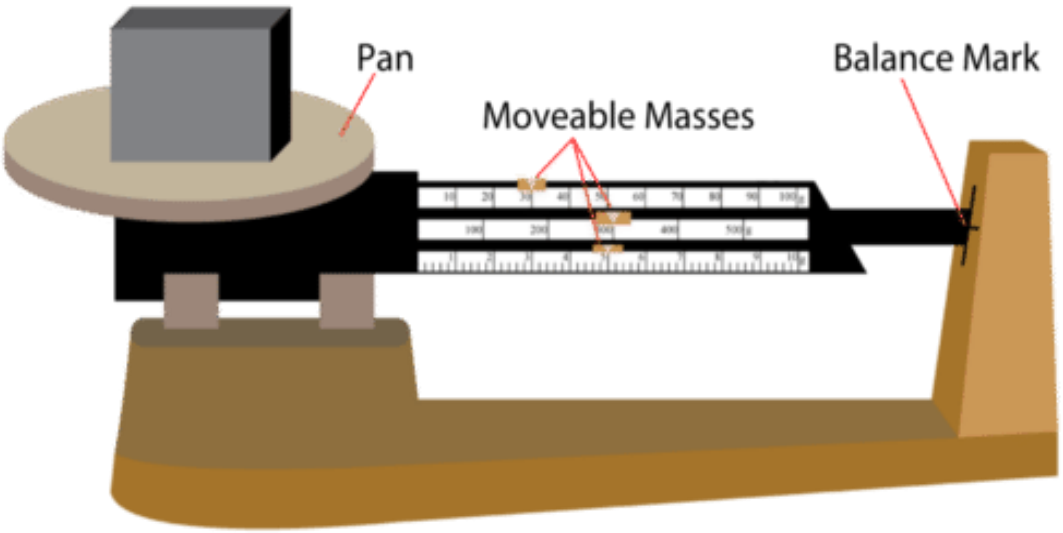
MASS	WEIGHT
• Is a quantity of matter in a body	• Is the force of gravity acting on an object
• Measured in kilogram (Kg)	• Measured in Newtons (N)
• Is a scalar quantity	• Is vector quantity
• It is constant	• Not constant
• Measured using beam balance scales	• Measured using spring balance

8. Demonstratehowto measuremassandweight byusingappropriate balances

Answer:

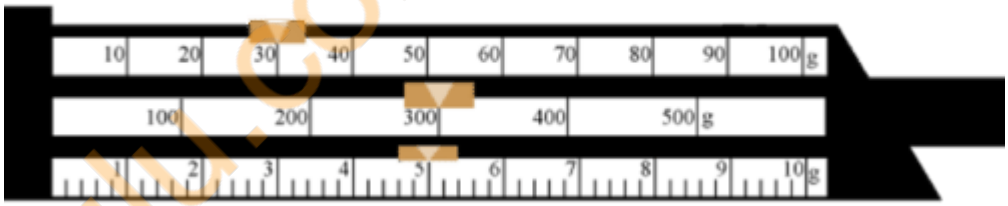
- **How to use a Triplebeambalances**

Triple beam balance consist of three beams with known masses stuck on each beam



Method:

- Put the solid substance to be measured on the scale pan.
- Start sliding the bigger mass until the pointer is pushed bellow the zero mark.
- Keep sliding the other masses to and fro until the pointer points towards the points towards the zero mark



- Sum up the readings of the three masses to get the total mass of the object.Therefore, the mass of the object in the pan is 335.1 grams (300 grams + 30 grams + 5.1 grams).

Precautions:

- Clean the pan and the beams to remove dust
- Zero the scale (the pointer must point at the zero mark) before measurement is started.

How to measure weight using a springbalances

The spring scale has a spring that stretches when an object is attached to it. The amount of stretching increases with increasing weight. We use standard weights to calibrate the stretch of the spring. An object that stretches the spring the same distance a standard weight does has the same weight as the standard. If the sample stretches the spring half the distance that the standard did then the object weighs half as much. Hmmm! Is it this easy?

9. Demonstratehowto determinethecentreof massofanobject

Answer

- For a regular shape: centre of mass is at the geometric centre.
- For an irregular lamina:
  a. Make three holes near the edge.
  b. Hang the lamina on a nail using one of the holes and allow it to swing freely.
  c. Hang a plumb line by the same nail and trace along it.
  d. Repeat procedures b and c for the other holes.
  e. The point where lines meet is the centre of mass.

10. Describe qualitatively the effect of the position of the centre of mass on the stability of an object.

Answer

- The lower the centre of gravity (G) is, the more stable the object. The higher it is the more likely the object is to topple over if it is pushed. Racing cars have really low centres of gravity so that they can corner rapidly without turning over.
- Increasing the area of the base increases the space within which the line of G operates. This also increase the stability of an object. The bigger the area the more stable the object. Rugby players will stand with their feet well apart if they are standing and expect to be tackled.
- If an object is tilted it will topple over if a vertical line from its centre of gravity falls outside its base.
- The higher the centre of gravity the more likely an object is to topple over if it is tilted.

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VOLUME AND DENSITY

11. Demonstratehowto measure volume of different liquidsandsolids

Answer

- Liquids

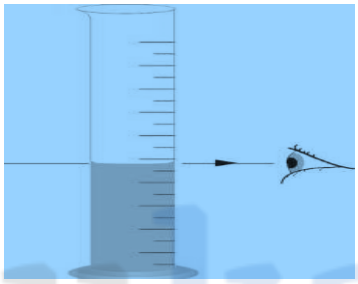
  Measuring the Volume of a Liquid

  Step 1: Gather the liquid you want to measure and a graduated cylinder.

  Step 2: Pour the liquid into the graduated cylinder. Don't fill it up all the way!

  Step 3: Place the graduated cylinder on a flat surface.

  Step 4: Read the meniscus at eye level to get the most accurate volume.



  The volume of the liquid is the number in mL that matches up with the bottom of the meniscus.

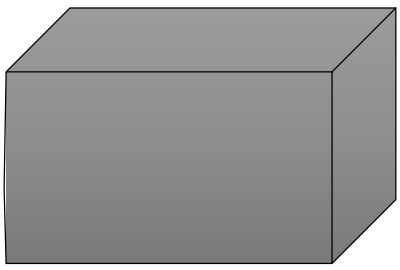
- **solids(regular)**

  Measuring the Volume of a Rectangular Solid

  Step 1: Gather a rectangular solid (e.g. a wooden block), a ruler, and a calculator.

  Step 2: Place the object on a flat surface and measure the length, width, and height of the object with the ruler.

  Step 3: Use the formula



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Volume=Length x Width x Height to calculate the volume of the object.

- **Solids (irregular)**

  Measuring the Volume of a Small, Irregular solid

  Step 1: Gather a small irregular solid (e.g. a pebble), and a graduated cylinder.

  Step 2: Place the graduated cylinder on a flat surface.

  Step 3: Pour some water into the graduated cylinder and read the meniscus at eye level. Record the volume of the water.

  Step 4: Drop the object into the graduated cylinder and try not to make a splash! If the object floats, get a long object (e.g. a pencil) and push the object down, remember not let go!

  Step 5: Read the new meniscus at eye level and record it.

  Step 6: Subtract the volume of the water from the volume of the water with the object it in it. This is called Volume by Displacement.

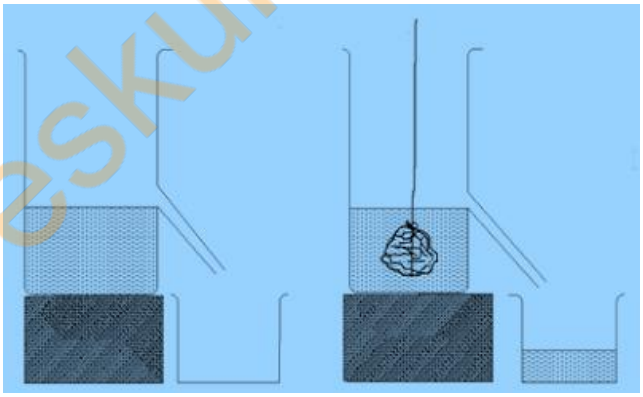
  The number that you get from subtracting is the volume of the small, irregular solid.

- **Large, irregular Solid**

  Measuring the Volume of a Large, irregular Solid

  Step 1: Gather a large, irregular solid (e.g. a large rock), an overflow can, and a graduated cylinder.

  Step 2: Fill the overflow can with water and place it on the edge of a sink, so the water can pour out of the spout on the can.



  Step 3: When water stops coming out of the overflow can, place a graduated cylinder underneath the spout of the overflow can.

Step 4: Put the object in the overflow can and try not to splash! Catch the water that comes out in the graduated cylinder.

This is called Volume by Overflow.

Step 5: Place the graduated cylinder on a flat surface and read the meniscus at eye level.

12. Determinethedensityofa liquid,aregularlyandan irregularlyshapedsolid

Answer

- **Determining the Density of an object**

  Use the formula ***Density=Mass/Volume***.

  To use this formula you need to know the mass and volume of the object, and you can find that by following the steps I showed you.

  Once you have the mass and volume, use the formula to calculate the density.

- **Measuring the Mass of a solid**

  Step 1: Gather the object you want to measure and an electronic mass balance.

  Step 2: Make sure the object weighs below 200g, and then place it on the balance.

  The mass of the solid is the number that appears on the balance.

- **Measuring the Mass of a Liquid**

  Step 1: Gather the liquid you want to measure, a beaker, and an electronic mass balance.

  Step 2: Put the beaker on the electronic mass balance and press the "tare" button. This will make the numbers on the balance reset.

  Step 3: Carefully pour the liquid into the beaker. Don't fill the beaker to the top or the mliquid could spill onto the balance!

  The numbers shown on the balance is the mass of the liquid.

13. Demonstratehowto calculatedensity usingthe appropriateformula

Answer:

- In simple cases we will be provided with two quantities. They are, mass and volume.
- Convert the given mass of the object in kg if not in this unit.

- Now convert the volume in cubic meter if not in the given unit.
- Simply divide mass by volume to find the density.
- The units of the answer are kg/m^3.

Example 1.

- A block of ice with volume $5.5m^3$ has a mass of 5060kg find the density of ice.

Solution

- Volume of block=$5.5m^3$
- Mass of block=5060kg
- Density=mass /volume =$5060/5.5m^3$.

= $920kg/m^3$.

14. Explain relative density

Answer:

- Relative density is the ratio of density of a substance to the density of a given reference material. It has no units. It is just a number which shows how many times the material is denser than the standard substance (water =1000kg m^{-3}, for solids and liquids and hydrogen =0.1kg m^{-3} for gases).

$$elative\ density = \frac{density\ of\ the\ substance}{density\ of\ the\ standard\ substance}$$

When relative density of substance is:	Relationship with the standard	Sinking and floating
Less than one	Substance is less dense than the standard	Substance will float on the standard e.g. ice on water
Greater than one	Substance is denser than the standard	Substance will sink into the standard
Exactly one	Densities are equal	

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15. Demonstrate how to calculaterelativedensityusingtheappropriate formula

Answer:

Examples:

A globe of steel has a mass of 12g and a volume of 15.2cm³, find its relative density.

Solution

$$\text{Relative density}=\frac{mass\ of\ any\ volume\ of\ substance}{mass\ of\ an\ equal\ volume\ of\ water}$$

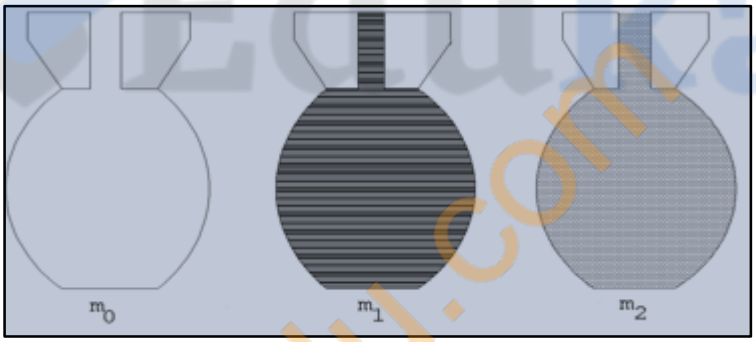
Mass of 15.2cm³ of water is 1g/cm³ x 15.2cm³
Mass=15.2g

$$\text{Relative density} = \frac{12g}{15.2g}$$

=0.79.

To measure relative density of liquid by density bottle

- Find mass of empty bottle –m_0
- Find mass of bottle and liquid-m_1
- Empty the bottle and rinse it with water
- Fill the bottle with water and find mass m_2



Mass of liquid= (m_1-m_0)g

Mass of equal volume of water= (m_2-m_0)g

$$\text{Relative density}=\frac{mass\ of\ any\ volume\ of\ substance}{mass\ of\ an\ equal\ volume\ of\ water}$$

$$\text{Relative density}=\frac{m_1-m_0}{m_2-m_0}$$

Example

The mass of density bottle is 19g when dry and empty, 45g when filled with water and 40g when full of liquid x. calculate the density of the liquid x.

Solution

Relative density $=\frac{m_1-m_0}{m_2-m_0}$

$=\frac{(40-19)g}{(45-19)g}$

$=0.81$

The density of liquid x is $0.81 g/cm^3$.

MECHANICS

Speed, velocity and acceleration

16. Explain the terms used in mechanics.

Distance, Displacement, Velocity, Speed and Acceleration

Answers

i. **Distance** is the total path length traveled from one location to another. It is a scalar quantity measured in metres (m).

ii. **Displacement** is the distance between two locations measured along the shortest path connecting them, in specified location. It is a vector quantity. The SI unit is metre m).

iii. **Speed** is the distance traveled per unit time or the rate of change of distance. It is a scalar quantity measured in metres /second (m/s).

$$speed = \frac{total\ distance\ travelled}{time\ taken}$$

iv. **Velocity** is the speed in a given direction or the rate of change of displacement. It is a vector quantity. The SI units are metres /second (m/s).

$$Average\ velocity = \frac{displacement}{time\ taken}$$

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v. **Acceleration** is the rate of change of velocity. It is a vector quantity measured in metres /second squared

$$Acceleration = \frac{change\ in\ velicity}{time\ taken}$$

Change of velocity = final velocity (v) – initial velocity (u)

Acceleration = (final velocity – initial velocity) / time taken

$$a = \frac{v - u}{t}$$

NB.

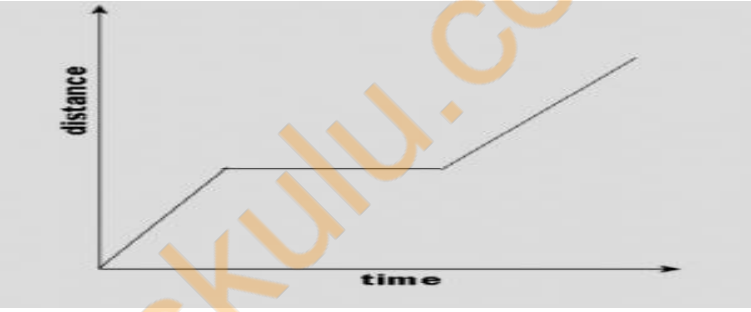
1. Constant velocity means the object is not accelerating. Acceleration is zero.
2. Constant acceleration means the object is increasing its velocity.

17. Demonstrate interpretation of graphical representation:

Graphs of Motion

Answer:

If the line is diagonal then its moving with a constant speed and if it is anything other than a straight line then the speed is varying.



- A body is said to be in uniform motion when the body covers the equal distance in equal time intervals.

Graph for uniform motion

- In uniform motion, the distance time graph would be a straight line, because the equal distance is covered in equal units of time.

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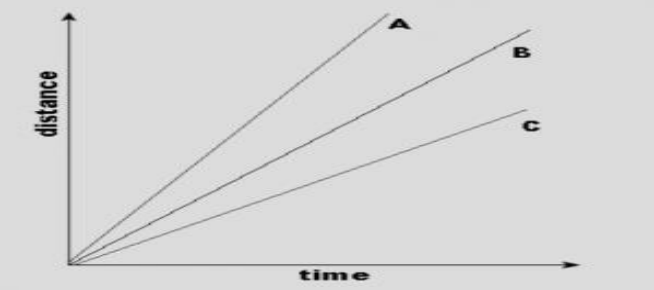


- The three bodies A, B and C, are all in uniform motion but they have different slopes because the slope of a distance-time graph determines the speed of that body.
- The steeper the slope the greater will be the speed of the body. From the above graph, body A has the highest speed and body C has the least speed.

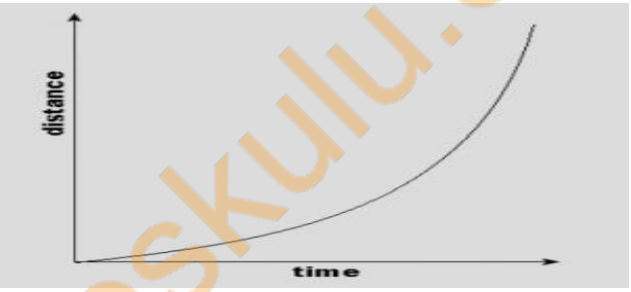
Velocity time graph

- It is the graph of velocity against time; it shows us how the velocity changes with respect to time. The slope of a velocity-time graph determines its acceleration.

A flat horizontal line in a velocity-time graph states that the body is moving at a constant velocity.

Constant acceleration

If the straight line has a slope, then that indicates the body is changing its velocity at a constant rate, or it means that the body has constant acceleration.



In this graph, the bodies has uniform motion, their velocity does not change with respect to time.

Uniformly accelerated

In the velocity time graph below velocity changes at a constant rate with respect to time. This is uniformly accelerating motion.

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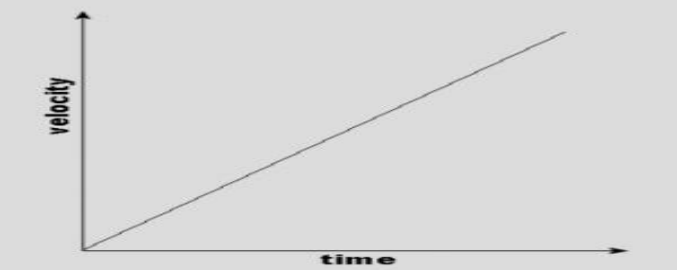
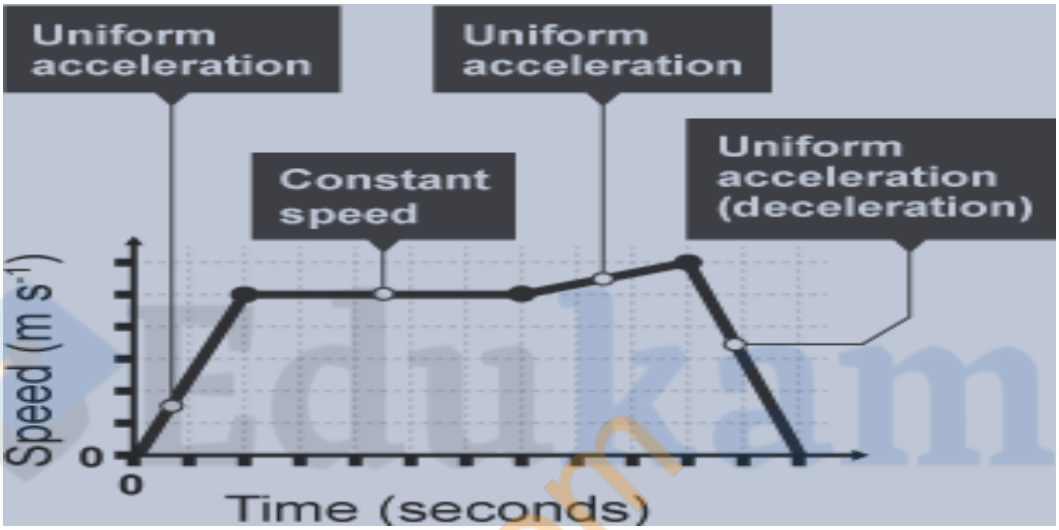


The graph is a straight line with its slope indicating the amount of acceleration.

18. Identify motion from the shape of a speed- time graph

Answer:



19. Demonstrate the use of equations of uniformly accelerated motion to solve problems

Answer:

- Examples:
- A body starting from rest travels for 10s with an acceleration of $5m/s^{2.}$ Find its
  i. final velocity and
  ii. the distance it cover in 10s.

  Solution

  Where v = final velocity, u = intial velocity, a = acceleration and t = time

  Data: u = 0 m/s, a = $5m/s^2$, t = 10s

  Solution:

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v = u + at,

v= 0m/s + 5m/s^2 X 10

V = 50m/s

ii. s = ut + ½ at^2

s = (0m/s X 10s) + ½ X 5m/s^2 X (10s)^2

s= 250m

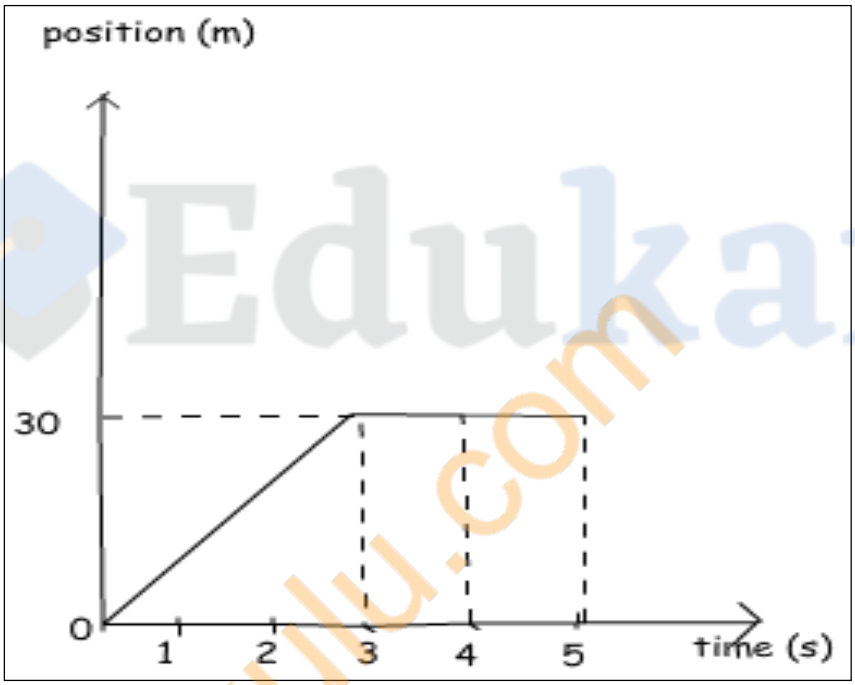
iii. v^2= u^2+ 2as

50^2 = 0^2 + 2 X 5 X S

2500 = 10s

S = 250

20. Demonstrate the use of graphs to solve problems of motion



$$V = \frac{\triangle X}{\triangle t}$$

(1s-3s);

$$V = \frac{Xf - Xi}{tf - ti}$$

$$V = \frac{30m - 0m}{3s - 0s} = 10m/s$$

(3s-5s);

$$V = \frac{Xf - Xi}{tf - ti}$$

$$V = \frac{30m - 30m}{5s - 3s} = 0m/s$$

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21. Explain consequences of over speeding

Answers:

- **Reaction time**: the time it takes between a people perceiving a danger and reacting to it is compromised.
- **Braking distance**: the distance a car travels before stopping when the brakes are applied depends on a number of variables. These include slope or grade of the roadway, the frictional resistance between the road and the car's tyres and high speed.
- **Impact on a pedestrian**: The impact speed increases rapidly as the travel speed increases, because the brakes are unable to bring the car to a stop in time.
- **Impact on a large object**: increases as the velocity increases.
- **Less control**: At higher speeds cars become more difficult to manoeuvre, due to inertia. It is inertia that keep a passenger moving when the car suddenly stop (unless restrained by a seatbelt).
- **Killer speed**: the risk of being involved in a casualty crash increases dramatically with increasing speed. The risk doubled with every 5 kilometres/hour above the speed limit.

22. Demonstrate that the acceleration of free fall for a body near the earth is constant.

Answer:

- A stone and a piece of paper, both of the same weight released at the same height do not touch down at the same time. The stone reaches the ground first because it experiences less air resistance due to its smaller surface area. However, when air resistance is neglected, they will both touch the ground at the same time because acceleration of free fall for a body near the earth is constant. It is approximately $10 m/s^2$.

23. Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance

Answer:

- When the speed of an object increases air resistance to a point where the air resistance becomes equal to the weight of the object, the object stops accelerating and falls with a constant speed. It reaches its terminal velocity.

FORCES

24. Explain what force is.

Answer:

- Force is defined as a Pull or push.
- It can also be said to be any influence that causes an object to undergo a certain change concerning movement, direction or shape.
- It is a vector quantity measured in Newtons.

25. Explain the effect of forces on bodies.

Answers:

- Force causes: motion of objects, change of direction of a moving object, stoppage, acceleration, change of shape of objects it acts on, stretche and compression of objects

26. Demonstrate mass as a measure of inertia.

Answer:

- Inertia is the ability of a body to resist change of state.
- If it is in motion it would want o continue in that state or a state of rest if it is at rest unless it is acted upon by an external force.
- The greater the mass the greater the inertia.

27. Demonstrate the relationship between force and acceleration

- Newton's second law of motion indicate that the **relationship between force and acceleration** is directly proportional. If the **force** applied to an object is increased, the **acceleration** of that object increases by the same factor. In short, **force** equals mass times **acceleration**.
- A constant force produces a constant acceleration

  Force = mass X acceleration

  F = ma

28. Demonstrate the relationship between mass and acceleration

The relationship between mass and acceleration is one where if one increases, the other decreases. For the **same** force, a body with a larger mass will accelerate less

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than a body with a smaller mass. They are inversely proportion i.e. acceleration is inversely proportional to mass, provided that the force applied remains constant.

$$\boldsymbol{Mass = \frac{force}{acceleration}}$$

33. Perform calculations on force.

- Acceleration is directly proportional to the force for a constant mass
- Use theformula(force =massxacceleration)

  Example:

  Calculate the acceleration of a 200kg body pushed along a holizontal surface with a 20N force.

$$acceleration = \frac{force}{mass}$$

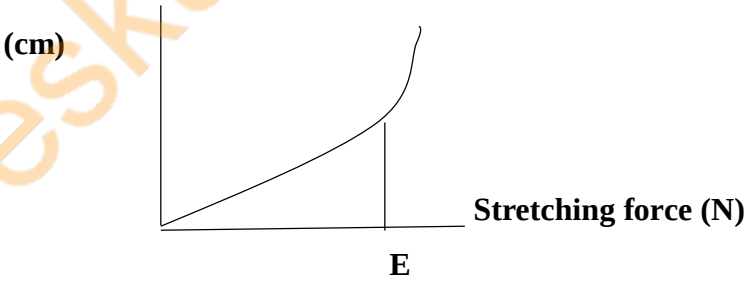
a = 20N/ 200kg

a = 0.1m/s^2

34. Demonstrate the effect of force on a spring.

- Hooke's law states that the extension of a spring is directly proportional to the stretching force provided the elastic limit is not exceeded (F α e)

- Graphical expression of extension against force



NB; E is the elastic limit or limit of proportionality

Formula:

$$Spring\ constant = \frac{stretching\ force}{extention}$$

35. Demonstrate the effects of friction on the motion of a body.

- Loss of energy through heat,
- wear and tear of machinery
- reduces the effectiveness of a machine

36. Describe qualitatively the motion in a curved path due to a perpendicular force.

- For a body to move in a circular motion, two opposite forces must be exerted on it. These are Centripetal and centrifugal forces
- Centripetal force is a force that makes a body follow a curved path. Its direction is always at right angle to the velocity of the body, towards a fixed point of the centre of curvature.
- Centrifugal force is a force that draws a rotating body away from the centr of rotation.

MOMENT OF FORCES

37. Describe the moment of a force in terms of its turning effects.

Answer:

- Moment of a force is the turning effect produced by the force. It is equal to the product of the force and the perpendicular distance from the point of application of the force to pivot.
- It is measured in newton metre

38. State the Principle of moments.

Answer:

- For a body to be in equilibrium, the sum of clockwise moments about a point is equal to the sum of anticlockwise moments about the same point.(Inequilibrium,totalanti- clockwisemoment= total closemoment)

39. Demonstrate the verification of the principle of moments.

Answer:

Moments Acting On A Seesaw

Both people exert a downward force on the seesaw due to their weights.

Person A's weight is trying to turn the seesaw anticlockwise whilst person B's weight is trying to turn the seesaw clockwise.

Person A's Moment = Force x perpendicular distance from fulcrum

1000 x 1 = 1000 Nm

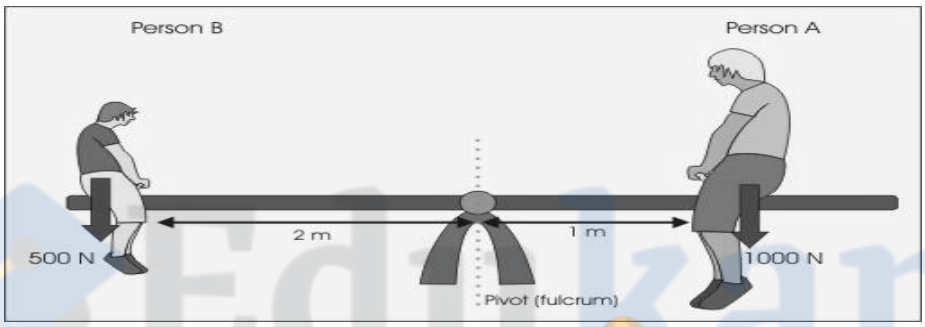
Person B's Moment = Force x perpendicular distance from fulcrum

500 x 2 = 1000 Nm

Persons A's moment = Persons B's Moment

Anticlockwise moment = Clockwise moment

Therefore seesaw is in equilibrium

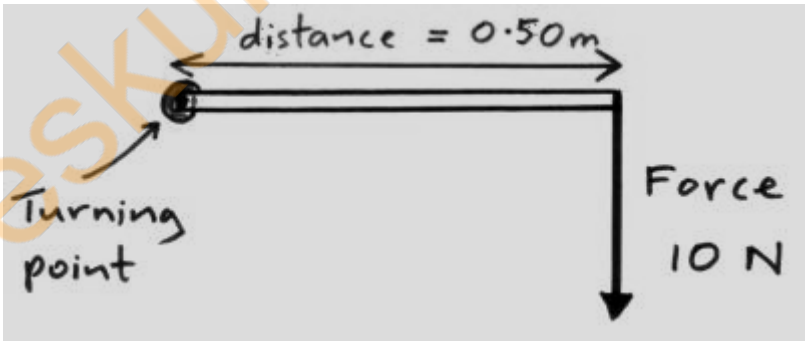


40. Perform calculations based on the principle of moments.

Answer:

Examples;

- A 10N force acts at a perpendicular distance of 0.50m from the turning point. What is the moment of the force?



- Moment = Fd

  = 10 x 0.50

  = 5.0 Nm

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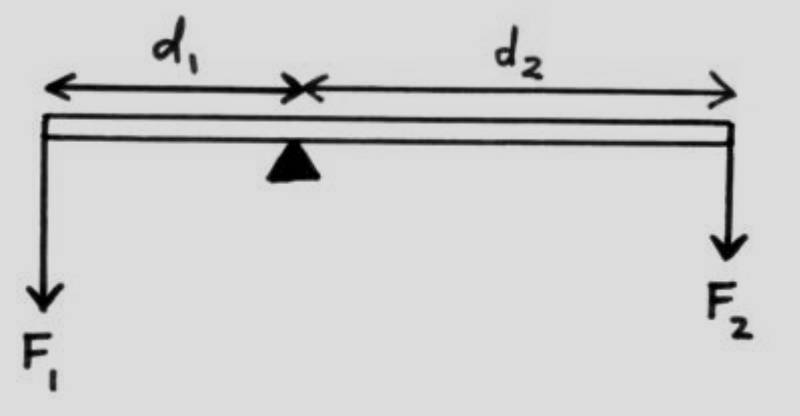
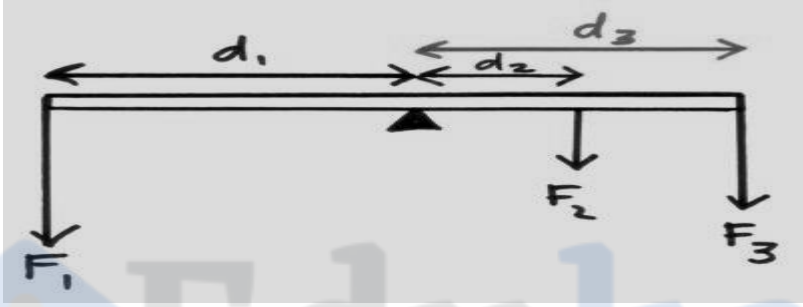


Sum of anticlockwise moments = sum clockwise moments

$F_1 \times d_1 = F_2 \times d_2$

OR



Sum of anticlockwise moments = sum clockwise moments

$F_1 \times d_1 = (F_2 \times d_2) + (F_3 \times d_3)$

---

41. Explain the everyday application of moments.

Answer:

- Hinged door,
- seesaw,
- steering wheel

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WORK, ENERGY AND POWER.

45. Explain the meaning of the terms work, energy and power.

Answer:

- Work (force moving through a distance in direction of force)
- Energy (ability to work)
- Power (rate of doing work)

46. Identify units of measurement for work, energy and power.

Answer:

- Work(joule),
- energy(joule) and
- power(watt)

47. Calculate work using the appropriate formula

Answer:

Work is a product of applied force and the perpendicular distance moved in the direction of the force.

$$work = force\ X\ distance$$

48. Identify different types of energy

Answer:

- Mechanical(Kinetics and gravitational potential energy),
- Sound Energy
- Chemical Energy
- Electrical Energy
- Atomic Energy

49. Explain qualitatively and quantitatively the terms gravitational potential and kinetic energy.

Answer:

- Gravitational potential (energy due to position) or stored energy or energy possessed by objects at rest
- Kinetic energy(energy due to motion) or energy possessed by objects in motion
- NB: Gravitational potential energy($E_P = mgh$)

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$$GPE = mgh$$

- Kinetic energy ($E_K=1/2mv^2$)

$$KE = \frac{1}{2}mv^2$$

50. Identify sources of renewable and non-renewable energy.

Answer:

Renewable sources of energy

- solar,
- wind,
- hydroelectric
- geothermal,
- bio-gas)

Non-renewable energy

- chemical/fuel,
- nuclear energy

51. Explain the effects of the use of energy sources on the environment.

Answer:

- pollution,
- land degradation

52. Demonstrate energy transformation from one form to another.

Answer:

- Chemical energy in a battery to heat energy in a wire cable to light energy in a bulb.
- Electric energy in a bulb to heat and light energy
- Hydroelectric power: potential to kinetic to magnetic to electrical energy

53. Explain nuclear fusion and fission in terms of energy releasing processes.

Answer:

- Fusion is called '**fusion**' because the **energy** is produced by fusing together light atoms, such as hydrogen, at the extremely high pressures and temperatures which exist at the centre of the sun (15 million ºC). ... When deuterium and tritium nuclei fuse, they form a helium nucleus, a neutron and a lot of **energy**.
- Fission(producing energy)

Fission is the splitting of heavy nuclei (such as uranium) – in two smaller nuclei. This process needs less **energy** to 'bind' them together – so **energy** is released.

Fission happens quite easily – and is used to generate electricity in conventional nuclear power stations.

54. Describe the conservation of energy.

Answer:

- Principle of conservation of energy states that energy can neither be created nor destroyed but changes from one form into another.

55. Demonstrate the solving of energy problems using the mass- energy equation.

Answer:

- **E** = mc^2: **Meaning**. ... Equivalence of the mass and energy is described by Einstein's famous formula **E**= mc^2. In words, energy equals mass multiplied by the speed of light squared. Because the speed of light is a very large number, the formula implies that any small amount of matter contains a very large amount of energy.
- Using the formula ($E=mc^2$)

56. Demonstrate the calculation of efficiency of energy conversion using the appropriate formula.

Answer:

- $Efficiency = \frac{energy\ output}{energy\ in\ put} \times 100.$

57. Demonstrate calculation of power using the appropriate formula

Answer:

- $Power = \frac{work\ done}{time\ taken}$

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SIMPLE MACHINES

58. Describe a simple machine.

Answer:

- Simple machine is any device which enable a large weight to be overcome by a small effort

59. **Identify different types of simple machines.**

Answer:

- Levers,
- pulleys,
- gears
- inclined plane (ramp)
- wheel and axle
- screw
- hydraulic press

60. Describe the distances moved by the effort and the load in a simple machine.

Answer:

- Distance moved by effort is greater than distance moved by the load

61. Explain the terms Mechanical advantage (MA), Velocity Ratio (VR) and Efficiency.

Answer:

- **Mechanical advantage (MA)**

  Mechanical advantage is the ratio of the load to effort. The dividend is the factor by which a given machine multiplies the effort applied to make doing work easy

$$MA = \frac{LOAD}{EFFORT}$$

Velocity Ratio (VR)

- Velocity Ratio (VR) is the ratio of distance moved by effort to distance moved by load. It has no units of measurement.

$$VR = \frac{\text{distancemovedby effort}}{\text{distancemovedby load}}$$

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- **Efficiency**

$$Efficiency = \frac{MA}{VR} \times 100$$

$$Efficiency = \frac{workoutput}{work\ input} \times 100$$

$$Efficiency = \frac{energy\ output}{energy\ input} \times 100$$

$$Efficiency = \frac{MA}{VR} \times 100$$

62. Demonstrate calculations involving simple machines

Answer:

- Pulleys

  A block and tackle of four pulleys, a force of 200N was applied to overcome a load of 600N which was lifted 1m high.

  Calculate:

  i. The Mechanical advantage of this pulley system.

  ii. The velocity ratio (distance ratio)

  iii. The efficiency of the above pulley system

i. MA = Load/ Effort =600N/200N = 3

ii. VR = Distance moved by effort/ distance moved by load = 4m/1m = 4

iii. Eff. = work done by load (output)/work done by effort X100%

Eff. = 600 X1m/200 X4m X 100% = 75%

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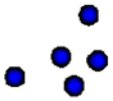
PHYSICS 5054

63. Explain the assumption of the kinetic theory

- Matter is composed of very tiny, discrete particles (atoms or molecules)

1. Describe quantitatively the molecular model of matter
   - The arrangement and movement of particles and strength of intermolecular forces determine which physical state (solid , liquid or gas) the substance is in

Solid - Molecules are held close to each other by their attractions of charge. They will bend and/or vibrate, but will stay in close proximity. The molecules have an ordered arrangement.	**Liquid** - Molecules will flow or glide over one another, but stay toward the bottom of the container. Motion is a bit more random than that of a solid. They have enough kinetic energy to slip out of the ordered arrangement of a solid.	**Gas** - Molecules are in continual straight-line motion. The kinetic energy of the molecule is greater than the attractive force between them, thus they are much farther apart and move freely of each other.
		

64. Demonstrate the application of the kinetic theory to explain rates of diffusion, Brownian motion, evaporation and cooling effect of evaporation
   - Diffusion is the movement of particles from areas of high concentration to areas of low concentration. Both gases and liquids will mix spontaneously without mechanical or outside help
   - The rate of diffusion depends on the temperature and the density of the substance involved
   - Brownian motion provides an evidence of the continuous random motion of molecules in air OR it is the random movement of microscopic particles suspended in a liquid or gas. The movement is caused by collision of the molecules of the surrounding gas or liquid.
   - Evaporation is defined as the change of a liquid into a gas at the surface. It occurs more at any temperature, but occurs more rapidly at higher temperature because heat gives more kinetic energy to the molecules and they escape from the surface faster

65. Demonstrate the kinetic theory to explain gas pressure
   - When a gas is enclosed in a container it exerts a pressure on the container. This gas pressure is caused by the collision of the gas particles with the walls of the container
   - Boyle's law states that for a fixed mass of a dry gas at constant temperature, the product of its volume and pressure is constant.

66. Demonstrate the effect of varying pressure on volume leading to Boyle's law
   - The pressure of a gas of constant volume increases when
     I. There are more molecules in the gas
     II. The molecules have a greater mass (PV = a constant at constant pressure)

<u>CHANGES OF STATE</u>

(A) Melting: solid to liquid

When a solid is heated the particles gain heat energy and their kinetic energy increases they vibrate faster and the spaces between them get larger

(B) Vaporization : liquid to gas

When a liquid is heated the particles gain heat energy and their kinetic energy increases the force of attraction between the particles is weakened.

(C) Freezing : solidifying liquid to solid

When a liquid is cooled the particles lose heat energy and their kinetic energy decreases they move slower and the space between them get smaller

(D) Condensation : gas to liquid

When a gas is cooled the particles lose heat energy and their kinetic energy decreases they move slower.

67. Describe temperature

- Temperature is the degree of hotness
- Temperature is the measure of the average kinetic energy of the particle in a substance

68. Describe quantitatively thermal expansion of solids, liquids and gases

- Thermal expansion is the process of particles in a substance moving further apart because they have been heated
- When molecules get heat energy they have more kinetic energy. They move or vibrate more. Then they need larger space between them.

69. Identify some of everyday application and consequences of thermal expansion.

- Thermal expansion is used n thermometer
- Used in bimetallic strip

CONSEQUENCES OF THERMAL EXPANSION

- The expansion of materials may cause bad influences if a solid or a liquid is prevented from expanding, very large forces are exerted. This force can destroy something egg bridge, buildings and roads.

70. Explain how a physical property which varies with temperature may be used for the measurement of temperature

- Two different materials e.g. copper and iron are used. The wires are soldered or just twisted tightly together at the end. When the two are placed in different temperatures an electric current flows around the circuit. The amount of current depends on the difference in temperature. If one of the junction is placed into the known.

71. demonstrate the construction of the following,

i) Laboratory thermometers

ii) Clinical thermometers both thermometers are calibrated by using the lower and up fixed points

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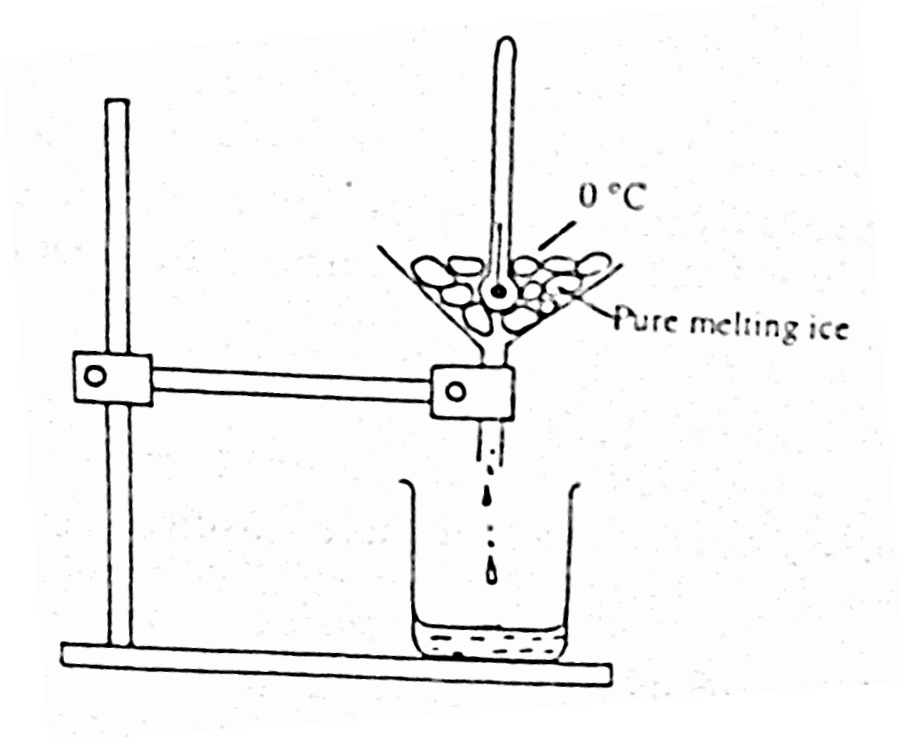
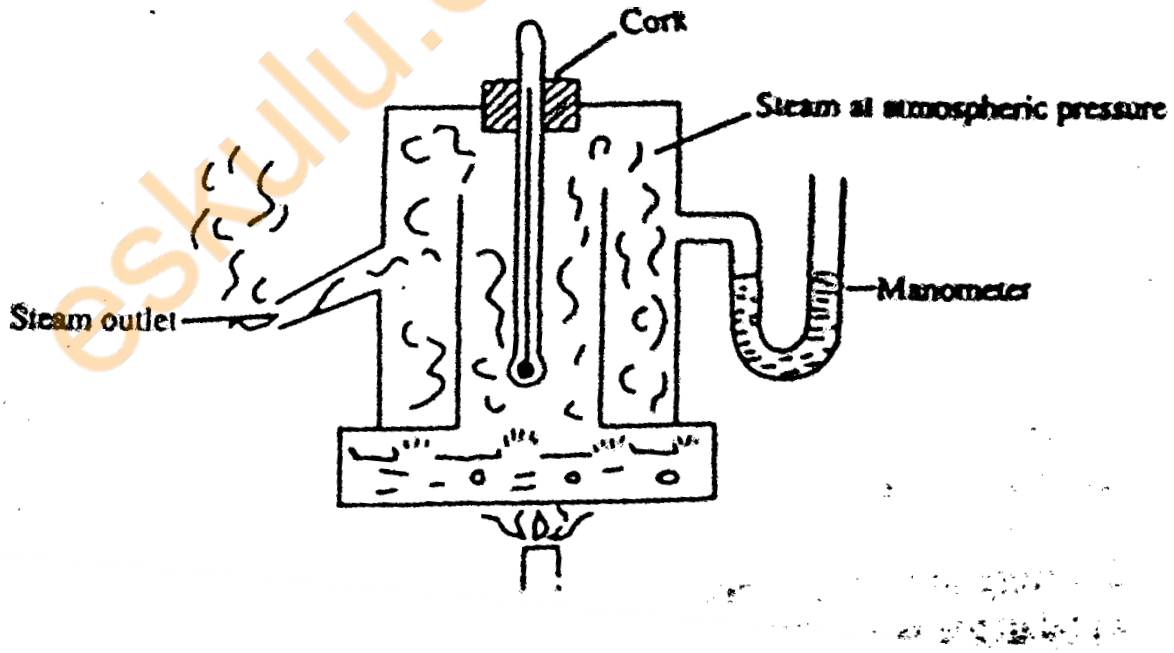
72. The experiment below shows the calibration of thermometer using the lower fixed point.



The reading on the thermometer is 0°C indicating the lower fixed point. Pure ice is used because it has in impurities that can affect the melting or boiling points.

The upper fixed point can be determined using the experiment below.



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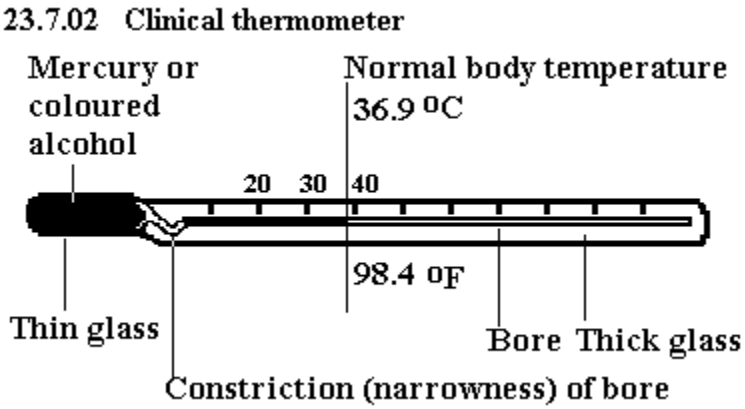
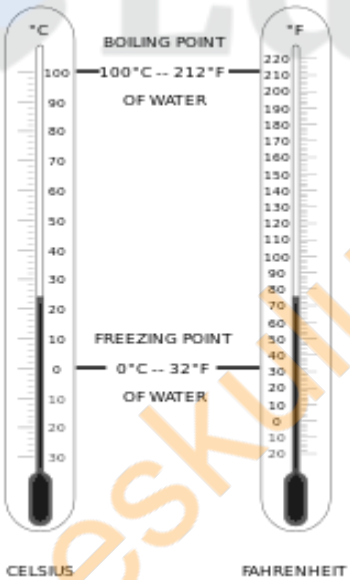
73. When the water boils, the thermometer records the highest mark of 100. This is the upper fixed point of the thermometer.
The diagrams below show structures of clinical and laboratory thermometers.

Clinical (ordinary) clinical digital



Laboratory thermometer



Describe the suitability of alcohol and mercury for use in liquid in gas thermometers.

- Suitability of thermometric liquids includes (properties)
  - Should be easily and cleanly seen i.e. do not wet the glass tube.
  - Should be able to expand and contract evenly or rapidly.
  - Should not stick to the glass

74. Describe the relationship between the Celsius and Kelvin scale.

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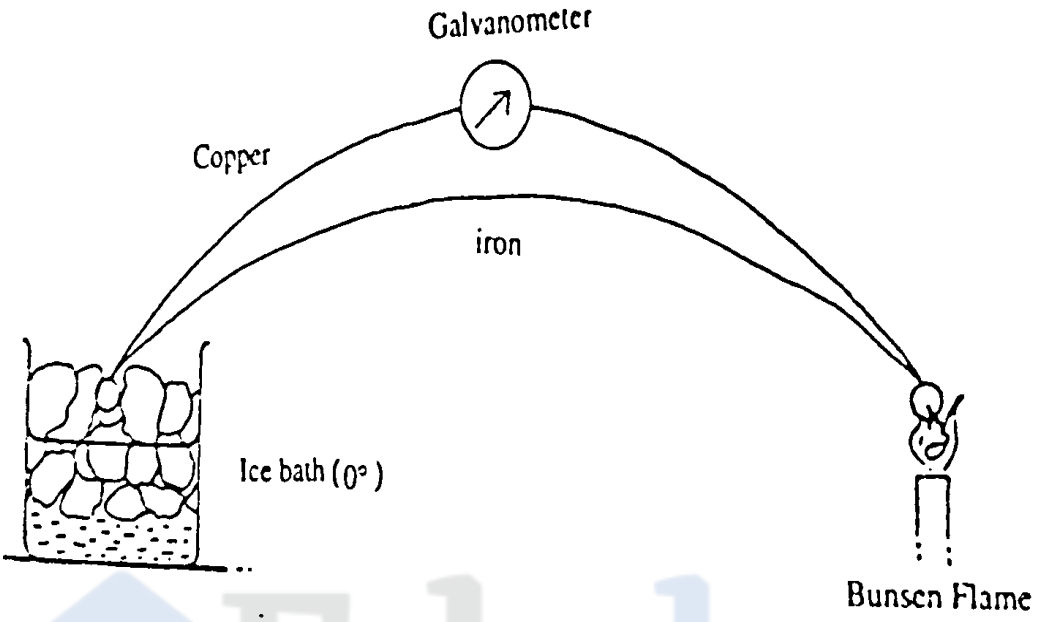
- Celsius and Kelvin scale

(K =t+ 273)

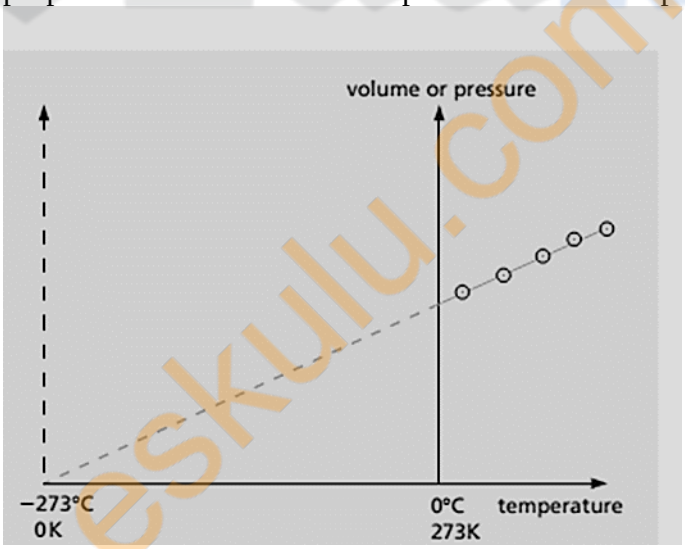
75. describe the structure of the thermocouple thermometers

It has two different metals i.e. copper and iron to measure rapid temperature changes.



76. describe the relation between temperature and volume.

From Charles law: law it states that the volume of the fixed mass of dry air is directly proportional to its absolute temperature at constant pressure.



77. From boyles law: the volume of a fixed mass of dry air inversely proportional to the pressure exerted on it at constant temperature.

Hence Boyle's law mathematically is.

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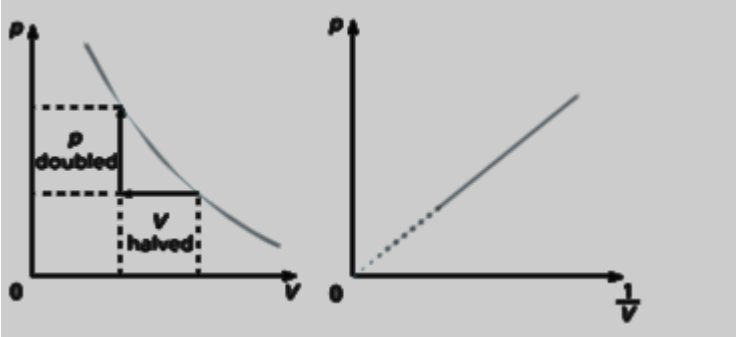


78. Demonstrate the use of idea gas equation to solve simple numerical problems.

Idea gas law equation is,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

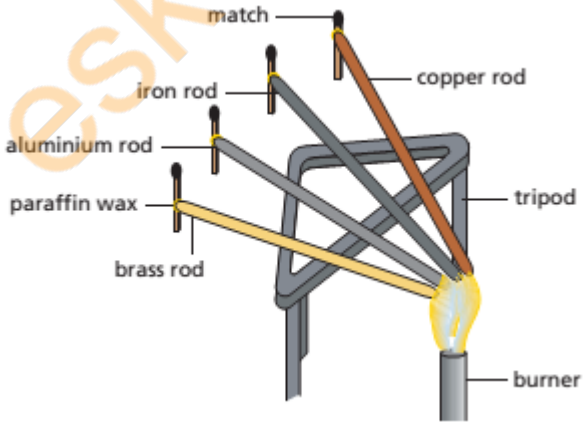
This is also known as general gas law equation

79. Explain methods of heat transfers

- Conduction, convection and radiation
- Conduction: is the method of heat transfer through a material without the movement of any part of the material itself. When a material is heated, the particles gain more heat energy and vibrate more. Hence transferring heat energy.
- Convection: this is the method of heat transfer by electromagnetic waves
- Radiation: this is the method of heat transfer by electromagnetic waves.

The following are experiment showing conduction, convection and radiation.

A simple demonstration of the different conducting powers of various metals is shown below. A match is fixed to one end of each rod using a little melted wax. The other ends of the rods are heated by a burner. When the temperatures of the far ends reach the melting point of wax, the matches drop off. The match on copper falls first, showing it is the best **conductor**, followed by aluminum, brass and then iron.



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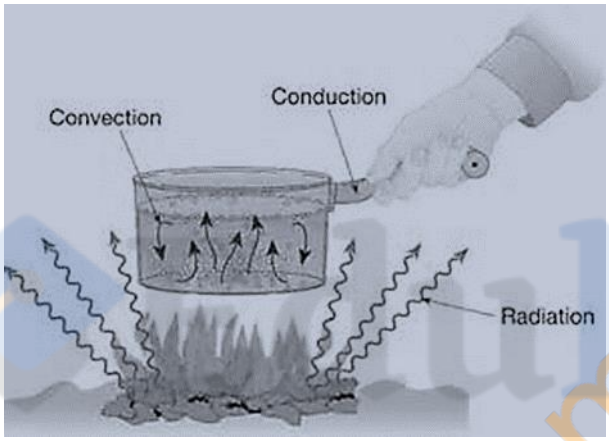
A

B

80. Liquids and gases also conduct heat but only very slowly. Water is a very poor conductor, as shown in part B. The water at the top of the tube can be boiled before the ice at the bottom melts.



81. Demonstrate the uses of bad and good conductors of heat.

- Cooking utensils are made of good conductors of heat. E.g. pots, pans
- Building materials, hair, blankets, handles of electric kettles are made of bad conductors. They slow down the conduction process

82. Explain the everyday applications of convection and radiation

They are used in thermos or vacuum flasks, electric kettles, land and sea breeze and greenhouse effect.

- Vacuum space prevents heat loss and gain by radiation process
- Silvered wall/vessel and cork stopper prevents heat loss by radiation and conduction.

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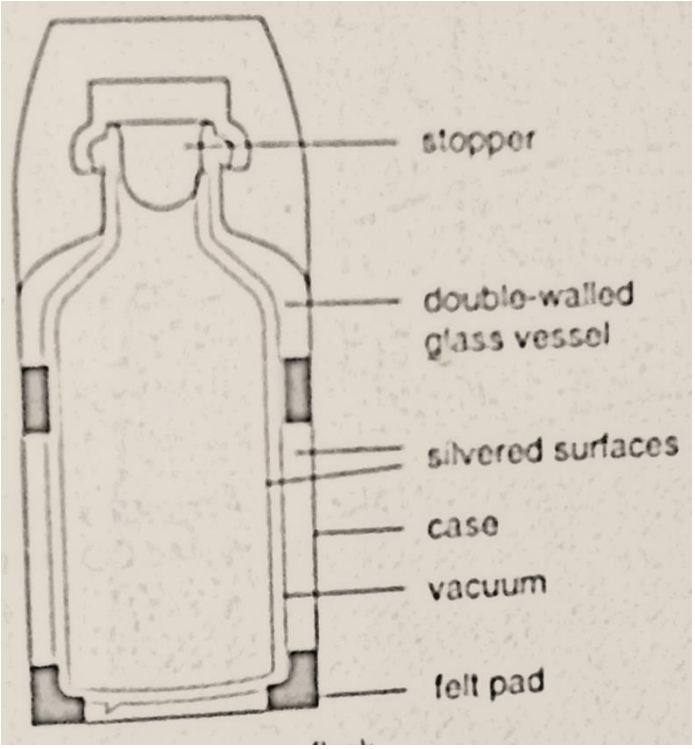

83. Describe the effect of radiation on human population

- It leads to global warming and ozone layer depletion resulting in excess radiation from the sun, droughts and excessive coldness.

84. Demonstrate the refraction of light.

The **bending of light** when it passes from one material (called a medium) to another is called **refraction**.

85. Demonstrate the laws of refraction of light

- The refracted ray, normal ray and emergent results in the ratio
- This constant value is the refractive index
- The incident ray, the normal ray and the refracted ray all lie in the same plain.

86. Demonstrate the passage of light through parallel sided transparent material.

- From the experiment, the table below should be completed.
- By using n = the refractive index of a given material can be found.

$$n = \frac{\text{sine of angle between ray in air and normal}}{\text{sine of angle between ray in glass and normal}} = \frac{\sin i}{\sin r}$$

87. Demonstrate refractive index (n) in terms of real and apparent depth

- Refractive index of a substance is given by;

$$\text{refractive index, } n = \frac{\text{speed of light in air (or a vacuum)}}{\text{speed of light in medium}}$$

88. Describe types of lens.

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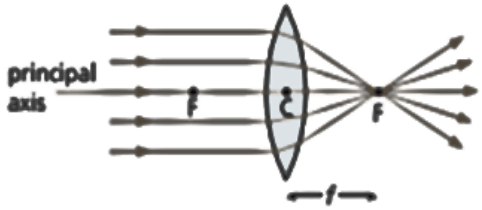
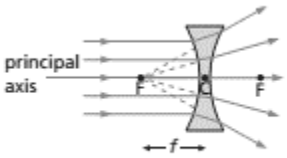
- Convex: thicker at the middle
- Concave thinner at the middle

89. Describe the action of a thin converging and diverging lens on a beam of light.

i). convex



ii) concave



90. Describe how to determine the focal [point, focal length optical centre and principle axis of a lens.

By using the method known as plain mirror method,

The image formed is inverted.
The lens formula is also used

By lens formulae
1/f = 1/u +1/v

91. Demonstrate how to obtain images formed by converging lenses

- By using Characteristics of image in terms of the position, size and nature of images formed by converging lenses.

92. Describe the uses of lenses in everyday life.

Use of lens: in correcting defects in vision: short sight-concave lens, long sight-convex lens, LCD, Camera etc.

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93. Describe the main components of electromagnet spectrum

93. The main components includes gamma rays (o) ultra violet, visible light, infrared, microwaves radio waves and x-rays

NAME	WAVE LENGTH (M)	SOURCE	DETECTION	USE
Radio waves	10 – 10	Radion circulates aerials	Radio T.V radar	Communication in TV, radion, phones
Microwaves	10 – 10	Special electric circuits	Special circuits	Forrada, cooking in microwaves
Infrared	7.5x10 – 10	All matters e.g hot objects sun heat	Transistor, photographic films, blankenedthermomoter	Burglar alarms security lights, remove heating purposes.
Light	3.5 x 10 – 7.5x 10	Lamp, flames, hot objects	Eye photographic film photocells	Seein g
Ultra-violent	10 – 3.5 x 10	Hot object mercury vapour	Fluorescent, photographit, photocells	In hospitals to kill microbes

94. Describe the properties of electromagnetic spectrum

In vacuum they travel at 3.0 x 10mls
Are produced by varying electric and magnetic fields
Are not affected by either electric or magnetic field
Are transverse
Travel in straight lines
Show interference and diffraction

95. Describe the methods of detection of each of the following

Gamma rays: by Geiger mulur

X-rays: giegermuller tube and photographic plates

Ultraviolet: by photographic plates, photocells and photo electric devices

Infrated: by photographic plates , heat sensitive dectors, thermopiles

Microwaves: by electric circuit

Radio waves: by T.V, Radios

96. Describe the use of electromagnetic spectrum fractures in everyday life.

X-rays are used in hospitals to detect fractures in bones

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Gamma is used in welding

Radio waves are used in T.Vs and radios

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UNIT: MAGNETISM

97. Describe the properties of magnets?

Ans. **Like charges repel, unlike charges attract.**

Magnets have two poles; north and south poles.

When suspended freely the magnet always lie in the north south direction

98. Demonstrate induced magnetism?

Ans. **When you stroke a needle with a permanent magnet several times lift the magnet every time you reach one end will make the needle to become magnetized. And you also use electrical method to magnetize a steel bar. Place a bar of unmagnetised in a solenoid and switch on D.C current and after a while it will be observed that the steel bar will be magnetized.**

99. Demonstrate the methods of demagnetizing of a magnet?

Ans. **The methods to demagnetize a magnet include;**

(i) Electrical method

(ii)Hammering,

(iii) Heating

Electrical method: To demagnetize a magnet; the magnet is placed in a coil in series with a.c supply. The magnet is withdrawn along a East-west direction until the magnet is a large distance away from the coil. The magnet will be demagnetized.

100. Distinguish the magnetic properties of iron and steel?

Ans. **Iron is easily magnetized and steel is easily demagnetized. This can be concluded by iron being susceptible while steel is retentive.**

101. Explain the use of magnetic screening and magnetic keepers?

Ans. **Magnetic screening is used for shielding equipment while magnetic keepers are used to prevent loss of magnetic strength.**

102. Describe the uses of magnets?

Ans. **They are used in circuit breakers, loud speakers and electromagnets.**

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UNIT: STATIC ELECTRICITY

103. Demonstrate the existence of static charges?

Ans. **There are positive and negative charges and these charges obey the law of electric charge which states that like charges repel while unlike charges repel.**

104. Explain how to detect the electric charges?

Ans. Charges can be detected by;

(i) Charging by contact: When a glass rod is rubbed against with fur it acquires positive charges

(ii) Testing the sign of charges by using gold-leaf electroscope.

105. Describe the properties and uses of static charges

Ans. **(i) Like charges repel, unlike charges attract (Law of electrostatics)**

Uses: (ii) Dust precipitation, ink jet printers, photocopiers.

106. Describe the electric charging and discharging of objects?

Ans. (i) **Electric charging can be done by friction (when a glass rod is rubbed against with fur it acquires positive charges.**

((ii) **induction. (When a negatively charged rod is brought near the metal cap electrons are repelled to the metal on the metal cap)**

Discharging of objects by static electricity.

(i) Objects can be discharged by touching the metal cap with the finger. The electrons flow to the earth if the electroscope is negatively charged or electrons flow from the earth if the electroscope is positively charged.

(ii) Bringing the cap of the charged electroscope near a water tap.

(iii) Putting a bare flame of a candle close to the cap

107. Explain the relationship between current and static electricity?

Ans. **The relationship between current and static electricity in terms of effects as static electricity produces same effects as current electricity. The effects include lighting**.

UNIT: ELECTRIC CURRENT

108. (i) Describe the terms associated with electricity?

Ans. (i) **Current is the flow of charge in a metallic conductor**

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(ii) Electric charge is the quantity of electric current passing a point every second.

(iii) Potential difference is the work done in moving a coulomb of charge between two points or the energy lost when one coulomb of charge passes between two points and it can also be defined as energy required to move a unit charge between two points in a circuit.

(iv) Volt is joule per coulomb

109. Identify the units of electric charge and current?

Ans**. Electric current is measured in Amperes (A) and Electric charge is measured in Coulombs. (C).But current also has a derived unit of volt per ohm.**

110. Differentiate between potential difference (PD) and electromotive force (EMF)?

Ans. **The difference is in terms of work done per unit of charge in driving charge in a circuit and through a component. In (PD) energy is lost while in (EMF) energy is gained.**

111. Explain the meaning of resistance?

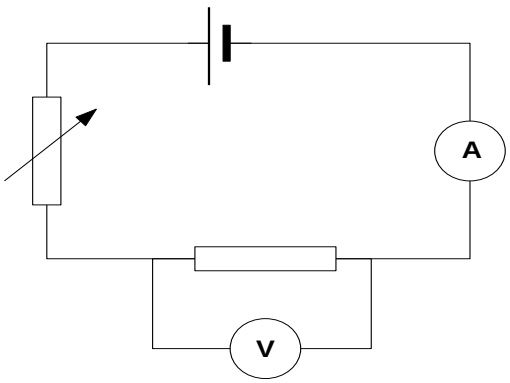
Ans. **Resistance is the opposition to the flow of charge.**

112. Describe what the internal resistance of a cell is?

Ans. **This is the resistance of a cell offered by the electrolyte in cells or batteries.**

113. How to determine the resistance in a simple circuit?

Ans. **$1/R = 1/R_1 + 1/R_2$). This formula is for series circuit**.



114. Describe the relationship of voltage, current and power?

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Ans. **You can demonstrate the relationship by using the formula E=VIt. This is the formula for electrical energy**.

115. Demonstrate energy transformations in an electric circuit?

Ans. **The energy of an electric current can be converted into various forms for example**

(i) **Electrical can be converted to mechanical energy in motors and washing machines.**

(ii) **Electrical energy can be converted to sound energy in record players and telephones**

(iii) **Electrical energy can be converted to heat energy in heating elements**

(iv) **Electrical energy can be converted to light energy or radian heat like in a filament lamps.**

116. Investigate the heating effect of an electric current?

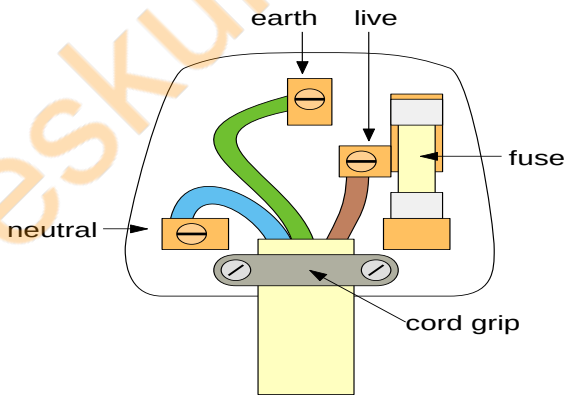
Ans. **When the switch is closed, current flows and after some time the resistance wire feels hot but the copper wire remains cold.**

117. Explain the need for earthling metal cases and for double insulation?

Ans. **The reason for this is to prevent electric shock and also as a safety precaution.**

118. Describe the meaning of three wires found in the cable?

Ans. **The three types of wires: Live (brown), earthing (green and yellow) and neutral is blue.**



119. Describe ways of conserving electrical in homes and industries?

Ans. **You can conserve electrical energy by using energy saving bulbs and also switching off lights when you are not using them. You can also use gas cooker instead of electric stove.**

120. Demonstrate how to calculate the cost of using electrical Energy?

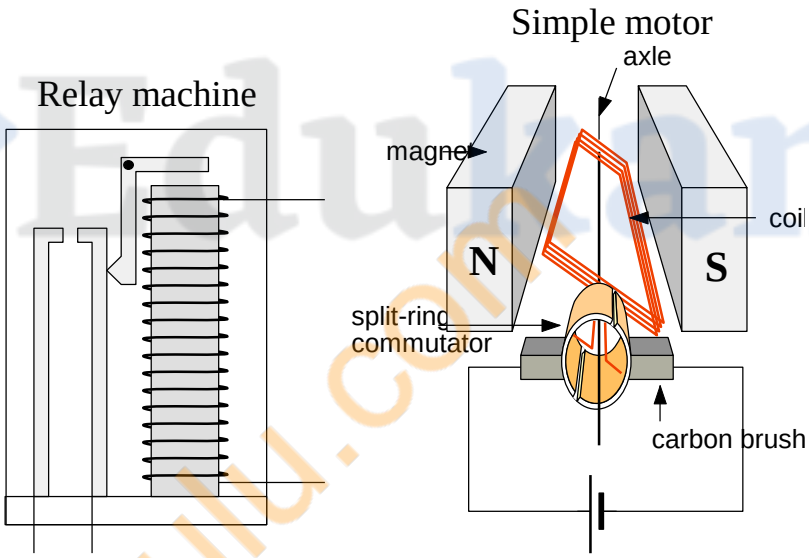
Ans. **Electrical Energy can be calculated using the formula E= Pt where power is in Kilowatt and time should be in hours to form Kwh which is equal to 1 x 1000W x 60 and the answer should be in Kwh.**

121. Describe the use of fuses, earthing and the three pin-plug?

Ans. **These serve as safety electrical components which prevent electrical shock and overload of power**.

122. Describe the applications of the magnetic effect of an electric current?

Ans. **Applications of electromagnetics include electric bell, relay switches and simple motor**



123. Explain the behavior of an electric current in a magnetic field?

Ans. **Displacement of current carrying wire or electron and there is attraction and repulsion of forces between parallel currents.**

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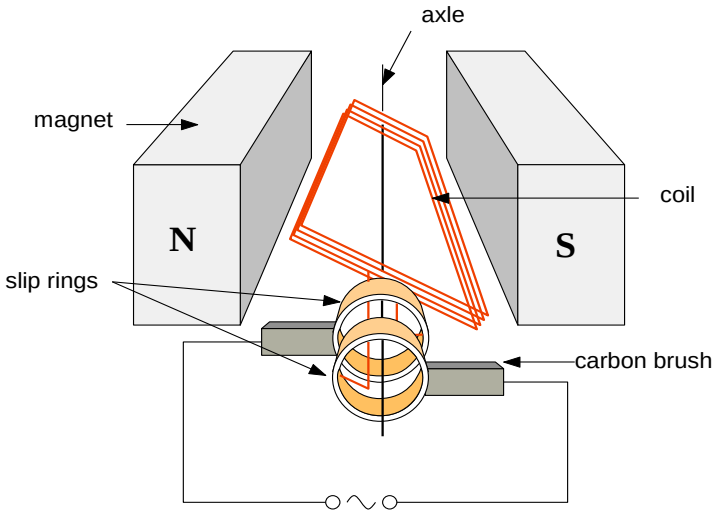
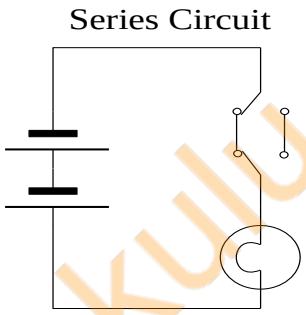


When a current carrying wire is placed in a magnetic field, there will be an interaction between the two fields which will create a force and this force will be induced in the current carrying conductor.

124. Describe the nature of forces between parallel currents?

Ans. **There is attraction and repulsion between parallel currents**



125. Describe the factors that affect the magnitude and direction of induced EMF?

Ans.

(i) **Speed of either magnet or coil**

(ii) **Strength of magnet**

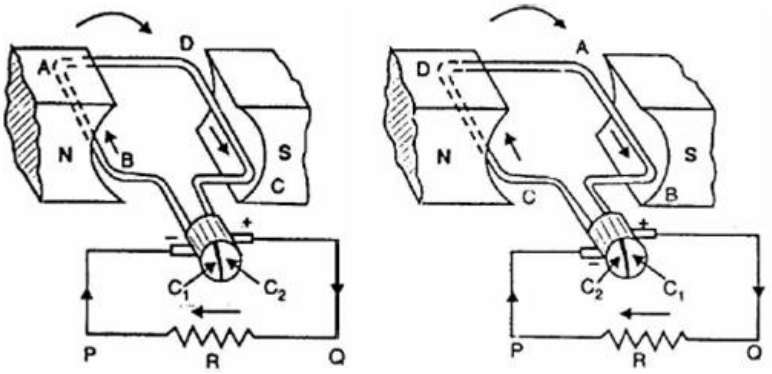
(iii) **Number of turns of a coil**

126. State the direction of current produced by an induced EMF?

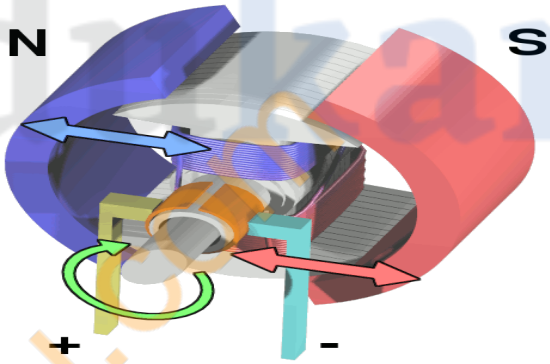
Ans. **To determine the direction you use Fleming right hand law**

127. Describe a simple AC and D.C generators?

Ans. **It consists of a rectangular coil made of insulated copper wire which rotates between permanent magnets. It has slip rings (fixed to the coil and rotates with it). It has two brushes (carbon) which are contacts that rub against slip rings. It produces alternating current.**



A DC generator is known as a dynamo. It consists of split rings (fixed to the coil and rotate with it). It produces direct current.



128. Explain the conversion of an A.C generator to a D.C generator?

Ans. **A rectifiers an electric device which coverts a.c. current to D.C. There are a number of rectifiers such as vacuum tube diode, Mercury – arc – valve, copper and selenium oxide rectifier, semi-conductors, silicon controlled etc.**

129. **Demonstrate the principles of mutual induction?**

Ans. **Principles of mutual induction says that changing current in one coil gives rise to current in the other**

130. Explain the advantages of high alternating potential difference power transmission?

Ans. **The advantage is that it helps reduce power losses in cables**.

131. Describe the effects of improper management of transformers?

Ans. **The effects include overheating, low voltages and also high voltages**.

132. Describe what thermionic emission is?

Ans. The removal of electrons from the atoms by applying heat energy. Therefore, thermionic emission is the evaporation of electrons from the metal that is heated.

133. State properties of cathode rays?

Ans.

(i) They can be deflected by electric and magnetic fields

(ii) They travel in a straight line

(iii) They are electron beam

(iv) They carry a positive charge

134. Describe the uses of cathode-ray oscilloscope?

Ans. **They are used in picture tubes in television receivers, electrocardiographs, computers and oscillators.**

BASIC ELECTRONICS

135. Describe what thermionic emission?

Ans. **This is a process of releasing electrons from a heated cathode**

136. Investigate properties of cathode rays?

Ans. **i) They travel in a straight line**

ii) They can be deflected by a magnetic and electric field

iii) They produce fluoresce when they strike a metal

iv) They are negatively charged

137. Describe applications of electron beams?

Ans. **Electron beams can be applied in CRO, TV set, X-ray machines.**

138. Describe basic structure an action of cathode- ray oscilloscope?

Ans. **the parts of CRO are described below in the diagram.**

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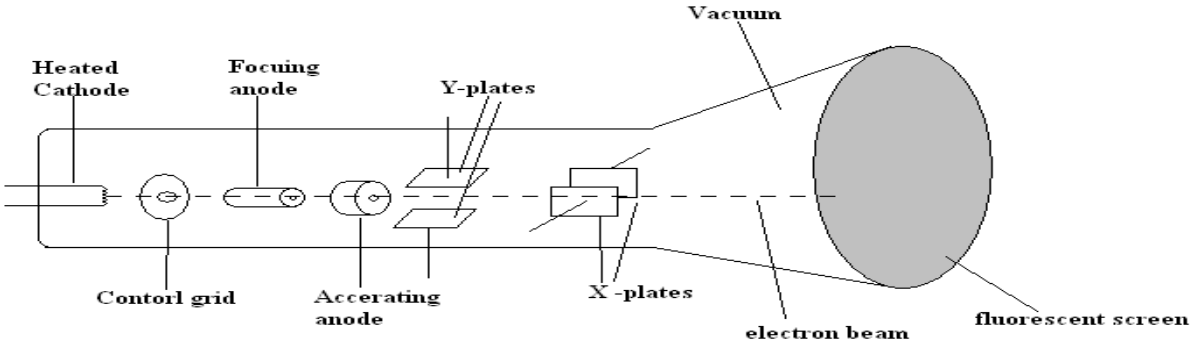


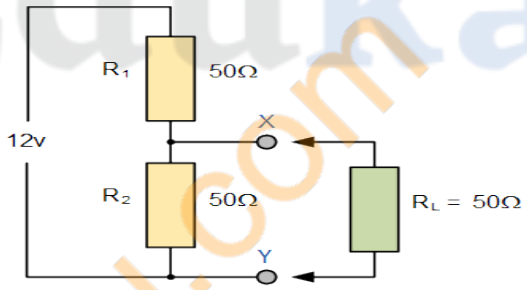
It is made up of electron gun, control grid, anode Y-plates, X-plates an fluorescent screen.

139. Describe the uses of cathode-ray oscilloscope?

Ans. **Uses of CRO include measuring peak voltage, time and frequency, T.V frequency.**

140. Describe the action of variable potential divider?

Ans. **It is a simple circuit that uses resistors or thermistors or LDR's to supply a variable potential difference. They can be used as audio volume controls, to control the temperature in a freezer or monitor changes in light in a room**



a) Without R_L connected

$R_{X-Y} = 50\Omega$

$V_{out} = V_{in} \times \frac{R_2}{R_1 + R_2}$

$V_{out} = 12v \times \frac{50}{50 + 50} = 6.0v$

b) With R_L connected

$R_{X-Y} = 25\Omega$ (Resistors in Parallel)

$V_{out} = V_{in} \times \frac{R_2}{R_1 + R_2}$

$V_{out} = 12v \times \frac{25}{50 + 25} = 4.0v$

141. Explain the action and application of thermistor and light dependent resistor?

Ans. **A thermistor also known as a semi-conductor is sensitive to temperature and changes in light intensity.**

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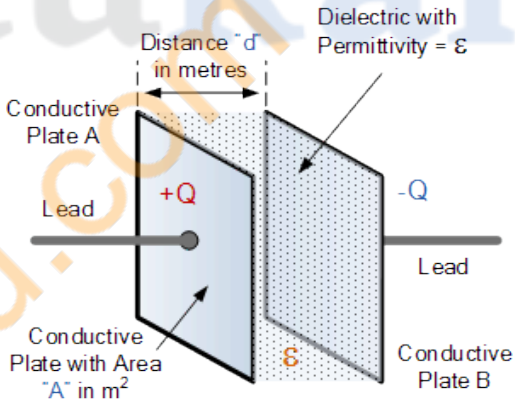
Thermistors are semiconductor devices that are used to measure temperature. Thermistors have an electrical resistance that is proportional to temperature

142. Investigate the charging and discharging of capacitors?

Ans. **Charging through a resistor can be done by connecting a capacitor to current flow and discharging can be done through a resistor when not connected to current flow.**



143. Describe the role of capacitors in electronic equipment?

Ans. **The role of capacitors in electronic equipment is to filter circuits, delay circuits, smothering rectified currents. The other function is to store electrical energy in electronic devices.**

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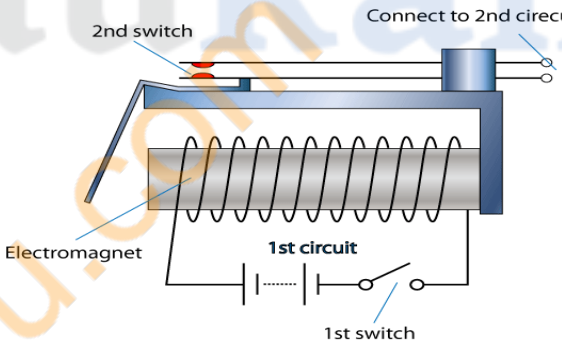
144. Explain how reed and relay switch work?

Ans. **The works of reed switch and relay switched is by attraction of two iron reeds to switch on/off current and relay switch works as an amplifier. [A reed switch is an electromagnetic switch used to control the flow of electricity in a circuit] while an relay is an electromagnetic switch operated by a relatively small electric current that turn on or off a much larger electric current.**



145. Describe application of reed switch and reed relay?

Ans. **The application of reed and relay switch is in alarm bells, starter motor and telephone.**

146. Describe the action of a bipolar transistor?

Ans. **Action of a bipolar transistor is current amplifier and they are also used as electronic switches.**

147. State the different types of logic gates?

Ans. NOT, AND, or NAND, NOR

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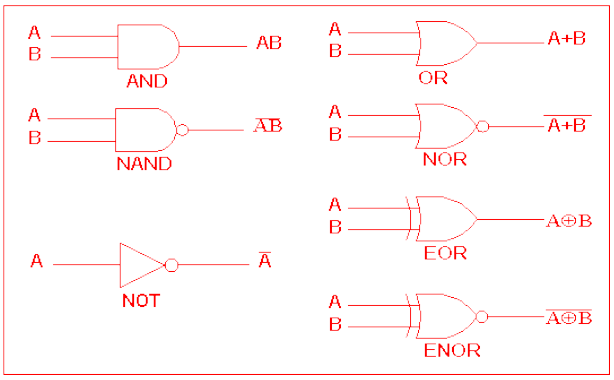


148. Describe uses of bistable and astable circuits?

Ans.**Bistable circuits are ross-coupled logic gates and used in computer for data storage while Astable circuits are used as pulse generator and used in clocks that controls operations in a computer.**

Bistable circuit

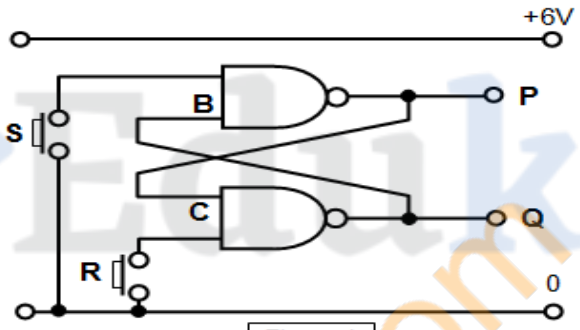
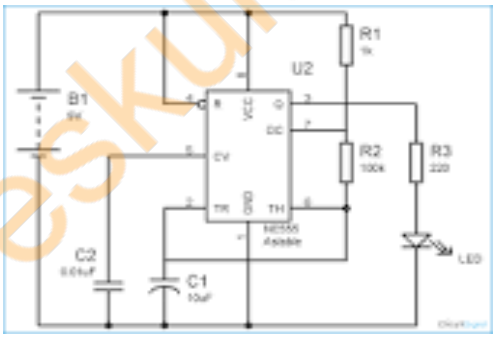


Figure 1

Astable circuit



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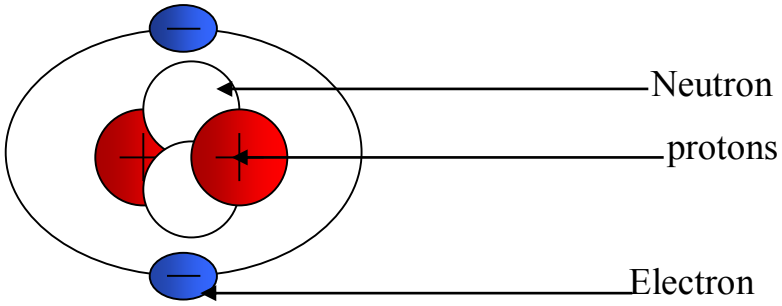
ATOMIC PHYSICS

149. Describe the structure of an atom?

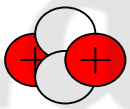
Ans. **An atom is a smallest particle of an element which take part in a chemical reaction and it is made of up of nucleus and electrons. The nucleus is made of protons and neutrons.**



150. Describe the nature of radioactivity?

Ans. **Nature of radioactivity can either be random or spontaneous**.

An alpha particle is identical to that of a helium nucleus



It contains two protons and two neutrons.

151. Describe the characteristics of Alpha (α), beta (β) and gamma (ϒ)

Ans.

RADIATION	**PENETRATION POWER**	**IONISATION POWER**	**CHARGE**	**MASS**	**NATURE**	**STOPPED BY**
ALPHA	Weak	Strong	+	4amu	Helium	Piece of paper
BETA	Medium	Medium	-	0	electron	5mm of aluminum foil
GAMMA	Strong	Weak			Electromagnetic energy	Lead concrete

152. Describe the methods of detecting radioactive emissions?

Ans. **You can detect radioactive emission by using Geiger Muller (G.M) tube, photographic film, scintillation counter and Cloud chamber, Gold leaf, Ratemeter**.

- Photographic film gets exposed.
- G.M. tube contains Argon /Neon. Charged particles of alpha and beta ionize the Argon and Neon atoms. The electric field accelerates the ions leading to further collisions. This collision produces more ionization to give a pulse on the meter connected to output.

153. Explain the origin and effects of background radiations?

Ans. **Causes of background radiations are;**

(i) Cosmic rays

(ii) Radioactive elements under rocks

154. Describe what radioactive decay is?

Ans. **Radioactive decay is the disintegration of nucleus by alpha, beta and gamma emissions.**

155. Describe what nuclear fusion and fission is?

Ans. **Nuclear fusion occurs when nuclei of light elements are forced togather at a high temperature and releases enormous energy while nuclear fission is the splitting process of nucleus.**

156. Explain uses of radioactive substances?

Ans. **Radioactive substances are used;**

- **in treatment of cancer,**
- **as tracers to check the flow of liquids underground,**
- **to sterilize hospital utensils detection of certain metals**

157. Define half-life?

Ans. **Half-life is time taken for half the nucleus of a radioactive element to decay.**

158. Describe the safety precautions necessary when handling or storing radioactive substances?

Ans. **Use protective materials such as gloves, goggles, overalls and lead shields.**

159. Explain the effects of radioactive substances on the environment and health?

Ans. **The effects include radiation pollution and health hazards.**

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