

My Favorite Guide On **SCIENCE & TECHNOLOGY**

विज्ञान व तंत्रज्ञान

Std - 9th - Semi English



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**Strictly As Per
BOARDS
New Syllabus**

**महाराष्ट्रात 11th आणि 12th (Science) ची पुस्तके
प्रथमच... English व Scientific मराठी मधून...**

Authors :
Qualified and Experienced Staffs From :
PUNE | LATUR PATTERN

TOPIC - 01

LAWS OF MOTION

Laws of Motion (गतीचे नियम)

1.1 Introduction

- i) We see the motion of several objects every day. Sometimes we cannot see the motion of an object directly, as in the case of a breeze.
- ii) You have learnt that motion is a relative concept. If the position of an object is changing with respect to its surroundings, then it is said to be in motion.

Introduction (प्रस्तावना) -

- i) Every day आपण Several Objects (अनेक वस्तू) ची motion पाहतो. काहीवेळा आपण Object ची motion पाहू शकत नाही, जसे की breeze (वारा, झुळुक) च्या बाबतीत.
- ii) Motion (गती) ही relative concept (सापेक्ष संकल्पना) आहे. हे आपण शिकलो आहे. जर Object ची position (स्थिती) ही तिच्या surrounding (सभोवताली) मुळे change होत असेल तर ती object ही motion (गती) मध्ये आहे असे म्हणतात.

Q.1 Can you tell?

Q.1) In which of the following examples can you sense motion?

2) How will you explain presence and absence of motion?

- i) The flight of a bird
- ii) A stationary train
- iii) Leaves flying through air
- iv) A stone lying on a hill

Ans: We can sense motion in the examples:

- i) The flight of a bird and
- ii) leaves flying through air.

A body is said to be in motion if it changes its position with respect to its surroundings and at rest otherwise.

Q.1 सांगा पाहू!

- 1) खालील पैकी कोणत्या examples मध्ये तुम्हाला motion जाणवते (sense)?

2) तुम्ही motion ची presence (अस्तित्व) आणि absence कसे स्पष्ट कराल?

- i) पक्षी हवेत उडणे / उडणारा पक्षी.
- ii) विराम अवस्थेतील आगगाडी.
- iii) हवेत उडणारे पान.
- iv) टेकडीवरून खाली येणारा दगड.

Ans: आपणाला motion ची जाणीव example i) आणि ii) मध्ये होते. जर एखादी body तिच्या surrounding बाबतीत तिची position (स्थान/जागा) बदलत असेल तर ती body motion मध्ये आहे, असे म्हणतात. अन्यथा ती rest (विराम) अवस्थेत असू शकते.

Q.2 Think about it.

1) You are travelling in a bus. Is the person sitting next to you in motion?

Ans: The person sitting next to me is not in motion with respect to me, but that person is in motion with respect to a person on the road.

2) What do you take into consideration to decide if an object is moving or not?

Ans: To decide whether an object is in motion or not we consider whether it changes its position with respect to its surroundings or not.

Q.2 विचार करा.

1) तुम्ही bus मधून travelling करत आहात. तुमच्या पुढच्या sit वर बसलेला person (प्रवासी) गतीमध्ये आहे का?

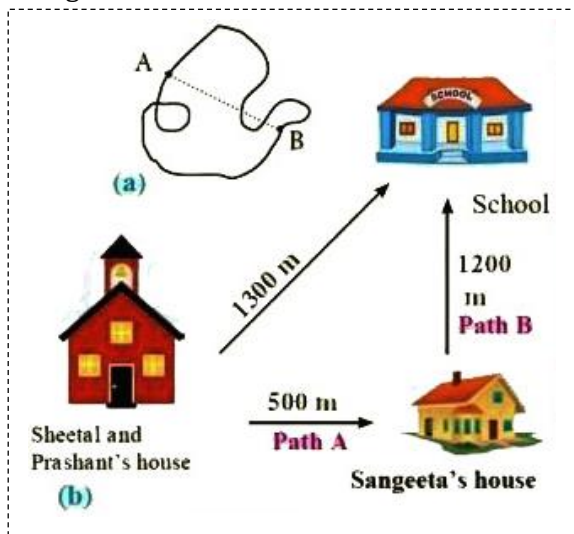
Ans: माझ्या समोरच्या sit वर बसलेला person माझ्या तुलनेत motion मध्ये नाही. परंतु तो road वर उभ्या असलेल्या person च्या बाबतीत motion मध्ये आहे.

2) जर एखादी object (वस्तू) motion मध्ये आहे का नाही? हे तुम्हाला कशावरून consider (समजणे) करून घ्याल?

Ans: एखादा object हा motion मध्ये आहे का नाही हे decide (निश्चित करणे) करण्यासाठी त्या object ची position ही surrounding च्या बाबतीत change होते का नाही हे consider करणे.

Q.3 Let's try this

Hint: Dear student, you can do this activity and try to give answers of the below questions by observing below figure.



- 1) Measure the distance between points A and B in different ways as shown in figure.
- 2) Now measure the distance along the dotted line. Which distance is correct according to you and why?

Q.4 Think about it.

A) Sheetal first went to her friend Sungeeta's house on her way to school (see figure.)

B) Prashant went straight from home to school. Both are walking with the same speed. Who will take less time to reach the school and why?

In the above example, is there a difference between the actual distance and the distance travelled? What is it?

Ans: Prashant will take less time to reach the school.

The distance travelled by Sheetal = $500 + 1200$
 $= 1700 \text{ m,}$

The distance travelled by Prashant = 1300 m.

The difference = $1700 - 1300 = 400 \text{ m.}$

Prashant and Sheetal walk with the same speed and the distance travelled by Prashant is less than that travelled by Sheetal. Hence, Prashant will take less time to reach the school.

Note: Speed = distance/ time.

$\therefore$ Distance = speed $\times$ time

1.2 Displacement and distance**Q.5 Define displacement and distance.**

Ans: i) Distance: Distance is the length of the actual path travelled by an object in motion while going from one point to another.

ii) Displacement: Displacement is the minimum distance between the starting and finishing points.

Displacement आणि distance (विस्थापण आणि अंतर) -

Q.5 Displacement (विस्थापण) आणि distance (अंतर):

Ans: i) Distance (अंतर): Distance म्हणजे object ने एका point (ठिकाण) पासून दुसऱ्या point पर्यंत जाण्यासाठी travel (प्रवास) केलेल्या actual path (प्रत्यक्ष मार्गक्रमण) ची length (लांबी) होय.

ii) Displacement (विस्थापण): Displacement म्हणजे starting (सुरुवात) point आणि finishing (अंतिम) point मधील minimum (कमीत कमी) distance होय.

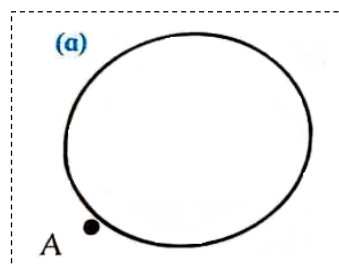
Q.6 Use your brain power!

1) Every morning, Swaralee walks round the edge of a circular field having a radius of 100 in. As shown in figure, if she starts from the point A and takes one round, how much distance has she walked and what is her displacement'?

Ans: The distance covered by Swaralee in one round = circumference of the circle

$$= 2\pi r = 2 \times \frac{22}{7} \times 100 \text{ m} = \frac{4400}{7} \text{ m}$$

= about 628.6 m, her displacement = zero metre.



2) If a car, starting from point P, goes to point Q (see figure and then returns to point P, how much distance has it travelled and what is its displacement?

2.2.3 Transformation of energy

Q.10 Can you tell?

Which are the different forms of energy? Which type of energy is used in each of the following processes?

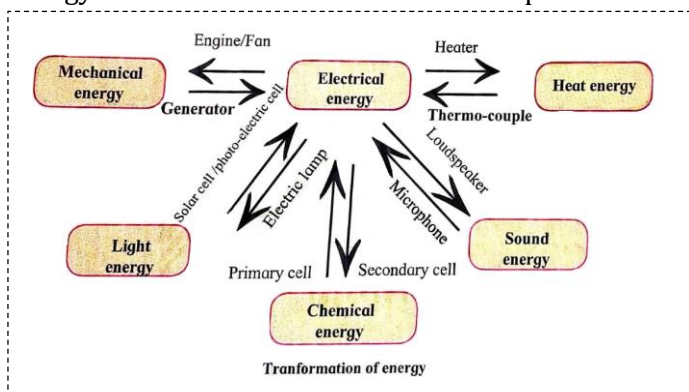
Different forms of energy:

- A stretched piece of rubber
- Fast moving car
- The whistling of a cooker due to steam
- The crackers exploded in Diwali
- A fan running on electricity
- Drawing out pieces of iron from garbage, using a magnet.
- Breaking of a glass window pane because of a loud noise.

Ans: i) Energy exists in various forms like mechanical, heat, light, sound, electro-magnetic, chemical, nuclear and solar.

ii) Energy can be transformed from one type to another. For example, the exploding firecrackers convert the chemical energy stored in them into light, sound and heat energy.

iii) The following figure shows the transformation of energy in their different forms with example.



Transformation of energy (ऊर्जेचे हस्तांतरण):

Q.10 सांगा पाहू.

Energy चे different forms (वेगवेगळी प्रकार/रूपे) कोणते? खालील processes (प्रक्रिया) मध्ये वापरण्यात आलेल्या energy चा प्रकार कोणता?

- Rubber चा stretch (ताणलेला) केलेला piece (तुकडा).
- वेगाने move होणारी car.

- Steam (वाफ) मुळे cooker ची होणारी whistle (शिड्टी).
- Diwali मध्ये explode (फुटणारे/स्फोट होणारे) cracker (फटाके)
- Electricity (विज) वर run (चालणारा) होणारा fan.
- Magnet (चुंबक) साहाय्याने garbage (कचरा) मधून वेगळे केलेले / करण्यात येणारे iron piece.
- Loud noise (गोंगाट) मुळे break होणारे glass window pan (खिडकीची काच)

Ans: i) Energy ही mechanical, heat, light, sound, electromagnetic, chemical, nuclear आणि solar या various form मध्ये exist असते.

ii) Energy ही एका type मधून दुसऱ्या type मध्ये transform (हस्तांतरित) होऊ शकते उदा. Explode होणारे firecrackers. हे त्यांच्यामध्ये असलेल्या chemical energy चे light energy, sound आणि heat energy मध्ये रूपांतर करतात.

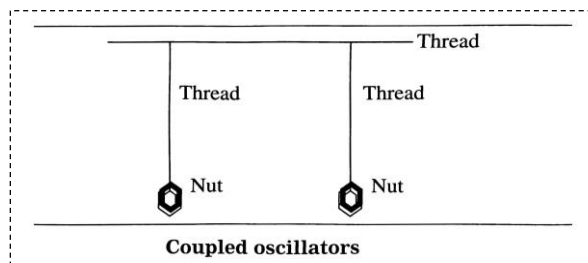
iii) वरील आकृती ही energy transformation चे different form आणि त्यांची examples दिली आहेत. ती व्यवस्थितपणे वाचून आत्मसात करावीत.

2.2.4 Law of conservation of energy

Q.11 State the Law of conservation of energy.

Ans: Law of conservation of energy:

The Law of conservation of energy states that, “**Energy can neither be created nor destroyed. It can be converted from one form into another. Thus, the total amount of energy in the universe remains constant**”.



i) Make two pendulums of the same length with the help of thread and two nuts. Tie another thread in the horizontal position.

ii) Tie the two pendulums to this horizontal thread in such a way that they will not hit each other while swinging.

iii) Now swing one of the pendulums and observe. What do you see?

6.3.2 Division II - Bryophyta

Q.6 Write the main features or characteristics of Bryophyta with examples.

Ans: Main features or characteristics of Bryophyta with examples:

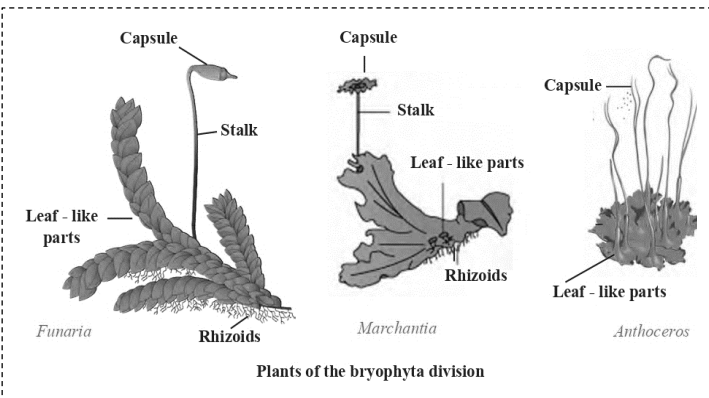
i) You may have seen a lush green soft carpet on old walls, bricks and rocks in the rainy season. Scrape it gently with a small ruler, observe it under a magnifying lens and discuss.

ii) This group of plants is called the 'amphibians' of the plant kingdom because they grow in moist soil but need water for reproduction.

iii) These plants are thalloid, multicellular and autotrophic. They reproduce by spore formation. The structure of the plant body of bryophytes is a ribbon-like long, without true roots, stem and leaves.

iv) Instead, they have stem-like or leaf-like parts and root-like rhizoids. They do not have specific tissues for conduction of food and water.

v) Examples are Moss (Funaria), Marchantia, Anthoceros, Riccia, etc.



Division - II (विभाग II) - Bryophyta (ब्रायोफायटा) -

ह्या गटातील वनस्पतींना वनस्पतीसृष्टीचे amphibians ('उभयचर') म्हटले जाते कारण त्या moist soil (ओलसर माती) मध्ये वाढतात. परंतु reproduction (प्रजनन) यासाठी मात्र त्यांना पाण्याची गरज भासते. या वनस्पती thalloid, multicellular and autotrophic (निम्नस्तरीय, बहुपेशीय व स्वयंपोषी) असतात. यांच्यामध्ये प्रजनन हे spore formation (बीजाणू निर्मिती) ने होते. Bryophyta विभागातील वनस्पतींची रचना चपटी ribbon-like long (रिबिनीसारखी लांब) असते. या वनस्पतींना खरी roots, stem and leaves (मुळे, खोड, पाने) नसतात तर पानांसारख्या रचना

असतात व मुळांऐवजी मुळांसारखे अवयव rhizoids (मुलाभ) असतात, पाणी व अन्नाच्या वहनासाठी विशिष्ट tissues (ऊती) नसतात. उदा. Moss मॉस, (Funaria), Marchantia (मर्केशिया) Anthoceros (अँन्यॉसिरॉस), Riccia (रिक्सिया) etc.

Observe and discuss.

You may have seen ferns among the ornamental plants in a garden. Take a leaf of a fully grown fern and observe it carefully.

Observe and discuss (निरीक्षण करा व चर्चा करा).

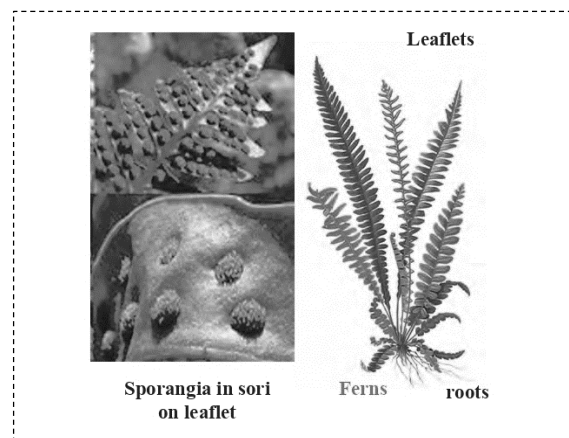
बागेतील शोभिवंत झुडपांमध्ये तुम्ही ferns (नेचे) पाहिलेच असेल. fully grown fern (पूर्ण वाढ झालेल्या नेचे) चे एक leaf (पान) घेऊन त्याचे सखोल observe (निरीक्षण) करा.

6.3.3 Division III- Pteridophyta

Q.7 Write the main features or characteristics of Pteridophyta with examples.

Ans: Main features or characteristics of Pteridophyta with examples:

i) Plants from this group have well-developed roots, stem and leaves and separate tissues for conduction of food and water. But, they do not bear flowers and fruits.
ii) They reproduce with the help of spores formed along the back or posterior surface of their leaves.



iii) Examples are ferns like Nephrolepis, Marsilea, Pteris, Adiantum, Equisetum, Selaginella, Lycopodium, etc.

iv) These plants reproduce asexually by spore formation and sexually by zygote formation. They have a well-developed conducting system.

Solved and Unsolved Examples:

1) Ohm's law and resistivity

Ex. 1): The resistance of the filament in a light bulb is 1000Ω . If the bulb is fed by a current from a source of potential different 230 V , how much current will flow through it?

Given: $R = 1000\Omega$

$$V = 230\text{ V}$$

$$\text{Formula: } I = \frac{V}{R}$$

$$\therefore I = \frac{230\text{ V}}{1000\Omega} = 0.23\text{ A.}$$

The current flowing through the filament of the bulb 0.23 A .

Ex. 2) The length of a conducting wire is 50 cm and its radius is 0.5 mm . If its resistance is 30Ω . What is the resistivity of its material?

Given: $L = 50\text{ cm} = 50 \times 10^{-2}\text{ m}$

$$r = 0.5\text{ mm} = 0.5 \times 10^{-3}\text{ m}$$

$$= 5 \times 10^{-4}\text{ m and } R = 30\Omega$$

$$\text{Resistivity } \rho = \frac{RA}{L}$$

$$\text{and } A = \pi r^2$$

$$\therefore \rho = R \frac{\pi r^2}{L}$$

$$= \frac{30 \times 3.14 \times (5 \times 10^{-4})^2}{50 \times 10^{-2}}$$

$$= \frac{30 \times 3.14 \times 25 \times 10^{-8}}{50 \times 10^{-2}}$$

$$= 47.1 \times 10^{-6}\Omega\text{ m}$$

$$= 4.71 \times 10^{-5}\Omega\text{ m}$$

Resistivity of the wire $4.71 \times 10^{-5}\Omega\text{ m}$

Ex. 3) A current of 0.24 A flows through a conductor when a potential difference of 24 V is applied between its two ends. What is its resistance?

Given: $V = 24\text{ V}, I = 0.24\text{ A}$

$$\text{Formula } R = \frac{V}{I}$$

$$\therefore I = \frac{24\text{ V}}{0.24\text{ A}}$$

$$R = 100\Omega$$

The resistance of the conductor is 100Ω .

Ex. 4) Determine the current that will flow when a potential difference of 33 V is applied between two ends of an appliance having a resistance of 110Ω . If the same current is to flow through an appliance having a resistance of 500Ω , how much potential difference should be applied across its two ends?

Given: $V = 33\text{ V}$ and $R = 110\Omega$

In the first case,

$$I = \frac{V}{R} = \frac{33}{110}$$

$$\therefore I = 0.3\text{ A}$$

Current flowing through the appliance = 0.3 A

In the second case,

$$I = 0.3\text{ A}, R = 500\Omega$$

$$V = IR = 0.3 \times 500\text{ V} = 150\text{ V.}$$

The required potential difference between its two ends = 150 V .

Ex. 5) Determine the resistance of a copper wire having a length of 1 km and diameter of 0.5 mm

Given: ρ = Resistivity of copper = $1.7 \times 10^{-8}\text{ m}$

Converting all measures into metres

$$L = 1\text{ km} = 1000\text{ m} = 10^3\text{ m}$$

$$d = 0.5\text{ mm} = 0.5 \times 10^{-3}\text{ m}$$

If r is the radius of the wire then, its area or cross-section

$$A = \pi r^2 \quad \therefore A = \pi \times \left(\frac{d}{2}\right)^2$$

$$= \frac{\pi}{4} (0.5 \times 10^{-3})^2 \text{ m}^2 = 0.2 \times 10^{-6} \text{ m}^2$$

$$R = \rho \frac{L}{A} = \frac{1.7 \times 10^{-8} \Omega \text{ m} \times (10^3 \text{ m})}{0.2 \times 10^{-6} \text{ m}^2} = 85\Omega$$

वरील सर्व example मध्ये Ohm's law, resistance, resistivity यांचे formula वापरून example solve करावेत. सुरुवातीला सर्व quantities च्या values SI पद्धतीत लिहून घ्याव्यात.

2) Resistors in series

Ex. 1) Three resistors having resistances of 15Ω , 3Ω and 4Ω are connected in series. What is the effective resistance in the circuit?

Given: $R_1 = 15\Omega, R_2 = 3\Omega, R_3 = 4\Omega$

Effective resistance $R_s = R_1 + R_2 + R_3$

Q.37 Classify the following radicals into two types. While doing this use a criterion other than the criteria used above. (Use your brain power!)

Ag^+ , Mg^{2+} , Cl^- , SO_4^{2-} , Fe^{2+} , ClO_3 , NH_4^+ , Br^- , NO_3^-

Ans: Simple radicals : Ag^+ , Mg^{2+} , Cl^- , Fe^{2+} , Br^-

Composite radicals : SO_4^{2-} , ClO_3^- , NH_4^+ , NO_3^-

Q.38 Write symbols of the following elements and the radicals obtained from them, indicate the charge on the radicals.

Mercury, potassium, nitrogen, copper, sulphur, carbon, chlorine, oxygen.

Elements	Symbols	Charge
Mercury	Hg	Hg^{2+}
Potassium	K	K^+
Nitrogen	N	N^{3-}
Copper	Cu	Cu^{2+}
Sulphur	S	S^{2-}
Carbon	C	C^+
Chlorine	Cl	Cl^-
Oxygen	O	O^{2-}

Q.39 Give examples:

i) Positive ions

ii) Basic radicals

iii) Composite radicals

iv) Metals with variable valency

v) Bivalent acidic radicals

vi) Trivalent basic radicals.

Ans: i) Positive ions:

i) Sodium ion Na^+

ii) Calcium ion Ca^{2+}

iii) Silver ion Ag^+

iv) Aluminium ion Al^{3+}

ii) Basic radicals: i) Mg^{2+} ii) K^+ iii) Fe^{2+} iv) Cu^{2+}

iii) Composite radicals:

i) H_3O^+ ii) NH_4^+ iii) CO_3^{2-} iv) SO_4^{2-}

iv) Metals with variable valency:

i) Cu: Cu^+ , Cu^{2+} ii) Hg: Hg^+ , Hg^{2+} iii) Fe: Fe^{2+} , Fe^{3+}

v) Bivalent acidic radicals: i) S^{2-} ii) O^{2-}

vi) Trivalent basic radicals: i) Al^{3+} ii) Cr^{3+} iii) Fe^{3+}

Q.40 Write the names of the following compounds and deduce the molecular masses.

Na_2SO_4 , K_2CO_3 , CO_2 , AlPO_4 , NaHCO_3 , KNO_3 , H_2O_2 , MgO , HNO_3 , H_2SO_4 , NaOH , MgCl_2

(Atomic masses H = 1, O = 16, N = 14, C = 12, Na = 23, Cl = 35.5, K = 39, Mg = 24, Al = 27, Ca = 40, P = 31, S = 32)

Ans:

1) Na_2SO_4 (Sodium sulphate)-

Molecule	Constituent elements	Atomic mass (u)	Number of atoms in the molecule	Atomic mass $\times$ number of atoms	Mass of the constituents
Na_2SO_4 (Sodium sulphate)	Na Sodium	23	2	23×2	46
	S Sulphur	32	1	32×1	32
	O Oxygen	16	4	16×4	64

Molecular mass = Sum of constituent atomic masses

Molecular mass of Na_2SO_4 = (Atomic mass of Na) $\times$ 2 + (Atomic mass of S) $\times$ 1 + (Atomic mass of O) $\times$ 4
 $= (23 \times 2) + (32 \times 1) + (16 \times 4)$
 $= 46 + 32 + 64 = 142$

Molecular mass of Na_2SO_4 = **142 u.**

Q.11 Observe and verify**Ans:**

	Dicotyledonous plants	Monocotyledonous plants
Seed	Two cotyledons	Single cotyledon
Root	Well developed, primary root (Tap root)	Fibrous roots
Stem	Strong, hard. Ex. Banyan tree	Hollow, Ex. Bamboo False, Ex. Banana Disc-like, Ex. Onion.
Leaf	Reticulate venation	Parallel venation
Flower	Flowers with 4 or 5 parts or in their multiples (tetramerous or pentamerous)	Flowers with 3 parts or in multiples of three (trimerous)
		

	द्विवीजपत्री वनस्पती	एकबीजपत्री वनस्पती
बी	दोन बीजपत्रे	एक बीजपत्र
मूळ	ठळक प्राथमिक मूळ (सोटमूळ)	तंतूमूळे
खोड	मजबूत, कठीण खोड. उदा, वटवृक्ष	पोकळ उदा, बांबू आभासी उदा, केळी चकतीसारखे उदा, कांदा
पान	जाळीदार शिराविन्यास	समांतर शिराविन्यास
फूल	4 किंवा 5 भागांचे फूल (चतुर्भागी किंवा पंचभागी)	3 किंवा 3 च्या पटीत भाग असणारे (त्रिभागी)

Q.12 Complete the sentences by filling in the blanks and explain those statements:

(Angiosperms, gymnosperms, spores, bryophyta, thallophyta, zygote)

1) plants have soft and fibre like body.**Ans:** Thallophyta.**Reason:** Thallophyta includes algae which have soft and fibre like body.**2)..... is called the 'amphibian' of the plant kingdom.****Ans:** Bryophyta.**Reason:** Plants belonging to Bryophyta grow on moist soil, but need water for reproduction. Since they share two habitats, such as soil and water, they are called amphibians.**3) In pteridophytes, asexual reproduction occurs by****Ans:** Spores.**Reason:** Pteridophytes reproduce by spores, which are formed along the posterior or back surface of the leaves.**4) Male and female flowers of are borne on different sporophylls of the same plant.****Ans:** Gymnosperms.**Reasons:** Only in gymnosperms male and female flowers are borne on different sporophylls of the same plant.

9.4.7 Period required for degradation of waste

Q.20 Write the period required for degradation of following waste materials.

Ans:

Waste Material	Period of Natural Degradation
Banana peelings	3 — 4 weeks
Cloth bags	1 month
Rags	5 months
Woollen socks	1 year
Wood	10 - 15 years
Leather shoes	40 - 50 years
Tin cans	50 - 100 years
Aluminium cans	200-250 years
Certain plastic bags	10 lakh years
Thermocol /styrofoam cup	Infinite duration

i) If the time required for degradation of the solid waste generated around us is long, it seriously affects other environmental factors. What care will you take to avoid this?

ii) Figure A, below shows a method of storing waste and B, shows the use of specific dustbins as per the type of waste. Think about how such eco-friendly waste management can be achieved by following these methods in our homes, too.



कचऱ्याच्या विघटनासाठी लागणारा कालावधी

पदार्थ	निसर्गतः विघटनासाठी लागणारा कालावधी सुमारे
केळ्याची साल	3 ते 4 आठवडे
कागदी पिशवी	1 महिना
कपड्यांच्या चिंध्या	5 महिने
लोकरी पायमोजे	1 वर्ष
लाकूड	10 ते 15 वर्षे
चामडी बूट	40 ते 50 वर्षे
जस्ताचे डबे	50 ते 100 वर्षे
अॅल्युमिनियम डबे	200 ते 250 वर्षे
विशिष्ट प्लॅस्टिक पिशवी	10 लाख वर्षे
थर्मोकॉल कप (स्टायरोफोम)	अनंतकाळ

आपल्या सभोवताली साठणाऱ्या घनकचरा विघटनासाठी लागणारा time (कालावधी) जास्त असेल तर त्याचा seriously affects (गंभीर परिणाम) पर्यावरणातील इतर घटकांवर होतो. तो होऊ नये यासाठी तुम्ही कोणती care (काळजी) घ्याल?

खालील चित्र A मध्ये कचरा कशा पद्धतीने ठेवावा हे दर्शवले आहे तर B मध्ये type of waste (कचऱ्याच्या प्रकार) त्यानुसार कोणत्या विशिष्ट डब्यांचा वापर करतात ते दाखवले आहे. आपल्या घरात देखील या पद्धतीचा वापर करून eco-friendly waste management (पर्यावरणस्नेही व्यवस्थापन) कसे साधता येईल याचा Think (विचार) करा.

A peep into the past

Ever since ancient times, special attention has been given to garbage disposal. In the Greek city of Athens, in 320 BCE, a law had been enacted regarding garbage disposal. It made throwing garbage in the open an offence.

A peep into the past (इतिहासात डोकावताना)

Ancient times (प्राचीनकाळ) तेव्हापासून कचऱ्याच्या व्यवस्थापनाकडे special attention (विशेष लक्ष) दिले गेले आहे. ग्रीसमध्ये इ.स.पू. 320 मध्ये अथेन्स नगरात कचऱ्याच्या disposal (विल्हेवाट) त्यासंबंधी law (कायदा) केला गेलेला होता. त्यानुसार garbage (कचरा) बाहेर टाकणे offence (गुन्हा) समजला जात असे.

d) What precautions should be taken while using various types of software on the computer? (संगणकातील विविध सॉफ्टवेअरचा वापर करताना कोणती काळजी घेणे आवश्यक आहे?)

संगणकातील विविध सॉफ्टवेअर वापरताना घ्यावयाची काळजी पुढीलप्रमाणे:

- Legal / licensed softwares (अधिकृत परवानाधारक सॉफ्टवेअरचा) परवानगी घेऊनच वापर करावा.
- फ्रीवेअर सॉफ्टवेअरशिवाय इतर परवानाधारक अधिकृत सॉफ्टवेअरच इन्स्टॉल/ लोड करावे.
- अधिकृत स्रोताद्वारे माहिती अॅक्सेस करावी. Other people's computer files (इतरांच्या फाइल्स) त्याच्या permission (परवानगीशिवाय) अॅक्सेस करू नयेत.
- सायबर लॉचा भंग होणार नाही या दृष्टीने अधिकृत मार्गानेच वैध सॉफ्टवेअरची खरेदी करून त्याचा वापर करावा.

e) Which are the various devices used in communication of information? How are they used in the context of science?

Ans: The various devices used for communication of information are computer and networking hardware, radio, television, telephone (both fixed line and mobile phones), video display unit (monitor), printer, plotter, modem, router, Internet and satellites.

The use of these communication devices in science are as follows:

- Demonstration of common or hazardous experiments.
- Prediction of weather, tides, etc. for early warning.
- Collection of scientific information from peers and experts all over the world.

e) Which are the various devices used in communication of information? How are they used in the context of science? (माहिती संप्रेषणाची विविध साधने कोणती आहेत? विज्ञानाच्या संदर्भात त्यांचा वापर कसा केला जातो?)

माहिती संप्रेषण तंत्रज्ञानाची साधने: दूरध्वनी, मोबाइल, संगणक, रेडिओ, दूरदर्शन, आंतरजाल (इंटरनेट), ई-मेल, व्हिडिओ कॉन्फरन्सिंग इत्यादी माहिती संप्रेषण तंत्रज्ञानाची साधने आहेत.

The use of these communication devices in science are as follows: (माहिती संप्रेषण तंत्रज्ञानाचा विज्ञानातील वापर):

- Common or hazardous (सामान्य आणि घातक) experiments (प्रयोगाचे) Demonstration (प्रात्यक्षिक)
- weather, tides (हवामान, भरती), इत्यादी विषयक माहिती लवकर दिली जाते.
- जगभरातील peers and experts (समवयस्क आणि तज्ञांकडून) scientific information (वैज्ञानिक माहिती) गोळा करणे.

f) Name the different parts of the Central Processing Unit and state their functions.

Ans: The three main parts of the Central Processing Unit and their functions are:

- ALU (Arithmetic and Logic Unit)** does all the arithmetic operations (addition, subtraction, multiplication and division) as well as logical operations like comparisons.
- CU (Control Unit)** regulates and manages the whole computer system.
- Memory unit temporarily stores the data, instruction and information during processing.

f) Name the different parts of the Central Processing Unit and state their functions. (सीपीयूचे भाग लिहून त्या प्रत्येक भागाचे कार्य लिहा.)

सीपीयूचे भाग व त्यांचे कार्य पुढीलप्रमाणे:

- अॅरिथमेटिक आणि लॉजिक युनिट (ALU):** या विभागात arithmetic operations (गणिती प्रक्रिया) addition, subtraction, multiplication and division (उदा., बेरीज, वजाबाकी, गुणाकार, भागाकार) आणि logical operations (तार्किकी प्रक्रिया) (उदा., comparisons (तुलना करणे)) केल्या जातात.
- कंट्रोल युनिट:** संगणकाच्या भागांवर नियंत्रण ठेवण्याचे कार्य केले जाते.
- मेमरी युनिट:** Information and Instruction (माहिती व सूचना) stores (साठवून) ठेवण्याचे कार्य मेमरी युनिटमध्ये केले जाते.

Q.18 Which technical difficulties did you face while using the computer? What did you do to overcome them?

Ans: Some of technical difficulties faced while using a computer are as follows:

Q.23 Solve the following examples:

a) An object of size (height) 7 cm is placed at 25 cm in front of a concave mirror of focal length 15 cm. At what distance from the mirror should a screen be placed so that we can get a sharp and clear image? Find the nature and size (height) of the image.

Sol: Data: Concave mirror, $h_1 = 7$ cm, $u = -25$ cm, $f = -15$ cm, $v = ?$, $h_2 = ?$

i) As the image is to be obtained on a screen, it must be a real image.

$$\text{ii) } \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-15} - \frac{1}{-25}$$

$$= -\left(\frac{1}{15 \text{ cm}} - \frac{1}{25 \text{ cm}}\right) = \frac{-(5-3)}{75 \text{ cm}} = \frac{-2}{75 \text{ cm}}$$

$$\therefore v = -\frac{75 \text{ cm}}{2} = -37.5 \text{ cm}$$

This gives the image distance. Therefore, the screen should be placed in front of the mirror at 37.5 cm from it.

$$\text{iii) } \frac{h_2}{h_1} = -\frac{v}{u} \therefore h_2 = -h_1 \times \frac{v}{u}$$

$$h_2 = -7 \times \left(\frac{-37.5}{-25}\right)$$

$$= -7 \times 1.5$$

$$= -10.5 \text{ cm}$$

The size (height) of the image,

$$h_2 = -10.5 \text{ cm}$$

The minus sign shows that the image is inverted.

b) A convex mirror has a focal length of 18 cm. The image of an object kept in front of the mirror is half the height of the object. What is the distance of the object from the mirror?

Sol.: Data : Convex mirror,

$$h_2 = \frac{h_1}{2} \quad u = ?$$

$$M = \frac{h_2}{h_1} = -\frac{v}{u} = \frac{1}{2}$$

$$v = -\frac{u}{2}$$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\therefore \frac{1}{-\frac{u}{2}} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{u} (1 - 2) = \frac{1}{f}$$

$$\frac{-1}{u} = \frac{1}{f}$$

$$u = -f = -18 \text{ cm}$$

The object is kept at 18 cm in front of the mirror.

c) A 10 cm long stick is kept in front of a concave mirror having focal length of 10 cm in such a way that the end of the stick closest to the pole is at a distance of 20 cm. What will be the length of the image?

Sol.: Given Data: concave mirror, $h_1 = 10$ cm, $f = -10$ cm, $u = -20$ cm, $h_2 = ?$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \therefore \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$\frac{u}{v} = \frac{u}{f} - 1 = \frac{-20 \text{ cm}}{-10 \text{ cm}} - 1 = 2 - 1 = 1$$

$$\therefore \frac{v}{u} = 1$$

$$M = \frac{h_2}{h_1} = -\frac{v}{u}$$

$$\therefore h_2 = -\frac{v}{u} \times h_1 = -1 \times h_1$$

$$= -1 \times 10 \text{ cm} = -10 \text{ cm}$$

The minus sign shows that the image is inverted.

Ans.: The length of the image (without considering the minus sign) = 10 cm

Q. वरील सर्व उदाहरणामध्ये दिलेल्या information नुसार physical quantities आणि त्यांची value लिहावी. विचारलेल्या quantity साठी योग्य तो formula लिहून योग्य गणितीय क्रिया करून उत्तर मिळवावे. मिळालेल्या उत्तरास unit अवश्य लिहावे.

Convex mirror साठी object distance negative असते हे लक्षात ठेवावे.

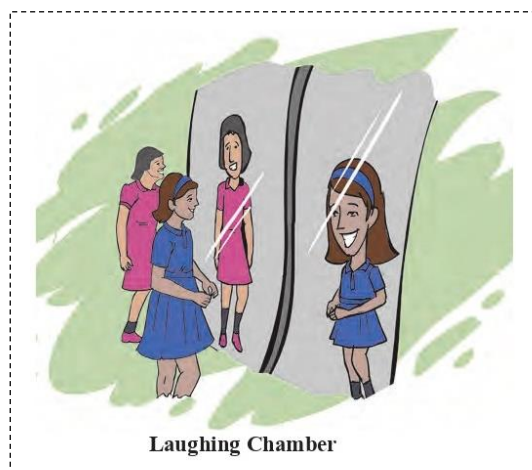
cartesian sign conversion नुसार चिन्ह संकेत वापरावेत.

BEST WISHES ...
DNYANADA PRAKASHAN ...

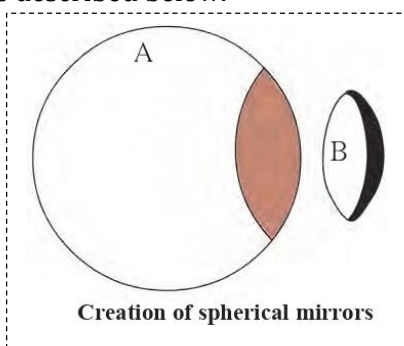
11.2.2 Spherical mirrors

Observe and discuss.

- You must have seen the mirrors displayed in the Laughing Chamber in a fair. Your face appears distorted in these mirrors. Why does this happen?
- These mirrors are different from the mirrors we have at home. They are curved. The images formed by curved mirrors are different from those formed by plane mirrors. Because of this we do not see the familiar images in these mirrors.
- The rear view mirrors in cars, which enable drivers to see the vehicles coming from behind are curved mirrors.



- If we cut a rubber ball into two parts as shown in figure, we can see that each of the two parts has two types of surfaces.
- Generally, spherical mirrors are parts of a hollow glass sphere like the part B in the figure.
- The inner or outer surface of this part is coated with a shiny substance to produce a spherical mirror.
- Reflection of light takes place either from its outer or inner surface. Thus, there are two types of spherical mirrors as described below.



Spherical mirrors (गोलीय आरसे) -

- Fair (यात्रा) मधील laughing chamber (हास्य दालन) मध्ये उभे केलेले mirror तुम्ही पाहिले असतील. त्या mirror मध्ये तुमचे face (चेहरा) हा distorted (व्यंग/आगळा-वेगळा) दिसून येतो. असे का घडते?
- हे Mirrors आपल्या घरातील mirror पेक्षा different असतात. ते curved (वक्र/गोलाकार) असतात. Plane mirror मध्ये form होणाऱ्या image पेक्षा curved mirror मध्ये form होणाऱ्या image या different असतात. या कारणामुळे आपण curved mirror मध्ये आपली familiar image पाहू शकत नाही.
- Cars मधील rear view/side mirror की ज्यामुळे driver ला पाठीमागून (behind) येणारी वाहने दिसण्यास मदत होते. ते mirror हे curved असतात.
- वरील figure मध्ये दाखवल्याप्रमाणे आपण rubber ball cut केला असता आपणाला त्याचे inner surface दोन प्रकारचे मिळतात.
- सामान्यतः spherical mirror हे hollow glass sphere चे parts असतात, जे part B मध्ये दाखवले आहेत.
- Spherical mirror produce करण्यासाठी part B चा inner किंवा outer surface shiny substance of coat केला जातो.
- Light चे reflection हे त्याच्या inner किंवा outer surface वरून घडून येते. यावरून spherical mirror चे दोन types आहेत. ते खालीलप्रमाणे

Spherical mirror types -

- जर spherical mirror चा inner surface (आंतरभाग / पृष्ठभाग) हा reflecting surface. (परावर्तक पृष्ठभाग) असेल तर त्याला concave (अंतर्वक्र) mirror म्हणतात.
- जर spherical mirror चा outer surface (बाह्य पृष्ठभाग) हा reflecting surface (परावर्तक पृष्ठभाग) असेल तर त्याला convex (बहिर्वक्र) mirror म्हणतात.

Types of spherical mirrors:

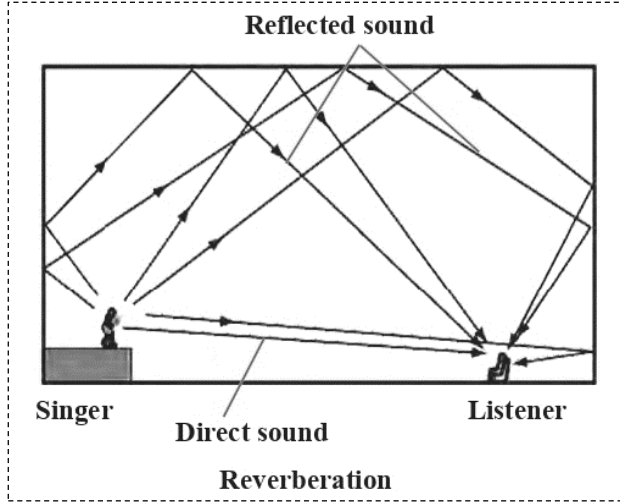
1) Concave mirror

If the inner surface of the spherical mirror is the reflecting surface, then it is called a concave mirror.

2) Convex mirror

If the outer surface of the spherical mirror is the reflecting surface then it is called a convex mirror.

iii) This is the reason why some auditoriums or some particular seats in an auditorium have inferior sound reception. This is shown in figure.



Reverberation (निनाद) -

- Room च्या roof (छप्पर / छत) आणि wall (भिंत) पासून sound wave multiple time (अनेक वेळा) reflect होतात. यामुळे single sound एकावेळी ऐकू न येता तो continuous (सतत) ऐकू येतो. यालाच reverberation (निनाद) म्हणतात.
- Particular sound wave च्या successive reflection (लगतचे परावर्तन) यामधील time आपल्यापर्यंत reach होईपर्यंत कमी होतो आणि reflected sound एकमेकांमध्ये mixup (मिसळणे) होतो. तसेच increased loudness चा continuous sound produce होतो ज्यामुळे तो clearly deciphered (उलगडणे) होत नाही.
- या कारणामुळे काही auditorium (सभागृह) किंवा particular seat (श्रोत्यांच्या बसण्याची ठिकाण) च्या ठिकाणी inferior sound reception (आतील आवाज ग्रहण) निकृष्ट ठरते.

Q.11 Use your brain power!

How will you reduce reverberation in public halls or buildings?

Ans.: The distance between the opposite walls, and also the height of the ceiling should be less than 17.2 m.

Q.11 Public halls (सार्वजनिक सभागृह) किंवा buildings (इमारती) मधील reverberation (निनाद) reduce कसे कराल?

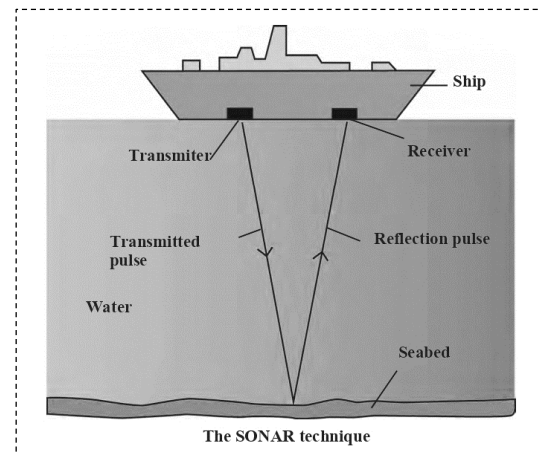
Ans- Opposite walls (समोरासमोरील भिंती) आणि ceiling (छत) ची Height 17.2m पेक्षा कमी असावी.

12.8 SONAR

Q.12 Write short note on: SONAR

Ans: SONAR

- SONAR is the short form for Sound Navigation and Ranging. It is used to determine the direction, distance and speed of an underwater object with the help of ultrasonic sound waves.
- SONAR has a transmitter and a receiver, which are fitted on ships or boats.
- The transmitter produces and transmits ultrasonic sound waves. These waves travel through water, strike underwater objects and get reflected by them. The reflected waves are received by the receiver on the ship.
- The receiver converts the ultrasonic sound into electrical signals and these signals are properly interpreted.
- The time difference between transmission and reception is noted. This time and the velocity of sound in water give the distance from the ship, of the object which reflects the waves.
- SONAR is used to determine the depth of the sea. SONAR is also used to search underwater hills, valleys, submarines, icebergs, sunken ships etc.



SONAR (सोनार) -

- Sound Navigation and Ranging याचे short form म्हणजे SONAR होय. Underwater object चा speed, direction आणि distance हे ultra sonic sound wave च्या मदतीने determine (शोधणे) करण्यासाठी used केला जातो.

Q.8 सांगा पाहू?**हे का घडते?**

- 1) Plants ची leaves particular season मध्ये fall off होतात.
- 2) fruits आणि flowers काही कालावधीनंतर fall off होतात.

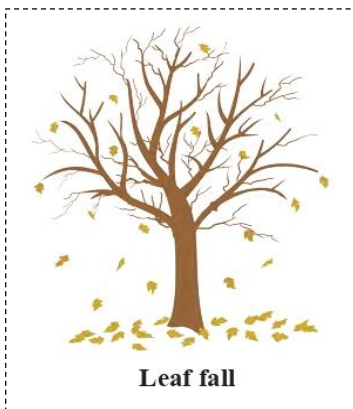
Ans: Plants मध्ये excretory system असत नाही. Plants मधील excretory matter हा trees च्या Vacuoles (रिक्तीका), flowers, fruits आणि barks मध्ये accumulate होतो. म्हणून हे material dispose करण्यासाठी particular season मध्ये leaves, flowers, fruits चे secretion घडून येते.

- 3) Resin, gum सारखे substances plant body पासून given out होतात.

Ans: Resin, gum सारखे substance आपल्याला useful असतात. पण plant साठी ते unwanted असतात. म्हणून त्यांची plants ला गरज असत नाही. ते plants body पासून thrown away केले जातात.

15.3.1 Excretion in plants

- i) Excretion is a simpler process in plants than in animals. There is no special organ or system for excretion in plants.
- ii) Gaseous substances are given out by diffusion. Most of the waste substances of plants are stored in vacuoles of leaf-cells and in flowers, fruits and the bark of the stem.
- iii) After some time these parts fall off. Some other waste materials are stored in old and worn xylem in the form of resin and gum.
- iv) Some waste materials are also given out through roots into the surrounding soil.

**Leaf fall**

- v) In some plants, waste materials are present in the form of crystals of calcium oxalate.

- vi) They are called raphides. As they are needle-shaped, they prickle and cause irritation of the skin.

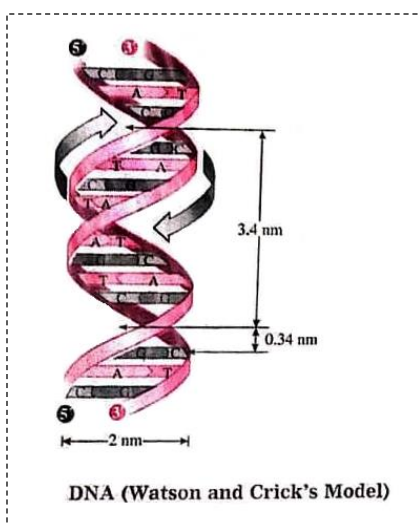
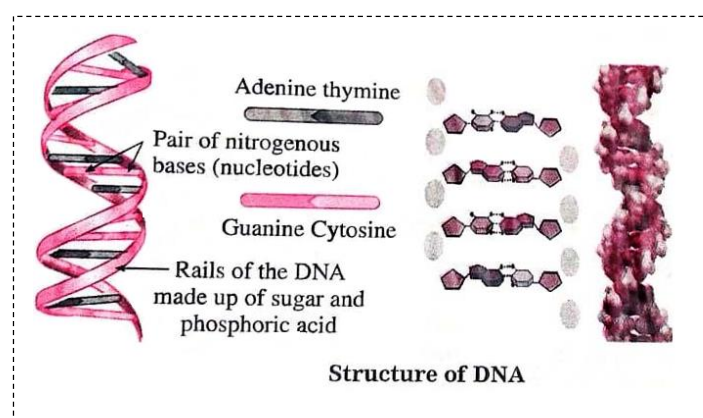
- vii) Some waste materials of plants are useful to humans, for example, gum, resin, latex of rubber, etc.

**Gum and latex****Plants मधील उत्सर्जन -**

- i) Excretion ही Animal पेक्षा plants मध्ये simpler process आहे. plants मध्ये excretion साठी कोणतीही special organ (इंद्रिय) किंवा System (संस्था) नाही.
- ii) Diffusion (विसरण) द्वारे gaseous substance given out केले जातात. Plants मधील waste material हे leaf cell च्या vacuoles (रिक्तीका), flowers, fruits, आणि stem च्या bark मध्ये store केले जाते.
- iii) काही कालावधीनंतर ते parts fall off (गळून पडणे) होतात. इतर काही waste material हे resin आणि gum च्या रूपात old आणि worn (जीर्ण) xylem मध्ये store केले जाते.
- iv) काही waste material हे roots मार्फत surrounding soil मध्ये given out केले जाते.
- v) काही plants मध्ये, Calcium oxalate च्या Crystal च्या रूपात waste materials असतात. त्यांना raphides म्हणतात. ते needle shaped (अणकुचीदार), prickles (काटे) असतात आणि त्यामुळे skin चे irritation घडून येते.
- vi) Plants चे काही waste material हे human ला useful असते. Ex. gum, resin, latex of rubber etc.

Q.20 Describe the structure of the DNA molecule.**Ans: Structure of the DNA molecule:**

- i) DNA structure was proposed by Watson and Crick in 1953.
- ii) According to their model. DNA has two parallel threads of nucleotides which are coiled around each other. Thus it is called a double helix.
- iii) Each strand is made up of nucleotides. Each nucleotide consists of a Deoxyribose sugar, phosphoric acid and a nitrogen base.
- iv) The sugar and phosphate joins alternately with each other on the DNA strand.



- v) There are two main types of nitrogenous bases, known as purines and pyrimidines. Adenine and guanine are two purines while cytosine and thymine are two pyrimidines.
- vi) One purine is bonded with other pyrimidine in the opposite strand of the DNA helix.
- vii) As a rule, purine adenine always makes pair with pyrimidine thymine by double hydrogen bond.

viii) Purine guanine always pairs with pyrimidine cytosine by triple hydrogen bond.

ix) These hydrogen bonds appear like steps of the ladder.

Q.21 Explain the structure, function and types of RNA.

Ans: i) The RNA is a nucleic acid that is found both in nucleus as well as in cytoplasm. It is made up of single strand that is twisted upon itself.

ii) The components of RNA are nucleotides which are made up of ribose sugar, phosphoric acid and the nitrogenous bases.

iii) The four types of nitrogenous substances in the RNA are adenine, guanine, cytosine and uracil. Thymine is not present in the RNA molecules. Of these adenine and guanine are purines while cytosine and uracil are the pyrimidines of the RNA. RNA is found both in nucleus as well as in cytoplasm.

iv) The RNA is of three types according to its functions.

A) Messenger RNA or mRNA:

During the process of protein synthesis the mRNA molecule carries the information of coding a particular protein from genes i.e. DNA chain. DNA is present in the cell nucleus but the information is passed to the ribosomes in the cytoplasm with the help of messenger RNA. Then later the proteins are synthesized in the ribosomes.

**B) Ribosomal RNA (rRNA):**

Ribosomal RNA is present in the ribosomes which are protein factories of the cell. This rRNA molecule performs the function of protein synthesis.

C) Transfer RNA (tRNA): The RNA molecule that transfers the amino acids according to the message of the mRNA, is called tRNA. It carries the amino acid up to the ribosomes during the process of protein synthesis.

Types of simple permanent tissues:

Name of Tissue	Parenchyma	Collenchyma	Sclerenchyma
Structure of Cells	Living cells with thin cell wall and intercellular spaces	Elongated living cells with thickened cell wall at corners due to cellulose and pectin	Dead and fibrous cells with tapering ends, cell wall contains lignin
Location	All parts like roots, stem, leaves, flowers and seeds	At the base of leaf petiole, branches and stem	Stem, veins of leaves, hard coats of seeds, outer covering of coconut
Functions	Support, storage of food and filling vacant spaces	Support and flexibility to various parts	Give strength and rigidity to parts of the plants.
Sub-types	Chlorenchyma: Leaves, performs photosynthesis. Aerenchyma: Helps aquatic plants, leaves and stem to float		

Types of complex permanent tissues:

Name of tissue	Xylem	Phloem
Characteristics	Consists of thick-walled dead cells	Consists of cytoplasm containing living cells

Types of cells	Tracheids, vessels and xylem fibres - dead cells Xylem parenchyma - living cells	Sieve tubes, companion cells, phloem parenchyma - living cells Phloem fibres - dead cells
Function	Structure like interconnected tubes, conduct water and minerals only in upward direction	Tubes joined to each other, conduct sugar and amino acids from leaves to various parts in upward and downward direction

Permanant tissue (स्थायी ऊती) -

i) Meristematic tissue च्या division (विभाजन) मुळे तयार झालेल्या new cell ची complete growth झाल्यानंतर त्या ठराविक ठिकाणी विशिष्ट कार्य करू लागतात. त्यावेळी त्यांची divide होण्याची ability संपते आणि त्या specific function perform करू लागतात.

ii) अशा प्रकारे ते specific structure (विशिष्ट रचना), shape (आकार) आणि location permanently acquire (धारण) करतात आणि Specific function perform करतात, यालाच differentiation (विभेदन) म्हणतात. आणि तसेच permanent tissue हे differentiated cell पासून formed होतात.

iii) Permanent tissue चे simple permanent (सरल स्थायी) आणि complex permanent (जटिल स्थायी) tissue हे दोन type आहेत.

A) सरल स्थायी ऊती -

या एकाच प्रकारच्या Cell च्या types पासून बनलेल्या असतात. त्यांचा function नुसार खालील प्रकार पडतात.

Simple permanent tissue च्या types चा table मध्ये त्यांची structure, locations आणि functions तसेच sub type ची information दिली आहे, ती काळजीपूर्वक वाचावी आणि लक्षात ठेवावी, त्यातील काही words चे अर्थ खाली दिले आहेत.

Paroochyma - मूल ऊती, intercellular spaces - आंतरपेशीय पोकळ्या, vacant space- मोकळी जागा chlorenchyma - हरीत ऊती, Aerenchyma - वायू ऊती, aquatic plants - जलीय diameter असलेली एक telescope होय. म्हणजेच 25km diameter असलेल्या telescope मुळे जी information मिळते ती information या 30 telescope arrangement मुळे मिळते. GMRT ही Indian scientists आणि engineers नी Minimum cost (कमी खर्च) मध्ये बनवलेली world standard research facility आहे. GMRT च्या साहाय्याने scientists हे solar system, solar winds (सौरवारे) pulsars (स्पंदक), supernova (महास्फोटक), interstellar hydrogen clouds (ताऱ्या दरम्यान असणार हायड्रोजन ढग) यांचा study केला जातो. या facilities चा use करण्यासाठी all over world मधील scientists, India मध्ये येतात.

18.5 Telescopes in space

Telescopes in space:

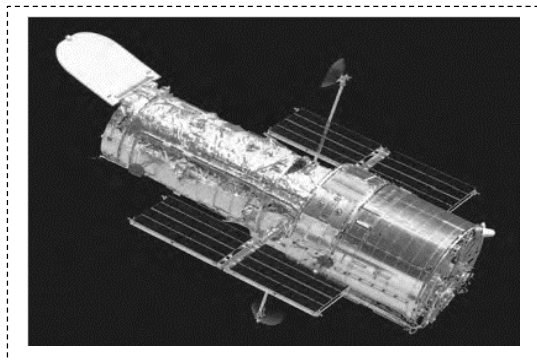
- i) Visible light and the radio waves emitted by heavenly bodies in space can pass through the earth's atmosphere and reach the earth's surface. So, optical and radio telescopes can be erected on the surface of the earth. However, these earth-based telescopes present some problems in making good quality observations.
- ii) The visible light coming from a heavenly body has to pass through the earth's atmosphere to reach the earth's surface. During this journey, some of the light is absorbed by the atmosphere and the intensity of the light reaching the earth's surface decreases.
- iii) A second problem is caused by the changes in atmospheric pressure and temperature. These changes cause turbulence in the atmosphere which in turn cause of the light rays to change their path slightly and thereby shake the position of the image.
- iv) Also, because of sunlight, we cannot use optical telescopes during the day. During the night too city lights and cloudy weather can cause difficulties in observing the heavenly bodies. To reduce these problems, optical telescopes are situated on top of mountains, at uninhabited places.

v) However, if we want to get rid of all the above problems completely, we should place the telescope above the earth's atmosphere, in space itself.

vi) These problems do not exist in the space and thus the image obtained by space telescopes would be bright and very clear and will remain at one place. Scientists have turned this idea into reality.

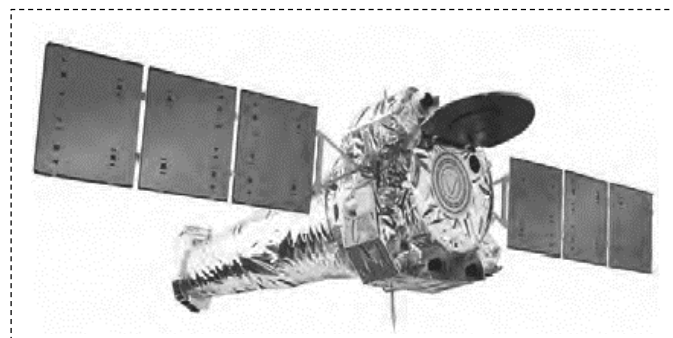
More information:

- i) In 1990, the National Aeronautics and Space Administration launched into space an optical telescope called the **Hubble telescope**.
- ii) It has a mirror of diameter 94 inches and is orbiting the earth at a height of 589 km from it.
- iii) This telescope is still working and has helped to make important discoveries.



More information:

- i) In 1999, the National Aeronautics and Space Administration launched an X-ray telescope named **Chandra**, in space, to study X-rays coming from heavenly objects.
- ii) Special mirrors which can reflect X-rays were used in this telescope.
- iii) Chandra has given us very useful information about stars and galaxies. The telescope is named after the famous Indian scientist Subramanian Chandrashekhar.

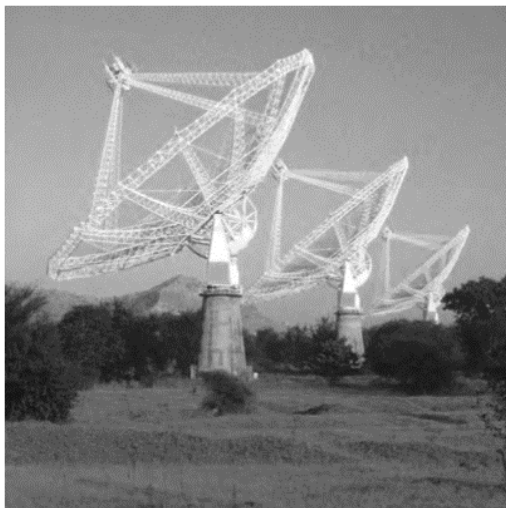


Telescopes in space (अवकाशातील दुर्बीण) -

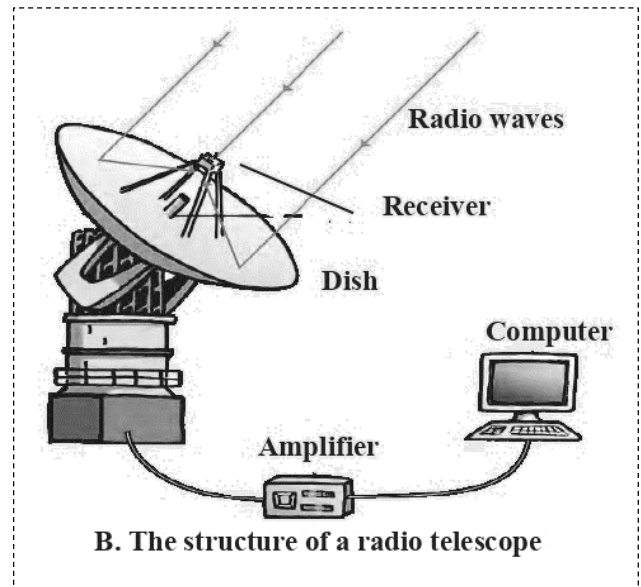
i) Space मधील heavenly bodies कडून emit केलेले visible light आणि radio waves earth's atmosphere मधून pass होवून earth's Surface वर पोहोचतात. म्हणून optical आणि radio telescope हे earth surface वर उभारण्यात (erect) आले आहेत.

More information:

- i) A large radio telescope called the Giant Meter-wave Radio Telescope (GMRT) has been erected at Narayangaon near Pune.
- ii) It uses radio waves having wavelengths of about a metre, coming from planets and stars to study those heavenly bodies.
- iii) This telescope is actually a collection of 30 dishes, each having a diameter of 45 m.
- iv) It is called a giant telescope as the arrangement of the 30 dishes over an area which measures up to 25 km across, is made in such a way that it works as a single dish having a diameter of 25 km.
- v) This means that the GMRT gives the same data that we would have got from a telescope having a single dish of 25 Km diameter! GMRT has been made by Indian scientists and engineers at minimum cost.
- vi) It is a world standard research facility. Scientists study the solar system, solar winds, pulsars, supernova, interstellar hydrogen clouds, etc. with the help of the GMRT.
- vii) Scientists from all over the world come to India to make use of this facility.



A. Radio telescope (photograph)



Radio telescope (रेडिओ टेलिस्कोप) -

- i) अनेक heavenly objects हे visible radiation शिवाय radio waves emit करतात. अशा प्रकारची radiations आपण आपल्या eyes ने पाहू शकत नाही.
- ii) म्हणून या rays receive करण्यासाठी special type चे telescope use केले जातात. यालाच radio telescope म्हणतात. Radio telescope हे एका parabolic shape च्या एक व अनेक dishes पासून बनवलेली असतात.
- iii) Optical telescope प्रमाणेच incident radio waves हे या dishes मधून reflected होतात आणि focus च्या ठिकाणी converge (एकत्रित) होतात. focal point पाशी radio receiver बसवलेला असतो.
- iv) या receiver कडून gather (ग्रहण) केलेली information ही computer वर passed केली जाते. ज्याचे analyses होते आणि source ची image construct होते.

अधिक माहितीस्तव -

Pune जवळील Narayangaon येथे Giant - Meter-wave Radio Telescope (GMRT) या नावाची large radio telescope erected (उभारण्यात) करण्यात आली आहे. Meter मध्ये wavelength असणाऱ्या radio waves ज्या planets आणि stars पासून येणाऱ्या heavenly bodies चा Study करण्यासाठी त्यांचा उपयोग होतो. यामध्ये प्रत्यक्षात 30 dishes चे collection असून प्रत्येकाची diameter 45m आहे. या telescopes ला giant telescope म्हणतात. याचे reason म्हणजे 30 telescope ची structure 25km area मध्ये spread झाली आहेत. ही structure म्हणजे 25km

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