

# General Science & Ability

Q3) Why atoms form chemical bonds?  
Discuss covalent bond in water molecule.

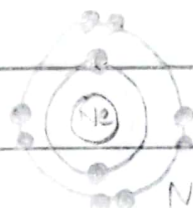
Ans **Chemical bond:**

Chemical bond refers to strong electric force of attraction between the atoms or ions in the structure.

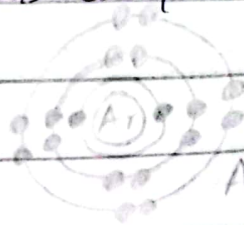
**Why do atoms form bonds?**

Atoms form chemical bonds in order to make their outer electron shells more stable. An ionic bond, where one atom essentially donates an electron to another, forms when one atom becomes stable by losing its outer electrons and the other atom becomes stable by gaining the electrons. Covalent bonds form when sharing electrons results in the highest stability. Some atoms are very reluctant to combine with other atoms and exist in the air around us as single atoms. These are noble gases and have very stable electron arrangements e.g. because their outer shells are full.

Helium  $1s^2$



Neon  $2, 8$



Argon  $2, 8, 8$

The octet rule states that elements gain or lose electrons to attain an electron configuration of the nearest noble gas.

## **Bonds & Valence Electrons:**

The first electron shell only holds two electrons, a hydrogen atom (at. no. 1) has one proton and a lone electron, so it can readily share its electron with the outer shell of another atom. A helium atom (at. no. 2), has two protons and two electrons. The two electrons complete its outer electron shell (the only electron shell it has), plus the atom is electrically neutral this way. This makes helium stable and unlikely to form a chemical bond.

## **Covalent Bond:**

When two non-metal atoms combine, they share one, or more, pairs of electrons. A shared pair of electrons is called a single covalent bond, or a bond pair. A single covalent bond is represented by

a single line between the atoms:

For example  $H-H$ . Hydrogen gas forms the simplest covalent bond in diatomic hydrogen molecule.

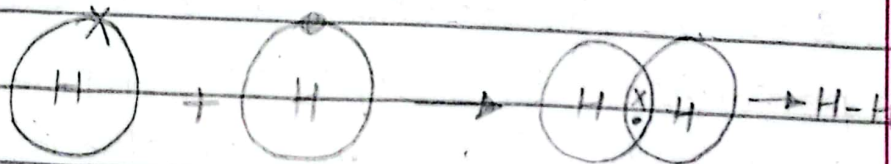
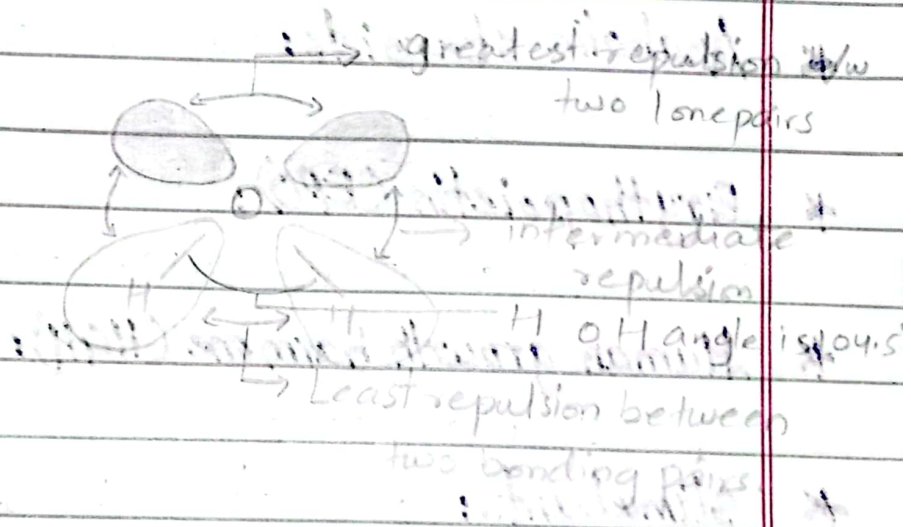


fig: Hydrogen atoms sharing a pair of electron.

## Covalent bond in water molecule:



Water has two bonding pairs of electrons and two lone pairs of electrons. The greatest electron pair repulsion is between the two lone pairs. This results in the bonds being pushed even close together. The shape of the water molecule is non linear V shape. The  $H-O-H$  bond angle is  $104.5^\circ$ .

b. What is doping? Discuss different types of ceramics.

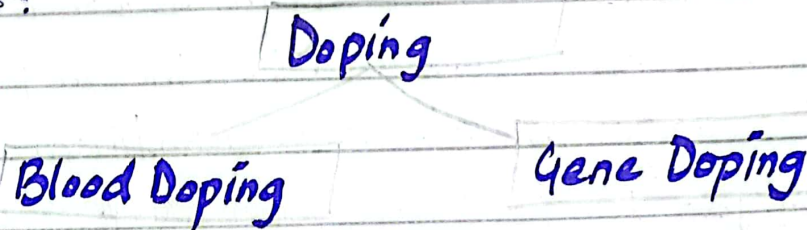
Ans: Doping:

Doping refers to the use of prohibited substances or methods to enhance athletic performance in competitive sports. It is considered a form of cheating and is typically done to gain an unfair advantage over other athletes.

Doping can involve the use of various substances, such as:

- \* **Anabolic steroids**: to increase muscle mass and strength.
- \* **Erythropoietin (EPO)**: to increase red blood cell count and endurance.
- \* **Human growth hormone (HGH)**: to enhance growth and recovery.
- \* **Stimulants**: to increase alertness and energy.

Doping can also involve methods such as:



⇒ Blood doping is transfusing blood to increase red blood cell count.

⇒ Gene doping is manipulating genes to enhance athletic performance.

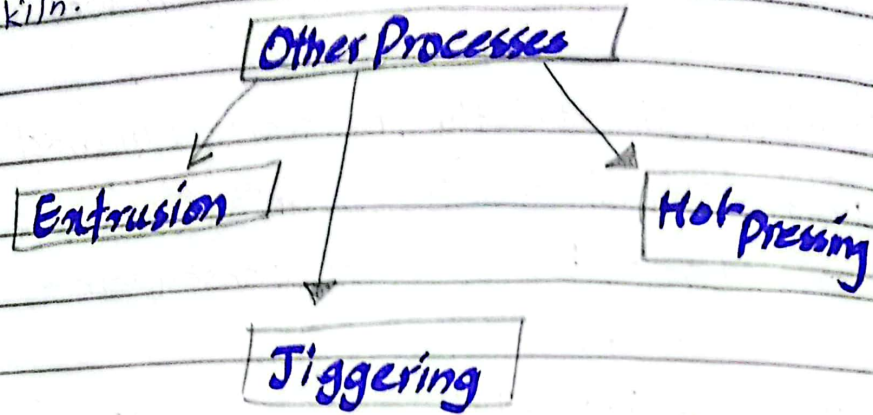
Doping is strictly prohibited in most professional sports organizations and can lead to serious consequences, including:

- \* Disqualification from competition.
- \* Loss of medals or titles.
- \* Suspension or ban from competition.
- \* Legal consequences.

## Ceramics:

Firing is the process by which ceramics have traditionally been made; indeed, the word "ceramic" can be traced back to a Sanskrit word meaning "to burn". Simple ceramics such as bricks and certain types of glass are still made by processes that would be recognized by people who lived thousands of years ago. Just as in ancient times, today's pottery is made by digging clay from

the grounds, mixing it with water to make it flexible, shaping it on a wheel or in a mold, and then firing it in a kiln.



### Extrusion:

Forcing a material into shape by squeezing it like toothpaste through a shaped tool.

### Jiggering:

laying the material into shape by squeezing it like automatically into a rotating mold.

### Hot Pressing:

Forcing a powdered form of the ceramic into a mold then simultaneously heating it and pressing it to fuse the material into shape.

## Applications:

Ceramics have application in the following areas:

- \* Aerospace
- \* Consumer Usage
- \* Automotive Industry
- \* Medical (Bio-ceramics)
- \* Military Equipment
- \* Computer and Electronics
- \* Abrasives
- \* Building and construction
- \* Coatings
- \* Nuclear Ceramics
- \* Optical Ceramics
- \* Tribological ceramics
- \* Refractories

## Classification of Ceramics:

Classification

Application Based System

Composition Based System

# Application Based System

Traditional Ceramics

Advanced Ceramics

\* White wares

\* Structural Clay products

\* Brick & tile

\* Abrasives

\* Refractories

\* Cement

\* Electroceramics

\* Electronic substrate, packaging ceramics

\* Capacitor dielectric, piezoelectric ceramics

\* Magnetic Ceramics

\* Optical Ceramics

\* Conductive Ceramics

Advanced structural ceramics

\* Nuclear ceramics

\* Bioceramics

\* Tribological Ceramics

\* Automotive Ceramics

## On Basis of Composition

Ceramics can be classified into

three distinct material categories:

- \* Oxides: alumina, zirconia, iron oxide etc.
- \* Non-oxides: carbides, borides, nitrides



and silicides.

- \* **Composites:** combinations of oxides and non-oxides.

**C. State some of the merits and demerits of global warming.**

**Global Warming:**

It refers to the long-term rise in the average surface temperature of the Earth due to the increasing levels of greenhouse gases in the atmosphere. These gases, such as  $\text{CO}_2$ ,  $\text{CH}_4$ , and water vapor ( $\text{H}_2\text{O}$ ), trap heat from the sun, leading to a warming effect on the planet.

**Main Causes:**

- The main cause of global warming is human activity, particularly:
- \* Burning fossil fuels for energy, which releases large amount of  $\text{CO}_2$  in atmosphere.
  - \* Deforestation and land-use changes, which leads to the release of stored carbon into the atmosphere.

## Merits & Demerits:

Here are some merits and demerits of the global warming:

### Merits:

#### \* Increased food production:

Warmer temperatures and  $\text{CO}_2$  levels can boost crop yields in some regions.

#### \* New trade routes:

Melting of Arctic ice opens up new shipping routes, reducing transportation costs.

#### \* Increased Energy Production:

Thawing of permafrost allows for access to new oil and gas reserves.

#### \* Longer growing seasons:

Warmer temperatures extend growing seasons, benefiting some agricultural regions.

#### \* Economic opportunities:

New industries and jobs emerge in fields like renewable energy and sustainable technologies.

## Demerits:

### \* Rising sea levels:

Thawing of polar ice caps, leading to coastal flooding and displacement of people.

### \* Extreme weather events:

Increased frequency and intensity of heatwaves, droughts, and heavy rainfall.

### \* Water scarcity:

Changes in precipitation patterns, leading to droughts and water shortages.

### \* Loss of biodiversity:

Rising temperatures threaten extinction of many plant and many species.

### \* Food Insecurity:

Impacts on agriculture, leading to crop failures and food shortages.

### \* Human Health:

Increased risk of heat-related illnesses, respiratory problems, and spread of diseases.

D. What is Polio? What are the challenges in eradication of polio in Pakistan?

## Polio:

Poliomyelitis (polio) is a highly infectious viral disease, which mainly affects young children. Polio cases have decreased by over 99% since 1988, from an estimated 350,000 cases then, to 74 reported cases in 2015.

The reduction is the result of global effort to eradicate the disease.

## Symptoms:

Polio is a highly infectious disease caused by a virus. It invades the nervous system, and can cause total paralysis in the matter of hours. Initial symptoms are fever, fatigue, headache, vomiting, and stiffness in the neck and pain in the limbs. One in 200 infections leads to irreversible paralysis (usually in legs). Among those paralysed, 5% to 10% die when their breathing muscles become immobilized. Polio mainly affects children under 5 years of age.

## How polio spreads and develops:

Polio virus spreads in human faeces.

People become infected with the virus through contaminated food and water, especially in areas where sanitation and hygiene are poor. Improper sewage disposal, for example, can contaminate a water supply. Adults can become infected by changing the diapers of an infected infant and then touching their mouth.

## Prevention:

There is no cure for Polio, it can only be prevented. Immunization with Polio vaccine is the best way to prevent it. Vaccines work by exposing the body's immune system to a microbial infection that is strong enough to provoke an immune response but not severe enough to result in full-blown illness.

## Polio Vaccine:

There are two types of vaccine that protect against Polio: Inactivated Polio vaccine (IPV) and Oral Polio

Polio Vaccine.

Vaccine

Inactivated  
Polio Vaccine

Oral Polio  
Vaccine

(IPV) is given as an injection in the leg or arm, depending on age. (OPV) is taken by mouth.

Children should be vaccinated with four doses of inactivated Polio Vaccine (IPV) at the following ages:

- \* 2 months
- \* 4 months
- \* 6-18 months
- \* A booster dose at 4-6 months.

## Challenges in eradication of Polio from Pakistan:

There are just two countries which have never stopped transmission of polio. These are Pakistan and Afghanistan. Pakistan face a range of challenges such as insecurity, weak

health system and poor sanitation.  
These are some more challenges  
listed below:

- \* Inadequate vaccination of children in conflict ridden areas.
- \* On going hesitancy of some communities to have their children vaccinated.
- \* Inadequate surveillance and detection in several areas.
- \* On-going circulation of virus in neighbouring Afghanistan, with which Pakistan shares a border.
- \* Fake - finger marking, where children are marked as vaccinated though they have not actually received the vaccine.
- \* Mismatched estimates of vaccination coverage.
- \* Security risks and attacks on health care workers administering the vaccine.

Q4A) Write a note on River Juice  
"Bile".

## Liver:

**Def:** Liver is the abdominal glandular organ in the digestive system. It is located in the right upper quadrant of abdomen, under the diaphragm. It is the second largest organ. It contains several bile ducts.

## Function:

It detoxifies, metabolism, hormone regulation, protein metabolism, digestion and decomposition of RBCs. It produces bile, a chemical substance that breaks down fats and makes them more easily digestible.

## "Bile"

Bile also known as liver juice, is a digestive fluid produced by the liver and stored in the gallbladder. It plays a vital role in digestion and absorption of fats and fat-soluble vitamins. Here are some key-points about bile:

**Composition:** It is a greenish yellow



fluid, consisting of water, bile salts, cholesterol, phospholipids, and bilirubin.

**Function:** It breaks down fats into smaller particles, making them more accessible to digestive enzymes. It also aids in absorption of fat-soluble vitamins (A, D, E, and K).

**Production:** It produces about 1 litre of bile daily, which is then stored in gallbladder.

**Secretion:** It is released into the small intestine through the bile duct in response to food consumption, especially fatty foods.

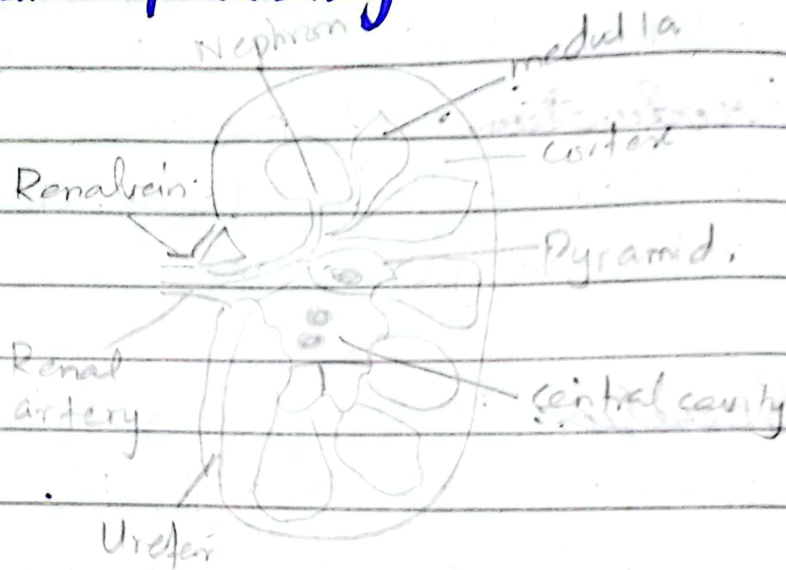
B) Describe the role of kidney in excretion.

Ans: **Excretion System:**

The excretory system is the system of an organism's body that performs the function of excretion, the bodily process of ~~excre~~ excreting wastes. It is responsible for the elimination of wastes of homeostasis. These

are several part, which perform this function such as kidneys, sweat glands, liver, lungs etc.

## Kidney System: Structure of kidney:



The kidneys are dark red, slightly flattened, bean-shaped organs about 10cm long, 5cm wide and 4cm thick and its weight is 270g. They are placed against the back wall of the abdominal cavity just below the diaphragm, one on either side of the vertebral column. They are protected by the two ribs. Each kidney is bean-shaped. The outer surface is convex and inner surface is concave.

## Function:

Urine is produced by the kidneys and it contains the by-products of metabolism (salts, toxins and water) that ends up in the blood. The kidneys and urinary tract filter and eliminate these waste substances from our blood. Without these kidneys, waste products and toxins would soon build up in the blood to dangerous levels.

C- Discuss different methods of Solid Waste Management.

Ans:

Def:

"Solid wastes" are the discarded left overs of our advanced consumer society. This growing mountain of garbage and trash represents not only an attitude of indifference towards valuable natural resources, but also a serious economic and public health problem.

~ Jimmy Carter

## Solid Waste Management System:

(SWM): It refers to the systemic management of the generation, collection, transfer, treatment, recycling, recovery and disposal of solid waste.

## Various Methods:

### 1. Landfilling:

Burial of waste in controlled environment, often with liner systems to prevent leachate contamination.

### 2. Recycling:

Processing of waste materials (paper, plastic, glass, metal) into new products, reducing waste volume and conserving resources.

### 3. Composting:

Biological decomposition of organic wastes (food, yard trimmings) into the nutrient-rich soil amendment.

### 4. Incineration:

High temperature burning of waste to

produce energy (electricity, heat) and reduce waste volume.

### 5. Waste to energy: (WtE)

Conversion of waste into energy through various technologies (gasification, pyrolysis, anaerobic digestion).

### 6. Donation & Reuse:

Recovery of reusable items (furniture, appliances, textiles) for reuse or redistribution.

### 7. Proper disposal:

Safe disposal of hazardous wastes (batteries, electronics, chemicals) through designated facilities.

### 8. Waste Reduction and Minimization:

Strategies to reduce waste generation (source reduction, product design changes).

### 9. Segregation & Sorting:

Separation of waste into different categories (organic, inorganic, recyclable)

for efficient management.

## 10. Bioreactors:

Landfills designed to accelerate decomposition and capture methane for energy production.

Effective SWM, involves integrating these methods to minimize environmental impacts and maximize resource recovery.

## D) Define the terms:

### 1) Anaemia:

Anaemia is the medical condition characterized by low RBCs count, reduced hemoglobin levels, and decreased ability of blood to carry oxygen to the blood tissues. It can be caused by various factors such as iron and vitamin deficiencies, chronic diseases like cancer and kidney diseases and genetic disorders. Symptoms include

fatigue, weakness, pale skin, shortness of breath, dizziness and headaches.

## ii) Appendicitis:

Appendicitis is a medical emergency that occurs when the appendix, a small pouch attached to the large intestine, becomes inflamed and fills with pus. The symptoms include sudden severe pain in the lower right abdomen, nausea, vomiting, loss of appetite, fever, abdominal tenderness, and diarrhea, and constipation.

## iii) Spleen:

It is an organ located in the upper right left region of the abdomen, just below the diaphragm. It plays a vital role in body's immune system, filtering the blood to remove old, damaged RBCs and other foreign substances. It also stores RBCs, platelets, and WBCs, releasing them as needed. It also produces antibodies to help fight

infections.

iv) Myopia:

Myopia, also known as near sightedness, is a common vision condition where

close objects appear clear but distant objects appear blurry. It occurs when the shape of the cornea or lens of the eye is too curved, causing light to focus in front of the retina instead of directly on it. It is caused by genetics, prolonged near-vision tasks, or a lack of outdoor activities.

Its symptoms include difficulty seeing distant objects, headaches, eye strain and squinting.

v) Isotones:

These are the atoms or nuclei that have same no. of neutrons in their atomic nucleus but differ in

no. of protons (at. no.). They have same neutron no. ( $N$ ) but different proton no. ( $Z$ ), resulting in different atomic masses ( $A$ ).

e.g: Carbon-13 and Nitrogen-15



are isotones, both having 8-neutrons but differing in the no. of protons (6 and 7 respectively).

## Section : II

(Q7) a) Volume of cylinder --- ?

Solution :

Given Data :

$$\Rightarrow r = 30 \text{ cm}$$

$$\Rightarrow h = 1 \text{ m}$$

$$h = 1 \text{ m} \rightarrow \text{cm}$$

$$1 \text{ m} = 100 \text{ cm}$$

$$\text{so, } h = 100 \text{ cm.}$$

Now,

$$\text{Volume of cylinder} = \pi r^2 h$$

$$= \frac{22}{7} \times (30 \text{ cm})^2 \times 100 \text{ cm}$$

$$= \frac{22}{7} \times 900 \text{ cm}^2 \times 100 \text{ cm}$$

$$= \frac{22}{7} \times 90000 \text{ cm}^3$$

$$= 282743.34 \text{ cm}^3.$$

Hence, volume of the cylinder is equal to  $282743.34 \text{ cm}^3$ .

b) The average age....?

Solution:

The average age = 15 years

ratio of ages = 3:5:7

age of youngest

boy = ?

let the boy's age =  $x$ , then the ages of remaining boys =  $3x$ ,  $5x$ , and  $7x$ .

According to the statement of Question the average age of 3 boys is 15 years.

So,

$$\frac{3x + 5x + 7x}{3} = 15$$

$$15x = 15 \times 3$$

$$\frac{15x}{15} = 3$$

$$\boxed{x = 3}$$

Now, putting value of  $x$  in the ages of boys:

$$* \quad 3x = 3 \times 3 = 9 \text{ years}$$

$$5x = 3 \times 5 = 15 \text{ years}$$

$$7x = 7 \times 3 = 21 \text{ years}$$

So, age of youngest boy is 9 years.

c) Identify ...

i) 8, 19, 52, 151, 447, \_\_\_\_\_ (Wrong no?)

lets multiply each no. with 3 and do minus 5 from each no.

$$8.$$

$$8 \times 3 - 5 = 19.$$

$$19 \times 3 - 5 = 52.$$

$$52 \times 3 - 5 = 151$$

$$151 \times 3 - 5 = 448.$$

So, 447, is the wrong no. in the series, and also,

$$448 \times 3 - 5 = 1339.$$

ii) 11, 13, 17, 19, 23, 29

The blank will have 29, as an answer because all these numbers are consecutive prime numbers from '11' - onwards.

d) If a triangle has ...?

Sol: To find angles of a triangle with sides of 5cm, 4cm, 6cm.

We can use law of cosine. However, since we do not have any information about angles so first, we must calculate the cosine of each angle using the 'formula':

$$\cos(A) = \frac{b^2 + c^2 - a^2}{2bc} = \frac{4^2 + 6^2 - 5^2}{2(4)(6)} = 0.9$$

$$\cos(B) = \frac{a^2 + c^2 - b^2}{2ac} = \frac{5^2 + 6^2 - 4^2}{2(5)(6)} = 0.96$$

$$\cos(C) = \frac{a^2 + b^2 - c^2}{2ab} = \frac{5^2 + 4^2 - 6^2}{2(5)(4)} = 0.48$$

Now, we can find the angles by taking the inverse cosine (arc cos) of these values.

- 1)  $A = \arccos(0.9) = 15.3^\circ$
- 2)  $B = \arccos(0.96) = 16.3^\circ$
- 3)  $C = \arccos(0.48) = 120.7^\circ$

So, the angles are  $15.3^\circ$ ,  $16.3^\circ$ , and  $120.7^\circ$  respectively.

Q) a) A man ... ?

Sol:

$$\text{Base} = 4 \text{ km}$$

$$\text{hyp} = 5 \text{ km}$$

$$\text{Perp} = ?$$

By using Pythagoras theorem. (4)

$$(\text{hyp})^2 = (\text{Base})^2 + (\text{Prep})^2 \quad \therefore ?$$

$$(5\text{km})^2 = (4\text{km})^2 + (\text{Prep})^2$$

$$25\text{km}^2 - 16\text{km}^2 = (\text{Prep})^2$$

$$\sqrt{9\text{km}^2} = \sqrt{(\text{Prep})^2}$$

$$\text{Prep} = 3\text{km}.$$

Total distance travelled in a triangle,

$$= 4\text{km} + 5\text{km} + 3\text{km}$$

Continuing 8km in the same direction

$$= 9\text{km} + 8\text{km} = 17\text{km}.$$

Using Pythagoras theorem again to find the distance travelled from starting point.

Distance from starting point is

$$= \sqrt{3^2 + 8^2}$$

$$= \sqrt{9 + 64}$$

$$= \sqrt{73}$$

$$= 8.54 \text{ km}$$

b) Hassan ...?

Sol:

Let Nasir's pocket money =  $x$   
Akbar's pocket money =  $3x$   
(3 times of Nasir)

Ali's pocket money = 5 times of  
Akbar  
 $= 5 \times 3x$   
 $= 15x$

Hassan's pocket money = One  
3rd of Ali's.

$$= \frac{1}{3} \times 15x$$

$$= 5x$$

Shahbaz's pocket money = Nasir's  
pocket money  
 $= x$

Sum of their pocket money = 8000  
So,

$$x + 3x + 15x + 5x + x = 8000$$

$$25x = 8000$$

$$x = \frac{8000}{25}$$

$$x = 320$$

So,

$$\text{Nasir's pocket money} = \text{Rs } 320.$$

$$\text{Shahbaz's pocket money} = \text{Rs } 320.$$

$$\begin{aligned}\text{Akbar's pocket money} &= 3 \times x \\ &= 3 \times 320 \\ &= \text{Rs } 960\end{aligned}$$

$$\begin{aligned}\text{Ali's pocket money} &= 15 \times x \\ &= 15 \times 320 \\ &= \text{Rs } 4800\end{aligned}$$

$$\begin{aligned}\text{Hassan's pocket money} &= 5 \times x \\ &= 5 \times 320 \\ &= \text{Rs } 1600\end{aligned}$$

c) What will ---?

Sol:

$$\text{Surface area of sphere} = ?$$

$$\text{Volume of the sphere} = ?$$

$$r = 7\text{m}$$

$$\text{Surface area of sphere}$$

$$= 4\pi r^2$$

$$= \frac{4 \times 22}{7} \times (7\text{m})^2$$

$$= \frac{4 \times 22}{17} \times 49\text{m}^2$$

$$= 88 \times 7\text{m}^2 = 616\text{m}^2$$

$$\text{Volume of sphere} = \frac{4}{3} \pi r^3$$

$$= \frac{4}{3} \times \frac{22}{7} \times (7\text{m})^3$$

$$= \frac{88}{21} \times 343\text{m}^3$$

$$= \frac{30184}{21} \text{m}^3$$

$$V = 1437.33 \text{m}^3$$

D) Distribute Rs 4320 ...?

Sol:

Total amount = Rs 4320

Zain : Arsalan : Ashraf = 2 : 3 : 7

Sum of ratios = 2 + 3 + 7

$$= 12$$

Zain's amount =  $\frac{\text{Zain's ratio} \times \text{total amount}}{\text{sum of ratio}}$

$$= \frac{2}{12} \times 4320$$

$$= \frac{8640}{12}$$

$$= \text{Rs } 720$$



$$\text{Aslam's amount} = \frac{3}{12} \times 4320$$

$$= \frac{12960}{12}$$

$$= \text{Rs } 1080.$$

$$\text{Ashraf's amount} = \frac{7}{12} \times 4320$$

$$= \frac{30240}{12}$$

$$= \text{Rs } 2520.$$