

FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION 2024

GENERAL KNOWLEDGE-I (General Science & Ability)

— COMPLETE SOLVED PAPER —

Part-I MCQs with answer key (correct options highlighted & ticked)

Part-II — Section A (Science) and Section B (Mental Ability) fully solved

Post: BS-17, Federal Government

Paper: General Knowledge-I — General Science & Ability

Coverage: Part-I (20 MCQs) & Part-II Section A (Q.2–Q.5), Section B (Q.6–Q.8) — all parts

TABLE OF CONTENTS

PART-I — MCQs (ANSWER KEY)

Q.1 20 Multiple Choice Questions — correct answers highlighted & ticked

SECTION A — GENERAL SCIENCE

Q.2 Tuberculosis & Hepatitis • Fiber Optic Cable • Cyclones vs Tornadoes • Ionic/Covalent Bonding

Q.3 Plastics vs Elastics • Remote Sensing & GIS • Kepler's Laws • Preservatives vs Antioxidants

Q.4 Carbohydrates & Vitamins • Liver & Pancreas • Drinking Water Standards • Radioactivity

Q.5 Plant Nutrition • Software vs Hardware • Earthquake Waves • EM & Gamma Radiation

SECTION B — MENTAL ABILITY

Q.6 Four-Number Equation • Jumbled Words • Number Series • Three-Digit Number Puzzle

Q.7 Triangle Path Distance • Pocket-Money Ratios • Sphere Geometry • Ratio Distribution

Q.8 Profit & Cost Price • Men-Days Work Problem • Shadow/Similar Triangles • Relative Speed of Cars

*Note: As per the examination instructions, candidates attempt any FOUR questions in Part-II (selecting TWO from each section), while all 20 MCQs in Part-I are compulsory. For complete preparation and revision value, this guide provides fully worked solutions to **every** question in both Part-I and Part-II.*

PART - I

Multiple Choice Questions (MCQs) — Answer Key — $20 \times 1 = 20$ Marks

1 In fish liver oil there is:

(A) Vitamin A only	(B) Vitamin D only
(C) Vitamin A and vitamin E	✓ (D) Vitamin A and Vitamin D

2 When day and night are equal?

(A) 23 rd February and 21 st September	✓ (B) 21 st March and 23 rd September
(C) 23 rd March and 21 st September	(D) None of these

3 What are total number of combinations of 09 things taken 03 at a time?

(A) 18	(B) 27
(C) 48	✓ (D) 84

4 The chemical formula for alum is:

✓ (A) $KAl(SO_4)_2 \cdot 12 H_2O$	(B) $KSi(SO_4)_2 \cdot 12 H_2O$
(C) $KAl(SO_4)_2 \cdot 8 H_2O$	(D) None of these

5 If the radius of a circle is increased three times then its area is increased:

(A) Three times	(B) Six times
✓ (C) Nine times	(D) None of these

6 One degree of longitude on the equator is equal to a distance of:

(A) 49 miles	✓ (B) 69 miles
(C) 39 miles	(D) 60 miles

7 The protein molecule is made of:

(A) Alkaloids	(B) Nucleosides
(C) Short range chain of amino acids	✓ (D) Long range chain of amino acids

8 The minimum amount of vitamin stored in the human body is of:

(A) Vitamin D	✓ (B) Vitamin C
(C) Vitamin E	(D) Vitamin A

9	The isotopes of any element contain equal number of:	
✓ (A) Protons	(B) Neutrons	
(C) Both electrons and protons	(D) None of these	
10	The pH of soil is raised using:	
✓ (A) Lime stone	(B) Gypsum	
(C) Urea	(D) None of these	
11	Which of the following is used for measuring distance?	
(A) Coulomb	✓ (B) light year	
(C) Farad	(D) Curie	
12	Which of the following contains a greater number of carbon atoms in one mole of each compound?	
(A) Chloroform	(B) Methanol	
(C) Water	✓ (D) Ethanol	
13	A pencil dipped in water appears bent due to:	
(A) Reflection	(B) Diffraction	
✓ (C) Refraction	(D) None of these	
14	Fishes die outside the water due to:	
(A) Carbon mono oxide	(B) Oxygen	
(C) Sun light	✓ (D) Non-absorption of oxygen	
15	In dementia a person:	
(A) Loses his weight	(B) Loses thinking and writing	
✓ (C) Loses thinking, remembering, and reasoning	(D) All of these	
16	Earthquake is measured by the instrument:	
(A) Wave guide	(B) Barometer	
✓ (C) Seismograph	(D) Hydrometer	

17 A cyclone is formed:	
(A) When the warm air rises upward over the ocean	(B) When moist air rises upward over the ocean
(C) When moist air pressed downward over the ocean	✓ (D) When warm, moist air rises upward over the ocean

18 Why red light is used in traffic signal for danger?	
(A) Due to short wavelength	(B) Due to high frequency
(C) It has long wavelength and high frequency	✓ (D) It has long wavelength and short frequency

19 The heavy water is:	
(A) Denoted by D_2O and contains simple hydrogen	(B) Denoted by H_2O and contains deuterium
✓ (C) Denoted by D_2O and contains deuterium	(D) Denoted by H_2O and contains simple hydrogen

20 The ionosphere is located within the thermosphere and extends:	
(A) From 60-300 km above the Earth's surface	(B) From 50-200 km above the Earth's surface
(C) From 50-300 km above the Earth's surface	✓ (D) None of the above

✓ = Correct Answer (highlighted in green). Options are reproduced exactly as printed in the original paper.

SECTION - A

General Science — Q.2 to Q.5

Q.2 General Science — Disease, Communication & Chemical Bonding

(20)

(a) What is the Tuberculosis and Hepatitis? Explain briefly.

SOLVED ANSWER

Tuberculosis (TB): A chronic infectious bacterial disease caused by *Mycobacterium tuberculosis*, which primarily affects the lungs but can also affect other organs. It spreads through airborne droplets when an infected person coughs or sneezes. Common symptoms include a persistent cough (often with blood), chest pain, fever, night sweats and weight loss. TB is treated with a prolonged course of antibiotics (multi-drug therapy) and is preventable through the BCG vaccine.

Hepatitis: Inflammation of the liver, most commonly caused by viral infection (Hepatitis A, B, C, D, or E), though it can also result from alcohol use, toxins or autoimmune conditions. Hepatitis A and E spread mainly through contaminated food/water, while Hepatitis B and C spread through infected blood or body fluids. Symptoms include jaundice, fatigue, abdominal pain and nausea. Vaccines are available for Hepatitis A and B.

(b) Explain the mechanism of Fiber Optic Cable for signal. Explain its construction.

SOLVED ANSWER

Mechanism: A fiber optic cable transmits information as pulses of light rather than electrical signals. Data is first converted into light pulses by a transmitter (laser or LED). The light travels through the glass core of the fiber, continuously reflecting off the boundary between the core and the surrounding cladding through **total internal reflection** — since the cladding has a lower refractive index than the core, light is trapped inside and travels long distances with minimal loss. At the receiving end, a photodetector converts the light signal back into an electrical/data signal.

Construction: A fiber optic cable consists of: (1) the **Core** — the thin, central glass/plastic strand that actually carries the light; (2) the **Cladding** — a layer surrounding the core with a lower refractive index that reflects light back into the core; (3) the **Buffer Coating** — a protective plastic layer guarding against moisture and damage; and (4) an outer **Protective Jacket** that provides strength and insulation to the overall cable.

(c) Explain the difference between Middle Latitude Cyclones and Tornadoes.

SOLVED ANSWER

- **Size:** Middle latitude (frontal) cyclones are very large weather systems spanning hundreds to thousands of kilometres, whereas tornadoes are small, localised systems usually only a few hundred metres wide.
- **Formation:** Middle latitude cyclones form along the boundary (front) between warm and cold air masses in the mid-latitudes, while tornadoes form from severe thunderstorms, typically associated with a rotating mesocyclone.
- **Duration:** Middle latitude cyclones can last several days, whereas tornadoes usually last only a few minutes to about an hour.
- **Wind pattern:** Cyclones have a broad, relatively gentle rotational wind pattern around a low-pressure centre; tornadoes have an extremely intense, violently rotating funnel of wind.
- **Impact area:** Cyclones affect very wide regions with rain and wind over a large area, while tornado damage is confined to a narrow, intense path.

(d) What is difference between the Ionic and Covalent bonding? Give examples.

SOLVED ANSWER

Ionic Bonding: Forms when one atom (usually a metal) transfers one or more electrons to another atom (usually a non-metal), creating oppositely charged ions (cation and anion) that are held together by strong electrostatic attraction. Ionic compounds typically have high melting points and conduct electricity when dissolved in water or molten. *Example:* Sodium Chloride (NaCl) — sodium loses an electron to chlorine.

Covalent Bonding: Forms when two atoms (usually both non-metals) share one or more pairs of electrons to achieve a stable electron configuration. Covalent compounds generally have lower melting points and do not conduct electricity. *Example:* Water (H₂O) — each hydrogen atom shares an electron pair with oxygen.

Key Difference: Ionic bonding involves complete transfer of electrons forming charged ions, while covalent bonding involves sharing of electrons between neutral atoms.

(a) What is difference between Plastics and Elastics? Explain briefly.

SOLVED ANSWER

Plastics: Synthetic or semi-synthetic polymers that can be moulded into rigid or semi-rigid shapes when heated and retain that shape after cooling. Once set (in thermosetting plastics) they do not return to their original form when deformed. They are valued for durability, light weight and resistance to chemicals. *Examples:* polyethylene, PVC, polystyrene.

Elastics (Elastomers): Polymers that can be stretched significantly under stress and return to their original shape once the stress is removed, due to their coiled molecular structure. *Examples:* natural rubber, synthetic rubber (used in bands, tyres).

Key Difference: Plastics are generally rigid and retain a moulded shape permanently, while elastics are flexible and elastic, returning to their original shape after being stretched or compressed.

(b) What is role of Remote sensing and GIS in environmental Science? Discuss briefly.

SOLVED ANSWER

Remote Sensing: Enables scientists to collect data about the Earth's surface and atmosphere from satellites or aircraft without physical contact. In environmental science, it is used to monitor deforestation, glacier retreat, land-use change, air and water quality, natural disasters (floods, wildfires) and climate patterns over large areas and long time periods.

GIS (Geographic Information System): A computer-based system used to capture, store, analyse and visualise spatial/geographic data as layered maps. In environmental science, GIS is used for mapping pollution sources, planning conservation areas, modelling flood-risk zones, tracking wildlife habitats and supporting urban and environmental planning decisions.

Combined Role: Remote sensing supplies the raw spatial data, while GIS organises, analyses and presents that data — together they are essential tools for environmental monitoring, disaster management and sustainable resource planning.

(c) What are Kepler laws related to the motion of planets?

SOLVED ANSWER

- **First Law (Law of Ellipses):** Every planet moves around the Sun in an elliptical orbit, with the Sun located at one of the two foci of the ellipse.
- **Second Law (Law of Equal Areas):** A line joining a planet to the Sun sweeps out equal areas in equal intervals of time — meaning a planet moves faster when closer to the Sun (perihelion) and slower when farther away (aphelion).
- **Third Law (Law of Periods):** The square of a planet's orbital period is directly proportional to the cube of the semi-major axis of its orbit ($T^2 \propto r^3$), meaning planets farther from the Sun take proportionally longer to complete one orbit.

(d) What is difference between preservatives and antioxidants? Discuss briefly with examples.

SOLVED ANSWER

Preservatives: Substances added to food (or other products) to prevent or slow down spoilage caused by micro-organisms such as bacteria, fungi and yeast, thereby extending shelf life. *Examples:* sodium benzoate, potassium sorbate, sodium nitrite.

Antioxidants: Substances that prevent or slow down the oxidation of food components (especially fats and oils), which would otherwise cause rancidity, discoloration and loss of nutritional value. *Examples:* Vitamin C (ascorbic acid), Vitamin E (tocopherol), BHA and BHT.

Key Difference: Preservatives mainly target microbial spoilage, while antioxidants specifically target chemical oxidation reactions; both are used together in many packaged foods to maximise freshness and shelf life.

(a) What is role of Carbohydrates and Vitamins in the body? Discuss briefly.

SOLVED ANSWER

Carbohydrates: The body's primary source of energy. They are broken down into glucose, which fuels cellular respiration and provides energy for muscles, the brain and other organs. Carbohydrates also support digestive health (through dietary fibre) and spare proteins from being used as an energy source. *Sources:* rice, wheat, potatoes, fruits.

Vitamins: Organic compounds required in small amounts for normal growth, metabolism and immune function. Each vitamin has a specific role — e.g., Vitamin A supports vision, Vitamin C boosts immunity and collagen formation, Vitamin D aids calcium absorption for bone health, and B-vitamins assist in energy metabolism. Unlike carbohydrates, vitamins do not provide energy directly but act as essential co-factors in the body's biochemical reactions.

(b) Discuss the functioning of Liver and Pancreas.

SOLVED ANSWER

Liver: The largest internal organ, performing over 500 functions including: producing bile (which emulsifies fats for digestion), detoxifying harmful substances and drugs from the blood, storing glycogen (a glucose reserve), synthesising blood-clotting proteins, and metabolising carbohydrates, fats and proteins.

Pancreas: Performs both exocrine and endocrine functions. As an exocrine gland, it secretes digestive enzymes (amylase, lipase, protease) into the small intestine to break down carbohydrates, fats and proteins. As an endocrine gland, it produces the hormones insulin and glucagon, which regulate blood glucose levels — insulin lowers blood sugar by promoting glucose uptake, while glucagon raises it by triggering glycogen breakdown.

(c) What are the standards of drinking water? How Heavy Metals in the water affect the living organisms?

SOLVED ANSWER

Standards of Drinking Water (typical WHO/national benchmarks):

- pH: 6.5 – 8.5
- Total Dissolved Solids (TDS): below 500–1000 mg/L
- Turbidity: below 5 NTU
- Arsenic: below 0.01 mg/L
- Lead: below 0.01 mg/L
- E. coli / faecal coliform: nil (zero) per 100 mL

Effects of Heavy Metals on Living Organisms: Heavy metals such as lead, arsenic, mercury and cadmium are non-biodegradable and accumulate in living tissue over time (bioaccumulation), causing serious harm even at low concentrations. They can damage the nervous system, kidneys and liver, impair growth and reproduction, cause developmental problems in children, and disrupt aquatic ecosystems by poisoning fish and other organisms, which can further pass up the food chain to humans (biomagnification).

(d) What is radioactivity? Discuss the laws of radioactivity. Name two radioactive elements.

SOLVED ANSWER

Radioactivity is the spontaneous disintegration of an unstable atomic nucleus, accompanied by the emission of energy in the form of alpha particles, beta particles, or gamma rays, as the nucleus transforms into a more stable configuration.

Laws of Radioactivity:

- **Law of Radioactive Decay:** The rate of decay of a radioactive substance at any instant is directly proportional to the number of undecayed atoms present at that instant.
- **Soddy-Fajans Group Displacement Laws:** When a radioactive atom emits an alpha particle, the new element formed shifts two places to the left in the periodic table (mass number decreases by 4, atomic number by 2); when it emits a beta particle, the new element shifts one place to the right (atomic number increases by 1, mass number unchanged).

Two Radioactive Elements: Uranium (U) and Radium (Ra) — other common examples include Thorium and Plutonium.

(a) What are the Plant nutrition elements? Enumerate them.

SOLVED ANSWER

Plants require several essential nutrients for healthy growth, broadly classified into macronutrients (needed in larger quantities) and micronutrients (needed in trace amounts).

Macronutrients: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulphur (S) — along with Carbon, Hydrogen and Oxygen obtained from air and water.

Micronutrients (Trace Elements): Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Boron (B), Molybdenum (Mo) and Chlorine (Cl).

(b) What is difference between software and hardware? Give five examples of each.

SOLVED ANSWER

Hardware: The physical, tangible components of a computer system that can be seen and touched — it carries out instructions given by software.

Examples: Central Processing Unit (CPU), Monitor, Keyboard, Hard Disk Drive, RAM (Memory).

Software: The set of instructions, programs, or data that tells the hardware what to do; it is intangible and cannot be physically touched.

Examples: Operating System (Windows), MS Word, Web Browser (Chrome), Antivirus Program, Video Games.

Key Difference: Hardware is the physical machinery, while software is the programming/instructions that operate that machinery.

(c) What are the types of earthquake waves? Discuss them.

SOLVED ANSWER

- **P-waves (Primary/Compressional Waves):** The fastest seismic waves; they travel through solids, liquids and gases by compressing and expanding the material in the direction of travel (longitudinal wave motion). They are the first waves detected by seismographs.
- **S-waves (Secondary/Shear Waves):** Slower than P-waves; they move the ground perpendicular to the direction of travel (transverse wave motion) and can only pass through solids, not liquids or gases.
- **Surface Waves:** Travel along the Earth's surface (rather than through its interior), arrive after P- and S-waves, and are generally the most destructive. They include:
 - – **Love Waves:** Cause side-to-side (horizontal) shearing motion of the ground.
 - – **Rayleigh Waves:** Cause a rolling, up-and-down motion similar to ocean waves.

(d) What are longitudinal waves, electromagnetic and Gamma radiations? Discuss them.

SOLVED ANSWER

Longitudinal Waves: Waves in which the particles of the medium vibrate parallel to (in the same direction as) the direction of wave propagation, creating alternating regions of compression and rarefaction. *Example:* sound waves travelling through air.

Electromagnetic Waves: Waves consisting of oscillating electric and magnetic fields that are perpendicular to each other and to the direction of propagation. Unlike mechanical waves, they do not require a medium and can travel through a vacuum at the speed of light. The electromagnetic spectrum includes radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays.

Gamma Radiation: The highest-energy, shortest-wavelength form of electromagnetic radiation, typically emitted during radioactive decay of unstable atomic nuclei or nuclear reactions. Gamma rays are highly penetrating and ionising, making them useful in medical treatment (radiotherapy) and sterilisation, but also hazardous to living tissue in high doses, requiring dense shielding such as lead or thick concrete.

SECTION - B

Mental Ability — Q.6 to Q.8

Q.6 Mental Ability — Equations, Word Puzzles & Number Series

(20)

(a) If the sum of four numbers is 105. When 03 is added to a number, twice of another number, five times of third number and fourth number become equal to each other. What are these numbers in ascending order?

SOLVED ANSWER

Let the four numbers be w, x, y, z such that:

$w + 3 = 2x = 5y = z = k$ (a common value k)

So: $w = k - 3, x = k/2, y = k/5, z = k$

Sum: $(k-3) + k/2 + k/5 + k = 105$

Combining k -terms: $k + k/2 + k/5 + k = 2.7k$, so: $2.7k - 3 = 105$

$2.7k = 108 \rightarrow k = 40$

$w = 40 - 3 = 37, x = 40/2 = 20, y = 40/5 = 8, z = 40$

Check: $37 + 20 + 8 + 40 = 105$ ✓

Answer (ascending order): 8, 20, 37, 40

(b) Find out the correct word from the given jumbled spellings: (i) UCTREUTRS (ii) LOVONAC (iii) CIHPROSTATAC (iv) YNTIAUMH (v) NNTHORER

SOLVED ANSWER

(i) UCTREUTRS → **STRUCTURE**

(ii) LOVONAC → **VOLCANO**

(iii) CIHPROSTATAC → **CATASTROPHIC**

(iv) YNTIAUMH → **HUMANITY**

(v) NNTHORER → **NORTHERN**

(c) Find the missing numbers in the series below: (i) 121, 11, 81, 9, ?, 7 (ii) 100, 50, 25, ?, 6.25 (iii) 4, 9, 64, 125, 1296, ? (iv) 2, 5, 12, 24, 48, ? (v) 44, 22, 66, 33, 132, ?

SOLVED ANSWER

(i) 121, 11, 81, 9, ?, 7

Each pair is (a square, its square root): $11^2=121$, $9^2=81$, and following the pattern, $7^2=49$.

Missing number = 49

(ii) 100, 50, 25, ?, 6.25

Each term is half of the previous term: $100 \div 2 = 50$, $50 \div 2 = 25$, $25 \div 2 = 12.5$, $12.5 \div 2 = 6.25$.

Missing number = 12.5

(iii) 4, 9, 64, 125, 1296, ?

Pattern: $2^2=4$, $3^2=9$, $4^3=64$, $5^3=125$, $6^4=1296$ — exponents rise in pairs (square, square, cube, cube, 4th power, 4th power).

Following the pattern, the next term is $7^4 = 2401$.

Missing number = 2401

(iv) 2, 5, 12, 24, 48, ?

From the third term onward, each number is exactly double the preceding number: $12 \rightarrow 24 \rightarrow 48$, continuing this doubling pattern gives the next term.

$$48 \times 2 = 96$$

Missing number = 96

(v) 44, 22, 66, 33, 132, ?

Pattern alternates: $\div 2$, $\times 3$, $\div 2$, $\times 4$, $\div 2$ — $44 \div 2 = 22$, $22 \times 3 = 66$, $66 \div 2 = 33$, $33 \times 4 = 132$, $132 \div 2 = 66$.

Missing number = 66

(d) If the sum of three digit number is 15 and sum of 10th and unit digit is 12. The difference of unit digit from 10th digit is equal to 02. What is the three digit number?

SOLVED ANSWER

Let the digits be: Hundreds = h, Tens = t, Units = u

Given: $h + t + u = 15$ and $t + u = 12$

So: $h = 15 - 12 = 3$

Also given: $t - u = 2$ (tens digit exceeds unit digit by 2)

From $t + u = 12$ and $t - u = 2$: adding both equations $\rightarrow 2t = 14 \rightarrow t = 7$, then $u = 5$

Check: $h+t+u = 3+7+5 = 15$ ✓, $t+u = 12$ ✓, $t-u = 2$ ✓

Answer: The three-digit number is 375

(a) A man travels over the path of a right-angle triangle having base and hypotenuse 4 and 5 kilometers, respectively. After a complete round he continues in the same direction for 6 km and then turns at 90 degree and continues for another 8 km. How long he has travelled and how far he is from his starting point?

SOLVED ANSWER

Since base = 4 km and hypotenuse = 5 km, this is a 3–4–5 right triangle, so the third side (perpendicular) = $\sqrt{5^2 - 4^2} = \sqrt{9} = 3$ km.

Perimeter of the triangular path = $3 + 4 + 5 = 12$ km.

Total distance travelled = one complete round (12 km) + 6 km + 8 km = **26 km**.

Since a 'complete round' brings him back to the starting point, his displacement after the triangle is zero — he then walks 6 km in a straight line, turns 90° , and walks 8 km.

This forms a new right-angle triangle with legs 6 km and 8 km:

Distance from start = $\sqrt{6^2 + 8^2} = \sqrt{36 + 64} = \sqrt{100} = 10$ km

Answer: Total distance travelled = 26 km; Distance from starting point = 10 km.

(b) Hassan, Ali, Akbar, Nasir and Shahbaz are classmates having different pocket money. Hassan's pocket money is one third as much as of Ali and Ali has five times as much as Akbar. Akbar has thrice as much as Nasir and Shahbaz gets equal to Nasir and that of Ali. If they get Rs. 8000 then find the pocket money of each.

SOLVED ANSWER

Let Ali's pocket money = A

Hassan = $A/3$

Ali = $5 \times$ Akbar $\rightarrow$ Akbar = $A/5$

Akbar = $3 \times$ Nasir $\rightarrow$ Nasir = Akbar/3 = $A/15$

Shahbaz = Nasir + Ali = $A/15 + A = 16A/15$

Total: Hassan + Ali + Akbar + Nasir + Shahbaz = 8000

$A/3 + A + A/5 + A/15 + 16A/15 = 8000$

Using a common denominator of 15: $(5A + 15A + 3A + A + 16A)/15 = 8000 \rightarrow 40A/15 = 8000$

$40A = 120000 \rightarrow A = 3000$

Ali = Rs. 3000, Hassan = $3000/3 =$ Rs. 1000, Akbar = $3000/5 =$ Rs. 600, Nasir = $600/3 =$ Rs. 200, Shahbaz = $200 + 3000 =$ Rs. 3200

Check: $1000 + 3000 + 600 + 200 + 3200 = 8000 \checkmark$

Answer: Hassan = Rs. 1000, Ali = Rs. 3000, Akbar = Rs. 600, Nasir = Rs. 200, Shahbaz = Rs. 3200.

(c) What will be the surface area and volume of a sphere if it has a radius of 7 m?

SOLVED ANSWER

Using $\pi \approx 22/7$ and radius $r = 7$ m:

$$\text{Surface Area} = 4\pi r^2 = 4 \times (22/7) \times 7^2 = 4 \times (22/7) \times 49 = 4 \times 22 \times 7 = 616 \text{ m}^2$$

$$\text{Volume} = (4/3)\pi r^3 = (4/3) \times (22/7) \times 7^3 = (4/3) \times (22/7) \times 343 = (4/3) \times 22 \times 49 = 4312/3 \approx 1437.33 \text{ m}^3$$

Answer: Surface Area = 616 m²; Volume $\approx$ 1437.33 m³ (1437 1/3 m³).

(d) Distribute Rs. 4320 among Zain, Aslam and Ashraf in such a way that if Zain gets 2 parts then Aslam gets three parts, whereas Ashraf gets seven parts.

SOLVED ANSWER

Ratio of Zain : Aslam : Ashraf = 2 : 3 : 7

Total parts = 2 + 3 + 7 = 12

Value of 1 part = $4320 \div 12 = \text{Rs. } 360$

Zain = $2 \times 360 = \text{Rs. } 720$

Aslam = $3 \times 360 = \text{Rs. } 1080$

Ashraf = $7 \times 360 = \text{Rs. } 2520$

Check: $720 + 1080 + 2520 = \text{Rs. } 4320 \checkmark$

Answer: Zain = Rs. 720, Aslam = Rs. 1080, Ashraf = Rs. 2520.

(a) A man purchases a car in an amount of Rs. 2400,000 in which he pays one-fourth extra as profit. Find the original amount of car and the amount of profit.

SOLVED ANSWER

Let the original price of the car = P

Selling price = $P + (1/4)P = (5/4)P$

Given: $(5/4)P = 2,400,000$

$P = 2,400,000 \times 4/5 = \text{Rs. } 1,920,000$

Profit = $2,400,000 - 1,920,000 = \text{Rs. } 480,000$

Answer: Original price = Rs. 19,20,000; Profit = Rs. 4,80,000.

(b) Twelve men can complete a job in twenty-four days. After four days four person quit. In how many days this job will be completed by the remaining persons.

SOLVED ANSWER

Total work = 12 men $\times$ 24 days = 288 man-days

Work completed in the first 4 days = 12 men $\times$ 4 days = 48 man-days

Remaining work = $288 - 48 = 240$ man-days

Remaining men after 4 quit = $12 - 4 = 8$ men

Days required = Remaining work $\div$ Remaining men = $240 \div 8 = 30$ days

Answer: The remaining 8 men will complete the job in 30 more days.

(c) The shadow of a 10 m tall tree is falling on a high rise building and its height is 100 m. If the tree is 20 m away from the wall, at what distance from the wall is the light source?

SOLVED ANSWER

Let the light source be at horizontal distance d from the tree (on the opposite side of the building), so the light source is $(d + 20)$ m from the wall.

By similar triangles, the ray grazing the top of the 10 m tree (at distance d from the source) continues to strike the wall at height 100 m (at distance $d + 20$ from the source):

$$10 / d = 100 / (d + 20)$$

$$10(d + 20) = 100d \rightarrow 10d + 200 = 100d \rightarrow 200 = 90d \rightarrow d = 200/90 = 20/9 \text{ m}$$

$$\text{Distance of light source from the wall} = d + 20 = 20/9 + 20 = 200/9 \approx 22.22 \text{ m}$$

Answer: The light source is approximately 22.22 m ($200/9$ m) from the wall.

(d) There are three cars and start moving in such a way that car A and B are moving opposite with speed 60 and 100 km/h. Car C is moving perpendicularly to both with speed 80 km/h. What is distance after 15 minutes between (i) A and B (ii) A and C (iii) B and C?

SOLVED ANSWER

All three cars start from the same point. Time = 15 minutes = 0.25 hours.

Set up coordinates: A moves along +x direction, B moves along -x direction (opposite to A), and C moves along the perpendicular y-direction.

Distance covered: A = $60 \times 0.25 = 15$ km $\rightarrow$ position (15, 0)

B = $100 \times 0.25 = 25$ km (opposite direction) $\rightarrow$ position (-25, 0)

C = $80 \times 0.25 = 20$ km (perpendicular) $\rightarrow$ position (0, 20)

(i) Distance A-B = $15 - (-25) = 40$ km (since A and B move directly apart, their speeds simply add: $(60+100) \times 0.25 = 40$ km)

(ii) Distance A-C = $\sqrt{[(15-0)^2 + (0-20)^2]} = \sqrt{(225+400)} = \sqrt{625} = 25$ km

(iii) Distance B-C = $\sqrt{[(-25-0)^2 + (0-20)^2]} = \sqrt{(625+400)} = \sqrt{1025} \approx 32.02$ km

Answer: A-B = 40 km, A-C = 25 km, B-C $\approx$ 32.02 km.

— End of Solved Paper —