Science and Technology Part 1

SSC Board Exam March 2027 – Practice Paper No. 2

Model Answer Paper

Time: 2 hours **Max. Marks: 40**

Model answers show one correct method; any other correct method gets full marks.

Q.1 (A) Choose the correct alternative and write its alphabet. **[5]**

(i) According to Kepler's third law, the square of the period of revolution of a planet around the Sun (T^2) is directly proportional to _____ (r = mean distance of the planet from the Sun).

(A) r (B) r^2

(C) r^3 (D) $1/r^2$

Answer (1 mark)
(C) r^3
Kepler's third law: $T^2 \propto r^3$, i.e. T^2/r^3 = constant for all planets.

(ii) In the reaction $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$, the reductant (reducing agent) is _____.

(A) Fe_2O_3 (B) CO

(C) Fe (D) CO_2

Answer (1 mark)
(B) CO
CO takes oxygen from Fe_2O_3 and is itself oxidised to CO_2, so CO is the reductant; Fe_2O_3 is reduced to Fe.

(iii) In the modern periodic table, the elements of the d-block (groups 3 to 12) are called _____.

(A) noble gases (B) transition elements

(C) metalloids (D) alkaline earth metals

Answer (1 mark)
(B) transition elements
Groups 3 to 12 form the d-block; the d-block elements are called transition elements.
(Metalloids lie along the zig-zag line in the p-block; noble gases are in group 18; alkaline earth metals are in group 2.)

(iv) Which of the following metals is found in the free state in nature?

(A) Sodium (B) Gold

(C) Aluminium (D) Calcium

Answer (1 mark)
(B) Gold
Gold is a least reactive (noble) metal, so it does not combine easily with oxygen, water etc. and is found in the free state.

(v) In an electric motor, the direction of current in the coil is reversed after every half rotation with the help of _____.

(A) carbon brushes alone
(B) split rings
(C) the axle
(D) the horseshoe magnet

Answer (1 mark)
(B) split rings
The two halves of the split ring change contact with the carbon brushes after every half rotation, reversing the current in the coil so that it keeps rotating in the same direction.

Q.1 (B) Answer the following. **[5]**

(i) Find the odd one out: Methane, Ethane, Ethene, Propane

Answer (1 mark)
Ethene.
Methane, ethane and propane are saturated hydrocarbons (alkanes, only C–C single bonds); ethene (CH_2=CH_2) is an unsaturated hydrocarbon with a double bond.

(ii) Complete the correlation:
Specific latent heat of fusion of ice : 80 cal/g :: Specific latent heat of vaporization of water : _____

Answer (1 mark)
540 cal/g.
1 g of water at 100 °C needs 540 cal to change into steam at 100 °C.

(iii) Match the column:
Column A: Iris
Column B: (a) Changes the focal length of the eye lens (b) Controls the size of the pupil (c) Forms the image of the object

Answer (1 mark)
Iris – (b) Controls the size of the pupil.
The iris adjusts the pupil and so controls the amount of light entering the eye. (Ciliary muscles change the focal length; the retina receives the image.)

(iv) State whether the following statement is true or false:
The critical velocity of an artificial satellite does not depend on the mass of the satellite.

Answer (1 mark)
True.
$v_c = \sqrt{(GM/(R + h))}$; it depends on the mass M of the Earth and the orbital radius (R + h), not on the mass of the satellite.

(v) Write the name: The polymer formed from the monomer ethylene (ethene).

Answer (1 mark)
Polyethylene (polythene).
Many ethylene molecules join by addition polymerisation: n CH_2=CH_2 → –(CH_2–CH_2)$_n$–; used for carry bags.

Q.2 (A) Give scientific reasons. (Any two) **[4]**

(i) Aluminium is a reactive metal, yet aluminium utensils and window frames do not corrode easily.

Answer (2 marks)

1. When aluminium comes in contact with the oxygen of air, a thin layer of aluminium oxide (Al_2O_3) forms on its surface: $4Al + 3O_2 \rightarrow 2Al_2O_3$.
2. This oxide layer is strong and sticks firmly to the metal; it does not flake off like rust.
3. It obstructs further contact of aluminium with air and water, so further oxidation (corrosion) is prevented.

Marking: Formation of a thin aluminium oxide layer – 1 mark · Layer prevents contact with air/water, so no further corrosion – 1 mark

Examiner tip: Name the layer (aluminium oxide). Writing only 'aluminium is not reactive' is wrong and gets no marks.

(ii) The bottom of a swimming pool filled with water appears to be raised (the pool looks shallower than it really is).

Answer (2 marks)

1. Light rays coming from the bottom of the pool travel from water (denser medium) into air (rarer medium).
2. At the water surface they are refracted and bend away from the normal.
3. To the eye these rays appear to come from a point above the actual bottom. Hence the bottom appears raised and the pool appears shallower.

Marking: Light passes from water to air and is refracted away from the normal – 1 mark · Rays appear to come from a higher point → bottom appears raised – 1 mark

Examiner tip: Use the words 'denser to rarer' and 'away from the normal'; just writing 'due to refraction' gets only ½ mark.

(iii) On winter mornings, drops of water are seen on the leaves of plants and on grass.

Answer (2 marks)

1. Air always contains some water vapour.
2. On clear winter nights the leaves and grass cool down a lot, so the air in contact with them also cools.
3. When the temperature of this air falls below its dew point temperature, the air becomes saturated and the extra water vapour condenses into droplets (dew) on the cool surfaces.

Marking: Air in contact with the cold surface cools below the dew point – 1 mark · Excess vapour condenses into droplets (dew) – 1 mark

Examiner tip: The key term is 'dew point temperature' – examiners look for it.

Q.2 (B) Answer the following. (Any three) **[6]**

(i) Two cargo ships of masses 3×10^6 kg and 4×10^6 kg are anchored 2 km apart at a port near Mumbai. Calculate the gravitational force between them. ($G = 6.67 \times 10^{-11}$ N m^2/kg^2)

Answer (2 marks)

Given: $m_1 = 3 \times 10^6$ kg, $m_2 = 4 \times 10^6$ kg, $d = 2$ km $= 2 \times 10^3$ m, $G = 6.67 \times 10^{-11}$ N m^2/kg^2

$F = G\, m_1\, m_2 / d^2$

$= (6.67 \times 10^{-11} \times 3 \times 10^6 \times 4 \times 10^6) / (2 \times 10^3)^2$

$= (6.67 \times 12 \times 10^1) / (4 \times 10^6)$

$= 6.67 \times 3 \times 10^{-5}$

$= 2.001 \times 10^{-4}$ N

Ans: The gravitational force is 2.001×10^{-4} N (very small, so the ships do not move towards each other).

Marking: Formula with correct substitution (d in metres) – 1 mark · Answer 2.001×10^{-4} N with unit – 1 mark

Examiner tip: Convert 2 km to 2×10^{3} m and square it (4×10^{6} m^2); forgetting to square d is the commonest error.

(ii) State Newlands' law of octaves. Write any two limitations of this law.

Answer (2 marks)

Law of octaves: When elements are arranged in increasing order of their atomic masses, every eighth element has properties similar to those of the first element (e.g. sodium is the eighth element from lithium and both have similar properties).

Limitations (any two):

1. The law was found to be applicable only up to calcium.
2. To fit all known elements in his table, Newlands placed two elements in some boxes (e.g. Co and Ni, Ce and La).
3. He placed some elements with different properties under the same note (e.g. the metals Co and Ni with the halogens).
4. There was no provision to accommodate newly discovered elements.

Marking: Statement of the law – 1 mark · Any two limitations – ½ + ½ mark

Examiner tip: Say 'every eighth element' and 'increasing atomic masses'; the musical-notes comparison alone is not the law.

(iii) The speed of light in a transparent medium A is 2.5×10^{8} m/s and in another medium B is 2×10^{8} m/s. Find (a) the absolute refractive index of medium A and (b) the refractive index of medium B with respect to medium A. (Speed of light in vacuum = 3×10^{8} m/s)

Answer (2 marks)

(a) $n_A = c / v_A = (3 \times 10^{8}) / (2.5 \times 10^{8}) = 1.2$

(b) $n_{BA} = v_A / v_B = (2.5 \times 10^{8}) / (2 \times 10^{8}) = 1.25$

Ans: (a) 1.2 (b) 1.25 (refractive index has no unit).

Marking: (a) $n_A = 1.2$ – 1 mark · (b) $n_{BA} = 1.25$ – 1 mark

Examiner tip: n_{BA} = speed in A ÷ speed in B. Writing the ratio upside down gives 0.8, which is wrong.

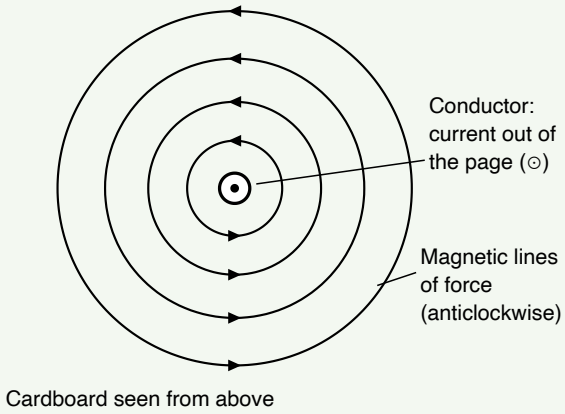
(iv) State the right hand thumb rule. Draw a diagram showing the magnetic lines of force around a straight conductor carrying current (conductor perpendicular to the page, current coming out of the page).

Answer (2 marks)

Right hand thumb rule: Imagine that you hold the current-carrying conductor in your right hand in such a way that your thumb points in the direction of the current. Then the direction in which your fingers curl around the conductor gives the direction of the magnetic lines of force.

Diagram: The lines of force are concentric circles with the conductor at the centre, in a plane perpendicular to the conductor. For current coming out of the page they are anticlockwise. They are drawn farther apart as the distance from the wire increases.

(Also accept: a sketch of the wire passing vertically through a horizontal cardboard, with current flowing upward and the circles on the cardboard drawn anticlockwise as seen from above. Circles must be concentric and carry direction arrows.)



Marking: Statement of the rule – 1 mark · Concentric circles with correct (anticlockwise) direction – 1 mark

Examiner tip: Show arrows on the circles; circles without direction lose ½ mark.

(v) Write two differences between saturated and unsaturated hydrocarbons. Give one example of each.

Answer (2 marks)

Saturated hydrocarbons	Unsaturated hydrocarbons
1. All carbon atoms are joined by single bonds only.	1. Contain at least one carbon–carbon double bond or triple bond.
2. Less reactive; mainly give substitution reactions.	2. More reactive; give addition reactions (e.g. decolourise iodine/bromine).
Example: ethane (C_2H_6)	Example: ethene (C_2H_4) or ethyne (C_2H_2)

Marking: Two correct differences – ½ + ½ mark · One example of each type – ½ + ½ mark

Examiner tip: Write the differences in a two-column table and give the formula of each example.

Q.3 Answer the following. (Any five) **[15]**

(i) In a house in Nashik, 300 g of hot water at 80 °C from a solar water heater is mixed with 200 g of tap water at 30 °C in an insulated bucket. (Specific heat of water = 1 cal/g °C; assume no heat is lost to the surroundings or the bucket.)
(a) State the principle of heat exchange.
(b) Find the final temperature of the mixture.
(c) How much heat is gained by the tap water?

Answer (3 marks)

(a) Principle of heat exchange: When hot and cold objects are brought in contact and the system is isolated (no heat exchange with the surroundings), heat lost by the hot object = heat gained by the cold object.

(b) Let the final temperature be T.

Heat lost by hot water = $m_1c(80 - T) = 300 \times 1 \times (80 - T)$

Heat gained by tap water = $m_2c(T - 30) = 200 \times 1 \times (T - 30)$

$300(80 - T) = 200(T - 30)$

$24000 - 300T = 200T - 6000$

$500T = 30000 \rightarrow T = 60$ °C

(c) Heat gained = $200 \times 1 \times (60 - 30) = 6000$ cal

(Check: heat lost = $300 \times 1 \times (80 - 60) = 6000$ cal.)

Ans: (b) 60 °C (c) 6000 cal

Marking: (a) Principle – 1 mark · (b) Equation and T = 60 °C – 1 mark · (c) 6000 cal – 1 mark

Examiner tip: Write 'heat lost = heat gained' as an equation first; then the algebra is easy.

(ii) A navigation satellite revolves in a circular orbit of radius 1.6×10^7 m measured from the centre of the Earth. (For the Earth take GM = 4×10^{14} N m^2/kg, i.e. $6.67 \times 10^{-11} \times 6 \times 10^{24}$ rounded; radius of the Earth R = 6400 km, π = 3.14)

(a) Find the critical velocity of the satellite.

(b) Find the time it takes to complete one revolution.

(c) Find its height above the Earth's surface and name the type of orbit.

Answer (3 marks)

Given: R + h = 1.6×10^7 m, GM = 4×10^{14} N m^2/kg

(a) $v_c = \sqrt{(GM/(R + h))} = \sqrt{(4 \times 10^{14} / 1.6 \times 10^7)} = \sqrt{(2.5 \times 10^7)} = \sqrt{(25 \times 10^6)} = 5 \times 10^3$ m/s = 5 km/s

(b) $T = 2\pi(R + h)/v_c = (2 \times 3.14 \times 1.6 \times 10^7) / (5 \times 10^3) = 20096$ s ≈ 5.58 h (about 5 h 35 min)

(c) h = (R + h) – R = 16000 km – 6400 km = 9600 km

Since 2000 km < h < 35780 km, the satellite is in a Medium Earth Orbit.

Ans: (a) 5 km/s (b) 20096 s ≈ 5.6 h (c) 9600 km, Medium Earth Orbit

Marking: (a) 5 km/s – 1 mark · (b) 20096 s (≈ 5.6 h) – 1 mark · (c) 9600 km and Medium Earth Orbit – 1 mark

Examiner tip: The orbital radius is (R + h), not h. Subtract R only when the height is asked.

(iii) An object 8 cm high is placed 36 cm in front of a concave lens of focal length 12 cm.

(a) Find the position of the image.

(b) Find the magnification and the height of the image.

(c) State the nature of the image.

Answer (3 marks)

Given: u = –36 cm, f = –12 cm (concave lens), h_1 = 8 cm

(a) Lens formula: 1/v – 1/u = 1/f

1/v = 1/f + 1/u = –1/12 – 1/36 = (–3 – 1)/36 = –4/36 = –1/9

v = –9 cm, i.e. the image is 9 cm from the lens on the same side as the object.

(b) M = v/u = (–9)/(–36) = +1/4 = 0.25

$h_2 = M \times h_1 = 0.25 \times 8 = 2$ cm

(c) The image is virtual, erect and diminished (2 cm high).

Marking: (a) v = –9 cm – 1 mark · (b) M = 0.25, h_2 = 2 cm – 1 mark · (c) Virtual, erect, diminished – 1 mark

Examiner tip: For a concave lens f is negative. A negative v means the image is on the same side as the object (virtual).

(iv) Write balanced chemical equations, with physical states, for the following and name the type of each reaction.

(a) Aqueous sodium sulphate is added to aqueous barium chloride.

(b) Electric current is passed through acidulated water.

(c) Hydrogen gas combines with chlorine gas.

Answer (3 marks)

(a) $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s)\downarrow + 2NaCl(aq)$

Type: Double displacement reaction (white precipitate of barium sulphate).

(b) $2H_2O(l) \xrightarrow{\text{(electric current)}} 2H_2(g)\uparrow + O_2(g)\uparrow$

Type: Decomposition reaction (electrolysis – decomposition by electrical energy).

(c) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

Type: Combination reaction.

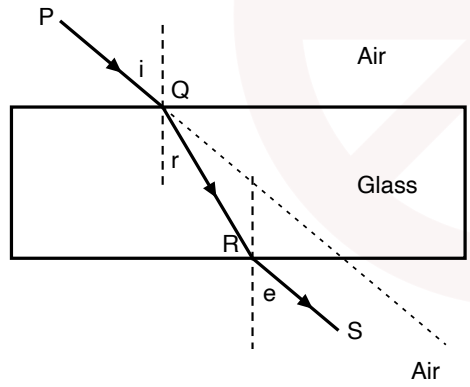
Marking: Each balanced equation (½) + type (½) – 1 mark × 3

Examiner tip: Mark the precipitate with (s) or ↓ and the gas with (g) or ↑; missing states cost ½ mark.

(v) Mendeleev left some places vacant in his periodic table. For one of them, below silicon, he predicted an element called eka-silicon with atomic mass 72.
(a) Which element was later discovered to fill this place?
(b) State Mendeleev's periodic law.
(c) Explain why the position of hydrogen was a demerit of Mendeleev's periodic table.

Answer (3 marks)
(a) Germanium (Ge).
(b) Mendeleev's periodic law: The properties of elements are a periodic function of their atomic masses.
(c) Hydrogen shows similarity with alkali metals (group I), e.g. HCl and NaCl, H_2O and Na_2O have similar formulae. It also shows similarity with halogens (group VII), e.g. it exists as diatomic H_2 like F_2 and Cl_2, and forms CH_4 like CCl_4. So it could not be decided whether hydrogen should be placed with the alkali metals or with the halogens.
Marking: (a) Germanium – 1 mark · (b) Periodic law – 1 mark · (c) Similarity with both alkali metals and halogens – 1 mark
Examiner tip: Mendeleev's law uses atomic MASSES; writing 'atomic numbers' (the modern law) loses the mark.

(vi) Observe the figure, in which a ray of light PQ passes through a rectangular glass slab, and answer the questions.
(a) Name the rays QR and RS.
(b) What is the relation between angle i and angle e? What is the relation between ray PQ and ray RS?
(c) If the glass slab is replaced by a slab of the same size made of a material of greater refractive index, will angle r increase or decrease? Why?



Answer (3 marks)
(a) QR – refracted ray; RS – emergent ray.
(b) ∠i = ∠e. The emergent ray RS is parallel to the incident ray PQ, but it is laterally displaced (shifted sideways, as shown by the dotted line).
(c) Angle r will decrease. By Snell's law, sin i / sin r = n, so sin r = sin i / n. For the same angle i, a larger n gives a smaller sin r, i.e. the ray bends more towards the normal.
Marking: (a) Refracted ray and emergent ray – 1 mark · (b) i = e and PQ ∥ RS – 1 mark · (c) r decreases with reason – 1 mark
Examiner tip: In (c) a reason using sin i / sin r = n is needed for the full mark.

(vii) Iron and other metals are protected from corrosion by different methods. Explain the following methods with one example each:
(a) Galvanizing
(b) Tinning
(c) Electroplating

Answer (3 marks)
(a) Galvanizing: A thin layer of zinc is applied on iron or steel. Zinc corrodes first and protects the iron below it. Example: galvanized iron sheets, shining iron nails and pins.
(b) Tinning: A layer of molten tin is deposited on a metal (called 'kalhaee'). Example: tinning of copper or brass vessels so that the poisonous greenish layer does not form and food such as buttermilk or curry does not get spoiled.
(c) Electroplating: A less reactive metal is coated on a more reactive metal by electrolysis. Example: silver-plated spoons, gold-plated ornaments.

Marking: Each method with an example – 1 mark × 3

Examiner tip: Name the coating metal (zinc, tin) in each method; a method without an example gets only ½ mark.

(viii) A planet X has a mass 6 times the mass of the Earth and a radius 2 times the radius of the Earth. (g on Earth = 9.8 m/s^2)
(a) Write the formula for the acceleration due to gravity g on the surface of a planet of mass M and radius R.
(b) Find the value of g on the surface of planet X.
(c) A stone dropped from rest on planet X takes 2 s to reach the ground. From what height was it dropped?

Answer (3 marks)
(a) $g = GM/R^2$
(b) $g_X = G(6M)/(2R)^2 = (GM/R^2) \times (6/4) = 1.5 \times 9.8 = 14.7\ m/s^2$
(c) $u = 0,\ t = 2\ s,\ a = g_X = 14.7\ m/s^2$
$s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 14.7 \times 2^2 = 29.4\ m$
Ans: (b) 14.7 m/s^2 (c) 29.4 m

Marking: (a) $g = GM/R^2$ – 1 mark · (b) 14.7 m/s^2 – 1 mark · (c) 29.4 m – 1 mark

Examiner tip: Doubling R makes R^2 four times bigger, so g becomes 6/4 (not 6/2) times Earth's g – do not forget the square.

Q.4 Answer the following in detail. (Any one) **[5]**

(i) Read the information and answer the questions.

A family in Pune uses an electric geyser rated 2400 W, 240 V. During the month of November (30 days), it is used for 1 hour every day.

(a) Find the current drawn by the geyser.

(b) Find the resistance of its heating coil.

(c) How much heat (in joule) does it produce in 5 minutes?

(d) How many units of electrical energy does it consume in November? Find the cost at ₹ 7 per unit.

(e) If the supply voltage drops to 120 V, what will be the power of the geyser? (Assume the resistance remains the same.)

Answer (5 marks)

Given: P = 2400 W, V = 240 V

(a) $I = P/V = 2400/240 = 10$ A

(b) $R = V/I = 240/10 = 24\ \Omega$

(c) $H = P \times t = 2400\ W \times (5 \times 60)\ s = 2400 \times 300 = 720000\ J = 7.2 \times 10^5\ J$ (also $= I^2Rt = 10^2 \times 24 \times 300$)

(d) Energy per day = 2.4 kW × 1 h = 2.4 kWh

Energy in November = 2.4 × 30 = 72 kWh = 72 units

Cost = 72 × 7 = ₹ 504

(e) $P' = V'^2/R = (120)^2/24 = 14400/24 = 600$ W

(Half the voltage gives one-fourth the power.)

Marking: (a) 10 A – 1 mark · (b) 24 Ω – 1 mark · (c) 7.2×10^5 J – 1 mark · (d) 72 units and ₹ 504 – 1 mark · (e) 600 W – 1 mark

Examiner tip: Change 5 minutes to 300 s for joules, but use kW and hours for units (kWh).

(ii) Read the paragraph and answer the questions.

A compound A (molecular formula C_2H_6O) is obtained by fermentation of molasses in sugar factories of Maharashtra and is used as a solvent in tincture iodine. When small pieces of sodium are put in A, a combustible gas B is given out. When A is heated at 170 °C with excess concentrated sulphuric acid, an unsaturated compound C is formed. C reacts with hydrogen in the presence of nickel to form D. When A is oxidised with alkaline potassium permanganate, compound E is formed, which gives effervescence with sodium bicarbonate.

(a) Identify A and write its structural formula.

(b) Write the chemical equation for the reaction of A with sodium and name the gas B.

(c) Write the chemical equation for the formation of C. What is the role of concentrated sulphuric acid?

(d) Name D and the type of reaction in which C changes to D.

(e) Identify E and write the chemical equation for its reaction with sodium bicarbonate.

Answer (5 marks)

(a) A is ethanol: $CH_3–CH_2–OH$

(b) $2CH_3–CH_2–OH + 2Na \rightarrow 2CH_3–CH_2–ONa + H_2\uparrow$

B is hydrogen gas (the other product is sodium ethoxide).

(c) $CH_3–CH_2–OH \xrightarrow{\text{(conc. } H_2SO_4,\ 170\ ^\circ C)} CH_2=CH_2 + H_2O$

C is ethene. Concentrated sulphuric acid acts as a dehydrating agent (removes a molecule of water).

(d) $CH_2=CH_2 + H_2 \xrightarrow{(Ni)} CH_3–CH_3$

D is ethane; the reaction is an addition reaction (hydrogenation).

(e) E is ethanoic acid (acetic acid), CH_3COOH.

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2\uparrow$

Marking: (a) Ethanol with structural formula – 1 mark · (b) Equation and hydrogen – 1 mark · (c) Equation and dehydrating agent – 1 mark · (d) Ethane and addition reaction – 1 mark · (e) Ethanoic acid and equation – 1 mark

Examiner tip: Write the reaction conditions (170 °C, conc. H_2SO_4; Ni catalyst) on the arrow – they carry ½ mark each.

All the best for your exam!