



Sri Lanka Junior Chemistry Olympiad

2025



Answer ALL questions
minutes

Number of Pages 11

Time: 1 hours and 30

Composition: **30 Multiple Choice Questions**

- Should indicate all your answers in the answer boxes provided to you.
- Select the best answer out of the five choices for each question and mark a cross using a **carbon pen** (blue/black) as shown below.

17.	(a)	(b)	(c)	(d)
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- Mark only **one answer** to each question. (Marks will not be given for marking more than one answer.)
- Clearly write your **index number** on the top right-hand corner of the answer sheet.

Calculators (scientific and normal) are allowed, but any other electronic devices (smart watches) are not allowed.

Physical Constants

Gas Constant $8.314 \text{ J mol}^{-1} \text{ K}^{-1}$	Avogadro Number $6.022 \times 10^{23} \text{ mol}^{-1}$	$0 \text{ }^\circ\text{C} = 273 \text{ K}$ $1 \text{ atm} = 760 \text{ mm Hg} = 1.013 \text{ bar}$
Plank constant $6.6 \times 10^{-34} \text{ m}^2 \text{ kg s}^{-1}$	Standard temperature and pressure: 273 K and 100 kPa	

1. Sucrose ($C_{12}H_{22}O_{11}$) or table sugar is a carbohydrate that occurs naturally in every fruit and vegetable. One mole of sucrose contains how many grams of sucrose? (Relative molar masses; C = 12, O = 16, H = 1)
- (a) 320 g
(b) 342 g
(c) 350 g
(d) 362 g
2. Solute Y was dissolved in water (20 cm^3), and its concentration was 0.4 mol dm^{-3} . It was shaken with octane (30 cm^3), and it was found that 0.002 mol of Y was transferred to the organic layer. The distribution coefficient is the ratio of the concentration of Y in the organic phase to the concentration of Y remaining in the aqueous phase. The distribution coefficient of Y in between octane/water is,
- (a) 0.34
(b) 0.22
(c) 0.54
(d) 0.44
3. Superphosphate fertilizer can be produced by reacting the mineral apatite with sulfuric acid. The reaction between apatite ($Ca_5(PO_4)_3F$) and sulfuric acid is represented
- $$2 Ca_5(PO_4)_3F + x H_2SO_4 \rightarrow y Ca(H_2PO_4)_2 + 7 CaSO_4 + z HF$$
- Stoichiometric coefficients x, y, and z, respectively are
- (a) 5, 2, 2 (b) 7, 3, 2 (c) 2, 3, 4 (d) 4, 3, 2
4. A 10.00 cm^3 portion of Na_2CO_3 base was titrated with 0.10 mol dm^{-3} HCl acid in the presence of phenolphthalein as the indicator. The volume of HCl consumed to reach the endpoint is 20.00 cm^3 . The stoichiometry of the reaction is 1:1. Calculate the concentration of Na_2CO_3 .
- (a) 0.10 mol dm^{-3}
(b) 0.20 mol dm^{-3}
(c) 0.05 mol dm^{-3}
(d) 0.40 mol dm^{-3}

9. Parts per million (ppm) is a unit typically used to express the concentration of a substance in a solution or mixture. For example, a mass fraction of 1 ppm is equivalent to 1 g of solute per million (10^6) grams of solution or 1 mg of solute per 1 kg of solution. A solution is made by dissolving 358.4 mg of iodine in 0.2500 dm^3 of ethanol (the density of ethanol is $0.7893 \text{ kg dm}^{-3}$). What is the mass fraction of iodine in this solution in ppm?
- 1120 ppm
 - 1422 ppm
 - 1534 ppm
 - 1816 ppm
10. The concentration of a coloured compound can be calculated by measuring the property known as absorbance. The absorbance of the analyte is directly proportional to its concentration. Which of the following statement is true?
- The absorbance could be increased by a factor of one half when the concentration of the analyte is increased by a factor of two
 - The absorbance could be increased by a factor of four when the concentration of the analyte is increased by a factor of two
 - The absorbance could be increased by a factor of two when the concentration of the analyte is increased by a factor of two
 - The absorbance could be increased by a factor of three when the concentration of the analyte is increased by a factor of two
11. Diet cola drinks have a pH of about 3.0, while milk has a pH of about 7.0. How many times greater is the H^+ concentration in diet cola than in milk?
pH is defined by the relationship, $\text{pH} = -\log_{10}[\text{H}^+]$ where $[\text{H}^+]$ is the concentration of hydrogen ions in mol dm^{-3} . This relationship can be transformed to $[\text{H}^+] = 10^{-\text{pH}}$.
- 1,000 times higher in diet cola than in milk
 - 0.43 times higher in diet cola than in milk
 - 2.3 times higher in diet cola than in milk
 - 10,000 times higher in diet cola than in milk
12. Which of the following solutions is acidic?
 $[\text{H}^+] \times [\text{OH}^-] = 10^{-14} \text{ M}^2$
- $[\text{OH}^-] = 1.0 \times 10^{-10} \text{ M}$
 - $[\text{H}^+] < 1.0 \times 10^{-7} \text{ M}$
 - $[\text{OH}^-] > 1.0 \times 10^{-7} \text{ M}$
 - $[\text{OH}^-] = 1.0 \times 10^{-7} \text{ M}$

13. Disodium phosphate is a chemical added to foods, cosmetics, and other products as a preservative and a flavor enhancer. In its' formula,
- I. for every phosphorus there are two sodium atoms
 - II. for every sodium, there are two oxygen atoms
 - III. for every hydrogen, there are two sodium atoms

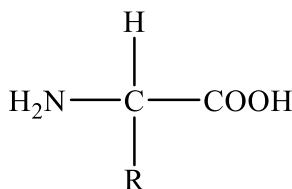
The formula of disodium phosphate is,

- (a) NaH_2PO_2 (b) Na_2HPO_4 (c) NaHPO_2 (d) $\text{Na}_2\text{H}_2\text{PO}_4$

14. Two beakers contain the same amount of magnesium. Hydrochloric acid volume, $V \text{ cm}^3$ was added into beaker 1 and the same volume of nitric acid was added in to beaker 2. Both acids have the same concentration. What observation would you expect to see?

- (a) The acids do not react with magnesium. Therefore, no reaction is observed
- (b) Same amount of hydrogen bubbles will evolve from both beakers as the concentration and the volume of the two acids are same
- (c) More hydrogen bubbles will evolve from beaker 1 as hydrochloric acid can give more H^+ to the medium compared to nitric acid
- (d) More hydrogen bubbles will evolve from beaker 2 as nitric acid can give more H^+ to the medium compared to hydrochloric acid

15. Below is the structure of a typical amino acid molecule. "R" represents a group containing both carbon and hydrogen.



Some examples of amino acids are given below.

Glutamine; $\text{R} = \text{CH}_2\text{CH}_2\text{CONH}_2$

Aspartic acid; $\text{R} = \text{CH}_2\text{COOH}$

Valine; $\text{R} = \text{CH}(\text{CH}_3)_2$

Lysine; $\text{R} = (\text{CH}_2)_4\text{NH}_2$

Glycine; $\text{R} = \text{CH}_2\text{NH}_2$

Among the above listed amino acids which pair has the molecular formula of $\text{C}_4\text{H}_7\text{O}_4\text{N}$ and $\text{C}_6\text{H}_{14}\text{O}_2\text{N}_2$, respectively.

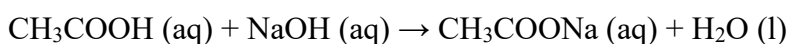
- (a) Aspartic acid and Glycine
- (b) Lysine and Glycine
- (c) Aspartic acid and Lysine
- (d) Aspartic acid and Valine

16. *Tennessine* is a synthetic chemical element with the symbol Ts and atomic number 117. It has two known isotopes, Ts-293 and Ts-294. Select the correct statement/statements.

- I. The number of protons of both Ts-293 and Ts-294 is 117.
- II. The number of neutrons of both Ts-293 and Ts-294 is 117.
- III. The number of neutrons in Ts-294 is 177.
- IV. The number of protons in Ts-293 is 176.

(a) I only (b) IV only (c) I and II (d) I and III

17. A particular brand of vinegar contains a known concentration of acetic acid, also known as ethanoic acid, (CH₃COOH). 10.0 cm³ of this vinegar was diluted with water (1:10 ratio). 10.0 cm³ from this diluted solution was neutralized using 14.0 cm³ of 0.10 mol dm⁻³ NaOH solution. Neutralization reaction is as follows:



The original concentration of the acetic acid in the vinegar is,

- (a) 1.4 mol dm⁻³
- (b) 1.0 mol dm⁻³
- (c) 0.14 mol dm⁻³
- (d) 0.10 mol dm⁻³

18. The polarity of a bond depends on the electronegativity difference between the two atoms sharing the bonding electrons. The electronegativities of some elements are shown in the following table.

Element	H	C	N	O	F	Cl	I
Electronegativity	2.24	2.55	3.04	3.44	3.98	3.16	2.66

Select the answer which lists the covalent bonds in the order of increasing polarity.

- (a) C—O, C—I, C—N, H—O
- (b) C—I, C—N, C—O, H—O
- (c) H—O, C—I, C—N, C—O
- (d) C—O, C—N, H—O, C—I

19. An electrochemical cell is developed using zinc, copper, and dil. H₂SO₄ acid. When the two electrodes zinc and copper are connected through a wire to a LED, the bulb lights up. The decreasing order of reactivity of the metals is given as Zn > Cu. In this cell;

- (a) Weight of the zinc metal decreases with time as it reduces and acts as the cathode.
- (b) Electron flow is from the copper electrode to the zinc electrode.
- (c) Hydrogen bubbles evolve at the copper electrode as it acts as the anode.
- (d) The zinc rod is the anode and the copper rod is the cathode as zinc is more reactive than copper.

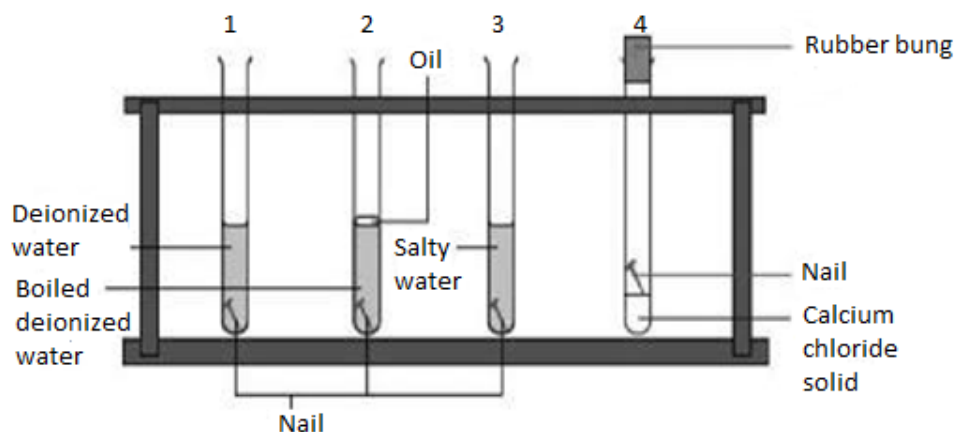
20. Microplastics are tiny plastic particles, typically in μm range, that pose significant environmental and health risks. Removal of microplastics from water is difficult from a normal filter. A scientist has developed a filter to remove microplastics using a material known as biochar with 80% efficiency. A water sample initially contains **450 particles/L** of microplastics. Calculate the number of microplastic particles in 500 mL of filtered water.

- (a) 45 (b) 90 (c) 180 (d) 360

21. The carat is a unit of mass equal to 0.2 g, which is used for weighing gemstones. The gemstone “garnet” has the molecular formula of $\text{Mg}_3\text{Al}_2(\text{SiO}_4)_3$. How many silicon (Si) atoms would be present in 2 carats of garnet? (Molar mass of $\text{Mg}_3\text{Al}_2(\text{SiO}_4)_3$ is 403.13 g mol^{-1}). (Relative atomic masses of O -16; Mg - 24; Al - 27; Si - 28)

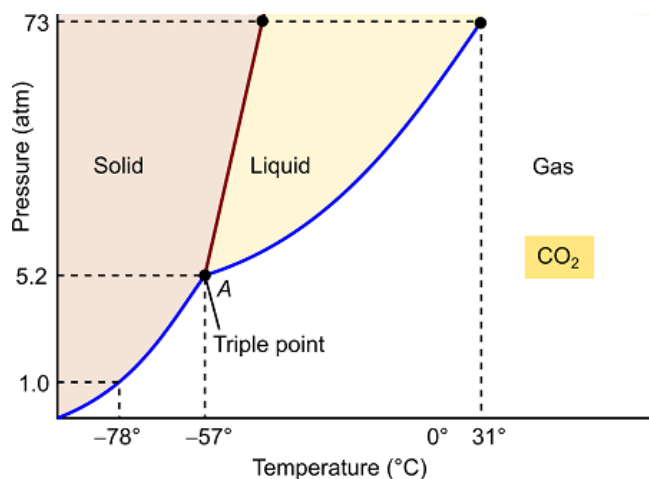
- (a) 1.2×10^{23} (b) 6.0×10^{23} (c) 1.2×10^{20} (d) 6.0×10^{20}

22. In the experiment shown below, students exposed iron nails to different conditions to find out what causes iron to rust. These were left for 4 days before being re-examined. Which statement regarding the experiment is incorrect?



- (a) Nail in tube 1 rusts as it is exposed both to air and water
 (b) Nail in tube 2 does not rust as it is not exposed to air
 (c) Nail in tube 3 rusts as it is exposed to air and water
 (d) Nail in tube 4 rusts as it is exposed to moisture, air and salt

23. A magician is using dry-ice (solid CO_2) to form a white fume (gaseous CO_2) in a beaker at the room temperature and pressure. According to the phase diagram of CO_2 , which statement explains this observation.



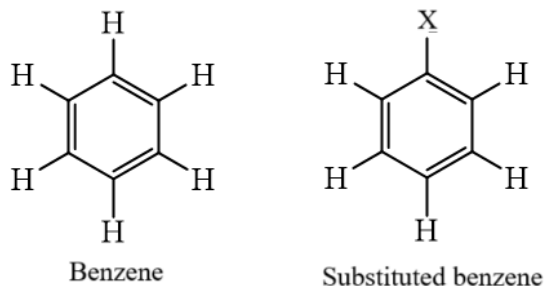
- (a) At room temperature CO_2 exists as a fluid
 (b) At atmospheric pressure only solid CO_2 can exist in equilibrium with gaseous CO_2
 (c) At room temperature CO_2 exists only as a gas
 (d) At 5.2 atm pressure and -57°C temperature, all 3 phases of CO_2 are in equilibrium
24. Acid-base indicators are compounds that change colour depending on the pH of the medium. Phenolphthalein and methyl orange are two acid-base indicators. Colours of the indicators at different pH values are given below:

	pH range	Colour
Methyl orange	0-3	Red
	3-5	Orange
	5-14	Yellow
Phenolphthalein	0-8	Colourless
	8-14	Pink

An acid solution ($\text{pH} = 2$) is added with both indicators methyl orange and phenolphthalein. A base is added to this beaker gradually, until the acid is neutralized and the base ($\text{pH} = 10$) remains in the medium. What colours will be observed during the course of the reaction?

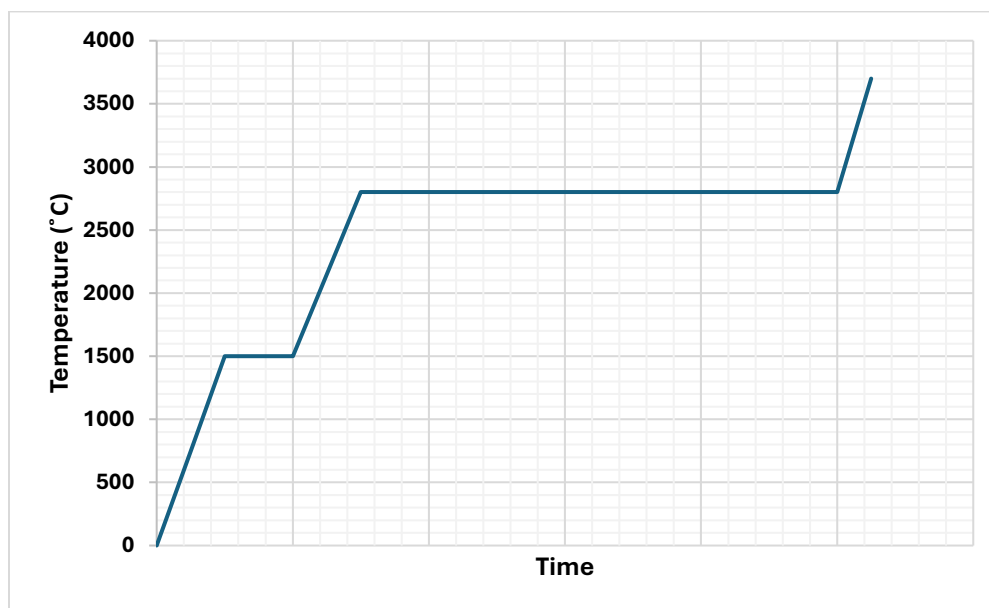
- (a) Red, Orange, Yellow, light Orange
 (b) Red, Yellow, Colourless, Pink
 (c) Orange, Yellow, Colourless, light Orange
 (d) Red, Yellow, Orange, Pink

25. Benzene shown below has a molecular formula, C_6H_6 . The substitution (replacement) of hydrogen atoms with different atoms/groups (X) results substituted benzene structures. If any three hydrogen atoms of a benzene are substituted (replaced) with two Br atoms and one F atom, how many different substituted benzene structures can be drawn?



- (a) 2 (b) 3 (c) 4 (d) 6

26. The figure below shows the effect of temperature on the metal, iron.



Which of the following cannot be observed from the graph?

- i. Iron metal melts around 1500 °C.
- ii. Temperature of the sample remains constant during the vaporization.
- iii. Specific heat capacity of iron differs from solid to liquid to vapour.

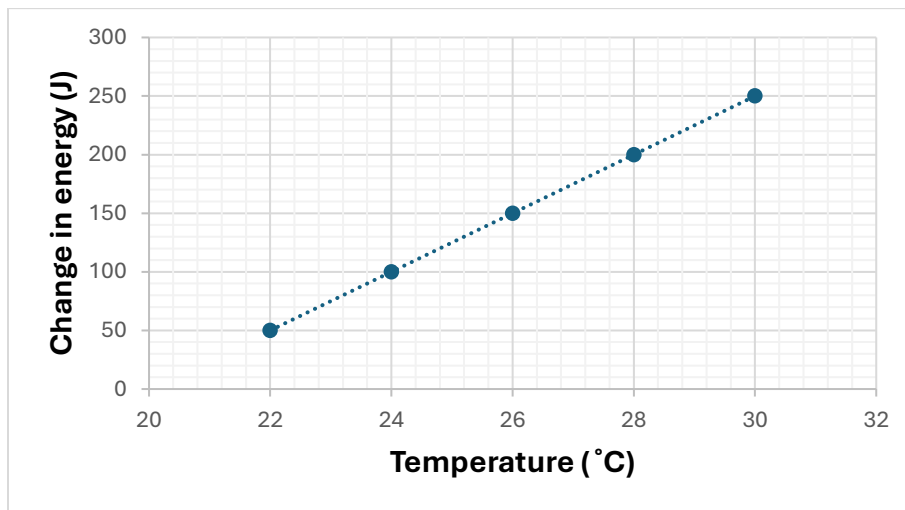
- (a) I and II only
- (b) I and III only
- (c) II and III only
- (d) All of the above can be observed from the graph

27. Starch gives a blue colour with iodine. Amylase is an enzyme that can break down the structure of starch. When the starch structure is broken down, it doesn't give a blue colour with iodine.

The same concentration of starch was mixed with iodine in different test tubes. Then amylase with different concentrations (1, 4, 8, and 10 %) was added into these test tubes with the same starch concentration. The time taken to diminish the blue colour was reported as 10, 2, 8, and 4 seconds, but the researcher missed the order. Which could be the correct order.

- (a) 10, 8, 4, 2
- (b) 2, 4, 8, 10
- (c) 8, 10, 4, 2
- (d) 10, 8, 2, 4

28. To determine the specific heat capacity of iron, a student measures the temperature of a 400 g block of iron and the change in its internal energy. The results are shown in the graph given below. The specific heat capacity of iron is,

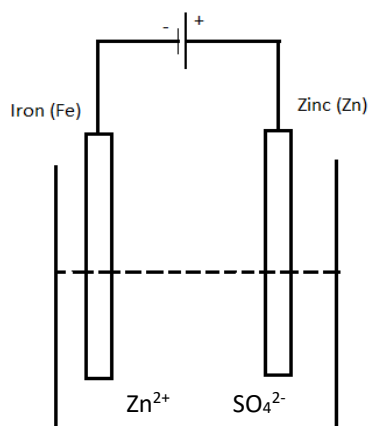


- (a) $10.4 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
- (b) $0.0625 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
- (c) $5.68 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
- (d) $62.5 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$

29. Enzymes are catalysts in biological systems, primarily proteins. Their activity is dependent on factors like temperature, pH and ionic strength. Proteins tend to change the 3D geometry at temperatures higher than 45 °C. The reaction rate is proportional to the enzyme concentration when other parameters are kept constant. Which of the following is true?

- (a) Reaction rate will increase when the enzyme concentration is doubled, and the temperature is increased to 47 °C
- (b) Reaction rate will increase when the enzyme concentration is doubled, and temperature is maintained at 27 °C
- (c) Reaction rate will increase when the enzyme concentration is doubled, and temperature is decreased to 10 °C
- (d) There will be no change in the reaction rate with the increase in the enzyme concentration

30. Given below is an electrochemical cell that is similar to the one used in electroplating. Which of the following statement is correct about the cell.



- (a) Fe acts as the cathode and its weight increases as the Zn layer deposits
- (b) Fe acts as the cathode and its weight decreases as it oxidizes
- (c) Zinc act as the cathode and its weight decreases as it oxidizes
- (d) Zinc act as the anode and its weight increases as the Fe layer deposits

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