இலங்கை பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

02 E I

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கல்விப் பொதுத் தராதரப்பத்திர(உயர் தர)ப் பரீட்சை, 2003 ஏப்பிரல்
General Certificate of Education (Advanced Level) Examination, April 2003

රසායන විද්‍යාව I
இரசாயனவியல் I
Chemistry I

පැ දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Important:

(i) *This question paper consists of* 08 *pages.*

(ii) *Answer all the questions.*

(iii) *Use of calculators is not allowed.*

(iv) *Write your Index Number in the space provided in the answer sheet and then indicate your Index Number by shading the appropriate numbers in the grid immediatly below it.*

(v) *In each of the questions* 1 *to* 60, *pick one of the alternatives:* (1), (2), (3), (4), (5) *which is correct or most appropriate and shade its number on the answer sheet in accordance with the instructions given therein.*

Universal gas constant, $R = 8{\cdot}314\ J\ K^{-1}\ mol^{-1}$
Avogadro Constant $N_A = 6{\cdot}022 \times 10^{23}\ mol^{-1}$

1. The valencies of an element with electronic configuration ... $ns^2\ np^4$ can be
(1) 1 and 4. (2) 2 and 1. (3) 2 and 5. (4) 2 and 6. (5) 5 and 6.

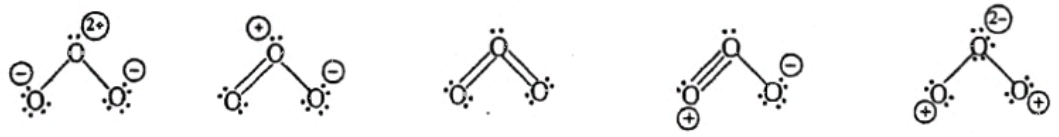
2. The molecule that has a shape similar to that of ion ICl_2^- is
(1) SO_2 (2) O_3 (3) $BeCl_2$ (4) H_2S (5) HOCl

3. The gas X_n dissociates according to the equation,

$$X_n \rightleftharpoons nX.$$

When 10% of the gas is dissociated, at constant temperature and volume, the pressure increases by 20%. Assuming ideal gas behaviour, the value of n should be
(1) 2 (2) 3 (3) 4 (4) 5 (5) 6

4. The most acceptable Lewis structure for the O_3 molecule is



(1) (2) (3) (4) (5)

5. The element Z has the electronic configuration ... $ns^2\ np^3$.
The electronic configuration of the element that forms the most covalent bond with Z is
(1) ... $ns^2\ np^1$ (2) ... $ns^2\ np^2$ (3) ... $ns^2\ np^3$ (4) ... $ns^2\ np^4$ (5) ... $ns^2\ np^5$

6. Which of the following d-block elements is likely to have the lowest melting point?
(1) Ti (2) Cr (3) Co (4) Mn (5) V

7. What volume (in cm^3) of dilute HNO_3 solution of density 1.10 g cm^{-3} and 20% HNO_3 by mass contains 10 g of HNO_3?
(1) 6 (2) 15 (3) 23 (4) 45 (5) 55

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8. Which one of the following statements, is not true regarding 3d transition elements?
   (1) The highest positive oxidation state is shown by Mn.
   (2) No two ions of these elements will have the same electronic configuration.
   (3) Compounds containing Ti^{4+} and Cu^{+} are white in colour.
   (4) Oxides of these elements have catalytic properties.
   (5) Some of the oxides of these elements are amphoteric.

9. Which of the following statements are not true regarding the atomic spectrum of hydrogen?
   (a) The transition from n = 4 to n = 2 corresponds to H_β line.
   (b) The energy difference between $n = \infty$ and n = 1 levels is the ionization energy of hydrogen.
   (c) Each line in the spectrum corresponds to an energy level of the H-atom.
   (d) The energy difference between n = 2 and n = 1 levels is smaller than the energy difference between n = 3 and n = 2 levels.

   (1) (a) and (b) (2) (b) and (c) (3) (c) and (d) (4) (a) and (c) (5) (b), (c) and (d)

10. The order of filling electrons into energy levels of the atoms in the fourth period of the periodic table is
    (1) 4s, 4p, 4d. (2) 4s, 4d, 4p. (3) 4s, 3d, 4p. (4) 3s, 4p, 4d. (5) 3d, 4s, 4p.

11. Crystalline sodium carbonate has the formula $Na_2CO_3.10H_2O$. What is the mass of anhydrous sodium carbonate required to make up 2·5 litres of 4·0 mol dm^{-3} solution? (H = 1; C = 12; O = 16; Na = 23)
    (1) 106 g (2) 286 g (3) 530 g (4) 1060 g (5) 2860 g

12. A student intends to titrate 25·00 cm^3 of solution Y with solution X. Which of the following washing procedures is most suitable in preparation for this titration?

	Washing burette with	Washing titration flask with
(1)	distilled water	solution Y
(2)	solution X	solution Y
(3)	solution X	distilled water
(4)	solution Y	distilled water followed by solution X
(5)	distilled water followed by solution X	distilled water

13. When 25·00 cm^3 of a Na_2CO_3 solution is titrated with an HCl solution (in burette), using phenolphthalein as indicator, the end point was observed at 25·00 cm^3.
    When the titration was repeated using 25·00 cm^3 of the same HCl solution and the same Na_2CO_3 solution (in burette) and using the same indicator, what will be the observed end point?
    (1) 25·00 cm^3 (2) 12·50 cm^3 (3) 50·00 cm^3
    (4) 37·50 cm^3 (5) an end point cannot be obtained.

14. A sample of water is contaminated with ions of a metal. Addition of NaOH solution to the water sample gives a light green gelatinous precipitate which forms a dark blue solution when ammonia is added.
    On passing H_2S through an acidified water sample, no precipitate is obtained.
    The metal ion in the water sample is
    (1) Ni^{2+} (2) Cu^{2+} (3) Hg^{2+} (4) Cr^{3+} (5) Sn^{2+}

15. Which of the following pairs of gases can be dried using conc. H_2SO_4 as well as anhydrous $CaCl_2$?
    (1) NH_3 and SO_2 (2) SO_2 and F_2 (3) Cl_2 and HCl
    (4) Cl_2 and F_2 (5) HCl and SO_2

16. Which of the following pairs of solutions will evolve the largest amount of heat when 25·0 cm^3 of each solution are mixed?
    (1) 2·0 mol dm^{-3} NaOH and 1·0 mol dm^{-3} H_2SO_4
    (2) 2·0 mol dm^{-3} NaOH and 2·0 mol dm^{-3} CH_3COOH
    (3) 1·0 mol dm^{-3} $Ba(OH)_2$ and 1·0 mol dm^{-3} H_2SO_4
    (4) 2·0 mol dm^{-3} NH_4OH and 1·0 mol dm^{-3} H_2SO_4
    (5) 2·0 mol dm^{-3} NaOH and 1·0 mol dm^{-3} oxalic acid

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Select which of the following statements are true regarding the halogen acids?

(a) HF has the highest boiling point.
(b) HF is the strongest acid in aqueous solution.
(c) HCl has the lowest boiling point.
(d) Passing F_2 into HCl, HBr and HI solutions will convert them to HF solutions.

(1) (a) and (b) (2) (b) and (c) (3) (b) and (d)
(4) (a), (c) and (d) (5) (b), (c) and (d)

18. Atoms of four different elements A, B, C and D have electronegativities as follows

A = 3·8, B = 3·3, C = 2·8, D = 1·3

If these elements form the molecules AB, AD, BD and AC, the order of increasing covalent character in these molecules is

(1) BD < AC < AB < AD (2) AD < BD < AC < AB
(3) AB < AC < BD < AD (4) AC < BD < AB < AD
(5) AD < BD < AB < AC

19. Noble gas xenon forms a covalent compound XeF_4. The likely geometry of XeF_4 is

(1) tetrahedral. (2) square planar. (3) octahedral. (4) trigonal pyramid. (5) see-saw.

20. Which one of the following is true with regard to the order of acid strength of H_2S, H_2Se and HBr?

(1) $H_2Se < H_2S < HBr$ (2) $H_2S < H_2Se < HBr$
(3) $HBr < H_2S < H_2Se$ (4) $H_2S < HBr < H_2Se$
(5) $HBr < H_2Se < H_2S$

21. A sample of neon gas was placed in a rigid container at 30 °C. The container was then heated until the pressure inside the container was trebled. The temperature of the neon gas would then be

(1) 90 °C (2) 90 K (3) 363 K (4) 636 °C (5) 909 °C

22. Under which of the following conditions will the behaviour of a real gas mostly approach that of an ideal gas?

	Temperature / K	Pressure/10^3 Pa
(1)	78	50 000
(2)	78	5
(3)	1000	100 000
(4)	1000	5
(5)	300	100

23. The ionic product, K_w, of water at 80 °C is $1{\cdot}0 \times 10^{-12}$ mol^2 dm^{-6}. Under these conditions, the pH of a 10^{-9} mol dm^{-3} NaOH solution is

(1) 3 (2) 6 (3) 7 (4) 9 (5) 12

24. Xenon is one of the least abundant inert gases in air. The amount of xenon in air is 0·076 parts per million (0·076 ppm) by volume. What volume of xenon gas, in dm^3, can be isolated from a given 1000 km^3 sample of air at the same temperature and pressure?

(1) 76 (2) 76×10^3 (3) 76×10^6 (4) 76×10^9 (5) 76×10^{12}

25. For the reaction

$$HCl(g) \longrightarrow H(g) + Cl(g)$$

the enthalpy change, ΔH, is 431 kJ mol^{-1}.
For HCl(g) this enthalpy change is its

(1) atomisation enthalpy. (2) bond enthalpy.
(3) enthalpy of vaporisation. (4) sublimation enthalpy.
(5) negative(-) value of the enthalpy of formation.

26. Assuming ideal gas behaviour, which one of the following gaseous subtances will have the highest volume per unit mass at the same temperature and pressure?

(H = 1; C = 12; O = 16; F = 19; S = 32)

(1) ethane, C_2H_6 (2) oxygen, O_2 (3) fluorine, F_2
(4) hydrogen sulphide, H_2S (5) ethene, C_2H_4

[see page four

27. H_2B is a strong acid which completely dissociates to $H^+(aq)$ and $HB^-(aq)$ in aqueous solution. $HB^-(aq)$ undergoes partial dissociation in water. When 0·5 mol of H_2B is dissolved in distilled water to make 500·0 cm^3 of aqueous solution, the amount of $H^+(aq)$ is found to be 0·95 mol. The concentration of $HB^-(aq)$ in solution in units of mol dm^{-3} is

(1) 0·05 (2) 0·10 (3) 0·45 (4) 0·95 (5) 10·05

28. 0·6 mole of zinc nitrate and 0·6 mole of iron (III) sulphate are dissolved in water to give a solution with a total volume of 2 dm^3. Which one of the following has a concentration of 0·3 mol dm^{-3}?

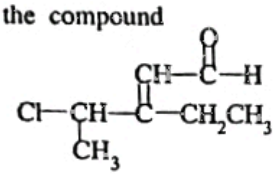
(1) sulphate ions
(2) negatively charged ions
(3) positively charged ions
(4) zinc ions
(5) nitrate ions

29. What is the ratio of the mass percentages of carbon to that of chlorine in the compound $C_6H_{12}Cl_2$?

(C = 12; H = 1; Cl = 35·5)

(1) 6 : 2 (2) 6 : 1 (3) 1 : 3 (4) 1 : 1 (5) 1 : 6

30. The IUPAC name for the compound



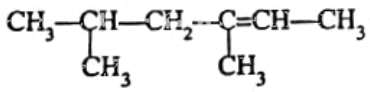
is,

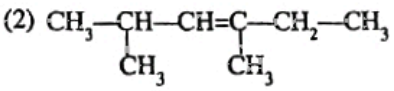
(1) 4-chloro-3-ethylpental-2-ene
(2) 4-chloro-3-ethylpent-2-enal
(3) 3-ethyl-4-chloropent-2-enal
(4) 3-ethyl-2-chloro-4-formyl-but-3-ene
(5) 3-ethyl-2-chloro-5-oxo-pent-3-ene

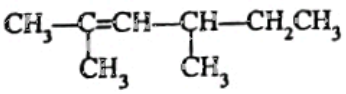
31. Ammoniacal silver nitrate can be used to distinguish aldehydes from ketones because

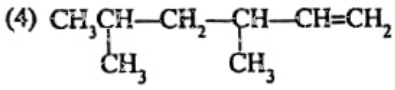
(1) aldehydes are easier to reduce than ketones.
(2) aldehydes are easier to oxidise than ketones.
(3) aldehydes react with ammonia faster than ketones.
(4) aldehydes react slower with ammonia than ketones.
(5) silver nitrate acts as a reducing agent in the presence of aldehydes but not ketones.

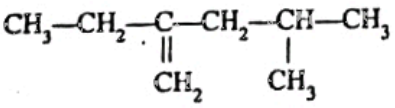
32. Which of the following compounds would yield 2-bromo-2, 4-dimethylhexane as the main product of reaction with HBr?

(1) 

(2) 

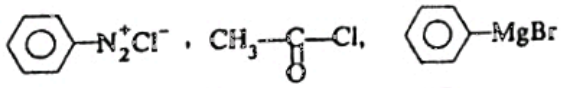
(3) 

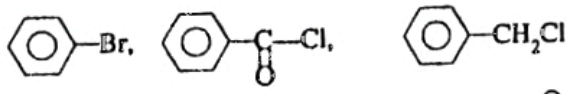
(4) 

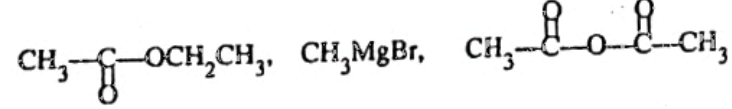
(5) 

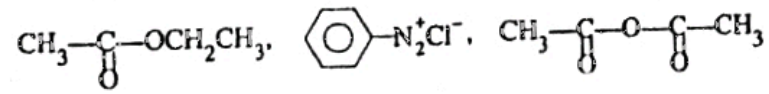
33. One of the following groups consists of compounds, all of which react rapidly with water at room temperature. Which is this group?

(1) $CHCl_3$, CH_3Br, CH_3F

(2) 

(3) 

(4) 

(5) 

[see page five

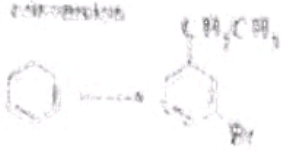
34. Consider the following reaction scheme

$$HC{\equiv}CH + BrCH_2CH_2CH_3 \xrightarrow{Na} A \xrightarrow{Sn^{2+}/conc.\ HCl} B$$

compound **B** is

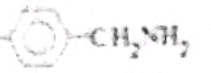
(1) pentanal (2) 2-bromopentanal (3) 2-pentanone
(4) 1-bromo-2-pentanone (5) 2-bromo-pent-1-ene

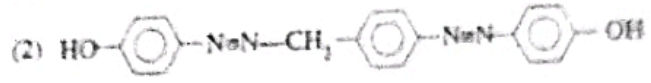
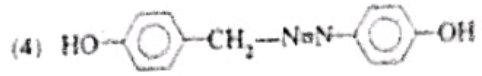
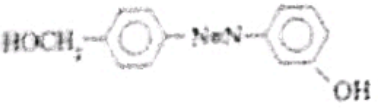
35. Consider the following conversion



Which set of reagents (in the given order) would be appropriate to bring about the conversion of Benzene to meta-bromoethyl benzene?

(1) CH_3COCl, $AlCl_3$, $Br_2/FeBr_3$, $LiAlH_4$
(2) CH_3COCl, $AlCl_3$, $Br_2/FeBr_3$, $Zn(Hg)/HCl$
(3) $Br_2/FeBr_3$, $CH_3COCl/AlCl_3$, $Zn(Hg)/HCl$
(4) $CH_3CH_2Cl/AlCl_3$, $Br_2/FeBr_3$
(5) $Br_2/FeBr_3$, $CH_3CH_2Cl/AlCl_3$

36. The compound  was reacted with nitrous acid at 0-5°C, and the resulting solution was added to a solution of phenol in aqueous NaOH at 0-5°C. The product obtained has the structure

(1) 
(2) 
(3) 
(4) 
(5) 

37. Consider the following compounds


(A)

NH_3
(B)

$CH_3CH_2NH_2$
(C)

The correct order of basicity of these compounds is

(1) A > B > C (2) B > C > A. (3) C > B > A. (4) A > C > B. (5) C > A > B.

Instructions for questions No. 38 to 49

For each of the questions 38 to 49, four responses (*a*), (*b*), (*c*) and (*d*) are given. One or more of these is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

(1) if only (*a*) and (*b*) are correct.
(2) if only (*b*) and (*c*) are correct.
(3) if only (*c*) and (*d*) are correct.
(4) if only (*d*) and (*a*) are correct.
(5) if **any other** number or combination of responses is/are correct.

Summary of above Instructions				
(1)	(2)	(3)	(4)	(5)
Only (*a*) and (*b*) correct	Only (*b*) and (*c*) correct	Only (*c*) and (*d*) correct	Only (*d*) and (*a*) correct	**any other** number or combination of responses correct

38. Propanone could be distinguished from propan-2-ol by

(*a*) heating with acidified dichromate. (*b*) treating with $ZnCl_2/HCl$.
(*c*) using Fehling's test. (*d*) treating with Na.

[see page six

39. Using your knowledge of the mechanism of the reaction of Cl_2 with methane, select which of the following statements is/are true.
   (*a*) Reaction of Cl_2 with ethane takes place at room temperature in the absence of light.
   (*b*) Reaction of Cl_2 with ethane produces a small amount of butane.
   (*c*) Reaction of Cl_2 with ethane produces HCl.
   (*d*) Reaction of Cl_2 with ethane produces propane.

40. According to the kinetic molecular theory, the pressure of a given volume of ideal gas increases with temperature due to which of the following reason(s)?
   (*a*) Intermolecular forces become negligible at high temperatures.
   (*b*) The kinetic energy of the molecules at high temperatures is large enough to break up intermolecular attractions.
   (*c*) Energy loss at collisions is much larger at higher temperatures.
   (*d*) In a given time the number of collisions of molecules with the vessel containing the gas increases with increasing temperature.

41. Which of the following statements are applicable to all three elements Zn, Co and Ni?
   (*a*) They all are transition metals.
   (*b*) Their ions form complexes with aqueous ammonia.
   (*c*) Their oxides are highly coloured.
   (*d*) The most stable ion in aqueous solution is the di-positive ion.

42. Which of the following solution(s) will decolorize a solution of I_2 in aqueous KI?
   (*a*) $Na_2S_2O_3$ (*b*) NaOH (*c*) Starch (*d*) H_2O_2

43. Which of the following processes is/are endothermic?
   (*a*) $Na(g) \longrightarrow Na^+(g) + e$ (*b*) $Cl(g) + e \longrightarrow Cl^-(g)$
   (*c*) $Na^+(g) + Cl^-(g) \longrightarrow Na^+Cl^-(s)$ (*d*) $Cl_2(g) \longrightarrow 2Cl\ (g)$

44. Which of the following statements is/are true for an atom of $^{118}_{50}Sn$?
   (*a*) It has 50 electrons.
   (*b*) It has 50 protons.
   (*c*) It has a total number of 118 electrons and protons.
   (*d*) It has 68 neutrons.

45. The reaction

$$2\,NO(g) + 2\,H_2(g) \longrightarrow N_2(g) + 2\,H_2O(g)$$

is second order with respect to NO(g) and first order with respect to $H_2(g)$. Under certain reaction conditions when a mixture of 1 mol of NO(g) and 1 mol of $H_2(g)$ are made to react, the rate of $N_2(g)$ formed initially is 0·02 mol s^{-1}. Under these conditions
   (*a*) the rate of reaction of $H_2(g)$ is 0·02 mol s^{-1}.
   (*b*) the rate of reaction of NO(g) is 0·04 mol s^{-1}.
   (*c*) the rate of reaction of $H_2(g)$ is 0·04 mol s^{-1}.
   (*d*) the rate of reaction of NO(g) is 0·02 mol s^{-1}.

46. Which of the following compounds are isomers of each other?
   (*a*) $CH_3—CH=CH—CH=CH_2$ (*b*) $HC\equiv C—CH_2—CH_2—CH_3$
   (*c*) $CH_3CH=CH—CH_2—CH_3$ (*d*) $CH_3—CH_2—CH_2—CH_2—CH_3$

47. Which of the following elements react(s) separately with both aqueous HCl and aqueous NaOH giving H_2 as one of the products?
   (*a*) Fe (*b*) Al (*c*) Na (*d*) Cu

48. Which of the following statement(s) is/are true regarding the formation of a stable chemical bond?
   (*a*) It involves the overlap of an orbital having one electron with another orbital having one electron.
   (*b*) It involves the overlap of an orbital having two electrons with another orbital having two electrons.
   (*c*) It involves the overlap of an orbital having two electrons with another orbital without any electrons.
   (*d*) Lateral overlap of orbitals produce π-bonds.

[see page seven

49. Which of the following statement(s) regarding the trends in properties of elements in going from left to right along the third period in the Periodic Table is/are true?

(*a*) acidity of oxides increases
(*b*) oxidising ability decreases
(*c*) electro-negativity decreases
(*d*) tendency to form ionic compounds decreases

○ **Instructions for questions No. 50 to 57**

In questions No. 50 to 57, two statements are given in respect of each question.
From the Table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements given for each of the questions and mark appropriately on your answer sheet.

Response	First Statement	Second Statement
(1)	True	True, and correctly explains the first statement.
(2)	True	True, but does not explain the first statement correctly.
(3)	True	False
(4)	False	True
(5)	False	False

	First Statement	Second Statement
50.	Propanone has a higher boiling point than that of propan-2-ol.	The carbon-oxygen double bond in propanone is more polarized than the carbon-oxygen single bond in propan-2-ol.
51.	The rate of a reaction consisting of several steps is determined by the step with the lowest activation energy.	At a given temperature, the rate of a reaction with a lower activation energy will always be faster than another reaction with a higher activation energy.
52.	At 25°C, the $[OH^-]$ of an aqueous HCl solution with pH = 5 is 10^{-9} mol dm^{-3}; $[OH^-]$ decreases to 10^{-10} mol dm^{-3} when this solution is diluted tenfold with distilled water. (K_w of water at 25°C = $1{\cdot}0 \times 10^{-14}$ mol^2 dm^{-6}).	The concentration of OH^- ions in aqueous solutions always decreases when diluted with distilled water.
53.	PCl_5 exists but NCl_5 does not.	The phosphorus atom is larger than the nitrogen atom.
54.	HNO_3 can be reduced but not oxidised.	HNO_3 is one of the strongest oxidising agents.
55.	Sucrose gives a black mass with conc H_2SO_4.	Conc H_2SO_4 is a powerful dehydrating agent.
56.	A mixture of two immiscible liquids always boils at a temperature less than the boiling points of both the pure liquids.	A liquid boils when its vapour pressure equals the external pressure.
57.	In industry, catalysts are used to get more product from a given amount of reactant(s) in a given time.	A good catalyst does not catalyse the reverse reaction.

[see page eight

○ **Read the passage given below and answer questions 58 and 59.**

Properties of Solutions

Concentration, molality, mole fraction and **mole percent** are different ways in which the composition of solutions can be expressed.

Concentration equals the number of moles of solute dissolved per unit volume of solution. It is dependent on the temperature.

Molality equals the number of moles of solute dissolved per unit mass of the solvent.

Extensive properties are those properties which **depend** on the extent of the system. Examples for these are volume and enthalpy. We refer to the enthalpy per mole as molar enthalpy.

Intensive properties are those properties which **do not depend** on the extent of the system. Examples for these are concentration, molality, molar volume and temperature. Since temperature is an intensive property, we do not have a property referred to as molar temperature.

58. Which one of the following statements is **incorrect**?
   (1) Molality of a solution of glucose in water at 20 °C is equal to the molality of the same solution at 30 °C.
   (2) Molar enthalpy is an intensive property.
   (3) Pressure is an intensive property.
   (4) Concentration of a NaOH solution containing 0·1 moles of NaOH dissolved in 1 dm^3 of water is 0·1 mol dm^{-3}.
   (5) Concentration of a solution depends on the temperature since the volume of the solution depends on the temperature.

59. Which one of the following statements is correct?
   (1) Concentration is an extensive property.
   (2) Mole percent is equal to the molality multiplied by 100.
   (3) Mole fraction of glucose in an aqueous solution is dependent on the pressure.
   (4) Molality of a Na_2CO_3 solution containing 0·1 moles of Na_2CO_3 dissolved in 1·0 kg of water is 0·1 mol dm^{-3} provided the density of water is 1 kg dm^{-3}.
   (5) Molality of a solution is independent of the temperature since mass is independent of temperature.

60. When a non-volatile solute is dissolved in a solvent, the vapour pressure exerted by the solvent in the solution is reduced. The boiling point of such a solution is therefore higher than that of the pure solvent. The said lowering of vapour pressure as well as the resultant elevation of boiling point are examples of what are referred to as **colligative properties**.

Colligative properties are defined as those properties which depend on **the number of dissolved particles (such as molecules, atoms and ions)** present in a given mass of solvent but not on their nature or structure.

Based on the above passage and your knowledge of ionic solutions, answer the question given below:-

Which one of the following aqueous solutions will have the highest boiling point if in each case 0·1 mole of solute molecules is dissolved in 1 kilogram of water?

   (1) glucose solution
   (2) oxalic acid solution
   (3) sodium chloride solution
   (4) sucrose solution
   (5) barium hydroxide solution

* * *