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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 1999 අගෝස්තු
கல்விப் பொதுத் தராதரப்பத்திர(உயர் தர)ப் பரீட்சை, 1999 ஒகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 1999

රසායන විද්‍යාව I
இரசாயனவியல் I
Chemistry I

original

02
E | I

පැය දෙකයි /இரண்டு மணித்தியாலம்/ Two hours

Important : This question paper consists of **two** sheets. Put the sheets together in the correct **order of pages** before answering.

*Enter your **Index Number** in the space provided on the answer sheet.*

*Use of calculators is **not** allowed.*

*You should attempt **all** the questions in this paper. For each question there are five responses of which only **one** is correct. When you have selected the response which you consider to be the best answer to a question, mark your response on the answer sheet. Answer easier questions first and leave aside any questions which you find too difficult and come back to them later.*

Universal gas constant (R) = 8·314 J K^{-1} mol^{-1}

N.B. The following abbreviations have been used.

aq = aqueous

C = Celsius or Centigrade or Coulomb

g = gas or gram

l = liquid

mol dm^{-3} = moles per cubic decimetre

s = solid or second

Other abbreviations also follow standard usage.

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1. In which one of the following atoms will the first ionization energy be the highest?
(1) Na (2) Be (3) Ne (4) Xe (5) F

2. In which one of the following atoms will the electronegativity be the highest?
(1) I (2) O (3) C (4) S (5) Si

3. In order to obtain an approximate value for the lattice energy of the hypothetical compound, 'BaF',
(1) the third ionization energy of Ba is necessary.
(2) the second ionization energy of Ba(g) is necessary.
(3) the first ionization energy of F is necessary.
(4) the second ionization energy of F(g) is necessary.
(5) none of the above is necessary.

4. In the valence shell of the Si atom in the $[SiF_6]^{2-}$ anion, there are
(1) 2 electrons. (2) 4 electrons. (3) 6 electrons. (4) 10 electrons. (5) 12 electrons.

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5. Assume that the element of atomic number 25 forms a gaseous cationic species of charge +1. The number of unpaired electrons in this cationic species is
(1) 1. (2) 2. (3) 5. (4) 6. (5) 7.

6. The molecular formula of an organic compound is C_3H_6O. It does not contain the $\diagdown C{=}C{-}O-$ atomic arrangement or the  atomic arrangement. The number of structures possible for this compound is
(1) 2. (2) 3. (3) 4.
(4) 5. (5) none of the above.

7. Which one of the following statements is most likely to be correct?
(1) CH_3OH and CH_3CH_2OH mixtures show positive deviations from Raoult's Law.
(2) $CH_3CH_2COCH_2CH_3$ and $CHBr_3$ mixtures show negative deviations from Raoult's Law.
(3) CH_3CH_2OH and $C_6H_5CH_3$ mixtures show negative deviations from Raoult's Law.
(4) CH_3COOH and D_2O mixtures obey Raoult's Law.
(5) C_6H_6 and $C_6H_5CH_3$ mixtures do not obey Raoult's Law.

8. For the determination of atomic numbers of elements
(1) emission spectra were used.
(2) emission spectra and absorption spectra were used.
(3) X-ray spectra were used.
(4) mass spectrometer was used.
(5) none of the above methods was used.

9. Consider the following compounds.

CH_3COCH_3	$C_6H_5CONH_2$	$CH_3CH{=}CHCH_3$	$C_6H_5CH_3$
(*a*)	(*b*)	(*c*)	(*d*)

Which of the above will be reduced by $LiAlH_4$?
(1) *a* and *b* (2) *c* and *d* (3) *a*, *b* and *c* (4) *b* and *d*. (5) *a* and *d*.

10. The $\frac{e}{m}$ ratio of cathode rays was first shown to be a constant by
(1) Millikan. (2) Faraday. (3) Rutherford.
(4) Chadwick. (5) none of the above.

11. Which one of the following will **not** react with $(CH_3)_2CHMgBr$?
(1) D_2O (2) C_6H_5CHO (3) CH_3COOH
(4) $(CH_3)_2C{=}CH_2$ (5) HCHO

12. P_2O_3 can be oxidized to H_3PO_4 by concentrated nitric acid. In this reaction, nitric acid is reduced to NO_2. The mole ratio, P_2O_3: HNO_3 in this reaction is
(1) 4 : 5. (2) 1 : 4. (3) 5 : 4. (4) 1 : 2. (5) 4 : 1.

13. Which one of the following statements concerning the reaction between Cl_2 gas and hot concentrated KOH is most appropriate?
(1) In this reaction, chlorine undergoes oxidation.
(2) In this reaction, chlorine undergoes reduction.
(3) In this reaction, chlorine does not undergo oxidation or reduction.
(4) In this reaction, chlorine undergoes both oxidation and reduction.
(5) None of the above statements is true.

14. The most suitable metal for the demonstration of the catalytic oxidation of ammonia gas by air in the laboratory is
(1) copper. (2) mercury. (3) gold. (4) platinum. (5) vanadium.

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15. In the production of sulphuric acid
(1) sulphur can be used.
(2) sulphide ores can be used.
(3) hydrogen sulphide can be used.
(4) both 1 and 2 mentioned above can be used.
(5) all of 1, 2 and 3 mentioned above can be used.

16. The concentrations of three HCl solutions are 0·100 mol dm^{-3}, 0·200 mol dm^{-3} and 0·300 mol dm^{-3}. Respectively, 100 cm^3, 200 cm^3 and 300 cm^3 of these solutions were mixed together. The concentration of the resulting solution is
(1) 0·266 mol dm^{-3}.
(2) 0·233 mol dm^{-3}.
(3) 0·216 mol dm^{-3}.
(4) 0·200 mol dm^{-3}.
(5) 0·140 mol dm^{-3}.

17. Which one of the following is very essential for obtaining the maximum economic advantages utilizing the rubber produced in Sri Lanka?
(1) Na_2CO_3 (2) H_2SO_4 (3) S (4) H_2 (5) CO

18. Assume that a piece of material supplied to you is a piece of dry rust. Which one of the following courses of action is most appropriate for showing that the above material could be rust?
(1) Adding aqueous $K_3[Fe(CN)_6]$ to the piece of material.
(2) Adding aqueous ammonia to the piece of material.
(3) Adding aqueous NH_4CNS to the piece of material.
(4) Adding hydrochloric acid and crystals of KCNS to the piece of material.
(5) Adding dilute H_2SO_4 to the piece of material.

19. Which one of the following is **not** useful in increasing the percentage of soluble phosphate obtainable from apatite?
(1) HCl (2) HNO_3 (3) CH_3COOH (4) Na_2CO_3 (5) Mg_2SiO_4

20. Which one of the following species has a shape that shows close similarities to the shape of the ammonia molecule?
(1) SO_3 (2) $SOCl_2$ (3) $COCl_2$ (4) CO_3^{2-} (5) BF_3

21. In respect of the hydroxides of the alkaline earth metals, which one of the following statements is true?
(1) The alkaline nature increases with the atomic number of the metal.
(2) The solubility decreases with the atomic number of the metal.
(3) The alkaline nature first increases and then decreases with the atomic number of the metal.
(4) The solubility first increases and then decreases with the atomic number of the metal.
(5) None of the above concerning the alkaline nature or the solubility is true.

22. Which one of the following compounds requires the minimum mass of oxygen for the complete combustion of one mole of the compound?
(1) ethanol
(2) dimethyl ether
(3) ethanal
(4) ethanoic acid
(5) ethene

23. When aqueous NH_4Cl and aqueous KOH are added to an aqueous solution of CrI_3
(1) a light green precipitate is obtained.
(2) a blue precipitate is obtained.
(3) a pink solution is obtained.
(4) a brown solution is obtained.
(5) a brown precipitate is obtained.

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24. When a saturated aqueous solution of As_2S_3 is in a state of equilibrium with solid As_2S_3, the solubility of As_2S_3 is x mol dm^{-3}. Which one of the following pertaining to this system is true?

(1) $K_{sp} = x^5$

(2) $K_{sp} = x^5$ mol^5 dm^{-15}

(3) $K_{sp} = 36x^5$ mol^5 dm^{-15}

(4) $K_{sp} = 108x^5$

(5) All of the above are false.

25. Which one of the following statements is true?

(1) $K_2Cr_2O_7$ undergoes oxidation by aqueous HI.

(2) $K_2Cr_2O_7$ undergoes reduction by aqueous HI.

(3) $K_2Cr_2O_7$ does not undergo oxidation or reduction by aqueous HI.

(4) K_2CrO_4 undergoes oxidation by aqueous KOH.

(5) K_2CrO_4 undergoes reduction by aqueous KOH.

26. Which one of the statements concerning the equation $PV = \frac{1}{3}mN\overline{c^2}$ is true?

(1) m is the molar mass.

(2) N is the number of moles.

(3) c is the mean velocity of the molecules.

(4) $\overline{c^2}$ is the square of the mean velocity of the molecules.

(5) None of the above statements is true.

27. Which one of the following statements concerning ethanal is most appropriate?

(1) It reacts with $CH_3CH_2NH_2$.

(2) It reacts with aqueous $[Cu(NH_3)_4]^{2+}$.

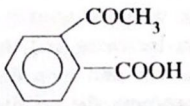
(3) It reacts with aqueous $[Ag(NH_3)_2]^{+}$.

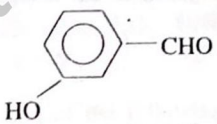
(4) It reacts with only the two cations mentioned above.

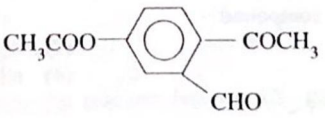
(5) It reacts with all three species mentioned above.

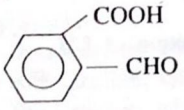
28. The organic compound **P** is insoluble in aqueous Na_2CO_3, but it dissolves in aqueous KOH. **P** gives a precipitate with Brady's reagent and **P** reduces Tollen's reagent. Which one of the following could be **P**?

(1) 

(2) 

(3) 

(4) 

(5) 

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29. The unsaturated organic compound, **Q** reacts with HBr and forms **R**. **R** reacts with an excess of ammonia and forms a primary amine **S**. When treated with $NaNO_2$/ dilute HCl, **S** gives a tertiary alcohol. Which one of the following could be **Q**?

(1) $CH_3CH=CH_2$

(2) $CH_3C(CH_3)=CH_2$

(3) $CH_3CH=CHCH_3$

(4) $CH_3CH_2CH=CH_2$

(5) **Q** could not be any of the above.

30. Which one of the following compounds will exhibit both geometrical isomerism and optical isomerism?

(1) $CHF=CH-CH(CH_3)-CH_3$

(2) $CF_2=CH-CH(CH_3)-CH_2CH_3$

(3) $CHF=CH-CHF-CH_3$

(4) $CHF=CH-CF_2-CH_3$

(5) None of the above will exhibit both geometrical isomerism and optical isomerism.

● **Instructions for questions No. 31 to 40**

For each of the questions **31** to **40** four responses (*a*), (*b*), (*c*), (*d*) are given. One or more of these is/are correct. Select the correct response/responses. Mark a cross (✕) against,

(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 only one response or any other number of responses are correct.

Summary of 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	Only one response or any other number of responses correct

31. Which of the following statements concerning catalysts is/are true?
(*a*) The velocities of gaseous molecules are decreased by some catalysts.
(*b*) The velocities of gaseous molecules are increased by some catalysts.
(*c*) The rates of reactions are decreased by some catalysts.
(*d*) The standard enthalpy changes of reactions are changed by some catalysts.

32. In the electrolysis of an aqueous solution of LiBr using copper electrodes,
(*a*) oxidation takes place at the cathode.
(*b*) lithium is formed at the cathode.
(*c*) an oxidation takes place at the anode.
(*d*) a copper compound may be formed at the anode.

33. Which of the following statements are/is true?
(*a*) A metal which is lower in the electrochemical series is displaced by a metal which is higher than it.
(*b*) A non-metal which is higher in the electrochemical series is displaced by a non-metal which is lower than it.
(*c*) A metal which is higher in the electrochemical series is displaced by a metal which is lower than it.
(*d*) A non-metal which is lower in the electrochemical series is displaced by a non-metal which is higher than it.

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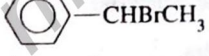
34. $\Delta H^{\ominus}$ for the reaction, $A_2(g) + 3B_2(g) \rightleftharpoons 2AB_3(g)$ is negative. Which of the following statements concerning this reaction are/is true?
(*a*) Increasing the pressure at constant temperature, aids the formation of more of $AB_3(g)$.
(*b*) Decreasing the pressure at constant temperature, aids the formation of more of $AB_3(g)$.
(*c*) Increasing the temperature at constant pressure, aids the formation of more of $AB_3(g)$.
(*d*) Decreasing the temperature at constant pressure, aids the formation of more of $AB_3(g)$.

35. Which of the following statements are/is true?
(*a*) α-particles are attracted towards the atomic nucleus.
(*b*) Cathode rays are not attracted towards the S–pole of a magnet.
(*c*) Positive rays are not attracted towards the N–pole of a magnet.
(*d*) The velocity of α-rays is greater than the velocity of X-rays.

36. Which of the following statements concerning the process of the formation of the bond between BF_3 and $N(CH_3)_3$ are/is true?
(*a*) It could be assumed that initially an electron is temporarily transferred from the N atom to the B atom.
(*b*) It could be assumed that initially an electron is temporarily transferred from the B atom to the N atom.
(*c*) The B atom supplies a pair of electrons for the formation of the bond.
(*d*) The N atom supplies a pair of electrons for the formation of the bond.

37. For the manufacture of iron
(*a*) the iron ore, haematite can be used.
(*b*) limestone is necessary.
(*c*) H_2 is necessary.
(*d*) limonite can be used.

38. For the removal of permanent hardness of water,
(*a*) Na_2CO_3 can be used.
(*b*) $Ca(OH)_2$ can be used.
(*c*) $CaCO_3$ can be used.
(*d*) zeolite can be used.

39. Which of the following materials could be used for obtaining $C_6H_5C{\equiv}CH$ in one step?
(*a*) $C_6H_5CHBrCH_2Br$
(*b*) $C_6H_5CH_2OCH_3$
(*c*) 
(*d*) $C_6H_5CH_2CHCl_2$

40. Which of the following statements concerning $C_6H_5CH_2Cl$ are/is true?
(*a*) It undergoes free-radical reactions.
(*b*) It undergoes electrophillic substitution reactions.
(*c*) It undergoes nucleophillic substitution reactions.
(*d*) It undergoes hydrolysis.

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Instructions for questions No. 41 to 50

In questions No. **41** to **50**, 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), (5) that **best** fits the two statements given for each of the questions and mark appropriately.

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

	First Statement	Second Statement
41.	$(CH_3)_3CCONH_2$ is strongly basic.	The three CH_3- groups repel electrons.
42.	Carbon cannot act as an oxidizing agent.	The electronegativity of carbon is relatively low.
43.	The boiling point of a mixture of H_2O and D_2O is always higher than the boiling points of the two pure liquids.	Since the D isotope weighs twice as much as the H isotope, the mixture does not behave ideally when it boils.
44.	Even if the pH of an aqueous solution is less than 7, it could be neutral.	Under certain conditions, the value of K_w could be higher than $1{\cdot}0 \times 10^{-14}$ mol^2 dm^{-6}.
45.	Hot concentrated H_2SO_4 could be used to distinguish between AgCl and AgBr.	Hot concentrated H_2SO_4 can act as a strong acid.
46.	The oxygen present in air does not contribute to pollution of the environment.	Oxygen gas is very essential to the life processes in man.
47.	N_2 present in air can be chemically converted to NH_3 without any catalysts.	N atoms have the ability to acquire electrons and form ions.
48.	The emission spectrum of the H atom and the emission spectrum of the Li atom are very closely similar.	H and Li atoms have only one electron in each of their outermost energy levels.
49.	When $C_6H_5OCH_3$ is subjected to nitration, para and ortho nitro compounds are formed.	The methyl group is ortho-para directing.
50.	An important step pertaining to the addition of HBr to propene under polar conditions can be depicted as shown below. $CH_3-CH=CH_2 \quad H-Br$	This is an addition reaction in which two free radicals participate.

51. 999 cm^3 of pure distilled water was added to 1 cm^3 of 0·001 mol dm^{-3} HCl. 999 cm^3 of pure distilled water was added to 1 cm^3 of the resultant solution. At 25 °C the pH of this last solution is
(1) about 9. (2) about 8. (3) about 7. (4) about 4. (5) about 3.

52. Dilute HNO_3 and aqueous $AgNO_3$ were added to a Lassaigne extract obtained from an organic compound. This reaction produced a white precipitate. Which one of the following statements concerning the organic compound is most appropriate?
(1) The compound contains Cl. (2) The compound contains Br.
(3) The compound contains Cl^-. (4) The compound contains Br^-.
(5) All of the above statements may be incorrect.

53. Which one of the following statements concerning the ethyne molecule is most appropriate?
(1) In the ethyne molecule there is one σ-bond.
(2) In the ethyne molecule there are two σ–bonds.
(3) In the ethyne molecule there is one π–bond.
(4) In the ethyne molecule, the two π–bonds are perpendicular to one another.
(5) In the ethyne molecule, the angle between the two planes of the two π–bonds is 90°.

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54. 45·0 g of water and 30·0 g of an alcohol were mixed together. The mole fraction of water in this solution was 0·833. What is the relative molecular mass of this alcohol? (H = 1·00 ; O = 16·0)
(1) 60 (2) 46 (3) 32 (4) 30
(5) The relative molecular mass of the alcohol cannot be calculated using the data given above.

55. The reaction between $SbCl_3$ and water is a reversible one. Which one of the following statements concerning this reversibility is most appropriate?
(1) It can be shown by adding water to $SbCl_3$.
(2) It can be shown by adding dilute hydrochloric acid to $SbCl_3$.
(3) It can be shown by adding water to SbOCl.
(4) It can be shown by adding dilute hydrochloric acid to SbOCl.
(5) None of the above methods is suitable for showing it.

56. For the industrial production of calcium carbide at low cost in Sri Lanka,
(1) limestone is very essential. (2) a carbon source is very essential.
(3) water is very essential. (4) both of 1 and 2 mentioned above are very essential.
(5) all of 1, 2, and 3 mentioned above are very essential.

57. You are supplied with an acidic solution containing the cations, Fe^{2+} and Ni^{2+}. Which one of the following statements concerning the demonstration of the presence of Ni^{2+} in this solution is most appropriate?
(1) Passing H_2S gas through the solution and filtering it through a filter paper, is a suitable course of action for this purpose.
(2) Passing an excess of H_2S gas through the solution and filtering it through a filter paper, is a suitable course of action for this purpose.
(3) Adding an excess of ammonium sulphide into the solution and filtering it through a filter paper, is a suitable course of action for this purpose.
(4) Adding an excess of aqueous ammonia into the solution and filtering it through a filter paper, is a suitable course of action for this purpose.
(5) None of the above is a suitable course of action for this purpose.

58. Which one of the following when heated will give CO_2 at the lowest temperature?
(1) An aqueous solution saturated with $BaCO_3$
(2) An aqueous solution saturated with $MgCO_3$
(3) Aqueous K_2CO_3
(4) Aqueous $NaHCO_3$
(5) Aqueous $Ca(HCO_3)_2$

59. Which one of the following statements concerning the compound, $K_4[Fe(CN)_6]$ is most appropriate?
(1) The IUPAC name of the compound is potassium ferrocyanide(II).
(2) The IUPAC name of this compound is potassium ferricyanide(III).
(3) The IUPAC name of this compound is potassium hexacyanoferrate(IV).
(4) The IUPAC name of this compound is potassium hexacyanoferrate(III).
(5) The IUPAC name of this compound is none of the above.

60. A student performed several titrations separately between several 25 cm^3 portions of a certain aqueous solution of KOH and a 0·100 mol dm^{-3} aqueous solution of HBr. The HBr solution was in the burette. The KOH solution was several days old. In one titration, he used methyl orange for the purpose of obtaining the burette reading. In the next titration, he used phenolphthalein for the purpose of obtaining the burette reading. The difference between these two burette readings was about 5 cm^3. Which one of the following statements concerning this difference is most appropriate?
(1) This difference has arisen because HBr is a weak acid.
(2) This difference has arisen because KOH is a very strong base.
(3) This difference has arisen because of the presence of K_2CO_3 in the KOH solution.
(4) This difference has arisen because of the presence of $KHCO_3$ in the KOH solution.
(5) This difference has arisen because of the presence of both $KHCO_3$ and K_2CO_3 in the KOH solution.

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