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முழுப் பதிப்புரிமையுடையது]
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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

02 E I

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2008 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர)ப் பரீட்சை, 2008 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2008

රසායන විද්‍යාව I
இரசாயனவியல் I
Chemistry I

පැය දෙකයි
இரண்டு மணித்தியாலங்கள்
Two hours

Important :

- *This paper consists of* **10** *pages (Periodic Table is also provided).*
- *Answer* ***all*** *the questions.*
- ***Use of calculators is not allowed.***
- ***Write your Index Number*** *in the space provided in the answer sheet.*
- *Instructions are given on the back of the answer sheet. Follow those carefully.*
- *In each of the questions* **1** *to* **60**, *pick one of the alternatives from* (1), (2), (3), (4), (5) *which is* ***correct*** *or* ***most appropriate*** *and* ***mark your response on the answer sheet with a cross*** (×) *on the number of the correct option in accordance with the instructions given on the back of the answer sheet.*

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

1. Which period in the periodic table contains the highest number of non-metallic elements?
(1) 1 (2) 2. (3) 3 (4) 4 (5) 5

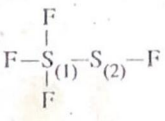
2. Of the molecules/ions given below, which one has a shape different from the shape of the others?
(1) SO_4^{2-} (2) $S_2O_3^{2-}$ (3) PCl_4^+ (4) NH_4^+ (5) SF_4

3. A gas **not** likely to be present in the emission of an automobile engine is
(1) CO_2 (2) SO_2 (3) H_2S (4) NO (5) CO

4. $MSO_4 \cdot xH_2O$ has 36% of H_2O by mass. The value of x is (H = 1.0, O = 16.0, S = 32.0, M = 64.0)
(1) 3 (2) 4 (3) 5 (4) 6 (5) 7

5. Which one of the following **does not** react with sodium metal?
(1) $CH_3{-}C{\equiv}CH$ (2) $HC{\equiv}CH$ (3) CH_3CH_2OH (4) CH_3CHO (5) C_6H_5OH

6. The oxidation states of the $S_{(1)}$ and $S_{(2)}$ atoms in the following molecule are respectively,



(1) +1 and +3 (2) +4 and +2 (3) +3 and +1 (4) −3 and −1 (5) +2 and +2

7. The following equilibrium occurs between A(g) and B(g)

$$A(g) \rightleftharpoons x\ B(g)$$

When 3 moles of A(g) are placed initially in an evacuated container, an equimolar mixture of A and B is formed at equilibrium. The value of x is
(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

[see page two

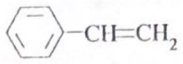
8. The partition coefficient of compound **A** between $CHCl_3$ and water is 9 with **A** more soluble in $CHCl_3$. 100 cm^3 of an aqueous solution of **A** initially contains 2.00 g of **A**. The total mass of **A** extracted into $CHCl_3$, when the solution of **A** is extracted twice with two, 100 cm^3 portions of $CHCl_3$ is
(1) 1.80 g (2) 0.198 g (3) 1.89 g (4) 1.09 g (5) 1.98 g

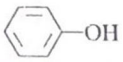
9. The two elements which are liquids at room temperature are
(1) Li and Be (2) Br and Be (3) Hg and Br (4) Hg and Xe (5) Se and Br

10. Which of the following requires the highest number of moles to oxidize one mole of I^- ions?
(1) Cl_2 (2) K_2CrO_4 (3) $K_2Cr_2O_7$ (4) $FeCl_3$ (5) $KMnO_4$

11. Consider the following compounds.

(A) HCHO (B) 

(C) $NH_2(CH_2)_4NH_2$ (D) 

(E) 

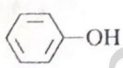
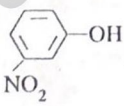
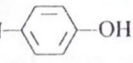
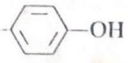
Which of the pairs given below will produce a thermosetting polymer?
(1) **B** and **E** (2) **B** and **C** (3) **A** and **C** (4) **A** and **E** (5) **B** and **D**

12. The volume of 0.20 mol dm^{-3} HCl required to react with 1.86 g of aniline is
(H = 1.0, C = 12.0, N = 14.0)
(1) 150 cm^3 (2) 10 cm^3 (3) 75 cm^3 (4) 200 cm^3 (5) 100 cm^3

13. Which of the following undergoes disproportionation in water?
(1) PCl_3 (2) NO_2 (3) SO_3 (4) SO_2 (5) NCl_3

14. Consider the industrial processes for the manufacture of H_2SO_4, Na_2CO_3 and HNO_3. The gas **X** is used as a starting material in one of these processes, but it is not incorporated in any form in the final product. The gas **X** is
(1) NH_3 (2) SO_2 (3) SO_3 (4) NO_2 (5) CO_2

15. Which of the following statements is **not** true regarding ozone (O_3)?
(1) It absorbs ultra-violet rays.
(2) Ozone layer can be damaged by oxides of nitrogen.
(3) Ozone is used as a disinfectant.
(4) Ozone oxidises I^- ions to I_2.
(5) The dipole moment of O_3 is zero.

16. (A)  (B)  (C) O_2N– (D) CH_3O–

The correct **increasing** order of the acid strength of the compounds **A**, **B**, **C** and **D** is
(1) **D** < **A** < **B** < **C** (2) **D** < **B** < **A** < **C** (3) **A** < **D** < **B** < **C**
(4) **D** < **A** < **C** < **B** (5) **A** < **B** < **C** < **D**

17. The salt **X** dissolves in dil. HCl forming a colourless solution. This solution
(i) gives a white precipitate when diluted with water.
(ii) gives a black precipitate when H_2S is passed.
The cation present in **X** is
(1) Cu^{2+} (2) Bi^{3+} (3) Hg^{2+} (4) Sb^{3+} (5) As^{3+}

18. When TiO_2 is heated in the presence of H_2(g) another oxide of titanium is formed. If 1.600 g of TiO_2 produces 1.440 g of this oxide, the formula of the oxide is (O = 16.0, Ti = 48.0)
(1) TiO (2) Ti_2O_3 (3) Ti_2O (4) Ti_3O_4 (5) Ti_2O_2

[see page three

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189

19. A = Benzoic acid, B = Ethanoic acid, C = Acetone, D = Ethanol

Which of the following represents the correct **increasing** order of boiling points of the compounds A, B, C and D ?

(1) D < C < A < B (2) D < C < B < A (3) C < D < A < B
(4) C < D < B < A (5) B < C < D < A

20. The correct **decreasing** order of the radii of the ions S^{2-}, Cl^-, K^+ and Ca^{2+} is

(1) $S^{2-} > Cl^- > K^+ > Ca^{2+}$ (2) $Cl^- > S^{2-} > K^+ > Ca^{2+}$
(3) $S^{2-} > Cl^- > Ca^{2+} > K^+$ (4) $Ca^{2+} > K^+ > S^{2-} > Cl^-$
(5) $K^+ > Ca^{2+} > Cl^- > S^{2-}$

21. A metal M was converted to its sulphate $M_2(SO_4)_3$. A solution of this sulphate was treated with $Pb(NO_3)_2$ to give $PbSO_4$. If 1.04 g of M gave 9.09 g (dry mass) of $PbSO_4$, the metal M is
(Al = 27.0, Cr = 52.0, Fe = 55.8, Co = 58.9; Ga = 69.7, $PbSO_4$ = 303.0)

(1) Al (2) Cr (3) Fe (4) Co (5) Ga

22. A, B, C and D are non-metallic elements.

$$2B^-(aq) + A_2 \rightarrow B_2 + 2A^-(aq)$$

$$2C^-(aq) + B_2 \rightarrow C_2 + 2B^-(aq)$$

$$2D^-(aq) + B_2 \rightarrow D_2 + 2B^-(aq)$$

$$2C^-(aq) + D_2 \rightarrow \text{No reaction}$$

The correct **increasing** order of the oxidizing ability of these elements is

(1) A < B < C < D (2) B < A < C < D (3) D < C < B < A
(4) A < C < D < B (5) A < B < D < C

23. Which of the following properties are consistent with the structure of butenedioic acid?

(A) It shows isomerism
(B) It liberates CO_2 with a solution of $NaHCO_3$
(C) It decolorises Br_2 water
(D) It reacts with $LiAlH_4$ to form butane-1,4-diol

(1) (A) and (D) (2) (C) and (D) (3) (A), (C) and (D)
(4) (A), (B) and (D) (5) (A), (B) and (C)

24. Consider the following reaction scheme,

$$CH_3C \equiv N \xrightarrow{\text{Conc.}H_2SO_4} CH_3COOH \xrightarrow[(2)\ H_3O^+]{(1)\ LiAlH_4} CH_3CH_2OH$$

(A) (B)

Reaction steps (A) and (B) are respectively,

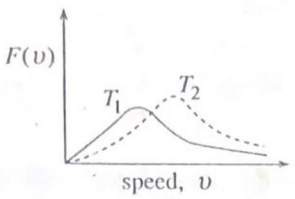
(1) oxidation and reduction. (2) oxidation and oxidation.
(3) oxidation and hydrolysis. (4) hydrolysis and reduction.
(5) reduction and reduction.

[see page four

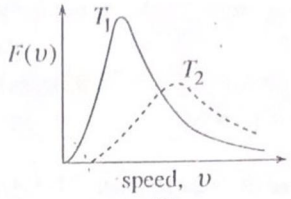
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25. The distributions of molecular speeds are shown below for a gas at two temperatures T_1 and T_2 with $T_2 > T_1$.

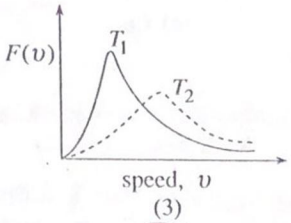
Which of the graphs 1 – 5 shows the most likely variations of the molecular speeds at T_1 and T_2?
[$F(\upsilon)$ = fraction of molecules with speed, υ]



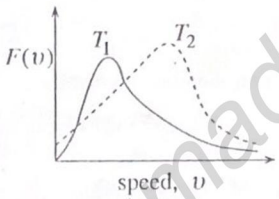
(1)



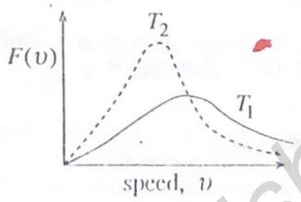
(2)



(3)



(4)



(5)

26. The salt **X** evolves a gas when warmed with dil. H_2SO_4. An aqueous solution of **X** gives a white precipitate with $Ba(NO_3)_2$ which is soluble in dil. HNO_3. However, when **X** is treated with H_2O_2 and $Ba(NO_3)_2$ added thereafter to the solution, a white precipitate insoluble in dil. HNO_3 is formed. The anion in salt **X** is

(1) SO_4^{2-} (2) PO_4^{3-} (3) SO_3^{2-} (4) S^{2-} (5) $C_2O_4^{2-}$

27. A solution of urea (NH_2CONH_2) is decomposed on heating as follows.

$$NH_2CONH_2 + 3H_2O \rightarrow CO_2 + 2NH_4OH$$

The mass of urea required to precipitate Al present in 100.0 cm^3 of 0.20 mol dm^{-3} $Al(NO_3)_3$ solution is
(H = 1.0, C = 12.0, N = 14.0, O = 16.0)

(1) 1.80 g (2) 0.90 g (3) 2.70 g (4) 3.60 g (5) 1.20 g

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28. Standard electrode protentials for the metals P, Q and R at 25 °C are given below.

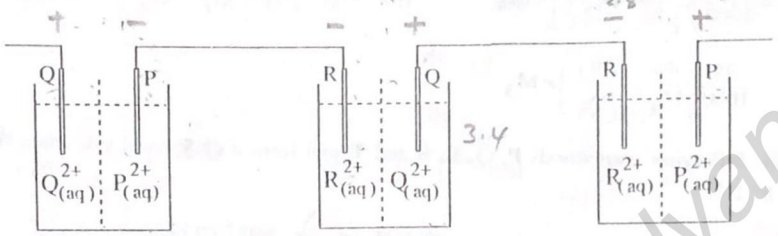
$P^{2+}(aq) + 2e \rightarrow P(s)$; $E^{\ominus} = -2.2V$

$Q^{2+}(aq) + 2e \rightarrow Q(s)$; $E^{\ominus} = +1.2V$

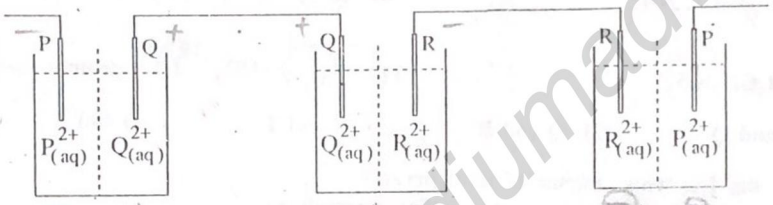
$R^{2+}(aq) + 2e \rightarrow R(s)$; $E^{\ominus} = -2.8V$

Which combination of the three electrochemical cells given below constructed using half cells of P, Q and R metals at their standard states produce an electromotive force of 8.0 V?

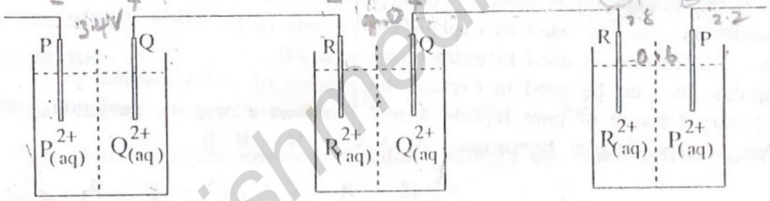
(1)



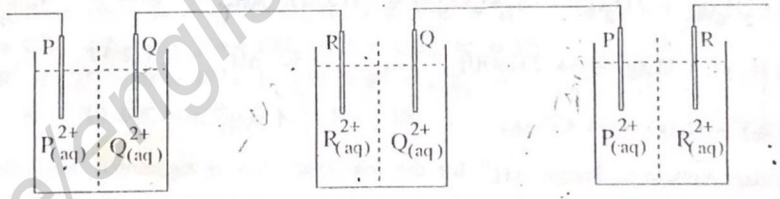
(2)



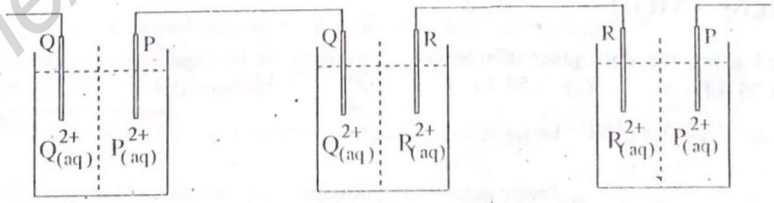
(3)



(4)



(5)



29. The IUPAC name of $\left[Fe(H_2O)_5OH\right]^{2+}$ is

(1) Hydroxopentaquairon(III) ion (2) Pentaaquahydroxyliron(III) ion
(3) Pentaaquahydroxoferrous(II) ion (4) Hydroxopentaaquairon(II) ion
(5) Pentaaquahydroxoiron(III) ion

30. CO_2 was passed through 25.00 cm^3 of a 0.10 mol dm^{-3} NaOH solution until 50% of NaOH was converted to Na_2CO_3. This solution was titrated with 0.10 mol dm^{-3} HCl solution using phenolphthalein as the indicator. The end-point of the titration would be,

(1) 18.75 cm^3 (2) 20.00 cm^3 (3) 37.50 cm^3 (4) 25.00 cm^3 (5) 12.50 cm^3

[see page six

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31. m_1 g of NaCl and m_2 g $MgCl_2$ were dissolved in water and diluted upto 1.00 dm^3. 25.00 cm^3 of this solution was treated with excess $AgNO_3$ solution. The mass of AgCl precipitate obtained was m_3 g.

(Relative molar mass : NaCl = M_1, $MgCl_2$ = M_2, AgCl = M_3)

Which of the following expressions is correct?

(1) $m_3 = \frac{m_1}{M_1} + \frac{2m_2}{M_2} \times M_3$

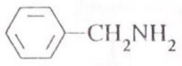
(2) $m_3 = \left[\frac{m_1}{M_1} + \frac{2m_2}{M_2}\right] \times M_3$

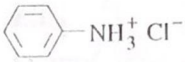
(3) $m_3 = \frac{25}{1000} \times \left[\frac{m_1}{M_1} + \frac{m_2}{M_2}\right] \times M_3$

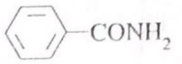
(4) $m_3 = \frac{1}{1000}\left[\frac{m_1}{M_1} + \frac{m_2}{M_2}\right] \times M_3$

(5) $m_3 = \frac{25}{1000}\left[\frac{m_1}{M_1} + \frac{2m_2}{M_2}\right] \times M_3$

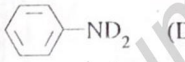
32. Which of the following compounds **P**, **Q**, **R**, **S** and **T** will form a diazonium salt when treated with dil. HCl and $NaNO_2$ at 5° C?

(P) 

(Q) 

(R) 

(S) $CH_3CH_2NH_2$

(T) 

(D = deuterium)

(1) **P** and **Q** (2) **Q** and **R** (3) **R** and **T** (4) **Q** and **T** (5) **S** and **T**

33. Which of the following statements is **incorrect**?

(1) Fractional distillation is used in refining petroleum.
(2) Raoult's law can be used to explain the process of fractional distillation.
(3) Steam distillation is used to extract citronella oil.
(4) Raoult's law can be used to explain the process of steam distillation.
(5) A binary mixture of pure liquids **A** and **B** shows a negative deviation from Raoult's law when the strength of molecular interactions **A**, **A** < **A**, **B** > **B**, **B**

34. $2C_2H_6(g) + 7O_2(g) \longrightarrow 4CO_2(g) + 6H_2O(l)$; $\Delta H_r^\circ = -3120$ kJ

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$; $\Delta H_f^\circ = -572$ kJ

$C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H_f^\circ = -394$ kJ

The standard enthalpy change ΔH° for the reaction,

$2C(s) + 3H_2(g) \longrightarrow C_2H_6(g)$

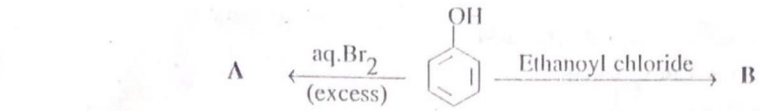
calculated using the data given above is

(1) +25 kJ (2) −58 kJ (3) +86 kJ (4) −86 kJ (5) −52 kJ

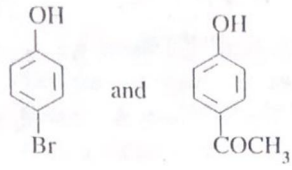
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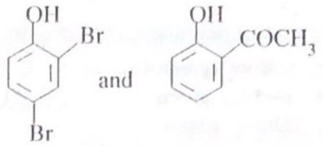
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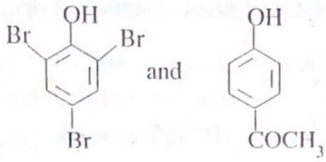
35. Consider the following reactions of phenol.

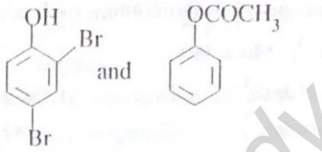


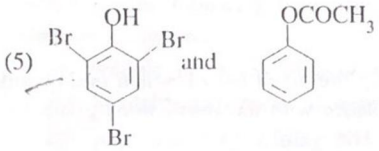
The structures of **A** and **B** respectively are,

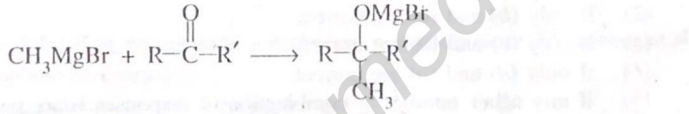
(1) 

(2) 

(3) 

(4) 

(5) 

36. 

The rate of the above reaction under identical conditions follows the order, (Ph stands for C_6H_5)

(1) R = R′ = Ph > R = R′ = CH_3 > R = R′ = H
(2) R = CH_3, R′ = Ph > R = H, R′ = CH_3 > R = R′ = H
(3) R = R′ = CH_3 > R = H, R′ = CH_3 > R = CH_3, R′ = Ph
(4) R = H, R′ = CH_3 > R = R′ = H > R = R′ = CH_3
(5) R = R′ = H > R = R′ = CH_3 > R = R′ = Ph

37. Which of the following statements is **not** true?

(1) Polluted water contains a lower amount of dissolved O_2 than pure water.
(2) Bleaching powder is manufactured by passing Cl_2 into slaked lime.
(3) Calcium carbide is manufactured by heating Ca metal with coke.
(4) Natural rubber is cis-poly(isoprene).
(5) $(NH_4)_2SO_4$ can be made by reacting an aqueous solution of $(NH_4)_2CO_3$ with $CaSO_4$.

38. Which of the following statements are true regarding **hydrocarbons**?

(A) All the carbon atoms in a hydrocarbon molecule may be sp^3 hybridised.
(B) The number of sp^2 hybridised carbon atoms, if any, should be even.
(C) The number of sp hybridised carbon atoms, if any, should be odd.
(D) They may be solids, liquids or gases at room temperature.

(1) **(A)**, **(B)** and **(D)** (2) **(A)**, **(B)** and **(C)** (3) **(B)** and **(C)**
(4) **(A)**, **(B)**, **(C)** and **(D)** (5) **(C)** and **(D)**

[see page eight

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39. Consider the following tests.

A : Addition of $FeCl_3$ to a solution of salicylic acid

B : Addition of Conc.HCl to a $CoCl_2$ solution

C : Addition of KI to a $Pb(NO_3)_2$ solution

D : Addition of ethanol to acidified $K_2Cr_2O_7$

The colours of solutions/precipitates obtained in **A**, **B**, **C** and **D** are respectively,

(1) purple, blue, yellow, green
(2) green, yellow, blue, purple
(3) blue, yellow, purple, green
(4) purple, blue, yellow, orange
(5) green, blue, yellow, green

40. The molar concentration of an ammonium molybdate $(NH_4)_2MoO_4$, solution which contains 48 ppm of Mo is

(1 ppm = 1 mg dm^{-3}, Mo = 96)

(1) 2.5×10^{-5} mol dm^{-3}
(2) 7.5×10^{-5} mol dm^{-3}
(3) 5.0×10^{-3} mol dm^{-3}
(4) 2.5×10^{-4} mol dm^{-3}
(5) 5.0×10^{-4} mol dm^{-3}

Instructions for question No. 41 to 50

For each of the questions **41** to **50**, four responses (*a*), (*b*), (*c*) and (*d*) are given out of which 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

41. An element shows the stable oxidation states +3, +5 and +7. The other stable oxidation state/states shown by this element is/are

(*a*) +1 (*b*) +2 (*c*) +6 (*d*) −1

42. Which of the following is **not** a green-house gas/are **not** green-house gases?

(*a*) CH_4 (*b*) CO_2 (*c*) O_2 (*d*) N_2

43. Which of the following statements is/are true in relation to addition of some amount of $CaCl_2$(s) to a saturated aqueous solution of $Ca(OH)_2$?

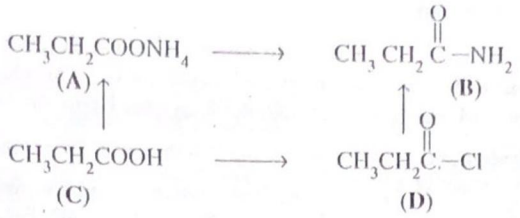
(*a*) $[OH^-]$ does not change. (*b*) Some amount of $Ca(OH)_2$ is precipitated.

(*c*) $[Ca^{2+}]$ will increase. (*d*) $[H^+]$ does not change.

[See page nine

https://t.me/englishmediumadvancelevel

44.



Which of the following statements is/are true regarding the reaction scheme given above?

(*a*) The same reagent can be used to convert **C** to **A** as well as **D** to **B**.

(*b*) Heating **A** produces NH_3 and **C** as main products.

(*c*) **C** is a stronger acid than CH_3COOH.

(*d*) **D** forms $CH_3CH_2CO^+AlCl_4^-$ with $AlCl_3$

45. Which of the following reacts/react with atmospheric oxygen?

(*a*) aqueous LiI solution (*b*) $Mn(OH)_2$ suspension in water

(*c*) aqueous $Ca(OH)_2$ solution (*d*) $Cr(OH)_3$ suspension in water

46. Which of the following statements is/are true regarding $Al(OH)_3$ and $Zn(OH)_2$?
Both of them are,

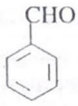
(*a*) soluble in excess of aqueous NH_4OH solution.

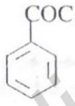
(*b*) insoluble in excess of aqueous NH_4OH solution.

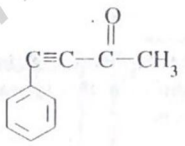
(*c*) precipitated by adding NH_4Cl and NH_4OH to a solution containing Al^{3+} and Zn^{2+} ions.

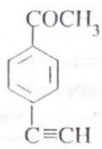
(*d*) amphoteric.

47. Which of the following compounds react/reacts separately with (i) ammoniacal $AgNO_3$ and (ii) 2,4-diritrophenylhydrazine

(*a*) 

(*b*) 

(*c*) 

(*d*) 

48. Which of the following statements is/are true regarding Le Chatelier's principle?

(*a*) It can be applied to any homogeneous equilibrium system.

(*b*) It can be used to explain the dependence of rate on concentration of chemical reactions.

(*c*) It does not provide correct information on equilibrium reactions involving gas evolution.

(*d*) It can be applied to explain the effect of the addition of an inert gas on a gas phase equilibrium system.

49. Which of the following pairs of lines has (have) a difference(s) between them which is equal to that between the $3^{rd}(H_\gamma)$ and $4^{th}(H_\delta)$ lines of the Lyman series of the atomic spectrum of hydrogen?

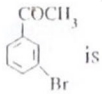
(*a*) 3rd and 4th lines of Balmer series (*b*) 1st and 2nd lines of Paschen series

(*c*) 2nd and 3rd lines of Balmer series (*d*) 3rd and 4th lines of Paschen series

50. Which of the following statements is/are true about the compound 

?

(*a*) When reduced with $NaBH_4$, the product molecules formed are optically active.

(*b*) When brominated in the presence of Fe, 

is formed.

(*c*) When reduced with Zn(Hg) and Conc. HCl, the product molecules formed are optically active.

(*d*) On oxidation with $KMnO_4$, 

can be formed.

[See page ten

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Instructions for questions No. 51 to 60

In questions No. **51** to **60**, 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
51.	I_2 is more soluble in aqueous KI than in pure water.	KI reduces the polarity of water making non-polar I_2 more soluble.
52.	When a reversible reaction is at equilibrium, the rate of the forward reaction is equal to the rate of the reverse reaction.	At equilibrium, the activation energy of the forward reaction is equal to the activation energy of the reverse reaction.
53.	SO_2, when used as a bleaching agent, acts as an oxidising agent.	Bleaching action is generally an oxidation process.
54.	CH_3CH_2COCl gives a white precipitate of AgCl with aqueous $AgNO_3$.	Organic compounds with ionic chlorine give a white precipitate of AgCl with aqueous $AgNO_3$.
55.	Silica (SiO_2) has a very high melting point.	Si–O bonds are strong covalent bonds.
56.	Solubility of gases in water increases with decreasing temperature.	Dissolution of gases in water is an exothermic process.
57.	When the temperature is increased the equilibrium of an endothermic reaction shifts in the forward direction forming more products.	For an endothermic reaction the activation energy of the forward reaction is higher than that for the reverse reaction.
58.	Zn^{2+} and Mn^{2+} are not precipitated as sulphides when H_2S is passed into a solution of these ions, acidified with dil. HCl.	ZnS and MnS are soluble in dil. HCl
59.	The compressibility factor, $Z(=pV/nRT)$ approaches unity at very low pressures for real gases.	Intermolecular forces do not affect the behaviour of gas molecules at very low pressures.
60.	Electrons behave sometimes as particles and sometimes as waves.	Electrons have both particle and wave properties.

1)	2	4	2	5	2/5	3
2)	5	5	3	4	5(b,c)	3
3)	3	2	5	4	2	5
4)	3	1	4	4	4	2
5)	4	5	3	5	5(b)	2
6)	3	1	3	5	5(d)	1
7)	2	2	1	3	4(a,d)	1/2
8)	5	2	3	1	5(d) 4	3
9)	3	4	5	1	2	1
10)	4	1	1	5	1	4

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