INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN CHEMISTRY 2017 -18

Date of Examination: 26TH November, 2017

Time: 1100 to 1300 Hrs

Q. Paper Code: C321

Write the question paper code mentioned above on YOUR answer sheet (in the space provided), otherwise your answer sheet will NOT be assessed. Note that the same Q. P. Code appears on each page of the question paper.

Instructions to Candidates –

1. Use of mobile phones, smartphones, ipads during examination is **STRICTLY PROHIBITED**.
2. In addition to this question paper, you are given answer sheet along with Candidate's copy.
3. On the answer sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
   Incomplete/ incorrect/carelessly filled information may disqualify your candidature.
4. On the answer sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. The email ID and date of birth entered in the answer sheet will be your login credentials for accessing performance report. Please take care while entering.
6. Question paper has 80 multiple choice questions. Each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

7. A correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer.
8. Any rough work should be done only in the space provided.
9. Use of **non-programmable** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting your answer paper, take away the Candidate's copy for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet.

Answer sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED.

Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE ANSWER SHEET.

Instructions to Candidates (continued) –

Read the following instructions after submitting the answer sheet.

12. **Comments regarding this question paper, if any, can be shared only on Google forms,** https://goo.gl/forms/Lxb1l8Bqov3Cl9FQ2 **till 28th November, 2017.**
13. **The answers/solutions to this question paper will be available on our website – www.iapt.org.in by 2nd December, 2017.**
14. **CERTIFICATES and AWARDS –**
    Following certificates are awarded by the IAPT to students successful in NSEs

    (i)Certificates to "Centre Top 10%" students

    (ii)Merit Certificates to "Statewise Top 1%" students

    (iii)Merit Certificates and a book prize to "National Top 1%" students

15. Result sheets can be downloaded from our website in the month of February. The "Centre Top 10%" certificates will be dispatched to the Prof-in-charge of the centre by February, 2018.
16. List of students (with centre number and roll number only) having score above MAS will be displayed on our website (www.iapt.org.in) by **22nd December, 2017.** See the **Eligibility Clause** in the Student's brochure on our website.
17. Students eligible for the INO Examination on the basis of selection criteria mentioned in Student's brochure will be informed accordingly.

Useful Constants:

Charge of electron, $e = 1.602 \times 10^{-19}$ C

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg

Planck's constant, $h = 6.626 \times 10^{-34}$ J s

Speed of light, $c = 3.0 \times 10^{8}$ m s^{-1}

Avogadro constant, $N_A = 6.022 \times 10^{23}$ mol^{-1}

Molar gas constant, $R = 0.082$ L atm mol^{-1} K^{-1}

$= 8.314$ J mol^{-1} K^{-1}

Indian Association of Physics Teachers

NATIONAL STANDARD EXAMINATION IN CHEMISTRY 2017-2018

Total time: 120 minutes **Marks: 240**

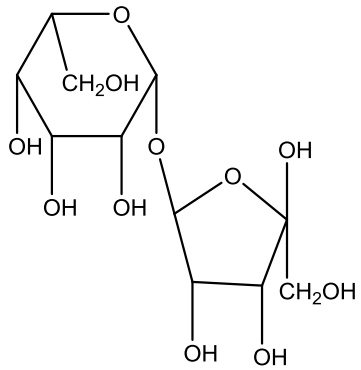
Only one out of four options is correct

1) At constant T and P, 5.0L of SO_2 are reacted with 3.0L of O_2 according to the following equation $2SO_2\,(g) + O_2\,(g) \rightarrow 2SO_3\,(g)$

The volume of the reaction mixture at the completion of the reaction is

(A) 0.5L (B) 8.0L (C) 5.5L (D) 5L

2) The following disaccharide is made up of



(A) D-aldose and D-ketose

(B) L-aldose and L-ketose

(C) D-aldose and L-ketose

(D) L-aldose and D-ketose

3) One mole of 4-nitrocatechol (4-nitro-1,2-dihydroxybenzene) on treatment with an excess of NaH followed by one mole of methyl iodide gives –

(A) 4-nitro-1,2-dimethoxybenzene

(B) 4-nitro-5-methyl-1,2-dimethoxybenzene

(C) 2-methoxy-5-nitrophenol

(D) 2-methoxy-4-nitrophenol

4) The colour changes of an indicator HIn in acid base titrations is given below

$$\underset{\text{Colour X}}{HIn\,(aq)} \rightleftharpoons \underset{\text{Colour Y}}{H^+\,(aq) + In^-\,(aq)}$$

Which of the following statements is correct?

(A) In a strong alkaline solution colour Y will be observed

(B) In a strongly acidic solution colour Y will be observed

(C) Concentration of In^- is higher than that of HIn at the equivalence point

(D) In a strong alkaline solution colour X is observed

5) The table below gives the results of three titrations carried out with 0.200 M HCl to determine the molarity of a given NaOH solution using phenolphthalein as indicator. NaOH was taken in the burette and HCl was taken in a conical flask for the titrations.

Titration No	$V_{HCl\ (mL)}$	$V_{NaOH\ (mL)}$	$M_{NaOH\ moldm^{-3}}$
I	21.4	19.3	0.222
II	18.6	16.8	0.221
III	22.2	21.1	0.210

The actual molarity of the prepared NaOH solution was 0.220 $moldm^{-3}$.

Which among the following could be the reason for the wrong value obtained in titration III?

(A) Number of drops of phenolphthalein added to the titration flask was more in this titration

(B) The concentration of HCl was wrongly used as 0.250 M for the calculation of M_{NaOH}

(C) A few drops of NaOH solution were spilled outside the titration flask during titration

((D) A few drops of the neutralized solution from titration II were left behind in the flask

6) The solution with pH value close to 1 is

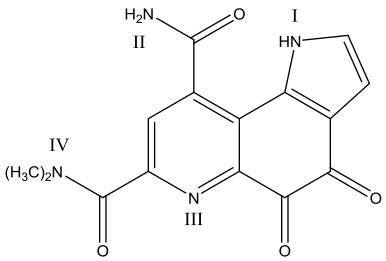
(A)10 mL of 0.1 M HCl + 90 mL of 0.1 M NaOH

(B) 55 mL of 0.1 M HCl + 45 mL of 0.1 M NaOH

(C) 75 mL of 0.2 M HCl + 25 mL of 0.2 M NaOH

(D) 75 mL of 0.2 M HCl + 25 mL of 0.1 M NaOH

7) The most basic nitrogen in the following compound is



(A) I (B) II

(C) III (D) IV

8) For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$, the rate expression is $-d[NH_3]/dt = k[H_2][N_2]$

The correct statement is

I. The reaction is not elementary II. The reaction is of second order

III. $-d[H_2]/dt = -d[NH_3]/dt$

(A) II only (B) I and II (C) II and III (D) I , II and III

9) Which of the following is correct?

A liquid with

(A) low vapour pressure will have a low surface tension and high boiling point

(B) high vapour pressure will have high intermolecular forces and high boiling point

(C) low vapour pressure will have high surface tension and high boiling point

(D) low vapour pressure will have low surface tension and low boiling point

10) At 25^0C, nitrogen exists as N_2 and phosphorous exists as P_4 because

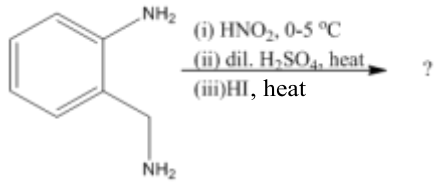
(A) N_2 has valence electrons only in bonding and nonbonding orbitals, while P has valence electrons in both bonding and antibonding orbitals

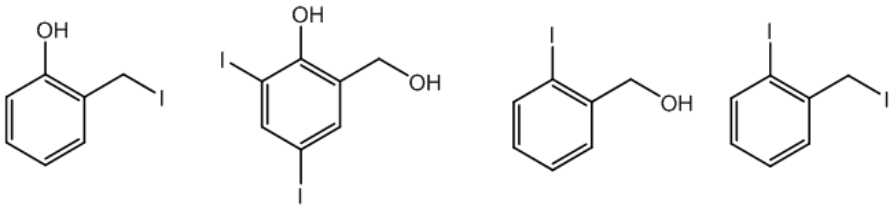
(B) higher electronegativity of N favours formation of multiple bonds

(C) bigger size of P does not favour multiple bonds

(D) P has preference to adapt structures with small bond angles

11) The product of the following reaction is





(**A**) (**B**) (**C**) (**D**)

12) Three samples of 100 g of water (samples I, II and III), initially kept at 1 atm pressure and 298 K were given the following treatments.

Sample I was heated to 320 K and cooled to 298 K

Sample II was heated to 300 K, cooled to 273K and heated to 298 K

Sample III was heated to 373K and cooled to 298 K

At the end of these processes, the internal energy of

(A) III is the highest

(B) II is the highest

(C) I and III are the same; II is lower than that of I and III

(D) I, II and III are the same

13) For the reaction

$5Br^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$

the rate expression was found to be $-d[BrO_3^-]/dt = k[Br^-][H^+]^2[BrO_3^-]$

Which of the following statement/s is /are correct?

I. Doubling the initial concentration of all the reactants will increase the reaction rate by a factor of 8

II. Unit of rate constant of the reaction in a buffer solution is min^{-1}

III. Doubling the concentration of all the reactants at the same time will increase the reaction rate by a factor of 16

IV. rate of conversion of BrO_3^- and rate of formation of Br^- are the same

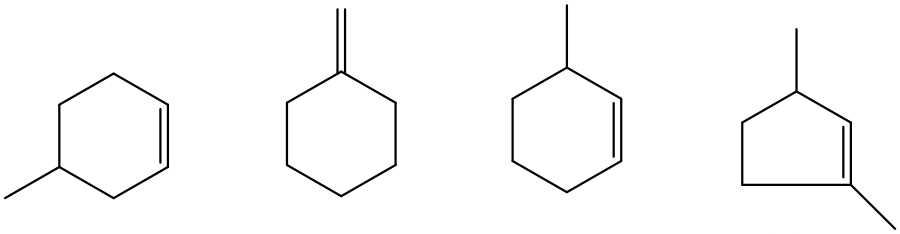
(A) I and II (B) II and III (C) II and IV (D) III only

14) In the Lewis structure of ozone (O_3), the formal charge on the central oxygen atom is

(A) +1 (B) -1 (C) 0 (D) -2

15) Which of the following on treatment with hot concentrated acidified $KMnO_4$ will give

2-methylhexane-1,6-dioic acid as the only organic product?



(A) (B) (C) (D)

16) For the following spontaneous process

$H_2O_{(l)} \rightarrow H_2O_{(s)}$ at 268 K , which of the following is true?

(A) $\Delta S_{sys} < 0$ (B) $\Delta S_{sys} > 0$ (C) $\Delta S_{surr} < 0$ (D) $\Delta S_{sys} = -\Delta S_{surr}$

17) Lithium oxide (Li_2O; molar mass =30 g mol^{-1}) is used in space shuttles to remove water vapour according to the following reaction

$Li_2O_{(s)} + H_2O(g) \rightarrow 2LiOH_{(s)}$

If 60 kg of water and 45 kg of Li_2O are present in a shuttle

I. water will be removed completely

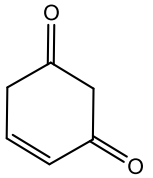
II. Li_2O will be the limiting reagent

III. 100 kg of Li_2O will be required to completely remove the water present

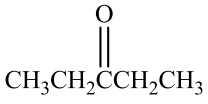
IV. 27 kg of water will remain in the shuttle at the end of the reaction

(A) II only (B) II and IV (C) III and IV (D) II, III

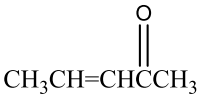
18) The order of enol content in the following molecules is



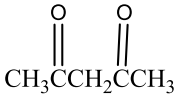
(a)



(b)



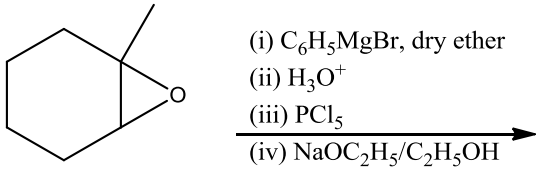
(c)

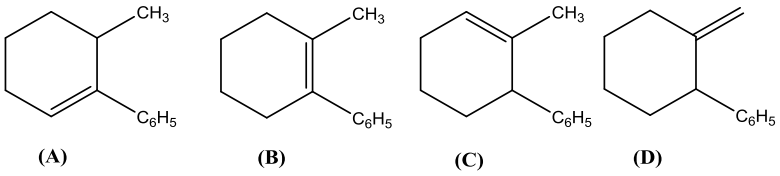


(d)

(A) a>d>c>b (B) a>c>d>b (C) a>c>b>d (D) a>b>c>d

19) The product of the following reaction is





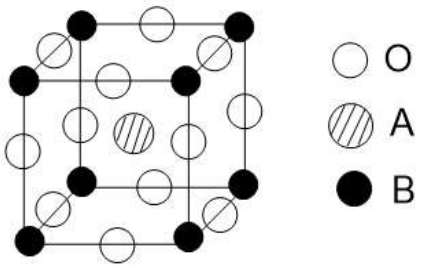
20) At constant volume, 6.0 mol of H_2 gas at 0^0 C and 100 kPa was heated to 250 kPa. The molar heat of H_2 at constant pressure (C_P) = 28.9 J mol^{-1}.(assume that the heat capacity values do not change with temperature).The final temperature of the H_2 gas and the change in entropy of the process are

(A) 273^0 C and 113 kJ mol^{-1} K^{-1} (B) 410^0 C and 158.8 J mol^{-1} K^{-1}

(C) 682.5^0 C and 113 J mol^{-1} K^{-1} (D) 682.5 K and 113 J mol^{-1} K^{-1}

21) The cubic unit cell of an oxide of metals A and B is as given below, in which oxygen,

A and B are represented by open circles, crossed circles and dark circles respectively.



The formula of the oxide can be deduced as

(A) AB_8O_{12} (B) ABO (C) ABO_6 (D) ABO_3

22) When a medal is electroplated with silver (Ag)

(A) the medal is the anode

(B) Ag metal is the cathode

(C) the solution contains Ag^+ ions

(D) the reaction at the anode is $Ag^+ + e^- \rightarrow Ag$

23) The energy of an electron in Bohr's orbit of hydrogen atom is – 13.6 eV. The total electronic energy of a 'hypothetical' He atom in which there are no electron – electron repulsions is

(A) 27.2 eV (B) -27. 2 eV (C) -108.8 eV (D) 108.8 eV

24) Iodine is a solid and sublimes at ordinary temperatures. This is because of

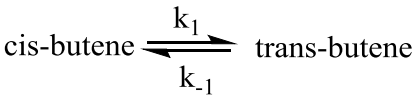
(A) weak I-I bonds

(B) strong I-I bonds

(C) lone pair - bond pair repulsions

(D) weak van der Waals forces between I_2 molecules

25) The equilibrium constants of the following isomerisation reaction at 400 K and 298 K are 2.07 and 3.42 respectively.



Which of the following is/are correct?

I. The reaction is exothermic

II. The reaction is endothermic

III. At 400 K 50% of cis-butene and 50% of trans-butene are present at equilibrium

IV. Both at 298 K and 400 K, $k_1 = k_{-1}$

(A) I and IV (B) II and IV (C) I and III (D) I only

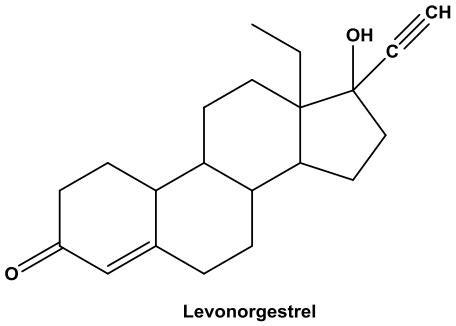
26) Which of the following *will not* give a straight line plot for an ideal gas?

(A) V vs T (B) T vs P (C) V vs 1/P (D) V vs 1/T

27) Levonorgestrel is a commonly used contraceptive. The number of chiral centers present in this molecule is

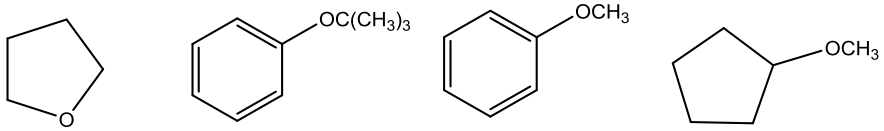
(A) 4 (B) 5

(C) 6 (D) 7



Levonorgestrel

28) Which of the following ethers *cannot* be prepared by Williamson Synthesis?



(A) (B) (C) (D)

29) IUPAC name of the complex ion $[CrCl_2(ox)_2]^{3-}$ is

(A) dichlorodioxalatochromium (III)

(B) dioxalatodichrlorochromate(III)

(C) dichlorodioxalatochromate (III)

(D) bisoxalaeodichlorochromate(III)

30) Sodium azide (NaN_3) is used in the airbag of cars. This is a safety device which inflates on an impact according to the reaction $2NaN_3 \rightarrow 2Na + 3N_2$

An air bag of a particular car can be filled with 44.8L of gas at STP. The mass (g) of NaN_3 required to fill this airbag completely at 298K and 1 atm. pressure is

(A) 87 (B) 130 (C) 84 (D) 100

31) Which of the following mixtures of water and H_2SO_4 would have mass percentage of H_2SO_4 close to 30?

(A) 30 g H_2SO_4 + 100 g H_2O

(B) 1 mol of H_2SO_4 + 2 mol of H_2O

(C) 1mol of H_2SO_4 + 200 g of H_2O

(D) 0.30 mol H_2SO_4 + 0.70 mol H_2O

32) In chlorides, the common oxidation states of aluminium and thallium are +3 and +1 respectively because

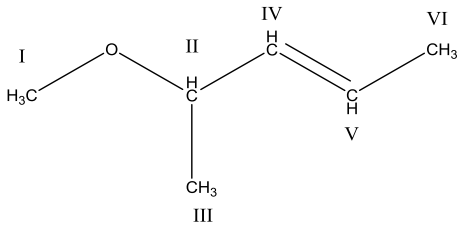
(A) Tl-Cl bond is ionic and Al-Cl bond is covalent

(B) 6s electrons of Tl are bound more strongly than the 3s electrons of Al

(C) Tl-Cl bond is stronger than Al-Cl bond

(D) 3s electrons of Al are bound strongly than the 6s electrons of Tl

33) In the given compound the order of ease with which hydrogen atom can be abstracted from carbons I to VI is



(A) II > VI > IV = V > I > III (B) II > I > VI > III > IV =V

(C) II > I > III > VI > IV =V (D) VI > II > I > III > IV =V

Use the table given below to answer questions 34 and 35

Reaction	E_0/V
$Ag \rightarrow Ag^+ + e^-$	-0.80
$Cr^{3+} + 3e^- \rightarrow 3\ Cr$	-0.74
$Zn^{2+} + 2e^- \rightarrow Zn$	-0.76
$I_2(s) + 2e^- \rightarrow 2\ I^-$	0.54
$Co^{2+} + 2e^- \rightarrow Co$	-0.28
$Ni^{2+} + 2e^- \rightarrow Ni$	-0.26

34) The best reducing agent among the following is

(A) Ag^+ (B) Zn^{2+} (C) Cr^{3+} (D) I^-

35) E^0 of the given cell is

$$Ni \mid (Ni^{+2},\ 1.0\ M) \parallel (Co^{+2},\ 1.0\ M) \mid Co$$

(A) +0.02 V (B) -0.02 V (C) -0.54 V (D) +0.54 V

36) Which of the following is *not* a pair of a Lewis acid and a Lewis base?

(A) H^+, $(C_2H_5)_2O$

(B) H_2O, $AlCl_3$

(C) Fe^{3+}, CO

(D) SiF_4, BF_3

37) The type/s of isomerism that $Co(NH_3)_4Br_2Cl$ can exhibit is/are

(A) geometric and ionisation

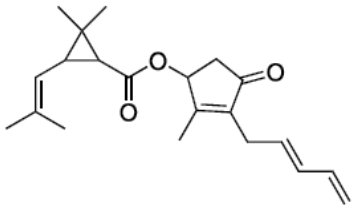
(B) ionisation

(C) Optical and ionisation

(D) Optical, ionisation and geometric

38) Pyrethrins are produced in chrysanthemum flowers and used as insecticides.

Structure of pyrethrin I is given below.



Pyrethrin I (molar mass = 328.0g/mol)

The volume of 0.05 mol dm^{-3} bromine water that would react with 500 mg sample of Pyrethrin I is

(A) 12.2 cm^3 (B) 122 dm^3 (C) 122 cm^3 (D) $1.31x10^3$ cm^3

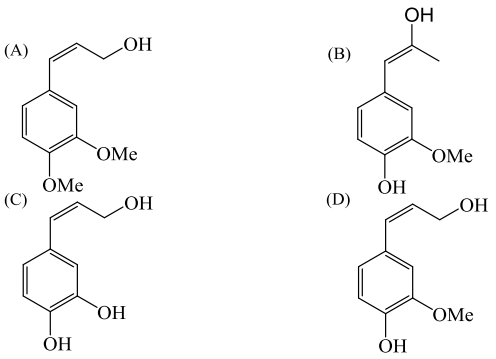
39) Coniferyl alcohol is isolated from pine trees. The following observations were made about this alcohol .

I. It forms methylated product with MeI in presence of a base

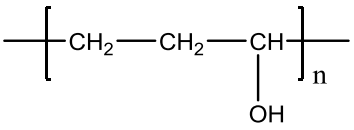
II. One equivalent of coniferyl alcohol reacts with two equivalents of benzoyl chloride

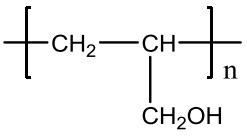
III. Upon ozonolysis , coniferyl alcohol gives a product 'Y' (M.F $C_2H_4O_2$)

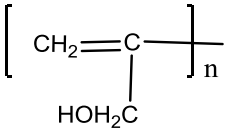
The structure of coniferyl alcohol would be

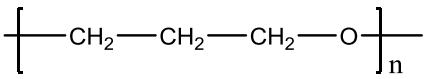


40) Which of the following represents a polymer of prop-2-en-1-ol?

(A) 

(B) 

(C) 

(D) 

41) A 500 mL glass flask is filled at 298 K and 1 atm. pressure with three diatomic gases X, Y and Z. The initial volume ratio of the gases before mixing was 5:3:1. The density of the heaviest gas in the mixture is not more than 25 times that of the lightest gas. When the mixture was heated, vigorous reactions take place between X and Y and X and Z in which all the three gases were completely used up.

The gases X, Y, Z respectively are

(A) H_2, O_2, N_2 (B) H_2, O_2, Cl_2 (C) H_2, F_2, O_2 (D) O_2, H_2, F_2

42) The reaction X +Y → Z is first order with respect to X and second order with respect to Y. The initial rate of formation of Z = R mol^{-} $dm^{3}sec^{-1}$ when $[X]_0$ and $[Y]_0$ are 0.40 mol dm^{-3} and 0. mol dm^{-3} respectively. If $[X]_0$ is halved and $[Y]_0$ is doubled, the value of the initial rate would become

(A) 4R (B) R/4 (C) R (D) 2R

43) Which one of the following statements *is not* correct about glucose ?

(molar mass of glucose =180 g mol^{-1})

(A) An aqueous 0.25 M solution of glucose is prepared by dissolving 45 g of glucose in water to give 1000 cm^3 of solution

(B) 1.00 mmol glucose has a mass of 180 mg

(C) 90.0 g glucose contain $1.8x10^{22}$ atoms of carbon

(D) 100 cm^3 of a 0.10 M solution contains 18 g of glucose

44) The van der Waals equation for one mole of a real gas can be written as $(P + a/V^2)(V - b) = RT$. For the gases H_2, NH_3, and CH_4, the value of 'a'(bar L^{-2} mol^{-2}) are

0.2453, 4.170 and 2.253 respectively.

Which of the following can be inferred from the 'a' values?

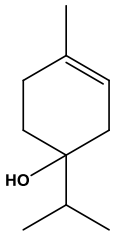
(A) NH_3 can be most easily liquefied

(B) H_2 can be most easily liquified

(C) value of 'a' for CH_4 is less than that of NH_3 because it has the lower molar mass

(D) intermolecular forces are the strongest in hydrogen

45) Terpinen-4-ol is an active ingredient in tea tree oil has the following structure



The correct observations for terpinen-4-ol is/are

I. It rotates the plane of plane polarized light

II. It reacts with Baeyers's reagent to form form a triol

III. On reaction with NaBr and H_2SO_4, it gives form a diobromo compound

IV. On ozonolysis it gives a compound with molecular formula $C_{10}H_{18}O_3$

(A) I, II, III and IV (B) I, III and IV (C) II and III (D) III and IV

46) The correct order of the ability of the leaving groups is

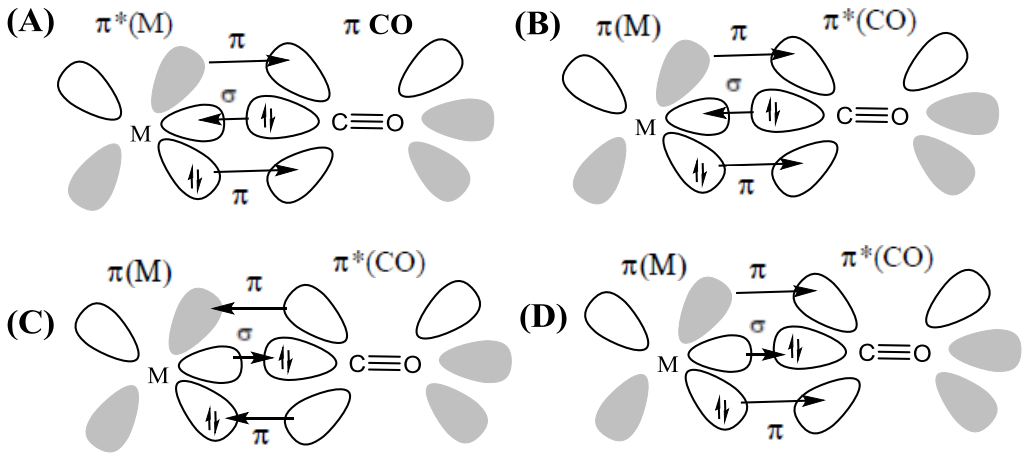
(A) $OCOC_2H_5 > OC_2H_5 > OSO_2Et > OSO_2CF_3$

(B) $OC_2H_5 > OCOC_2H_5 > OSO_2CF_3 > OSO_2Me$

(C) $OSO_2CF_3 > OSO_2Me > OCOC_2H_5 > OC_2H_5$

(D) $OCOC_2H_5$ > OSO_3CF_3 > OC_2H_5 > OSO_2Me

47) Metal 'M' forms a carbonyl compound in which it is present in its lower valance state. Which of the following bonding is possible in this metal carbonyl ?



48) Acetic acid (CH_3COOH) is partially dimerised to $(CH_3COOH)_2$ in the vapour phase. At a total pressure of 0.200 atm, acetic acid is 92.0% dimerized at 298 K. The value of equilibrium constant of dimerisation under these conditions is

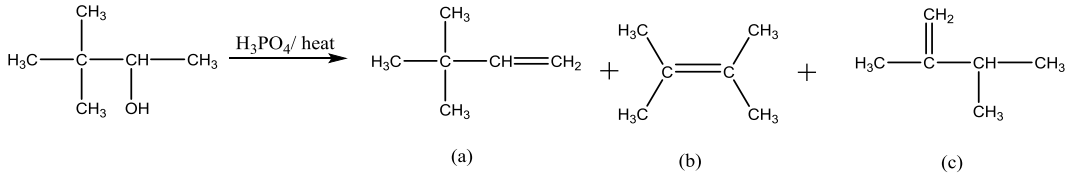
(A) 57.5 (B) 9.7 (C) 97 (D) 194

49) Silanes are silicon hydrides of general formula Si_nH_{2n+2} and have several applications. From the data given below, the bond dissociation enthalpy of Si-Si bond can be deduced as

ΔH of the reaction $2Si\ (s) + 3H_2\ (g) \rightarrow Si_2H_6\ (g)$ is 80.3kJ mol^{-1}
Bond dissociation enthalpy for H–H = 436 kJ/mol
Bond dissociation enthalpy for Si–H = 304 kJ/mol
Δf_H [Si(g)] = 450 kJ/mol

(A) – 304 kJ mol^{-1} (B) 384.3 kJ mol^{-1} (C) 304 kJ mol^{-1} (D) -384.3 kJ mol^{-1}

50) In the following reaction, three products a, b, c are obtained.



The approximates experimental yields of the three compounds were 64%, 33% and 3%. Which of the following is the correct with respect to yield and the corresponding product?

(A) (a)-33%; (b)-64%; (c)-3% (B) (a)-3%; (b)-64%; (c)-33%

(C) (a)-3%; (b)-33%; (c)-64 % (D) (a)-64%; (b)-3%; (c)-33%

51) Which of the following represents the correct order of dipole moment?

(A) $NH_3 > NF_3 > H_2O$ (B) $NH_3 > H_2O > NF_3$

(C) $H_2O > NH_3 > NF_3$ (D) $H_2O > NF_3 > NH_3$

52) The best reaction sequence for the synthesis of 2-pentanone would be -

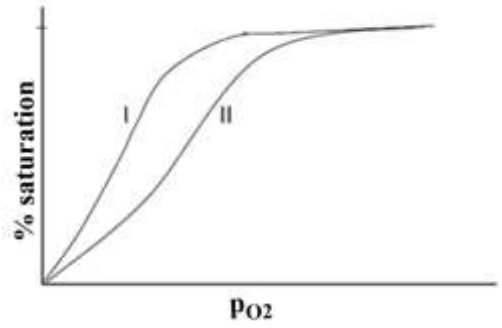
(A) $CH_3CH_2CH_2CHO \xrightarrow[\text{ether}]{CH_3MgI} X \xrightarrow[]{H^+, H_2O}$

(B) $CH_3CH_2CH_2CN \xrightarrow[\text{ether}]{CH_3MgI} X \xrightarrow[]{H^+, H_2O}$

(C) $CH_3CH_2CH_2CHO \xrightarrow[\text{ether}]{CH_3MgI} X \xrightarrow[]{H^+, H_2O}$

(D) $CH_3CH_2CH_2MgI + CH_2O \xrightarrow[\text{Ether}]{} X \xrightarrow[]{H^+, H_2O}$

53) Haemoglobin is a Fe containing protein responsible for oxygen transport in the blood.. The curves given below indicate the percentage saturation of haemoglobin by O_2 as a function of partial pressure of O_2.



Which of the following statement/s is/are correct for the given curves?

I. In presence of CO_2, higher p_{O2} is needed for a given percentage saturation

II. In presence of CO_2, lower p_{O2} is needed for a given percentage saturation

III. The maximum percentage saturation is not affected by the presence of CO_2

IV. In the absence of CO_2, maximum saturation of haemoglobin occurs at lower p_{O2}

(A) I and IV (B) II and IV (C) I, III and IV (D) II and III

54) An appropriate reagent for the conversion of 1-propanol to 1-propanal is

(A) acidified potassium dichromate

(B) alkaline potassium permanganate

(C) pyridinium chlorochromate

(D) acidified CrO_3

55) A student performed an experiment to determine the molecular formula of a given sample of hydrated copper (II) sulphate by weighing the sample before and after heating. The formula obtained experimentally was $CuSO_4\ 5.5H_2O$ while the actual formula of the given sample is $CuSO_4\ .5H_2O$. Which experimental error would account for the wrongly obtained result?

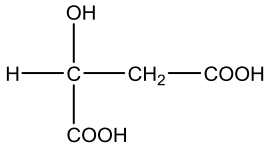
(A) During heating, some of the hydrated copper(II) sulphate was lost

(B) The hydrated sample was not heated long enough to remove all the water present

(C) Weight of the hydrated sample recorded was less than the actual weight taken

(D) The balance used in the study showed all weights consistently high by 0.10 g

56) Malic acid is a dicarboxylic acid present in apples and it has the following structure



Which of the following synthetic routes will give (±)malic acid?

(i) $H_2C{=}CH{-}COOH$ → (i) HBr (ii) KOH (aq.) (iii) HCN/H_3O^+

(ii) $H_2C(Br){-}CH_2{-}COOH$ → (i) KOH (aq.) (ii) PCC (iii) HCN/H_3O^+

(iii) $H_3C{-}CH_2{-}COOH$ → (i) Red P/I_2 (ii) NaOH (aq.) (iii) [O] (iv) HCN/H_3O^+

(iv) $H_2C{=}CH{-}COOH$ → (i) B_2H_6/H_2O_2 (ii) [O] (iii) HCN/H_3O^+

(A) i and ii (B) ii (C) ii and iii (D) i and iii

57) Which of the following cannot act as an oxidising agent?

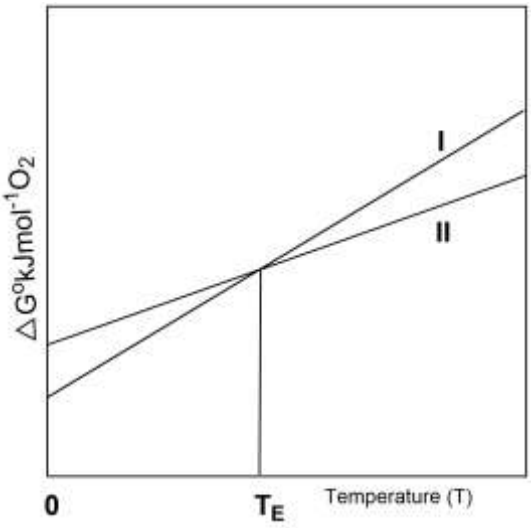
(A) S^{2-} B.Br_2 C. HSO_4^- D. SO_3^{-2}

58) Ellingham diagrams are plots of ΔG^0 vs temperature which have applications in metallurgy.

$2H_2 + O_2 = 2H_2O$ $\Delta G\ (J) = -247500 + 55.85\ T$ ……... (I)

$2CO + O_2 = 2CO_2$ $\Delta G\ (J) = -282400 + 86.81T$ …….……(II)

The Ellingham diagrams for the oxidation of H_2 (I) and CO (II) are given below. The two lines intersect (T_E) at 1125K.



Which of the following is correct?

I. $\Delta G°$ for reaction (i) is more negative at T < 1125K

II. ΔG° for the reduction of CO is more negative at T < 1125K

III. H_2 is a better reducing agent at T > 1125K

IV. H_2 is a better reducing agent at T < 1125K

(A) I and II (B) I and III (C) III only (D) I and IV

59) Hydrazine used in rocket fuels can be obtained by the reaction of ammonia and hydrogen peroxide according to the following equation

$2NH_3(g) + H_2O_2(l) \rightarrow N_2H_4(l) + 2H_2O(l)$ ($\Delta H^0_{reaction}$ = -241kJ/mol)

If ΔH^0 (formation) of NH_3, H_2O_2 and H_2O are -46.1, - 187.8 and – 285.8kJ/mol respectively, ΔH^0 for the decomposition of hydrazine into N_2 and H_2 is

(A) 50.6 kJ/mol (B) 241kJ/mol (C) -50.6kJ/mol (D)120.5kJ/mol

60) Sn^{2+} compounds like SnO and $SnCl_2$ are well known reducing agents, while PbO_2 acts as an oxidizing agent. Which of the following statements support these reactivities?

I. SnO is more stable than SnO_2

II. Sn^{4+} is more stable than Sn^{2+}

III. Pb^{4+} is more stable than Pb^{2+}

IV. Pb^{2+} is more stable than Pb^{4+}

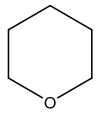
(A) I and III (B) I, III and IV

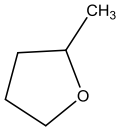
(C) II and IV (D) I, II and IV

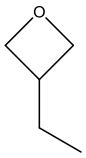
61) A fuel/oxidant system consisting of N,N-dimethylhydrazine $(CH_3)_2NNH_2$ and N_2O_4 (both liquids) is used in space vehicle propulsion. The liquid components are mixed stoichiometrically so that N_2, CO_2 and H_2O are the only products. If all gases are under the same reaction conditions, number of moles of gases produced from 1mole of $(CH_3)_2NNH_2$ is

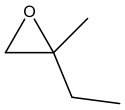
(A) 3 (B) 6 (C) 9 (D) 4.5

62) An ether (X) with molecular formula $C_5H_{10}O$ reacts with excess of hot aq. HI to give a product which on further reaction with hot NaOH in ethanol forms 1,3 pentadiene. Structure of X is

(A) 

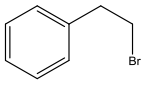
(B) 

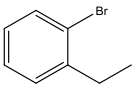
(C) 

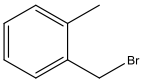
(D) 

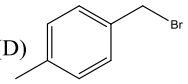
63) Compound 'Y' with molecular formula C_8H_9Br gives a precipitate on heating with alcoholic $AgNO_3$. Oxidation of 'Y' gives product 'Z' ($C_8H_6O_4$) which gives an anhydride upon heating.

Compound 'Y' is

(A) 

(B) 

(C) 

(D) 

64) The observed effective magnetic moment of two octahedral complexes, $K_4[Mn(CN)_6].3H_2O$ (X) and $K_4[Mn(SCN)_6]$ (Y) are 2.18 BM and 6.06 BM, respectively. Which of the following is correct?

I. X is a low spin complex with two unpaired electrons

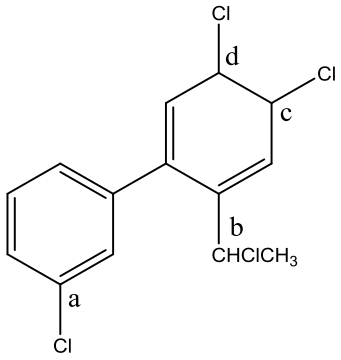
II. Y is a high spin complex with 5 unpaired electrons

III. X is a high spin complex with two unpaired electrons

IV. Y is a low spin complex with 5 unpaired electrons

(A) I and III (B) I, II (C) I , II and IV (D) I, II and III

65) The increasing reactivity of the sites (a-d) in the following compound in S_N1 reaction is



(A) d > b > c > a (B) d > c > a > b

(C) d > c > b > a (D) c > d > b > a

66) Which of the following has the shortest bond length?

(A) O_2 (B) O_2^- (C) O_2^+ (D) O_2^{2-}

67) Which of the following statement/s is/are correct about weak acids in aqueous solutions?

I. When pH = pKa of a monoprotic acid, 50% of the acid is ionised

II. If pH = pKa_2 of a diprotic acid, the average charge of all the ionised species is 0.5

III. When pH = pKa +1 , 10% of the acid is ionised

IV. When pH =7, 50% of a monobasic acid is ionised

(A) I and IV (B) I, II and IV (C) I, II and IV (D) I only

68) 'Iodine number' is the grams of iodine atoms (atomic mass = 127 g mol^{-1}) that can react completely with100 g of a vegetable oil. Iodine monochloride (ICl) is a reagent used to determine iodine number. In an experiment, 25.00 cm^3 of 0.100 mol dm^{-3} ICl was added to 127g of the oil. The unreacted ICl was found to be equivalent to 40.00 cm^3 of 0.10 mol dm^{-3} of $Na_2S_2O_3$.

The iodine number of the oil can be deduced as

(A) 127 (B) 100 (C) 200 (D) 50

69) When NiO is doped with a small quantity of Li_2O

(A) both cation and anion vacancies are generated

(B) Shottky defects are generated

(C) NiO becomes an n-type semiconductor

(D) NiO becomes a p-type semiconductor

70) When a sample of gas kept at 20 °C and 4.0 atm is heated to 40 °C at constant volume

(A) average speed of the gas molecules will decrease

(B) number of collisions between the gas molecules per second will remain the same.

(C) average kinetic energy of the gas will increase.

(D) pressure of the gas will become 8 atm.

71) Addition of bromine to *cis*-3-hexene gives

(A) racemic dibromide (B) a mixture of diastereomeric dibromides

(C) optically active dibromide (D) meso dibromide

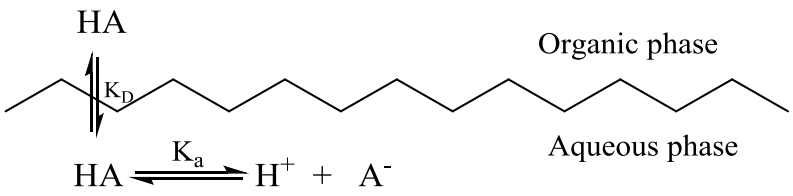
72) An organic compound "X" forms an orange–yellow precipitate with 2,4-DNP reagent. It does not react with aqueous $[Ag(NH_3)_2]NO_3$. X on reduction with $NaBH_4$ gives a secondary alcohol and on oxidation with nitric acid yields a dicarboxylic acid containing the same number of carbon atoms. On bromination, X gives a monobromo product. On the basis of these reactions, it can be concluded that X

I. contains aldehydic carbonyl group II. contains ketonic carbonyl group

III. contains ester carbonyl group IV. does not contain C=C bonds

(A) I only (B) III and IV (C) III only (D) II and IV

73) The undissociated form of a weak organic acid HA can be extracted from the aqueous phase into an organic phase using a water-immiscible organic solvent according to the following scheme



Which of the following is/are correct for this extraction?

I. $[HA]_{org}/[HA]_{aq}$ depends on the pH of the aqueous phase

II. HA can be efficiently extracted from basic aqueous solutions

III. $[HA]_{org}/[HA]_{aq}$ depends on the initial concentration of HA

IV. $[HA]_{org}/[HA]_{aq}+[A^-]$ depends on the pH of the aqueous phase

(A) II and IV (B) IV only (C) I only (D) III and IV

74) The correct order of reactivity in nucleophilic substitution reaction of the following compounds a, b, and c would be

$CH_3CH_2CONH_2$ (a) $CH_3CH_2COOCH_3$ (b) CH_3CH_2COCl (c)

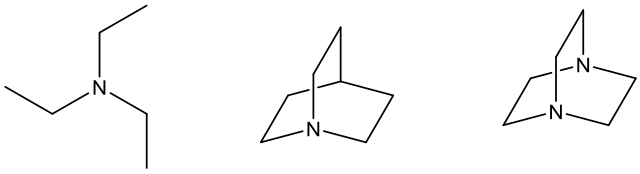
(A) a > c > b (B) a > b > c (C) c > b > a (D) c > a > b

75) The complex ion that does not have d electrons in the metal atom is

(A) $[MnO_4]^-$ (B) $[Co(NH_3)_6]^{3+}$

(C) $[Fe(CN)_6]^{3-}$ (D) $Cr(H_2O)_6]^{3+}$

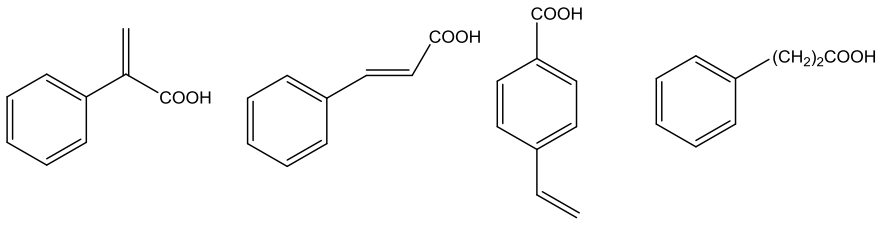
76) The order in which the compounds a, b and c react with CH_3I would be



(a) (b) (c)

(A) a > c > b (B) b > c > a (C) c > b > a (D) b > a > c

77) An organic compound 'P' with molecular formula $C_9H_8O_2$ on oxidation gives benzoic acid as one of the products. The possible structure/s of 'P' is/are



(I) (II) (III) (IV)

(A) I and III (B) II and IV (C) I and II (D) II only

78) The energy of an electron in the ground state of H atom is -13.6eV.

The negative sign indicates that

(A) electrons are negatively charged

(B) H atom is more stable than a free electron

(C) energy of the electron in the H atom is lower than that of a free electron

(D) work must be done to make a H atom from a free electron and proton

79) Radius of Ar atom is 145pm. The percentage volume occupied by an Ar atom at STP is

(A) 0.03 (B) 3.0 (C) 0.30 (D) 0.06

80) The reduction of O_2 to H_2O in acidic solution has a standard reduction potential of 1.23 V. If the pH of the acid solution is increased by one unit, half cell potential will

$$O_2\,(g) + 4\,H^+(aq) + 4e^- \rightarrow 2H_2O\,(l)$$

(A) decrease by 59 mV

(B) increase by 59 mV

(C) decrease by 236 mV

(D) increase by 236 mV

Rough Sheet