JAM 2015

Question Paper with Answers



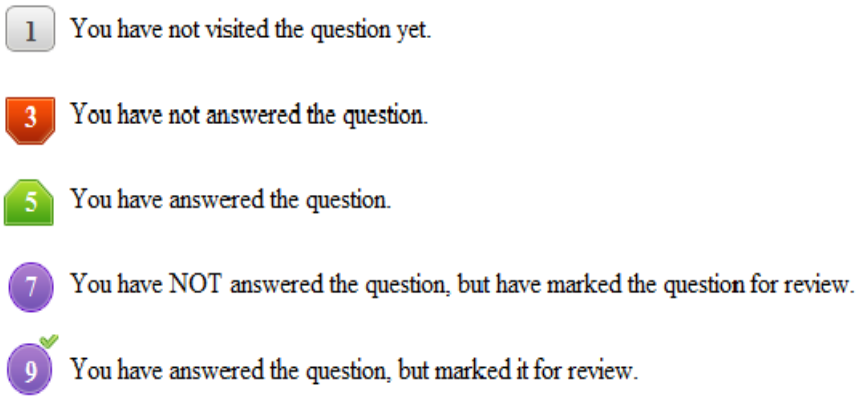
For All Subjects Question Papers with Answers please visit:

http://admission.aglasem.com/jam-previous-year-question-papers/

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JAM 2015: General Instructions during Examination

1. Total duration of the JAM 2015 examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use only your own **non-programmable calculator**.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:



7. The **Marked for Review** status for a question simply indicates that you would like to look at that question again. *If a question is 'answered, but marked for review', then the answer will be considered for evaluation unless the status is modified by the candidate.*

Navigating to a Question :

8. To answer a question, do the following:
   - **a.** Click on the question number in the Question Palette to go to that question directly.
   - **b.** Select the answer for a multiple choice type question and for the multiple select type question. Use the virtual numeric keypad to enter the answer for a numerical type question.
   - **c.** Click on **Save & Next** to save your answer for the current question and then go to the next question.
   - **d.** Click on **Mark for Review & Next** to save and to mark for review your answer for the current question, and then go to the next question.

Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

9. You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question :

10. Procedure for answering a multiple choice question (MCQ):
    - **a.** Choose the answer by selecting only one out of the 4 choices (A,B,C,D) given below the question and click on the bubble placed before the selected choice.

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b. To deselect your chosen answer, click on the bubble of the selected choice again or click on the **Clear Response** button.

c. To change your chosen answer, click on the bubble of another choice.

d. To save your answer, you MUST click on the **Save & Next** button.

11. Procedure for answering a multiple select question (MSQ):

a. Choose the answer by selecting one or more than one out of the 4 choices (A,B,C,D) given below the question and click on the checkbox(es) placed before each of the selected choice (s).

b. To deselect one or more of your selected choice(s), click on the checkbox(es) of the choice(s) again. To deselect all the selected choices, click on the **Clear Response** button.

c. To change a particular selected choice, deselect this choice that you want to change and click on the checkbox of another choice.

d. To save your answer, you MUST click on the **Save & Next** button.

12. Procedure for answering a numerical answer type (NAT) question:

a. To enter a number as your answer, use the virtual numerical keypad.

b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.

c. To clear your answer, click on the **Clear Response** button.

d. To save your answer, you MUST click on the **Save & Next** button.

13. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ and MSQ types) or entered (for NAT) for a question that is* **Marked for Review***, that answer will be considered in the evaluation unless the status is modified by the candidate.*

14. To change your answer to a question that has already been answered, first select that question and then follow the procedure for answering that type of question as described above.

15. Note that ONLY those questions for which answers are ***saved*** or ***marked for review after answering*** will be considered for evaluation.

Choosing a Section :

16. Sections in this question paper are displayed on the top bar of the screen. All sections are compulsory.

17. Questions in a section can be viewed by clicking on the name of that section. The section you are currently viewing will be highlighted.

18. To select another section, simply click the name of the section on the top bar. You can shuffle between different sections any number of times.

19. When you select a section, you will only be able to see questions in this Section, and you can answer questions in the Section.

20. After clicking the **Save & Next** button for the last question in a section, you will automatically be taken to the first question of the next section in sequence.

21. You can move the mouse cursor over the name of a section to view the answering status for that section.

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JAM 2015 Examination

CY: Chemistry

Duration: **180 minutes** *Maximum Marks*: **100**

Read the following instructions carefully.

1. To login, enter your Registration Number and Password provided to you. Kindly go through the various coloured symbols used in the test and understand their meaning before you start the examination.
2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **Question Paper** button in the screen.
3. This test paper has a total of 60 questions carrying 100 marks. The entire question paper is divided into three **sections, A, B** and **C**. All sections are compulsory. Questions in each section are of different types.
4. **Section – A** contains **Multiple Choice Questions (MCQ)**. Each MCQ type question has four choices out of which only one choice is the correct answer. This section has 30 Questions and carry a total of 50 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.30 carry 2 marks each.
5. **Section – B** contains **Multiple Select Questions (MSQ)**. Each MSQ type question is similar to MCQ but with a difference that there may be one or more than one choice(s) that are correct out of the four given choices. The candidate gets full credit if he/she selects all the correct choices only and no wrong choices. This section has 10 Questions and carry 2 marks each with a total of 20 marks.
6. **Section – C** contains **Numerical Answer Type (NAT)** questions. For these NAT type questions, the answer is a real number which needs to be entered using the virtual numerical keypad on the monitor. No choices will be shown for these type of questions. This section has 20 Questions and carry a total of 30 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.20 carry 2 marks each.
7. Depending upon the JAM test paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Data** button that appears at the top, right hand side of the screen.
8. The computer allotted to you at the examination centre runs specialized software that permits only one choice to be selected as answer for multiple choice questions using a mouse, one or more than one choices to be selected as answer for multiple select questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual numeric keypad and mouse.
9. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.
10. Multiple choice questions (Section-A) will have four choices against A, B, C, D, out of which only **ONE** choice is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (○) placed before the choice.
11. Multiple select questions (Section-B) will also have four choices against A, B, C, D, out of which **ONE OR MORE THAN ONE** choice(s) is /are the correct answer. The candidate has to choose the correct answer by clicking on the checkbox (□) placed before the choices for each of the selected choice(s).
12. For numerical answer type questions (Section-C), each question will have a numerical answer and there will not be any choices**. For these questions, the answer should be entered** by using the mouse and the virtual numerical keypad that appears on the monitor.
13. In all questions, questions not attempted will result in zero mark. In **Section – A** (MCQ), wrong answer will result in **NEGATIVE** marks. For all 1 mark questions, 1/3 marks will be deducted for each wrong answer. For all 2 marks questions, 2/3 marks will be deducted for each wrong answer. In **Section – B** (MSQ), there is **NO NEGATIVE** and **NO PARTIAL** marking provisions. There is **NO NEGATIVE** marking in **Section – C** (NAT) as well.

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14. **Non-programmable calculators** are allowed but sharing of calculators is not allowed.

15. Mobile phones, electronic gadgets other than calculators, charts, graph sheets, and mathematical tables are **NOT** allowed in the examination hall.

16. You can use the scribble pad provided to you at the examination centre for all your rough work. The scribble pad has to be returned at the end of the examination.

Declaration by the candidate:

"I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition".

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SECTION – A

MULTIPLE CHOICE QUESTIONS (MCQ)

Q. 1 – Q.10 carry one mark each.

Q.1 The first row transition metal complexes having tetrahedral geometry are high-spin due to

(A) $\Delta_t > P$ (B) $\Delta_t < P$ (C) $\Delta_t = P$ (D) $\Delta_t > \Delta_o$

Q.2 The species responsible for the superacidity of SbF_5-HSO_3F system is

(A) HSO_3F (B) SbF_5 (C) HF (D) $H_2SO_3F^+$

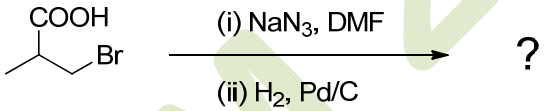
Q.3 A filter paper moistened with cadmium acetate solution turns yellow upon exposure to H_2S. The transition responsible for the yellow colour is

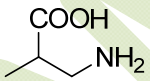
(A) d−d
(B) metal-to-ligand charge transfer
(C) ligand-to-metal charge transfer
(D) σ−σ*

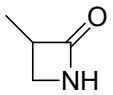
Q.4 Low-spin iron(III) center is present in

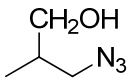
(A) deoxy form of hemoglobin
(B) oxy form of hemoglobin
(C) hemocyanin
(D) carbonic anhydrase

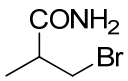
Q.5 The major product formed in the following reaction is



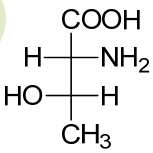
(A) 

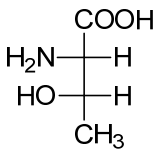
(B) 

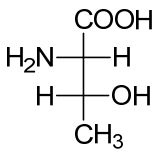
(C) 

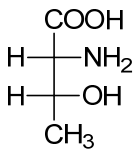
(D) 

Q.6 The structure of (2*S*,3*R*)-2-amino-3-hydroxy butanoic acid is

(A) 

(B) 

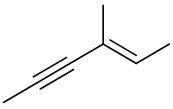
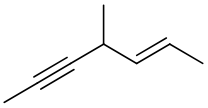
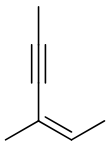
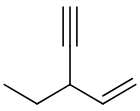
(C) 

(D) 

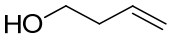
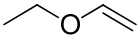
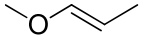
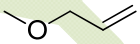
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Q.7 The ene-yne that produces a chiral compound upon treatment with Lindlar's catalyst is

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

Q.8 An organic compound **P** (C_4H_8O) is positive to Bayer's test, but inert to sodium metal. On treatment with conc. HCl, **P** gives CH_3CH_2Cl and CH_3CHO. The structure of **P** is

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

Q.9 Which one of the following is an identity matrix?

(A) $\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$ (B) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ (C) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ (D) $\begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$

Q.10 The intermolecular van der Waals potential is inversely proportional to r^6. The corresponding force is proportional to

(A) $\frac{1}{r^5}$ (B) $\frac{1}{r^6}$ (C) $\frac{1}{r^7}$ (D) $\frac{1}{r^{12}}$

Q. 11 – Q. 30 carry two marks each.

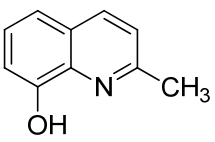
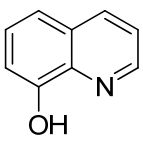
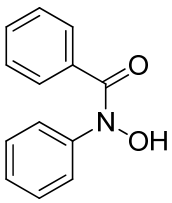
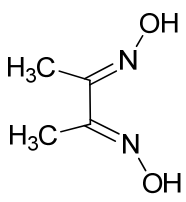
Q.11 The normal spinel among the following mixed metal-oxides is

(A) $CoFe_2O_4$ (B) $NiFe_2O_4$ (C) $CuFe_2O_4$ (D) $ZnFe_2O_4$

Q.12 The ground state term for a free ion with $3d^7$ configuration is

(A) $^4F_{3/2}$ (B) $^4F_{9/2}$ (C) $^4F_{1/2}$ (D) $^4F_{5/2}$

Q.13 The reagent 'oxine' commonly used in analytical chemistry is

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

Q.14 The species having trigonal pyramidal shape is

(A) NO_3^- (B) CO_3^{2-} (C) BrF_3 (D) SO_3^{2-}

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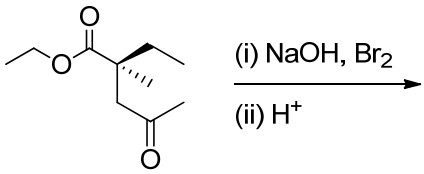
Q.15 The correct statement about ionization potential (IP) is

(A) Non-metallic character of an element decreases as the IP increases
(B) IP decreases down the group in the periodic table
(C) Second IP of Ca is larger than second IP of K
(D) IP decreases on going from left to right in the periodic table

Q.16 The Volhard method is used for the estimation of

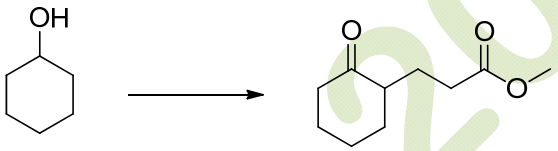
(A) cyanide ion by titration with silver nitrate
(B) silver ion directly
(C) oxygen in water
(D) glucose in blood

Q.17 The set of products formed in the following reaction is



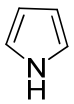
(A) $CHBr_3$ and a racemic acid
(B) $CHBr_3$ and a chiral acid
(C) $CHBr_3$ and a racemic ester
(D) CH_2Br_2 and a chiral ester

Q.18 The correct set of reagents required for the following transformation is

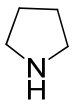


(A) (i) CrO_3; (ii) acrylonitrile; (iii) H_3O^+
(B) (i) O_2; (ii) methyl acrylate
(C) (i) CrO_3; (ii) NaOMe/MeOH, methyl acrylate; (iii) H_3O^+
(D) (i) H_2O; (ii) methyl acrylate

Q.19 The correct order of the p*K*a values for the conjugate acids of heterocyclic compounds given below is

(I) 

(II) 

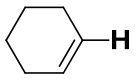
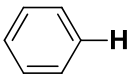
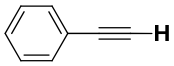
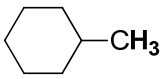
(III) 

(IV) 

(A) **II > III > I > IV** (B) **IV > II > III > I** (C) **III > II > IV > I** (D) **III > IV > II > I**

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Q.20 The correct order of the ^1H NMR chemical shift values (δ) for the indicated hydrogens (in bold) in the following compounds is

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

(A) **I > II > III > IV** (B) **II > I > III > IV** (C) **III > II > I > IV** (D) **II > III > IV > I**

Q.21 Which of the following statements are correct for S_NAr reaction?

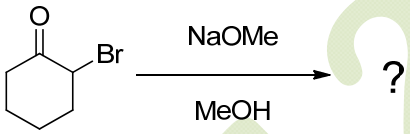
(i) Follows second order kinetics
(ii) $K_H/K_D > 1$
(iii) Involves carbanion-type intermediate
(iv) Involves two transition states

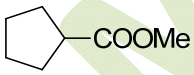
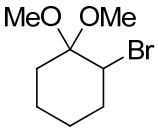
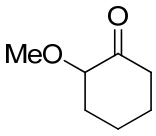
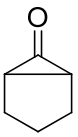
(A) (i) and (ii) only (B) (ii) and (iii) only
(C) (i), (iii) and (iv) only (D) (i) and (iii) only

Q.22 According to the equipartition principle, the predicted high temperature limiting value of the molar heat capacity at constant volume for C_2H_2 is

(A) 5.5R (B) 6.0R (C) 9.0R (D) 9.5R

Q.23 The major product formed in the following reaction is



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

Q.24 At 25 °C, the solubility product (K_{sp}) of CaF_2 in water is 3.2×10^{-11}. The solubility (in mole per kg of water) of the salt at the same temperature (ignore ion pairing) is

(A) 4.0×10^{-6} (B) 3.2×10^{-4} (C) 2.5×10^{-4} (D) 2.0×10^{-4}

Q.25 For an isothermal free expansion of an ideal gas into vacuum, which one of the following set of values is correct?

(A) $\Delta U = 0, q > 0, w < 0$ (B) $\Delta U > 0, q > 0, w = 0$
(C) $\Delta U = 0, q = 0, w = 0$ (D) $\Delta U < 0, q = 0, w < 0$

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Q.26 The kinetics of the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ in liquid bromine medium was measured independently for three different initial concentrations of N_2O_5: 0.11, 0.07 and 0.05 mol L^{-1}. The half-life of the reaction was found to be 4.5 hours for all these concentrations. The order of the reaction is

(A) 0 (B) 1 (C) 2 (D) 0.5

Q.27 The concentration of K^+ ion inside a biological cell is 20 times higher than outside. The magnitude of potential difference between the two sides is [Given: 2.303 RT/F = 59 mV]

(A) 0 mV (B) 26 mV (C) 77 mV (D) 177 mV

Q.28 The correct order of the fundamental vibrational frequencies of the following diatomic molecules is

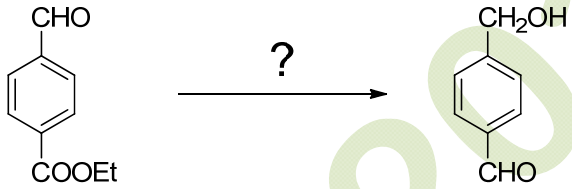
(A) $^1H^{35}Cl > {}^1H^{37}Cl > {}^2D^{35}Cl$

(B) $^2D^{35}Cl > {}^1H^{37}Cl > {}^1H^{35}Cl$

(C) $^1H^{37}Cl > {}^1H^{35}Cl > {}^2D^{35}Cl$

(D) $^1H^{37}Cl > {}^2D^{35}Cl > {}^1H^{35}Cl$

Q.29 Identify the correct reagents required for the following transformation



(A) (i) $NaBH_4$; (ii) H_3O^+

(B) (i) $LiAlH_4$; (ii) H_3O^+

(C) (i) $HOCH_2CH_2OH$, H^+; (ii) $LiAlH_4$; (iii) H_3O^+

(D) (i) $HSCH_2CH_2SH$, H^+; (ii) $LiAlH_4$; (iii) H_3O^+

Q.30 The complex that is expected to show orbital contribution to the overall magnetic moment is

(A) $[Cr(CN)_6]^{3-}$ (B) $[Co(H_2O)_6]^{2+}$ (C) $[Ni(en)_3]^{2+}$ (D) $[Cu(NH_3)_6]^{2+}$

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SECTION - B

MULTIPLE SELECT QUESTIONS (MSQ)

Q. 1 – Q. 10 carry two marks each.

Q.1 The common feature(s) of Rb^+, Kr and Br^- is/are that they

(A) have same number of valence electrons
(B) have same magnitude of effective nuclear charge
(C) have same magnitude of first ionization potential
(D) are isoelectronic species

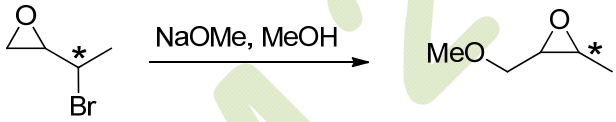
Q.2 The characteristics of the blue solution of sodium in liquid ammonia is/are

(A) diamagnetic
(B) paramagnetic
(C) reducing in nature
(D) conducts electricity

Q.3 Which of the following statement(s) is/are true about the transition metal-alkene complexes?

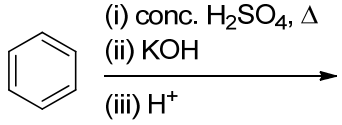
(A) Back-bonding weakens the double bond of the alkene
(B) σ-Bonding and back-bonding synergistically strengthen metal-alkene interaction
(C) Electron-withdrawing substituents on alkene reduce back-bonding
(D) π-Acidic co-ligands on metal strengthen back-bonding

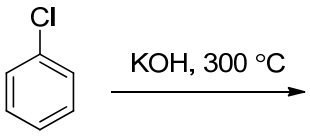
Q.4 Which of the following statement(s) is/are true about the reaction given below?

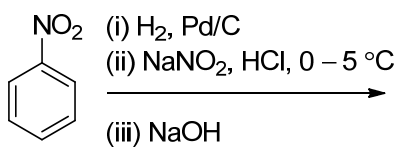


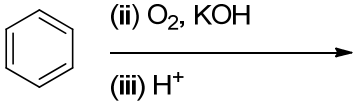
(A) It involves a carbocation intermediate
(B) Rearrangement is due to S_N1 reaction mechanism
(C) It proceeds via a concerted S_N2 pathway
(D) It involves neighbouring group participation

Q.5 The reaction(s) which give(s) phenol is/are

(A) 

(B) 

(C) 

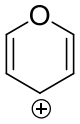
(D) 

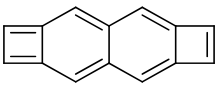
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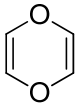
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Q.6 Which of the following species is/are aromatic in nature?

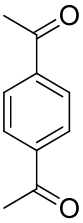
(A) 

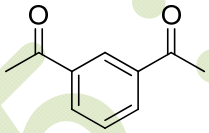
(B) 

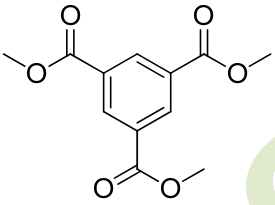
(C) 

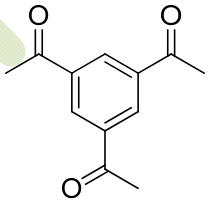
(D) 

Q.7 Which of the following compound(s) show(s) only two signals in ^{1}H NMR and a strong IR band at ~1690 cm^{-1}?

(A) 

(B) 

(C) 

(D) 

Q.8 If $\hat{x} = x \times$ and $\hat{p}_x = \frac{h}{2\pi i}\frac{d}{dx}$, then the value(s) of $\hat{p}_x\hat{x} - \hat{x}\hat{p}_x$ is/are

(A) $\frac{\hbar}{i}$ (B) $-i\hbar$ (C) 0 (D) $\frac{i}{\hbar}$

Q.9 At what angle(s) of incidence, X-rays of wavelength 5.0 Å will produce diffracted beam from the (110) planes in a simple cubic lattice with a = 10 Å?

(A) 6.8° (B) 10.2° (C) 20.7° (D) 45.0°

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Q.10 Which of the following thermodynamic relation(s) is/are correct?

(A) $\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$

(B) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(C) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(D) $\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

SECTION – C

NUMERICAL ANSWER TYPE (NAT)

Q. 1 – Q. 10 carry one mark each.

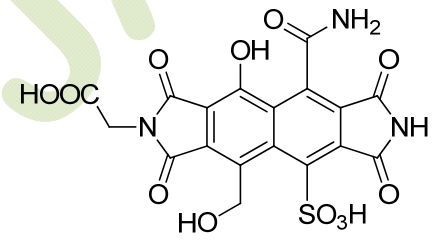
Q.1 Given that the crystal field stabilization energy for $[Co(H_2O)_6]^{2+}$ is 7360 cm^{-1}, the calculated value of Δ_o in kJ mol^{-1} is _____

Q.2 The amount (in grams) of potassium dichromate (MW = 294) present in 75 mL of 0.16 M aqueous solution is _____

Q.3 Given that the expected spin-only magnetic moment for $(Et_4N)_2[NiCl_4]$ is 2.83 μ_B, the total number of unpaired electrons in this complex is _____

Q.4 The pK_a values of lysine are 2.18, 8.95 and 10.79. The isoelectric point of lysine is _____

Q.5 The amount (in grams) of NaOH (MW = 40) required for complete neutralization of one mole of the following compound is _____



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Q.6 In the given list, the total number of compounds that form a clear homogenous solution on treatment with cold dilute H_2SO_4 is _____

1-propyne
cyclohexanone
cyclohexane
1-propene
propan-1-amine
propoxypropane
tetrahydropyran
ethyl butanoate
pyridine

Q.7 In the gas phase, the ratio of excluded volume to molecular volume for a spherical molecule is _____

Q.8 The pK_a values of H_3PO_4 are 2.12, 7.21 and 12.67. The pH of a phosphate buffer containing 0.2 M NaH_2PO_4 and 0.1 M Na_2HPO_4 is _____

Q.9 For the reaction, $2SO_2 + O_2 \leftrightharpoons 2SO_3$, the equilibrium constant K_P = 5.0 at 207 °C. If the partial pressures of SO_2, O_2 and SO_3 are 1.0×10^{-3}, 0.20 and 1.0×10^{-4}, respectively, then the Gibbs free energy of the reaction ($\Delta_r G$) in kJ mol^{-1} at 207 °C is _____ [Given: R = 8.314 J K^{-1} mol^{-1}]

Q.10 Two moles of an ideal gas is expanded isothermally and reversibly from 5 to 1 bar at 298 K. The change in the entropy (in J K^{-1}) of the system is _____

Q. 11 – Q. 20 carry two marks each.

Q.11 The ionic radii of Cs^+ and Cl^- ions are 181 and 167 pm, respectively. The Born exponents for the He, Ne, Ar, Kr and Xe configurations are 5, 7, 9, 10 and 12, respectively. If the value of $\frac{ANe^2}{4\pi\varepsilon_0}$ is 2.45×10^{-4} J m, the lattice energy (in kJ mol^{-1}) of CsCl according to Born-Landé equation is _____

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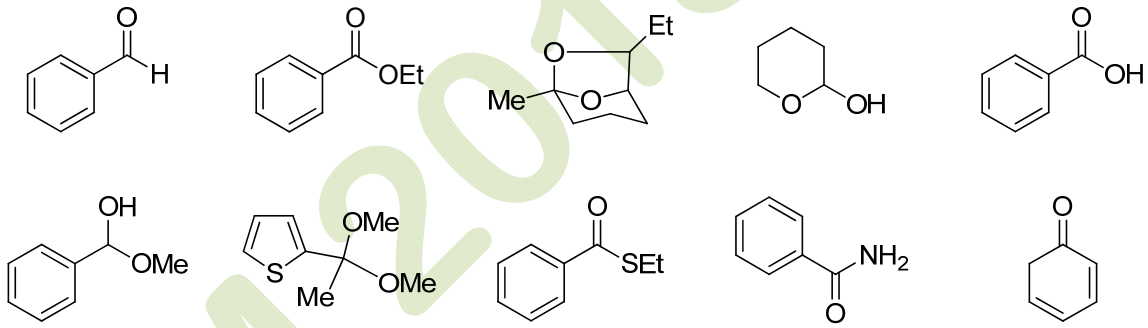
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Q.12 A 2.5×10^{-4} M solution of a complex exhibits an absorption maximum at 625 nm with an absorbance of 0.90 when measured in a cuvette with a path length of 1.5 cm. The absorbance of 1.5×10^{-3} M solution of the same complex recorded in a cuvette with a path length of 0.2 cm is _____

Q.13 A wood specimen containing ^{14}C taken from an ancient palace showed 24 counts in 3 minutes per gram of carbon in a detector. However, a fresh wood showed 52 counts in 2 minutes per gram of carbon. Assuming no background signal in the detector and half life of ^{14}C as 5730 years, the age (in years) of the wood specimen is _____

Q.14 The magnetic field (in Tesla) required for flipping a ^{1}H nucleus in an NMR spectrometer operating at 400 MHz is _____ [Given: $\gamma = 2.67 \times 10^{8}\ T^{-1}\ s^{-1}$, $\pi = 3.14$]

Q.15 The total number of compounds (shown below) that form phenylhydrazone derivatives under acidic conditions is _____



Q.16 The number of possible monoalkylated products formed in the Friedel-Crafts reaction of anisole with 2-chloro-3-methylbutane in the presence of anhydrous $AlCl_3$ at 50 °C is _____

Q.17 For a reaction, the rate constant at 25 °C is doubled when the temperature is raised to 45 °C. The activation energy (in kJ mol^{-1}) of the reaction is _____ [Given: ln2 = 0.693]

Q.18 The standard reduction potentials of the Fe^{3+}/Fe^{2+} and Fe^{2+}/Fe couples are 0.77 and −0.44 V, respectively. The standard reduction potential (in V) for the Fe^{3+}/Fe couple is _____

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Q.19 When a perfect monolayer of stearic acid is formed at the air-water interface, each molecule of stearic acid (MW = 284, density = 0.94 g cm^{-3}) occupies an area of 20 $Å^2$. The length (in Å) of the molecule is _____

Q.20 In an ideal monoatomic gas, the speed of sound is given by $\sqrt{\frac{5RT}{3M}}$. If the speed of sound in argon at 25 °C is 1245 km h^{-1}, the root mean square velocity in m s^{-1} is _____

END OF THE QUESTION PAPER

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Answer Keys for the Test Paper: Chemistry (CY)

Section A - MCQ Multiple Choice Questions			Section B - MSQ Multiple Select Questions			Section C - NAT Numerical Answer Type Questions		
Q. No.	Key	Marks	Q. No.	Key	Marks	Q. No.	Range	Marks
1	B	1	1	A;D	2	1	109.0 to 111.0	1
2	D	1	2	B;C;D	2	2	3.52 to 3.54	1
3	C	1	3	A;B	2	3	2 to 2	1
4	B	1	4	C;D	2	4	9.0 to 10.0	1
5	A	1	5	A;B;C;D	2	5	160 to 160	1
6	C	1	6	A;B;C	2	6	4 to 4	1
7	B	1	7	A;D	2	7	8 to 8	1
8	B	1	8	A;B	2	8	6.9 to 7.0	1
9	B	1	9	C;D	2	9	-18.5 to -18.3	1
10	C	1	10	B;C	2	10	26.5 to 27.0	1
11	D	2				11	-638.0 to -636.0	2
12	B	2				12	0.70 to 0.74	2
13	B	2				13	9600 to 9900	2
14	D	2				14	9.0 to 10.0	2
15	B	2				15	5 to 5	2
16	X	2				16	4 to 4	2
17	B	2				17	27.0 to 27.6	2
18	C	2				18	-0.04 to -0.03	2
19	C	2				19	24 to 26	2
20	B	2				20	462 to 465	2
21	C	2						
22	D	2						
23	A	2						
24	D	2						
25	C	2						
26	B	2						
27	C	2						
28	A	2						
29	C	2						
30	B	2						

Note: 'X' means 'Marks to All'.