

## GATE 2014: General Instructions during Examination

1. Total duration of the GATE 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 Common 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 a non-programmable type calculator, however, sharing of calculators is not allowed.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:



You have not visited the question yet.



You have not answered the question.



You have answered the question.



You have NOT answered the question, but have marked the question for review.



You have answered the question, but marked it for review.

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 :

7. 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 an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices, namely A, B, C and D. Use the virtual numeric keypad to enter a number as 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 your answer for the current question and also mark it for review, 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.

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 :**

8. Procedure for answering a multiple choice (MCQ) type question:
  - a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
  - b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
  - c. To change your chosen answer, click on the bubble of another option.
  - d. To save your answer, you MUST click on the **Save & Next** button.
9. Procedure for answering a numerical answer type 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
10. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is **Marked for Review**, that answer will be considered in the evaluation unless the status is modified by the candidate.*
11. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
12. Note that ONLY Questions for which answers are ***saved*** or ***marked for review after answering*** will be considered for evaluation.

### **Choosing a Section :**

13. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing will be highlighted.
14. A checkbox is displayed for every optional Section, if any, in the Question Paper. To select the optional Section for answering, click on the checkbox for that Section.
15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

16. 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.
17. You can move the mouse cursor over the name of a Section to view the answering status for that Section.

### **Changing the Optional Section :**

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section. If you do not want to reset the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.
19. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?" If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.
20. You can shuffle between different Sections or change the optional Sections any number of times.

**GATE 2014 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 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 **View All Questions** button in the screen.
3. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory.  
The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.  
The subject specific GATE paper section consists of **55** questions, out of which question numbers 1 to 25 are of 1-mark each, while question numbers 26 to 55 are of 2-mark each.
4. Depending upon the GATE 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 Common Data** button that appears at the top, right hand side of the screen.
5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.
6. 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**.
7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.
8. The question paper may consist of questions of **multiple choice type (MCQ)** and **numerical answer type**.
9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (○) placed before the choice.
10. For numerical answer type questions, 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 virtual keyboard that appears on the monitor and the mouse.
11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of  $\frac{1}{3}$  marks for a 1-mark question and  $\frac{2}{3}$  marks for a 2-mark question.
12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must 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”.

**Q. 1 – Q. 5 carry one mark each.**

- Q.1 A student is required to demonstrate a high level of comprehension of the subject, especially in the social sciences.

The word closest in meaning to comprehension is

- (A) understanding (B) meaning (C) concentration (D) stability

- Q.2 Choose the most appropriate word from the options given below to complete the following sentence.

One of his biggest \_\_\_\_\_ was his ability to forgive.

- (A) vice (B) virtues (C) choices (D) strength

- Q.3 Rajan was not happy that Sajan decided to do the project on his own. On observing his unhappiness, Sajan explained to Rajan that he preferred to work independently.

Which one of the statements below is logically valid and can be inferred from the above sentences?

- (A) Rajan has decided to work only in a group.  
 (B) Rajan and Sajan were formed into a group against their wishes.  
 (C) Sajan had decided to give in to Rajan's request to work with him.  
 (D) Rajan had believed that Sajan and he would be working together.

- Q.4 If  $y = 5x^2 + 3$ , then the tangent at  $x = 0, y = 3$

- (A) passes through  $x = 0, y = 0$  (B) has a slope of +1  
 (C) is parallel to the  $x$ -axis (D) has a slope of -1

- Q.5 A foundry has a fixed daily cost of Rs 50,000 whenever it operates and a variable cost of Rs 800Q, where Q is the daily production in tonnes. What is the cost of production in Rs per tonne for a daily production of 100 tonnes?

**Q. 6 – Q. 10 carry two marks each.**

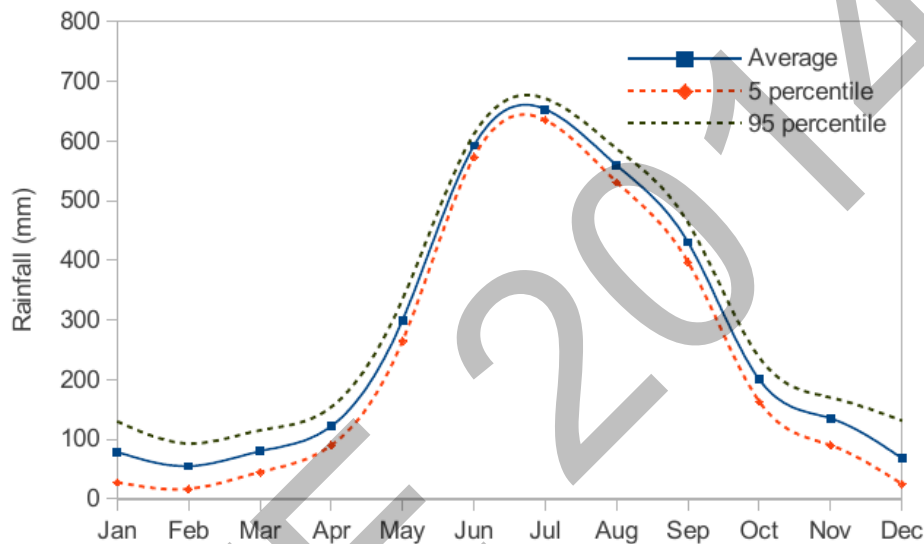
- Q.6 Find the odd one in the following group: ALRVX, EPVZB, ITZDF, OYEIK

- (A) ALRVX (B) EPVZB (C) ITZDF (D) OYEIK

- Q.7 Anuj, Bhola, Chandan, Dilip, Eswar and Faisal live on different floors in a six-storeyed building (the ground floor is numbered 1, the floor above it 2, and so on). Anuj lives on an even-numbered floor. Bhola does not live on an odd numbered floor. Chandan does not live on any of the floors below Faisal's floor. Dilip does not live on floor number 2. Eswar does not live on a floor immediately above or immediately below Bhola. Faisal lives three floors above Dilip. Which of the following floor-person combinations is correct?

	Anuj	Bhola	Chandan	Dilip	Eswar	Faisal
(A)	6	2	5	1	3	4
(B)	2	6	5	1	3	4
(C)	4	2	6	3	1	5
(D)	2	4	6	1	3	5

- Q.8 The smallest angle of a triangle is equal to two thirds of the smallest angle of a quadrilateral. The ratio between the angles of the quadrilateral is 3:4:5:6. The largest angle of the triangle is twice its smallest angle. What is the sum, in degrees, of the second largest angle of the triangle and the largest angle of the quadrilateral?
- Q.9 One percent of the people of country X are taller than 6 ft. Two percent of the people of country Y are taller than 6 ft. There are thrice as many people in country X as in country Y. Taking both countries together, what is the percentage of people taller than 6 ft?
- (A) 3.0 (B) 2.5 (C) 1.5 (D) 1.25
- Q.10 The monthly rainfall chart based on 50 years of rainfall in Agra is shown in the following figure. Which of the following are true? ( $k$  percentile is the value such that  $k$  percent of the data fall below that value)



- (i) On average, it rains more in July than in December  
(ii) Every year, the amount of rainfall in August is more than that in January  
(iii) July rainfall can be estimated with better confidence than February rainfall  
(iv) In August, there is at least 500 mm of rainfall
- (A) (i) and (ii) (B) (i) and (iii)  
(C) (ii) and (iii) (D) (iii) and (iv)

**END OF THE QUESTION PAPER**

## USEFUL DATA – CY CHEMISTRY

## COMMON DATA

Gas constant	:	$8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
	:	$0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$
Faraday constant	:	$96500 \text{ C mol}^{-1}$
$2.303RT/F$ at 300 K	:	$0.06 \text{ V}$
$N_A$	:	$6.02 \times 10^{23}$
Atomic numbers	:	B = 5, N = 7, Mg = 12, S = 16, Ti = 22, V = 23, Cr = 24, Mn = 25 Fe = 26, Co = 27, Ni = 28, Cu = 29, Rh = 45, Ta = 73

**Q. 1 – Q. 25 carry one mark each.**

- Q.1 The maximum non- $PV$  work that a system can perform at constant  $P$  is  
 (A)  $\Delta H$  (B)  $\Delta G$  (C)  $\Delta S$  (D)  $\Delta A$
- Q.2 Consider the reaction:  
 $A + B \rightleftharpoons C$   
 The unit of the thermodynamic equilibrium constant for the reaction is  
 (A)  $\text{mol L}^{-1}$  (B)  $\text{L mol}^{-1}$  (C)  $\text{mol}^2 \text{L}^{-2}$  (D) dimensionless
- Q.3 The number of IR active vibrational normal modes of  $\text{CO}_2$  is \_\_\_\_\_
- Q.4 The number of  $C_2$  axes in  $\text{CCl}_4$  is \_\_\_\_\_
- Q.5 The value of the magnetic quantum number of a  $p_x$  orbital is  
 (A)  $-1$  (B)  $0$  (C)  $+1$  (D) undefined
- Q.6 The molecular partition function for a system in which the energy levels are equispaced by  $\varepsilon$ , is  
 (A)  $\frac{1}{1 + e^{\beta\varepsilon}}$  (B)  $\frac{1}{1 - e^{\beta\varepsilon}}$  (C)  $\frac{1}{1 + e^{-\beta\varepsilon}}$  (D)  $\frac{1}{1 - e^{-\beta\varepsilon}}$
- Q.7 A monoatomic gas,  $X$ , adsorbed on a surface, follows Langmuir adsorption isotherm. A plot of the fraction of surface coverage,  $\theta$ , against the concentration of the gas  $[X]$ , for **VERY LOW** concentration of the gas, is described by the equation  
 (A)  $\theta = K[X]$  (B)  $1 - \theta = \frac{1}{K[X]}$   
 (C)  $\theta = K^{1/2}[X]^{1/2}$  (D)  $\theta = \frac{K[X]}{1 + K[X]}$
- Q.8 At a given temperature and pressure, the ratio of the average speed of hydrogen gas to that of helium gas is approximately \_\_\_\_\_
- Q.9 An example of *nido*-borane from the following is  
 (A)  $\text{B}_4\text{H}_{10}$  (B)  $\text{B}_6\text{H}_{10}$   
 (C)  $\text{B}_6\text{H}_{12}$  (D)  $\text{B}_8\text{H}_{14}$
- Q.10 The geometries of  $\text{Ni}(\text{CO})_4$  and  $[\text{NiCl}_4]^{2-}$ , respectively, are  
 (A) tetrahedral and square planar  
 (B) square planar and tetrahedral  
 (C) tetrahedral and tetrahedral  
 (D) square planar and square planar
- Q.11 The number of S–S bonds in  $\text{H}_2\text{S}_5\text{O}_6$  is \_\_\_\_\_
- Q.12 In atomic absorption spectroscopy, the atomization process utilizes  
 (A) flame (B) electric field (C) magnetic field (D) electron beam
- Q.13 At room temperature, the number of singlet resonances observed in the  $^1\text{H}$  NMR spectrum of  $\text{Me}_3\text{CC}(\text{O})\text{NMe}_2$  (N,N-dimethyl pivalamide) is \_\_\_\_\_



Q.14 Amongst the following, the metal that does **NOT** form homoleptic polynuclear metal carbonyl is

- (A) Mn (B) Fe (C) Cr (D) Co

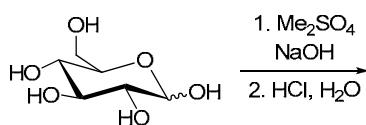
Q.15 The reaction of  $[\text{Cp}_2\text{TaMe}_2]\text{I}$  ( $\text{Cp} = \text{C}_5\text{H}_5^-$ ) with NaOMe yields

- (A)  $[\text{Cp}_2\text{Ta}(\text{OMe})_2]\text{I}$  (B)  $[\text{Cp}_2\text{Ta}(\text{Me})\text{OMe}]\text{I}$  (C)  $\text{Cp}_2\text{Ta}(\text{Me})=\text{CH}_2$  (D)  $\text{Cp}_2\text{Ta}(\text{OMe})=\text{CH}_2$

Q.16 The complexes  $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{NO}_2$  and  $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}(\text{NO}_2)]\text{Cl}$  are

- (A) linkage isomers  
(B) positional isomers  
(C) ionization isomers  
(D) optical isomers

Q.17 The major product of the following reaction is



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

Q.18 Amongst the following, the structure of guanosine is

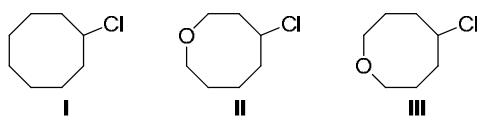
- (A) (B) (C) (D)

Q.19 The correct order of IR stretching frequency of the  $\text{C}=\text{C}$  in the following olefins is



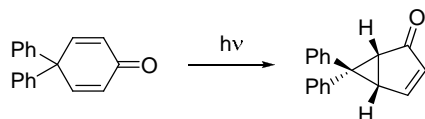
- (A)  $\text{I} > \text{II} > \text{III}$  (B)  $\text{II} > \text{III} > \text{I}$  (C)  $\text{III} > \text{II} > \text{I}$  (D)  $\text{III} > \text{I} > \text{II}$

Q.20 The correct order of the rate of solvolysis for the following chlorides in acetic acid is



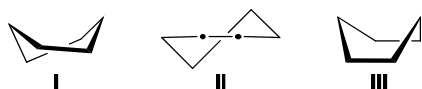
- (A)  $\text{II} > \text{I} > \text{III}$  (B)  $\text{III} > \text{II} > \text{I}$  (C)  $\text{III} > \text{I} > \text{II}$  (D)  $\text{I} > \text{III} > \text{II}$

Q.21 Formation of the product in the following photochemical reaction involves



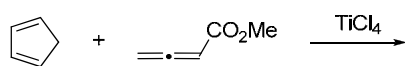
- (A) di- $\pi$ -methane rearrangement (B) Paterno-Buchi reaction  
(C) [2,3]-sigmatropic rearrangement (D) Norrish type I reaction

Q.22 The correct order of stability for the following conformations of cyclohexane is



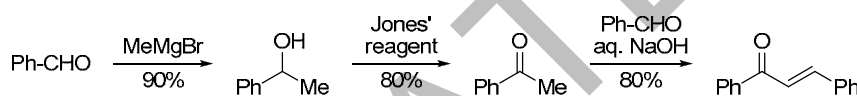
- (A) I > II > III (B) I > III > II (C) II > I > III (D) III > I > II

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

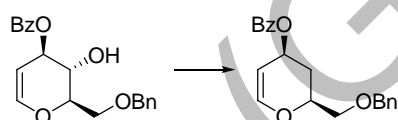


- (A) (B) (C) (D)

Q.24 The overall yield (in %) for the following reaction sequence is \_\_\_\_\_



Q.25 The most suitable reagent combination to effect the following conversion is



- (A) i. NaH, CS<sub>2</sub>, then MeI; ii. Bu<sub>3</sub>SnH, AIBN, C<sub>6</sub>H<sub>6</sub>, reflux  
(B) i. I<sub>2</sub>, PPh<sub>3</sub>, imidazole; ii. H<sub>2</sub>, 10% Pd-C, AcOH, high pressure  
(C) i. Me<sub>3</sub>SiCl, pyridine, DMAP; ii. Bu<sub>3</sub>SnH, AIBN, C<sub>6</sub>H<sub>6</sub>, reflux  
(D) i. MsCl, pyridine, DMAP; ii. LiAlH<sub>4</sub>, THF, reflux

**Q. 26 – Q. 55 carry two marks each.**

Q.26  $\psi = N r(6 - Zr)e^{-Zr/3} \cos \theta$ , is a proposed hydrogenic wavefunction, where  $Z$  = Atomic number,  $r$  = radial distance from the nucleus,  $\theta$  = azimuthal angle,  $N$  is a constant. The **INCORRECT** statement about  $\psi$  is

- (A)  $\psi = 0$  in the  $xy$ -plane  
(B) two radial nodes are present in  $\psi$   
(C) one angular node is present in  $\psi$   
(D) the size of the orbital decreases with increase in atomic number

Q.27 The van der Waals constants  $a$  and  $b$  of CO<sub>2</sub> are 3.64 L<sup>2</sup> bar mol<sup>-2</sup> and 0.04 L mol<sup>-1</sup>, respectively. The value of  $R$  is 0.083 bar dm<sup>3</sup> mol<sup>-1</sup> K<sup>-1</sup>. If one mole of CO<sub>2</sub> is confined to a volume of 0.15 L at 300 K, then the pressure (in bar) exerted by the gas, is \_\_\_\_\_

- Q.28 A plot of osmotic pressure against concentration ( $\text{g L}^{-1}$ ) of a polymer is constructed. The slope of the plot
- increases with increase in temperature
  - increases with increase in molar mass of the polymer
  - decreases with decrease in concentration of the polymer
  - decreases with increase in temperature
- Q.29 A platinum electrode is immersed in a solution containing  $0.1 \text{ M Fe}^{2+}$  and  $0.1 \text{ M Fe}^{3+}$ . Its potential is found to be  $0.77 \text{ V}$  against *SHE*. Under standard conditions and considering activity coefficients to be equal to unity, the potential of the electrode, when the concentration of  $\text{Fe}^{3+}$  is increased to  $1 \text{ M}$ , is \_\_\_\_\_
- Q.30 Molybdenum crystallizes in a *bcc* structure with unit cell dimensions of  $0.314 \text{ nm}$ . Considering the atomic mass of molybdenum to be  $96$ , its density (in  $\text{kg m}^{-3}$ ) is \_\_\_\_\_
- Q.31 The ratio of molecules distributed between two states is  $9.22 \times 10^6$  at  $300 \text{ K}$ . The difference in energy (in  $\text{kJ mol}^{-1}$ ) of the two states is \_\_\_\_\_
- Q.32 A Carnot engine operates at  $55\%$  efficiency. If the temperature of reject steam is  $105^\circ\text{C}$ , then the absolute temperature of input steam is \_\_\_\_\_
- Q.33 Of the following plots, the correct representation of chemical potential ( $\mu$ ) against absolute temperature ( $T$ ) for a pure substance is (*s*, *l* and *g* denote solid, liquid and gas phases, respectively)
- (A)

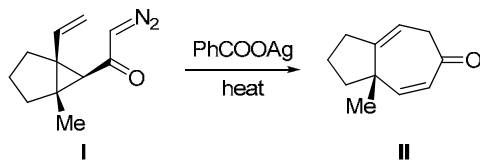
(B)

(C)

(D)
- Q.34 The enthalpy of fusion of ice at  $273 \text{ K}$  is  $6.01 \text{ kJ mol}^{-1}$  and the enthalpy of vaporization of water at  $273 \text{ K}$  is  $44.83 \text{ kJ mol}^{-1}$ . The enthalpy of sublimation (in  $\text{kJ mol}^{-1}$ ) of ice at  $273 \text{ K}$ , is \_\_\_\_\_
- Q.35 Suppose  $\psi_1$  and  $\psi_2$ , are two hybrid orbitals:  
 $\psi_1 = 0.12\psi_{3s} + 0.63\psi_{3p_x} + 0.77\psi_{3p_y}$   
 and  
 $\psi_2 = 0.12\psi_{3s} - 0.63\psi_{3p_x} - 0.77\psi_{3p_y}$   
 The angle (in degrees) between them is \_\_\_\_\_
- Q.36  $\text{BCl}_3$  and  $\text{NH}_4\text{Cl}$  were heated at  $140^\circ\text{C}$  to give compound **X**, which when treated with  $\text{NaBH}_4$  gave another compound **Y**. Compounds **X** and **Y** are
- $\text{X} = \text{B}_3\text{N}_3\text{H}_3\text{Cl}_3$  and  $\text{Y} = \text{B}_3\text{N}_3\text{H}_6$
  - $\text{X} = \text{B}_3\text{N}_3\text{H}_9\text{Cl}_3$  and  $\text{Y} = \text{B}_3\text{N}_3\text{H}_6$
  - $\text{X} = \text{B}_3\text{N}_3\text{H}_3\text{Cl}_3$  and  $\text{Y} = \text{B}_3\text{N}_3\text{H}_{12}$
  - $\text{X} = \text{B}_3\text{N}_3\text{Cl}_6$  and  $\text{Y} = \text{B}_3\text{N}_3\text{H}_6$

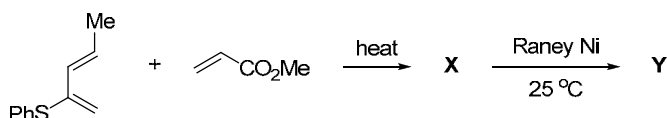
- Q.37 The number of microstates in term  $^1G$  is \_\_\_\_\_
- Q.38 The set of protons (underlined) in  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_3$  that would exhibit different splitting patterns in high (500 MHz) and low (60 MHz) field  $^1\text{H}$  NMR, is
- (A)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_3$   
 (B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_3$   
 (C)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_3$   
 (D)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_3$
- Q.39 Amongst the following, the complex ion that would show strong Jahn-Teller distortion is
- (A)  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  (B)  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  (C)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  (D)  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- Q.40 Amongst the following, the metal carbonyl species having the highest  $\nu_{\text{CO}}$  stretching frequency is
- (A)  $[\text{Mn}(\text{CO})_6]^+$  (B)  $\text{Cr}(\text{CO})_6$  (C)  $[\text{V}(\text{CO})_6]^-$  (D)  $[\text{Fe}(\text{CO})_4]^{2-}$
- Q.41 The correct order of thermal stability for the given compounds is
- (A)  $\text{TiMe}_4 > \text{Ti}(\text{CH}_2\text{CMe}_3)_4 > \text{TiEt}_4$   
 (B)  $\text{TiEt}_4 > \text{Ti}(\text{CH}_2\text{CMe}_3)_4 > \text{TiMe}_4$   
 (C)  $\text{TiMe}_4 > \text{TiEt}_4 > \text{Ti}(\text{CH}_2\text{CMe}_3)_4$   
 (D)  $\text{Ti}(\text{CH}_2\text{CMe}_3)_4 > \text{TiMe}_4 > \text{TiEt}_4$
- Q.42 Amongst the following, the complex ion that is expected to show the highest magnetic moment at room temperature is
- (A)  $[\text{Ni}(\text{CN})_4]^{2-}$  (B)  $[\text{Fe}(\text{CN})_6]^{3-}$  (C)  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  (D)  $[\text{Co}(\text{CN})_6]^{3-}$
- Q.43  $\text{MnCr}_2\text{O}_4$  is
- (A) normal spinel with total CFSE of  $-15.5 \text{ Dq}$   
 (B) inverse spinel with total CFSE of  $-15.5 \text{ Dq}$   
 (C) normal spinel with total CFSE of  $-24 \text{ Dq}$   
 (D) inverse spinel with total CFSE of  $-24 \text{ Dq}$
- Q.44  $\text{Mg}^{2+}$  is preferred in photosynthesis by chlorophyll because
- (A) it has strong spin-orbit coupling  
 (B) it has weak spin-orbit coupling  
 (C) it is a heavy metal  
 (D) it binds strongly with chlorophyll
- Q.45 In Monsanto acetic acid process shown below, the role of HI is
- $$\text{CH}_3\text{OH} + \text{CO} \xrightarrow[180^\circ\text{C, 30 bar}]{\text{Rh(I) catalyst / HI}} \text{CH}_3\text{CO}_2\text{H}$$
- (A) to convert  $\text{CH}_3\text{OH}$  to a stronger nucleophile ( $\text{CH}_3\text{O}^-$ )  
 (B) to reduce the Rh(I) catalyst to a Rh(0) species  
 (C) to reduce a Rh(III) active species to a Rh(I) species in the catalytic cycle  
 (D) to convert  $\text{CH}_3\text{OH}$  to  $\text{CH}_3\text{I}$

Q.46 Formation of the ketone **II** from the diazoketone **I** involves



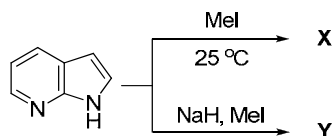
- (A) generation of carbene and a [2,3]-sigmatropic rearrangement  
 (B) generation of carbene and an electrocyclic ring closing reaction  
 (C) generation of ketene and a [2+2] cycloaddition  
 (D) generation of ketene and a [3,3]-sigmatropic rearrangement

Q.47 The major products **X** and **Y** formed in the following reaction sequence are

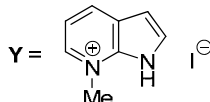
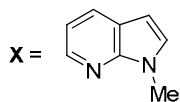


- (A)
- X** = CC1(C=CC(=O)OC)C(=C)C1Sc2ccccc2
**Y** = CC1(C=CC(=O)OC)C=CC1
- (B)
- X** = CC1(C=CC(=O)OC)C(=C)C1Sc2ccccc2
**Y** = CC1(C=CC(O)C)C(=C)C1Sc2ccccc2
- (C)
- X** = CC1(C=CC(=O)OC)C=CC1Sc2ccccc2
**Y** = CC1(C=CC(O)C)C=CC1Sc2ccccc2
- (D)
- X** = CC1(C=CC(=O)OC)C(=C)C1Sc2ccccc2
**Y** = CC1(C=CC(=O)OC)C(=C)C1Sc2ccccc2

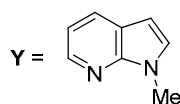
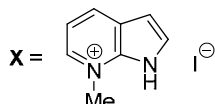
Q.48 The major products **X** and **Y** formed in the following reactions are



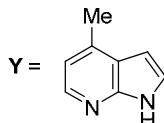
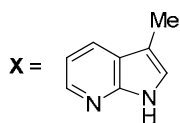
(A)



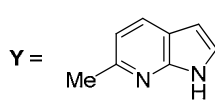
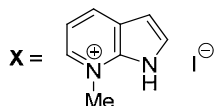
(B)



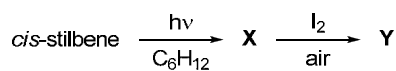
(C)



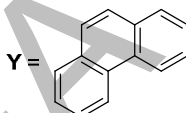
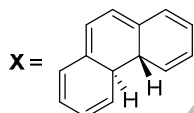
(D)



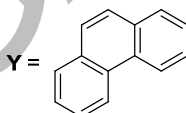
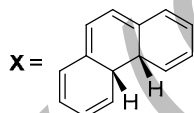
Q.49 The major products **X** and **Y** formed in the following reaction sequence are



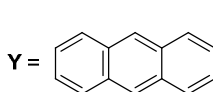
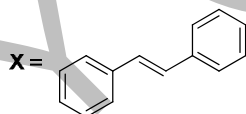
(A)



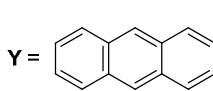
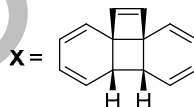
(B)



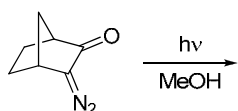
(C)



(D)

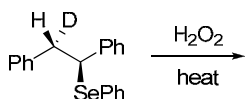


Q.50 The product of the following reaction gave 6 line  $^{13}\text{C}$  NMR spectrum with peaks at  $\delta$  175, 52, 50, 46, 37, 33 ppm. The structure of the product is



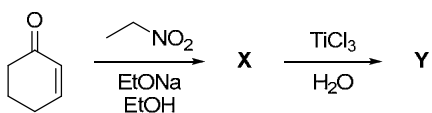
- (A) (B) (C) (D)

Q.51 The major product formed in the following reaction is



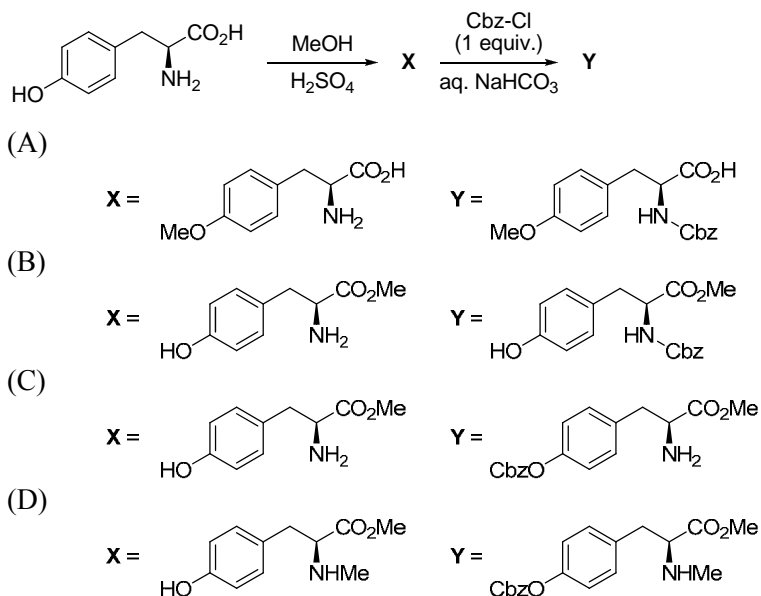
- (A) (B) (C) (D)

Q.52 The major products **X** and **Y** formed in the following reaction sequence are

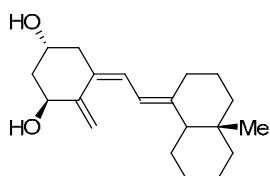


- (A) **X** = **Y** = (B) **X** = **Y** = (C) **X** = **Y** = (D) **X** = **Y** =

Q.53 The major products **X** and **Y** formed in the following reaction sequence are



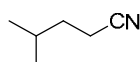
Q.54 Given the fact that 1,3-butadiene has a UV absorption of 217 nm, the absorption wavelength (in nm) for the conjugated system shown below is \_\_\_\_\_



(Use these absorption values for auxochromic groups:

alkyl: +5; *exo*-cyclic double bond: +5; every additional conjugated C=C: +30)

Q.55 The  $m/z$  value of the detectable fragment formed by McLafferty like rearrangement of the following compound in mass spectrometer is \_\_\_\_\_



**END OF THE QUESTION PAPER**