SAMPLE QUESTION PAPER

CHEMISTRY

Class - XI

Government of Kerala
Department of Education

Prepared by
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Guidelines for the Preparation of Question Paper for
Higher Secondary Education 2014-15

Introduction

Term evaluation is an important aspect of Continuous and Comprehensive Evaluation (CCE). It covers the assessment of learning aspect of the CCE. The Kerala School Curriculum 2013 postulated that the examination system should be recast so as to ensure a method of assessment that is a valid, reliable and objective measure of student development and a powerful instrument for improving the learning process. The outcome focused written tests are being used as tools for terminal assessment. Practical assessment is also considered for some subjects. The syllabus, scheme of work, textual materials, teacher texts and learning experiences may be considered while developing tools for term evaluation.

In order to make the examination system effective and objective, quality of the question paper needs to be ensured. Questions of different types considering various learning outcomes, thinking skills and of varying difficulty levels are to be included in the question paper. This makes question paper setting a significant task that has to be undertaken with the support of proper guidelines.

The guidelines for the preparation of the question paper have been divided into four heads for its effective implementation and monitoring. The areas are i) preparatory stage, ii) nature of questions, iii) question paper setting and iv) structure of the question paper.

I. Preparatory stage

Before starting the process of question paper setting, the question paper setter should ensure that she/he has:

- Familiarised the current syllabus and textbook of the concerned subject.
- secured the list of LOs (Learning Outcomes) relating to the subject.
- acquired the list of thinking skills applicable to the subject.
- prepared a pool of questions from each unit of the subject.
- verified the scheme of work and weight of score for each unit/lesson.

II. Nature of questions

Questions selected from the pool to be included in the question paper should reflect the following features:

- stem of the question text should be relevant to the question posed.
- multiple choice questions should be provided with four competitive distracters.
- the possibilities of higher order thinking skills should be considered while setting MCQs
- time allotted for each question should be justified according to the thinking skills involved.
- the scope and length of the answer should be clearly indicated.
- questions should be prepared by considering the learning level of the learner.
- the question should focus on the learning outcomes.
a wide range of thinking skills and learning outcomes from each unit/lesson should be considered.

varied forms of questions should be covered.

there should be a balance between the time allotted and the level of question.

question should be very specific and free from ambiguity.

question text should not be too lengthy and complicated.

questions can be prepared based on a single or a cluster of learning outcomes which is scattered over one particular unit or units.

cluster of learning outcomes from different units can be considered only for graded questions (questions with sub-divisions).

the possibilities of graded questions reflecting different thinking skills can be explored.

while preparing questions for language papers importance should be given to the language elements, language skills, discourses, textual content and elements of creativity.

while preparing questions for subjects other than languages, importance should be given to content, concepts and skills.

questions should cater the needs of differently abled learners and CWSEN (Children With Special Educational Needs).

the questions should contain varied forms such as objective type with specific focus to multiple choice test items and descriptive types (short answer and essay types).

directions regarding the minimum word limit for essay type questions should be given.

sufficient hints can be provided for essay type questions, if necessary.

maximum usage of supporting items like pictures, graphs, tables and collage may be used while preparing questions.

questions which hurt the feelings of caste, religion, gender, etc. must be completely avoided.

III. Question paper setting

During the process of question paper setting the question setter should:

prepare a design of the question paper with due weight to content, learning outcomes, different forms of questions and thinking skills.

prepare a blueprint based on the design.

prepare scoring key indicating value points and question based analysis along with the question paper.

while preparing scoring key, thinking skills should also be integrated.

60% weight should be given to thinking skills for conceptual attainment and 40% to thinking skills for conceptual generation.

15 to 20% weight of total scores must be given to objective type questions and up to 20% weight of total score must be given to essay type questions.

the highest score that can be given to a question in the question paper is limited to 10% of the total score.
• while fixing the time for answering a question, time for reading, comprehending and writing the answer must be considered.
• The total time limit of the question paper - two hours for 60 scores and \(2\frac{1}{2}\) hours for 80 scores question papers with an extra cool-off time of 15 minutes.

IV. Structure of the question paper

The question paper should reflect the following features in general:
• general instructions for the question paper should be given on the top.
• instructions for specific questions can be given before the question text.
• monotony of set patterns (objective or descriptive) should be avoided.
• questions should be prepared in bilingual form.
• there should not be any mismatch between the bilingual versions of the questions.
• choice can be given for questions up to 20% of the total score.
• while giving choice, alternative questions should be from the same unit with the same level of thinking skills.
• in the case of languages, language of the questions and answers should be in the particular language concerned. Necessary directions in this regard must be given in the question paper.

THINKING SKILLS

<table>
<thead>
<tr>
<th>Category/processes</th>
<th>Alternative terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remember</td>
<td>Retrieve relevant knowledge from long-term memory</td>
</tr>
<tr>
<td>1.1. Recognising</td>
<td>identifying- (e.g. Recognize the dates of important events in Indian history)</td>
</tr>
<tr>
<td>1.2. Recalling</td>
<td>retrieving - (e.g. Recall the major exports of India)</td>
</tr>
<tr>
<td>2. Understand</td>
<td>Construct meaning from instructional messages, including oral, written and graphic information</td>
</tr>
<tr>
<td>2.1. Interpreting</td>
<td>clarifying, paraphrasing, representing, translating (e.g. Write an equation [using B for the number of boys and G for the number of girls] that corresponds to the statement ‘There are twice as many boys as girls in this class’)</td>
</tr>
<tr>
<td>2.2. Exemplifying</td>
<td>illustrating, instantiating (e.g. Locate an inorganic compound and tell why it is inorganic)</td>
</tr>
<tr>
<td>2.3. Classifying</td>
<td>categorizing, subsuming (e.g. Classify the given transactions to be recorded in Purchase returns book and Sales returns book)</td>
</tr>
<tr>
<td>2.4. Summarising</td>
<td>abstracting, generalizing (e.g. Students are asked to read an untitled passage and then write an appropriate title.)</td>
</tr>
<tr>
<td>2.5. Inferring</td>
<td>concluding, extrapolating, interpolating, predicting (e.g. a student may be given three physics problems, two involving one principle and another involving a different principle and ask to state the underlying principle or concept the student is using to arrive at the correct answer.)</td>
</tr>
<tr>
<td>2.6. Comparing</td>
<td>contrasting, mapping, matching (e.g. Compare historical events to contemporary situations)</td>
</tr>
</tbody>
</table>
2.7. **Explaining**
constructing models (e.g. the students who have studied Ohm’s law are asked to explain what happens to the rate of the current when a second battery is added to a circuit.)

3. **Apply**
*Carry out or use a procedure in a given situation*

3.1. **Executing**
Carrying out (e.g. Prepare Trading and Profit and loss Account from the Trial Balance given and find out the net profit.)

3.2. **Implementing**
using (e.g. Select the appropriate given situation where Newton’s Second Law can be used)

4. **Analyse**
*Break material into its constituent parts and determines how the parts relate to one another and to an overall structure or purpose*

4.1. **Differentiating**
discriminating, distinguishing, focusing, selecting (e.g. distinguish between relevant and irrelevant numbers in a mathematical word problem)

4.2. **Organising**
finding coherence, integrating, outlining, parsing, structuring (e.g. the students are asked to write graphic hierarchies best corresponds to the organisation of a presented passage.)

4.3. **Attributing**
deconstructing (e.g. determine the point of view of the author of an essay in terms of his or her ethical perspective)

5. **Evaluate**
*Make judgements based on criteria and standards*

5.1. **Checking**
coordinating, detecting, monitoring, testing (e.g. after reading a report of a chemistry experiment, determine whether or not the conclusion follows from the results of the experiment.)

5.2. **Critiquing**
judging (e.g. Judge which of the two methods is the best way to solve a given problem)

6. **Create**
*Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure*

6.1. **Generating**
hypothesizing (e.g. suggest as many ways as you can to assure that everyone has adequate medical insurance)

6.2. **Planning**
designing (e.g. design social intervention programmes for overcoming excessive consumerism)

6.3. **Producing**
constructing (e.g. the students are asked to write a short story based on some specifications)

Considering the intellectual level of learners, while setting the question paper;

1. **60% weight may be given to thinking skills used for factual and conceptual attainment and**

2. **40% weight may be given to thinking skills for conceptual generation** (higher thinking skills has to be ensured in this category). Thinking skills for conceptual generation means thinking skills needed for elaborating the concepts.

*Refer the range of thinking skills given above. We can include the thinking skills no.1.1 to 3.2 (11 processes) under first category and 4.1 to 6.3 (8 processes) under second category.*
1. Multi level questions should be promoted.
2. The weight of objective questions should be between 15%-20% of total score and it should carry one score.
3. The weight of essay question should be between 15%-20% of total score and it should carry four or five scores.
4. The short answer question should carry two or three scores.
5. The content items in trivia in the SCERT text book should not be used for term end evaluation.
6. Numerical problems should be included for 15%-20% of total score.
7. Graphs, diagrams and pictures should be included in the questions wherever necessary.
8. Specific hints should be included in the questions if needed.
CHEMISTRY
Sample Question Paper

General Instructions to candidates:
• There is 'Cool off time' of 15 minutes in addition to the writing time of 2 hrs.
• You are neither allowed to write your answers nor to discuss anything with others during the 'cool off time'.
• Use the 'cool off time' to get familiar with questions and to plan your answers.
• Read the questions carefully before answering.
• All questions are compulsory and only internal choice is allowed.
• When you select a question, all the sub-questions must be answered from the same question itself.
• Calculations, figures and graphs should be shown in the answer sheet itself.
• Malayalam version of the questions is also provided.
• Give equations wherever necessary.
• Electronic devices except nonprogrammable calculators are not allowed in the Examination Hall.
1. “Equal volumes of gases at the same temperature and pressure should contain equal number of molecules.”
   a. Name the above law. (1)
   b. The amount of sodium hydroxide required to prepare 500 mL of 0.1 M sodium hydroxide solution is
      [(a) 4 g (b) 2 g (c) 1 g (d) 5 g] (1)
   c. An organic compound contains 80% C and 20% H. Determine its empirical formula. (2)

2. a. The number of radial nodes for a 5p orbital is
      [(a) 5 (b) 4 (c) 3 (d) 2] (1)
   b. Rutherford and his students discovered nucleus with the help of α-ray scattering experiment.
      With the help of a schematic diagram explain the observations and conclusions of this experiment.
      OR
      What are quantum numbers? Explain the significance of each. (4)

3. The modern periodic law is based on the observations of Henry Moseley on X-ray spectra of elements.
   a. State modern periodic law and write any two features of the long form of the periodic table. (2)
   b. Analyze the following graph between ionization enthalpy and atomic number:

   ![Graph showing trend in ionization enthalpy with atomic number]

   What you observe from the graph? Give justification for your observation. (2)
4. a. Draw the Lewis electron dot structure of ozone and assign formal charge on each atom.
   (3) b. Write the molecular orbital electronic configuration of N₂ molecule and calculate its bond order.

**OR**

Predict the shapes of the following molecules on the basis of hybridisation.

BCl₃, NH₃

5. a. A plot of volume (V) versus temperature (T) for a gas at constant pressure is a straight line passing through the origin. The plots at different values of pressure are shown below:

Which of the following order of pressure is correct for this gas?

(i) p₁ > p₂ > p₃ > p₄
(ii) p₁ = p₂ = p₃ = p₄
(iii) p₁ < p₂ < p₃ < p₄
(iv) p₁ < p₂ = p₃ < p₄

6. a. Standard molar enthalpy of formation, $ΔH^\circ_f$ is just a special case of enthalpy of reaction, $Δ_rH^\circ$. Is the $Δ_rH^\circ$ for the following reaction same as $Δ_rH^\circ_f$? Give reason.

$$CaO(s) + CO_2(g) \rightarrow CaCO_3(s) : Δ_rH^\circ = -178.3 \text{ kJ mol}^{-1}$$ (2)

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4. a. ഓസ്ജെന്റി അക്ഷരാകൃതി അന്തരീക്ഷം ചെറു നിച്ചയത്തിന്റെ വായും തണ്ടും അന്തരീക്ഷം അന്തരീക്ഷം എന്നാൽ തണ്ടും അന്തരീക്ഷം അന്തരീക്ഷം എന്നാൽ
   (2) b. N₂ അക്ഷരാകൃതി അക്ഷരാകൃതി അന്തരീക്ഷം ചെറു നിച്ചയത്തിന്റെ വായും തണ്ടും അന്തരീക്ഷം അന്തരീക്ഷം എന്നാൽ

ഉപയോഗിക്കുന്ന അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം

(2) BCl₃, NH₃

5. a. ബൈലോൺ അക്ഷരാകൃതിയാണ്‌ മറ്റുനിർമ്മാണം അന്തരീക്ഷം വായും തണ്ടും (V) അന്തരീക്ഷം (T) അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം

ഉപയോഗിക്കുന്ന അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം

6. a. നിരാശയോ വായും അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം. $Δ_iH^\circ_f$ എന്ന് അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം അന്തരീക്ഷം $Δ_rH^\circ$ എന്നാൽ $Δ_rH^\circ_f$ എന്നാൽ $Δ_rH^\circ$ എന്നാൽ $Δ_iH^\circ$ എന്നാൽ $Δ_iH^\circ_f$ എന്നാൽ $Δ_iH^\circ$ എന്നാൽ $Δ_iH^\circ$ എന്നാൽ $Δ_iH^\circ_f$ എന്നാൽ $Δ_iH^\circ$ എന്നാൽ

$$CaO(s) + CO_2(g) \rightarrow CaCO_3(s) : Δ_rH^\circ = -178.3 \text{ kJ mol}^{-1}$$ (2)
b. Calculate the standard enthalpy of formation of methane if the standard enthalpy of combustion of carbon, hydrogen and methane are -393.5, -285.8 and -890.3 kJ mol\(^{-1}\) respectively at 298 K.  

\[(2)\]

7. a. The relationship between \(K_p\) and \(K_c\) is  

\[K_p = K_c (RT)^\Delta n\]

What would be the value of \(\Delta n\) for the reaction  

\[\text{NH}_3(g) + \text{HCl}(g) \rightarrow \text{NH}_4\text{Cl}(s)\]

\[(i) 1 \quad (ii) 0.5 \quad (iii) 1.5 \quad (iv) 2\]  

(1)

b. Which of the following will produce a buffer solution when mixed in equal volumes?  

(i) 0.1 mol dm\(^{-3}\) \(\text{NH}_3\text{OH}\) and 0.1 mol dm\(^{-3}\) \(\text{HCl}\)  
(ii) 0.05 mol dm\(^{-3}\) \(\text{NH}_3\text{OH}\) and 0.1 mol dm\(^{-3}\) \(\text{HCl}\)  
(iii) 0.1 mol dm\(^{-3}\) \(\text{NH}_3\text{OH}\) and 0.05 mol dm\(^{-3}\) \(\text{HCl}\)  
(iv) 0.1 mol dm\(^{-3}\) \(\text{CH}_3\text{COONa}\) and 0.1 mol dm\(^{-3}\) \(\text{NaOH}\)

(1)

c. On the basis of Le Chatelier principle explain how temperature and pressure can be adjusted to increase the yield of ammonia in the following reaction.  

\[\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)\]

\[\Delta H = -92.38 \text{ kJ mol}^{-1}\]

What will be the effect of addition of argon to the above reaction mixture at constant volume?  

(3)

8. Balance the following equation using oxidation number method in acidic medium:  

\[\text{Fe}^{2+}(aq) + \text{Cr}_2\text{O}_7^{2-}(aq) \rightarrow \text{Fe}^{3+}(aq) + \text{Cr}^{3+}(aq)\]

\[\text{OR}\]

What are disproportionation reactions? Show that the following reaction is a disproportionation  

\[\text{P}_4(aq) + 3 \text{OH}^-(aq) + 3\text{H}_2\text{O}(l) \rightarrow \text{PH}_3(g) + 3\text{H}_2\text{PO}_3(aq)\]

(3)

9. Hydrogen resembles group 1 and group 17 elements.

a. Which of the following statements about hydrogen are correct?  

(i) Hydrogen has three isotopes of which protium is the most common.
(ii) H⁺ ions as such are never found in ionic salts.

(iii) Hydrogen ion, H⁺ exists freely in solution.

(iv) Dihydrogen does not act as a reducing agent.

b. How is H₂O₂ prepared? Show the difference between the structures of H₂O₂ and H₂O by drawing their spatial structures.

10. Alkaline earth metals can impart characteristic colour to thier flame.

a. A substance which gives brick red flame and breaks down on heating to give oxygen and a brown gas is

(i) Magnesium nitrate (ii) Calcium nitrate (iii) Barium nitrate (iv) Strontium nitrate

b. When water is added to compound ‘A’ of calcium, solution of compound ‘B’ is formed. When carbon dioxide is passed into the solution, it turns milky due to the formation of compound ‘C’. If excess of carbon dioxide is passed into the solution milkiness disappears due to the formation of compound ‘D’. Identify the compounds A, B, C, D. Explain why the milkiness disappears in the last step.

11. Diborane is an electron deficient hydride. How can you prepare it in the laboratory? Draw its structure and explain its bonding.

12. Write all the possible isomers of a compound with molecular formula C₅H₁₂ and write their IUPAC names.

13. Write structures of all carbocations that can be obtained from 2-methylbutane. Arrange these carbocations in order of increasing stability.

OR

(ii) ഹ്റ് ഇയുകൾ എന്ന രീതിയില്‍ H⁺

ഉഭയസംബന്ധത്തില്‍ ഉണ്ടാക്കുന്ന രീതി

കണ്ഠമോരം കിരിക്കുന്നു.

(iii) ഹ്റ് ഇയുക്തമ്യിനും ഹ്റ് ഇയുക്തം

മാനവരുടെ മേഖലയില്‍ ഉണ്ടാക്കുന്നു.

(iv) ഹ്റ് ഉമ്മയാം ദക്ഷിണകിഴക്കുള്ള

അവസ്ഥ വികാരമാക്കുന്നു.

b. H₂O₂ നൈക്കും കോഴ്സാമും? ബൂള

മാനവരും മോഡലൂം മേഖലയില്‍

H₂O-എന്ന വിഭാഗത്തില്‍ ഉണ്ടാക്കാനുള്ള

അവസ്ഥകളും.

10. ദക്ഷിണാന്തരായായ കിരീതം ഉമ്മയാം കരി

മാനവരും മേഖലയില്‍ ഉണ്ടാക്കുന്നു.

a. ഹ്റ് ഇയുക്തമായ മേഖലയില്‍ അവസ്ഥയില്‍

യുമ്മയുമ്മയില്‍ ഉണ്ടാക്കാനുള്ള

അവസ്ഥകളും പ്രക്രിയയില്‍ ഉണ്ടാക്കാനുള്ള

ഇനി മേഖലയില്‍ ഉണ്ടാക്കാനുള്ള

(1) മോഡലും തടിയും (2) ദക്ഷിണാന്തരായായ

(3) മേഖലയില്‍ തടിയും (4) ദക്ഷിണാന്തരായായായ

തടിയും

b. 'A' എന്ന മേഖലയില്‍ ഭാഗം വെള്ളം

സം‌ബന്ധം 'B'-യുടെ മേഖലയില്‍ യുമ്മയുമ്മയില്‍

മാനവരും കിരീതം ഉണ്ടാക്കുന്നു.

സം‌ബന്ധം 'C' എന്ന മേഖലയില്‍ ഹ്റ് ഇയുക്തമായ

സ്ഥാനത്ത് ലഭിക്കുന്നു.

സം‌ബന്ധം 'D' എന്ന മേഖലയില്‍ ഹ്റ് ഇയുക്തമായ

ഉഭയസംബന്ധത്തില്‍ ഉണ്ടാക്കുന്നു.

(1) എന്ന മേഖലയില്‍ കിരീതം ഉണ്ടാക്കുന്നു

(2) ദക്ഷിണാന്തരായായ

(3) മേഖലയില്‍ 

11. അതിശയായ ഔഷധവൃഭതയുടെ ഉപയോഗം അതിശയായ ഔഷധവൃഭതയ്യാണ്. അതിശയായ

ഔഷധവൃഭതയുടെ ഉപയോഗ പ്രാധാന്യത്തില്‍ ഉണ്ടാക്കുന്നു. മൂലം ഇരിക്കുന്ന

4. എന്ന പ്രക്രിയയില്‍ കിരീതം ഉണ്ടാക്കാനുള്ള

സ്ഥാനത്ത് ലഭിക്കുന്നു.

12. C₅H₁₂ എന്ന മേഖലയില്‍ ഭാഗം വെള്ള

സംബന്ധത്തില്‍ ഹ്റ് ഇയുക്തമായ

മേഖലയില്‍ കിരീതം ഉണ്ടാക്കാനുള്ള

സ്ഥാനത്ത് ലഭിക്കുന്നു അപേക്ഷിക്കാനുള്ള

IUPAC സമനിർദ്ദേശം

(3)

13. 2-മെണ്ടിയോബറ്റിലിന്റെ മേഖലയില്‍ ഉല്പന്നം

ഉണ്ടാക്കുന്ന കിരീതം

ലോസി കിരീതം

സ്ഥാനത്ത് ലഭിക്കുന്നു. അപേക്ഷിക്കാനുള്ള

മേഖലയില്‍ ഉണ്ടാക്കുന്ന

ബന്ധം കിരീതം

മേഖലയില്‍ 

അവസ്ഥ.
A compound on Lassaigne’s test gave a blood red colouration. No other tests were answered. Which are the elements that may be present in the organic compound other than carbon and hydrogen? Explain the chemistry involved with the help of chemical equations. (3)

14. a. Which of the following reactions of methane is/are controlled oxidation reactions?
   (i) \(2\text{CH}_4 + \text{O}_2\text{Cu/523K/100atm} \rightarrow 2\text{CH}_3\text{OH}\)
   (ii) \(\text{CH}_4 + \text{O}_2 \rightarrow \text{Mo}_2\text{O}_3 \rightarrow \text{HCHO} + \text{H}_2\text{O}\)
   (iii) \(\text{CH}_4 + \text{O}_2 \rightarrow \text{C}_x + 2\text{H}_2\text{O}_l\)
   (iv) \(\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_{2g} + 2\text{H}_2\text{O}_l\) (1)

b. Benzene is treated with a mixture of conc. HNO_3 and conc. H_2SO_4. Predict the product formed here and explain the mechanism of the reaction. (4)

15. a. Which of the following gases is not a green house gas?
   (i) \(\text{CO}\) (ii) \(\text{O}_3\) (iii) \(\text{CH}_4\)
   (iv) \(\text{H}_2\text{O} \text{vapour}\) (1)

b. On the basis of chemical reactions involved, explain how do chlorofluoro-carbons cause thinning of ozone layer in stratosphere. (2)
### (v) Answer Key/Value Points

<table>
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<tr>
<th>Sl No.</th>
<th>Answer Key/Value Points</th>
<th>Score</th>
<th>Total</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>a.</strong> Avogadros Law</td>
<td>(1)</td>
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<td></td>
<td><strong>b.</strong> 2 g</td>
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<td></td>
<td><strong>c.</strong> For determining number of moles</td>
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<td></td>
<td>For determining correct EF (CH₃)</td>
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<td>2</td>
<td><strong>a.</strong> (c) 3 (No. radial nodes = n-1-1 = 5-1-1=3)</td>
<td>(1)</td>
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<td></td>
<td><strong>b.</strong> Correct schematic diagram</td>
<td>(1)</td>
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<td></td>
<td>Three correct observations</td>
<td>(1)</td>
<td></td>
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<td></td>
<td>Three correct conclusions</td>
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<td></td>
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<td></td>
<td>OR</td>
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<td></td>
<td>A set of numbers which give information like size, shape and orientation of the orbitals.</td>
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<td></td>
<td>For writing the four quantum numbers</td>
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<td></td>
<td>For writing the values of each</td>
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<td></td>
<td>For writing the significance of each</td>
<td>(1)</td>
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<td>3</td>
<td><strong>a.</strong> The physical and chemical properties of the elements are periodic functions of their atomic numbers.</td>
<td>(1)</td>
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<td></td>
<td>Elements are arranged in the increasing order of atomic numbers</td>
<td>(½)</td>
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<td></td>
<td>An element’s location in the periodic table reflects the quantum numbers of the last orbital filled. (Or any two relevant features).</td>
<td>(½)</td>
<td>4</td>
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<td></td>
<td><strong>b.</strong> Ionisation enthalpy decreases from top to bottom in group 1.</td>
<td>(1)</td>
<td></td>
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<td></td>
<td>Elements are arranged in the increasing order of atomic numbers</td>
<td>(½)</td>
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<td></td>
<td>Down the group increase in shielding outweighs the increasing nuclear charge.</td>
<td>(½)</td>
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<td>4</td>
<td><strong>a.</strong> For drawing the correct Lewis structure.</td>
<td>(1½)</td>
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<td></td>
<td>For assigning formal charge to each atom</td>
<td>(1½)</td>
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<td></td>
<td><strong>b.</strong> For writing correct electronic configuration.</td>
<td>(1)</td>
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<td></td>
<td>For calculating bond order (=3)</td>
<td>(1)</td>
<td></td>
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<td></td>
<td>OR</td>
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<td>5</td>
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<td></td>
<td>BCl₃ - sp² - Trigonal Planar</td>
<td>(1)</td>
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<tr>
<td></td>
<td>NH₃ - sp³ - Trigonal Pyramidal</td>
<td>(1)</td>
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<tr>
<td>5</td>
<td><strong>a.</strong> (iii) p₁ &lt; p₂ &lt; p₃ &lt; p₄</td>
<td>(1)</td>
<td></td>
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<td></td>
<td><strong>b.</strong> Correct derivation ( d = \frac{pM}{RT} )</td>
<td>(1)</td>
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<td></td>
<td>Correct substitution</td>
<td>(1)</td>
<td></td>
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<td></td>
<td>Correct answer with unit (1.3 g L⁻¹)</td>
<td>(1)</td>
<td>4</td>
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<td>Sl No.</td>
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<td>6</td>
<td><strong>a.</strong> No&lt;br&gt;In the given reaction CaCO$_3$ is not formed from its constituent elements in their reference state.</td>
<td>(1)</td>
<td>4</td>
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<td></td>
<td><strong>b.</strong> Correct formulation of given datat into three thermochemical equations&lt;br&gt;Correct substitution [((\text{Eq 1) + 2x(\text{Eq 2) + -(\text{Eq 3))}})]&lt;br&gt;Correct answer with unit (-74.8 kJ mol$^{-1}$)</td>
<td>((\frac{1}{2}))</td>
<td></td>
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<td>7</td>
<td><strong>a.</strong> (iv) 2</td>
<td>(1)</td>
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<td></td>
<td><strong>b.</strong> (iii) 0.1 mol dm$^{-3}$ NH$_3$OH and 0.05 mol dm$^{-3}$ HCl</td>
<td>(1)</td>
<td>5</td>
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<td></td>
<td><strong>c.</strong> Since the forward reaction is exothermic low temperature increases the yield. An optimum temperature of about 700 K is used to ensure attainment of equilibrium.&lt;br&gt;Since number of moles decreases in the forward reaction a high pressure increases the yield of NH$_3$. A pressure of about 200 atm is applied.&lt;br&gt;When an inert gas argon is added at constant volume the equilibrium remains undisturbed because it does not change the partial pressures or the molar concentrations of the substance involved in the reaction.</td>
<td>(1)</td>
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</table>
| 8     | For writing the correct balanced equation with all the required steps<br>\[6\text{Fe}^{2+}_{(aq)} + 3\text{Cr}_2\text{O}_7^{2-}_{(aq)} + 14 \text{H}^+_{(aq)} \rightarrow 6\text{Fe}^{3+}_{(aq)} + 2\text{Cr}^{3+}_{(aq)} + 7\text{H}_2\text{O}_{(l)}\]  
[If only the balanced equation is written credit 2 scores and if only the correct oxidation states are written credit only 1 score.]<br>**OR**<br>Special type of redox reactions in which an element in one oxidation state is simultaneously oxidised and reduced.<br>In the given reaction P (oxidation state = 0) is reduced to PH$_3$ (oxidation state of P is -3) and oxidised to H$_2$PO$_4^-$ (oxidation state of P is +1) | (3)   | 3     |
<p>| 9     | <strong>a.</strong> (i) &amp; (ii) | ((\frac{1}{2})) |       |
|       | <strong>b.</strong> Acidifying hydrated barium peroxide and removing excess water by evaporation under reduced pressure.&lt;br&gt;For drawing non-planner structure of H$_2$O$_2$&lt;br&gt;For drawing the bent structure of H$_2$O | (1)   | 4     |</p>
<table>
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<tr>
<td>10</td>
<td>(a) Calcium nitrate</td>
<td>(1)</td>
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<td></td>
<td>(b) Compound ‘A’ - CaO</td>
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<td></td>
<td>Compound ‘B’ - Ca(OH)_2</td>
<td>(½)</td>
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<td></td>
<td>Compound ‘C’ - CaCO_3</td>
<td>(½)</td>
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<td></td>
<td>Compound ‘D’ - Ca(HCO_3)_2</td>
<td>(½)</td>
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<td>Milkiness is due to the formation of while CaCO_3 insoluble in water. When excess of CO_2 is passed through it the Ca(HCO_3)_2 formed in soluble in H_2O.</td>
<td>(1)</td>
<td>4</td>
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<tr>
<td>11</td>
<td>(a) By the oxidation of sodium borohydride with iodine (Or correct chemical equation)</td>
<td>(1)</td>
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<td></td>
<td>(b) Correct structure</td>
<td>(1)</td>
<td>4</td>
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<td></td>
<td>Correct explanation of bonding specifying the hybridisation (sp^3) and 3-centre-2-electron bond.</td>
<td>(2)</td>
<td></td>
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<tr>
<td>12</td>
<td>(a) For writing the structural formulae of the three isomers.</td>
<td>(1 ½)</td>
<td>3</td>
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<td></td>
<td>(b) For writing the three IUPAC names (Pentane, 2-Methylbutane and 2,2-Dimethylpropane)</td>
<td>(1 ½)</td>
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<td>13</td>
<td>For writing the following four carbocations:</td>
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<tr>
<td></td>
<td>CH_3–CH–CH_2–CH_3</td>
<td>(2)</td>
<td>3</td>
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<td></td>
<td>CH_3–CH–CH–CH(CH_3)</td>
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<td>(I)</td>
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<td>CH_3–CH–CH–CH(CH_3)</td>
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<td></td>
<td>(II)</td>
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<td></td>
<td>CH_3–CH_3–CH(H)</td>
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<td></td>
<td>CH_3–CH_3–CH(H)</td>
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<td></td>
<td>(III)</td>
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<td>CH_3–CH–CH–CH(CH_3)</td>
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<td></td>
<td>CH_3–CH–CH–CH(CH_3)</td>
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<td></td>
<td>(IV)</td>
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<td></td>
<td>For writing the correct increasing order of stability as I&lt;IV&lt;II&lt;III</td>
<td>(1)</td>
<td>OR</td>
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<td>OR</td>
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<td></td>
<td>Nitrogen and Sulphur</td>
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<td>During the preparation of sodium fusion extract sodium thiocyanate (NaSCN) is formed (With chemical equation) The thiocyanate ions react with Fe³⁺ ions to form blood red coloured ferric thiocyanate, [Fe(SCN)]²⁻ (With chemical equation)</td>
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<tr>
<td>14</td>
<td>a. (i) &amp; (ii)</td>
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<tr>
<td></td>
<td>b. Nitrobenzene</td>
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<td></td>
<td>Correct mechanism involving 3 steps</td>
<td>(1)</td>
<td>(3)</td>
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<td></td>
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<td>(½ + ½)</td>
<td>5</td>
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<tr>
<td>15</td>
<td>a. CO</td>
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<td></td>
<td>b. CFC’s are stable compounds. These undergo decomposition in presence of sunlight. Reactions:</td>
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|       | \[
\begin{align*}
\text{CF}_2\text{Cl}_2 (g) & \xrightarrow{UV} \text{Cl} (g) + \text{CF}_2\text{Cl} (g) \\
\text{Cl} (g) + \text{O}_3 (g) & \rightarrow \text{ClO} (g) + \text{O}_2 (g) \\
\text{ClO} (g) + \text{O} (g) & \rightarrow \text{Cl} (g) + \text{O}_2 (g)
\end{align*}
\] |       |       |
|       | Chain reactions continue in which ozone layer is depleted. |       |       |
General Instructions to candidates:

- There is a 'Cool off time' of 15 minutes in addition to the writing time of 2 hrs.
- You are neither allowed to write your answers nor to discuss anything with others during the 'cool off time'.
- Use the 'cool off time' to get familiar with questions and to plan your answers.
- Read the questions carefully before answering.
- All questions are compulsory and only internal choice is allowed.
- When you select a question, all the sub-questions must be answered from the same question itself.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Malayalam version of the questions is also provided.
- Give equations wherever necessary
- Electronics devices except nonprogrammable calculators are not allowed in the Examination Hall.

 Malayalam Instructions:

- നൽകിയിരിക്കുന്ന ചോദ്യങ്ങളും പരിപാലനത്തിന്റെ മൂന്നാം പ്രവാചകം എന്റെ സെല്ലുകളുടെ പ്രകാരം എണ്ണാക്കിയിരിക്കും. എല്ലാ ചോദ്യങ്ങൾക്കും സൂചിപ്പിക്കുന്ന പാഠം കൂടുതലായിരിക്കും. 
- നൽകിയിരിക്കുന്ന ചോദ്യങ്ങളും പരിപാലനത്തിന്റെ മൂന്നാം പ്രവാചകം എന്റെ സെല്ലുകളുടെ പ്രകാരം എണ്ണാക്കിയിരിക്കും. 
- എല്ലാ ചോദ്യങ്ങളും പരിപാലനത്തിന്റെ മൂന്നാം പ്രവാചകം എന്റെ സെല്ലുകളുടെ പ്രകാരം എണ്ണാക്കിയിരിക്കും.
- എല്ലാ ചോദ്യങ്ങളും പരിപാലനത്തിന്റെ മൂന്നാം പ്രവാചകം എന്റെ സെല്ലുകളുടെ പ്രകാരം എണ്ണാക്കിയിരിക്കും.
- എല്ലാ ചോദ്യങ്ങളും പരിപാലനത്തിന്റെ മൂന്നാം പ്രവാചകം എന്റെ സെല്ലുകളുടെ പ്രകാരം എണ്ണാക്കിയിരിക്കും.
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1. When a solution is diluted its concentration changes.

   a. If 500 mL of a 5M solution is diluted to 1500 mL, what will be the molarity of the solution obtained?

     (i) 1.5 M  
     (ii) 1.66 M  
     (iii) 0.017 M  
     (iv) 1.59 M  

   b. State the law of multiple proportions. Illustrate this law with an example.

2. The distribution of electrons into orbitals of an atom or ion is called its electronic configuration.

   a. The pair of ions having same electronic configuration is

     (i) Cr^{3+}, Fe^{3+}  
     (ii) Fe^{3+}, Mn^{3+}  
     (iii) Fe^{3+}, Co^{3+}  
     (iv) Sc^{3+}, Cr^{3+}  

   b. The Balmer series in the hydrogen spectrum corresponds to the electron transition from $n = 2$ to $n = 3, 4, \ldots$. This series lies in the visible region. Calculate the wave number of line associated with the transition in Balmer series when the electron moves to $n = 4$ orbit.

   c. Why was a change in the Bohr Model of atom required? What were the important developments on the basis of which the concept of movement of an electron in an orbit was replaced by the concept of probability of finding electron in an orbital? What is the name given to the changed model of atom?

3. In the modern periodic table there is a direct connection between the electronic configuration of the elements and their position in the periodic table.
a. Identify the group and valency of the element having atomic number 119. Also predict the outermost electronic configuration and write the general formula of its oxide. (2)

b. Give reason for the following:
   (i) Electronegativity of elements increase on moving from left to right in the periodic table.
   (ii) Ionisation enthalpy decrease in a group from top to bottom? (2)

4. The energy levels of the different molecular orbitals can be determined experimentally from spectroscopic data.

a. The energy of $\sigma 2p_z$ molecular orbital is greater than $\pi 2p_x$ and $\pi 2p_y$ molecular orbitals in nitrogen molecule. Write the complete sequence of energy levels in the increasing order of energy in the molecule. Compare the relative stability and write the magnetic behaviour of the following species: $N_2$, $N_2^+$, $N_2^-$, $N_2^{2-}$ (3)

b. What is meant by the term average bond enthalpy? Why is there difference in bond enthalpy of O—H bond in ethanol ($C_2H_5OH$) and water? (2)

OR

Name the hybridisation of the central atoms in the case of $PCl_3$ and $SF_6$. The axial bonds are longer as compared to equatorial bonds in $PCl_3$ whereas in $SF_6$ both axial bonds and equatorial bonds have the same bond length. Explain. (2)

5. Partial pressure of a gas in a mixture is the pressure that it would exert if it alone is present in the same volume under the same conditions. (2)
a. The pressure of a mixture of dihydrogen and
dioxygen in the molar ratio 1:4 enclosed in a
vessel is 1 bar. What would be the partial
pressure of dioxygen?

(i) $0.8 \times 10^5$ atm (ii) $0.008 \text{ Nm}^{-2}$
(iii) $8 \times 10^4 \text{ Nm}^{-2}$ (iv) $0.25\text{ Nm}^{-2}$

b. One of the assumptions of kinetic theory of
gases states that “there is no force of
attraction between the molecules of a gas.”
How far is this statement correct? Is it
possible to liquefy an ideal gas? Explain.

6. Phase transformations involve energy changes.

a. 18.0 g of water completely volatilises at
100°C and 1 bar pressure and the enthalpy
change in the process is 40.79 kJ mol$^{-1}$. What
will be the enthalpy change for volatilising
two moles of water under the same
conditions? What is meant by the standard
enthalpy of volatilisation for water?

b. Extensive properties depend on the quantity
of matter but intensive properties do not.
Categorise the following properties as
extensive or intensive.

Mass, temperature, pressure, heat capacity

7. Equilibrium state can be achieved in physical as
well as chemical processes.

a. Which of the following is not a general
characteristic of equilibria involving physical
processes?

(i) Equilibrium is possible only in a closed system
at a given temperature.
(ii) All measurable properties of the system
remain constant at equilibrium
(iii) All the physical processes stop at equilibrium.
(iv) The opposing processes occur at the same
rate and there is dynamic but stable
condition.
b. $pK_a$ for CH$_3$COOH is 4.80 and $pK_a$ for NH$_4$OH is 4.74. The pH of ammonium acetate will be

(i) 7.03  
(ii) 4.77  
(iii) 7.0  
(iv) Between 6 and 7  

(1)

c. How can you predict the following stages of a reaction by comparing the value of $K_c$ and $Q_c$?

(i) Net reaction proceeds in the forward direction.
(ii) Net reaction proceeds in the backward direction.
(iii) No net reaction occurs.  

(3)

8. a. The reaction

\[ \text{Cl}_2(g) + 2\text{OH}^-(aq) \rightarrow \text{ClO}^-(aq) + \text{Cl}^-(aq) + \text{H}_2\text{O}(l) \]

represents the formation of bleaching agent. Predict the type of redox reaction. Can ClO$^-$ act as an oxidising agent? Explain.

OR

b. Write chemical equation for the following reaction and balance the equation by ion electron method.

Permanganate ion (MnO$_4^-$) reacts with sulphur dioxide gas in acidic medium to produce Mn$^{2+}$ and hydrogensulphate ion (HSO$_4^-$).  

(3)

9. Water gas is a mixture of carbon monoxide and hydrogen.

a. How can production of hydrogen from water gas be increased by using water gas shift reaction?  

(2)
10. a. By adding gypsum to cement
   (i) setting time of cement becomes less
   (ii) setting time of cement increases
   (iii) colour of cement becomes light
   (iv) shining surface is obtained

11. Prepare a brief account of silicones highlighting their chemical constitution, method of preparation and uses.

12. Chromatography is an important technique extensively used in separation and purification of substances.
   Explain the principle and procedure involved in column chromatography.
13. Resonance effect is the polarity produced in a molecule which can transmit through a delocalised system.

Explain positive and negative resonance effects taking aniline and nitrobenzene as examples.

[Note: The resonating structures should be drawn to support your answer.]

OR

Dumas’ method and Kjeldahl’s method are the two important methods used for the estimation of nitrogen in organic compounds.

Explain the principle involved in any one of these methods. (3)

14. a. The gas formed when calcium carbide reacts with water is ________________ (1)

b. Consider the reaction:

\[ \text{CH}_3 - \text{CH} = \text{CH}_2 + \text{HBr} \xrightarrow{\text{(C}_6\text{H}_5\text{CO})_2\text{O}_2} \]

Name the above reaction and predict the major product.

Substantiate your answer using the mechanism involved. (4)

15. The word ‘smog’ is derived from the words ‘smoke’ and ‘fog’.

a. Which of the following statements is not true about classical smog?

(i) Its main components are produced by the action of sunlight on emissions of automobiles and factories.

(ii) Produced in cold and humid climate.

(iii) It contains compounds of reducing nature.

(iv) It contains smoke, fog and sulphur dioxide. (1)

b. Dissolved oxygen in water is very important for aquatic life. What processes are responsible for the reduction of dissolved oxygen in water? (2)
## Answer Key/Value Points

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Answer Key/Value Points</th>
<th>Score</th>
<th>Total</th>
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<tbody>
<tr>
<td>1</td>
<td>a. (ii)</td>
<td>(1)</td>
<td></td>
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<tr>
<td></td>
<td>b. Correct statement of the law Illustration with a suitable example.</td>
<td>(1)</td>
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<td></td>
<td></td>
<td>(2)</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>a. (ii) Fe³⁺, Mn²⁺</td>
<td>(1)</td>
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<td></td>
<td>b. For writing Rydberg’s equation Correct substitution</td>
<td>(1)</td>
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<td></td>
<td></td>
<td>(½)</td>
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<td></td>
<td>c. Answer with unit (20564.44 cm⁻¹)</td>
<td>(½)</td>
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<tr>
<td></td>
<td>It was not in accordance with the wave nature of electron and failed in the case of multi electron systems. Dual nature of matter and Uncertainty principle Quantum mechanical model</td>
<td>(½)</td>
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<td>5</td>
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<tr>
<td>3</td>
<td>a. Group 1 Valency 1 Outermost electronic configuration - 8s¹ Formula of oxide - M₂O.</td>
<td>(½)</td>
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<td></td>
<td>b. (i) Decrease in atomic size and Increase in nuclear charge. (ii) Atomic size increases, increase in shielding outweighs the increasing nuclear charge.</td>
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<tr>
<td>4</td>
<td>a. For correct energy sequence For assigning relative stability (N₂⁺ &lt; N₂⁺=N₂⁺&lt;N₂₂) For writing correct magnetic behaviour (N₂⁺⁺, N₂⁺ - diamagnetic, N₂⁺⁺=N₂⁺⁺ - paramagnetic)</td>
<td>(1)</td>
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<td>b. It is obtained by dividing the total bond dissociation enthalpy of a particular type of bond by the number of bonds broken. Since the O-H in these two molecules are in different chemical environments.</td>
<td>(1)</td>
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<tr>
<td></td>
<td>OR</td>
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<td></td>
<td>PCl₃ - sp³d</td>
<td>(½)</td>
<td></td>
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<tr>
<td></td>
<td>SF₆ - sp³d²</td>
<td>(½)</td>
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<td>In PCl₃, the distance between the axial and equitorial bond pairs is less than that between the equitorial bond pairs. Greater repulsion of axial pairs by equitorial pairs make axial bond longer. In SF₆, distance between all the bond pairs are equal due to its symmetric structure.</td>
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<tr>
<td>5</td>
<td>a. (iii) 8×10⁴ Nm⁻²</td>
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<td>b. This statement holds good when the gas molecules are far away. i.e., occupy large volume at high temperature. An ideal gas cannot be liquefied. Since there is no intermolecular forces of attraction in an ideal gas.</td>
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</table>
| 6     | **a.** \(2 \times 40.79 \text{ kJ} = +81.58 \text{ kJ}\)  
Correct definition.  
**b.** Extensive - Mass, heat capacity  
Intensive - Temperature, Pressure | (1) | 4 |
| 7     | **a.** (i) All the physical processes stop at equilibrium.  
(iii) 7.03 | (1) | 5 |
|       | **c.** (i) \(Q_c < K_c\)  
(ii) \(Q_c > K_c\)  
(iii) \(Q_c = K_c\) | (1) |  |
| 8     | Disproportionation  
Yes. In \(\text{ClO}_2^-\), Cl is in +1 state. Hence it can act as oxidising agent by changing to -1 state.  
**OR**  
For writing the unbalanced skeletal equation.  
\[\text{MnO}_4^{-}(aq) + \text{SO}_2(l) \rightarrow \text{Mn}^{2+}(aq) + \text{HSO}_4^{-}(aq)\]  
For balancing the equation with necessary steps. | (1) | 3 |
| 9     | **a.** By reacting CO of syn gas mixtures with steam in presence of iron chromate as catalyst, (Or correct chemical equation)  
The \(\text{CO}_2\) formed is removed by scrubbing with sodium arsenite solution.  
**b.** Mention of difficulties of liquefaction/storage/control of combustion.  
Any method of present use. | (1) | 4 |
| 10    | **a.** (ii) setting time of cement increases  
**b.** Blue colour of the solution is due to the ammoniated electron which absorbs energy in the visible region of light.  
\[M + (x+y)\text{NH}_3 \rightarrow [M(\text{NH}_3)_x]^{+} + [e(\text{NH}_3)_y]^{-}\]  
On standing the solution it slowly liberate \(\text{H}_2\) resulting in the formation of amide.  
\[M^{+}_{(am)} + e^{-} + \text{NH}_3(l) \rightarrow \text{MNH}_2(\text{am}) + \frac{1}{2}\text{H}_2(g)\] | (1) | 4 |
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</table>
| 11    | For writing definition with general formula  
For writing the method of preparation with required  
chemical equations.  
For writing the uses. |       | 4     |
| 12    | Principle - difference in the rate of adsorption of the components in a mixture.  
Brief procedure with supporting diagram. |       | 3     |
| 13    | Explanation of +R and -R effects  
For drawing correct resonating structures of aniline for +R effect  
For drawing correct resonating structures of nitrobenzene for -R effect.  
**OR**  
Correct principle of Dumas’ method or Kjeldahl’s method with required equation. **(2x1 ½)** |       | 3     |
| 14    | **a.** Acetylene  
**b.** Kharash effect/Peroxide effect/Anti Markovnikov addition.  
1-Bromo propane  
For writing the free radical mechanism in correct sequence. |       | 4     |
| 15    | **a.** (i) Its main components are produced by the action of sunlight on  
emissions of automobiles and factories.  
Presence of organic waste in water.  
Presence of phosphate from fertilizers which enhance algae growth. |       | 3     |