ANSWER SHEET

121

QUESTION PAPER SERIES CODE
A

Registration No. : | | | | | |

Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

ENTRANCE EXAMINATION, 2018

M.Sc. CHEMISTRY

[Field of Study Code : CHEM (227)]

Time Allowed : 3 hours

Maximum Marks : 100

INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate circle of Question Paper Series Code on the Answer Sheet.**

(iii) **All** questions are compulsory. For each question **one and only one** of the five choices given is the correct answer.

(iv) Answer all 40 questions in the Answer Sheet provided for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) or (e) with **BALLPOINT PEN** only against each question in the corresponding circle. Any overwriting or alteration will be treated as wrong answer.

(v) Each correct answer carries **2·5** marks. **There will be negative marking and 0·5 mark will be deducted for each wrong answer.**

(vi) Answer written by the candidates inside the Question Paper will not be evaluated.

(vii) Calculators may be used.

(viii) Please use the space provided for Rough Work.

(ix) **Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

1. Use only Blue/Black Ballpoint Pen (Do not use pencil) to darken the appropriate Circle.
2. Please darken the whole Circle.
3. Darken ONLY ONE CIRCLE for each question as shown in the example below :

Wrong	Wrong	Wrong	Wrong	Correct
● ⓑ ⓒ ● ⓔ	Ø ⓑ ⓒ ⓓ ⓔ	Ø ⓑ ⓒ Ø ⓔ	◐ ⓑ ⓒ ● ⓔ	ⓐ ⓑ ⓒ ● ⓔ

4. Once marked, no change in the answer is allowed.
5. Please do not make any stray marks on the Answer Sheet.
6. Mark your answer only in the appropriate space against the number corresponding to the question.
7. **Ensure that you have darkened the appropriate circle of Question Paper Series Code on the Answer Sheet.**

1. The standard heat of combustion of ethanol, C_2H_5OH is 1372 kJ/mol. How much heat (in kJ) would be liberated by completely burning a 20 g sample?

(a) 686 kJ

(b) 519 kJ

(c) 715 kJ

(d) 597 kJ

(e) 469 kJ

2. The half-life for a first-order reaction is 32 s. What was the original concentration, if after 2 minutes, the reactant concentration is 0·062 *M*?

(a) 0·84 *M*

(b) 0·069 *M*

(c) 0·091 *M*

(d) 0·075 *M*

(e) 0·13 *M*

3. When a sample of 1 mol Ar, regarded here as a perfect gas, undergoes an isothermal reversible expansion at 20 °C from 10 dm^3 to 30 dm^3, the work done is

(a) 2·78 kJ

(b) – 2·68 kJ

(c) 5·45 kJ

(d) 2·68 kJ

(e) 2·56 kJ

4. What is the unit of k for the rate law, Rate = $k[A][B]^2$, when the concentration unit is mol/L?

(a) s^{-1}

(b) s

(c) $L\ mol^{-1}\ s^{-1}$

(d) $L^2\ mol^{-2}\ s^{-1}$

(e) $L^2\ s^2\ mol^{-2}$

5. A compressor cools a refrigerator which discards heat to the surroundings at 30 °C. The compressor is designed for maximum electric power of 100 W. The heat load on the refrigerator is 375 W. The minimum temperature that can be maintained in this refrigerator is

(a) 0 °C

(b) – 100 °C

(c) – 41·3 °C

(d) – 33·8 °C

(e) – 26·3 °C

6. If a diatomic molecule of reduced mass of 16×10^{-27} kg and having a force constant between atoms of 600 Nm^{-1} rotates 10^{12} times per second, then the number of full vibrations the molecule can undergo during one cycle of rotation is

(a) 30

(b) 3×10^{13}

(c) 10^{12}

(d) 16×10^9

(e) 0

7. In an electrochemical cell, during electrolysis of NaCl (aq), H^+ ions are accumulated more than Na^+ at the cathode because

(a) discharge potential of H^+ ≥ discharge potential of Na^+

(b) H^+ is lighter than Na^+

(c) discharge potential of H^+ < discharge potential of Na^+

(d) H^+ has higher ionic mobility than Na^+

(e) size of H^+ is lower than that of Na^+

8. If a current of 10 A from a 12 V supply is passed for 300 s, then the energy supplied as heat is

(a) 36 kJ

(b) $3 \cdot 6 \times 10^4$ kJ

(c) 56 kJ

(d) 46 kJ

(e) 55 kJ

9. If $pK_{NH_4} = 9 \cdot 26$, then the molar ratio of NH_3 and NH_4Cl to be mixed to make a buffer solution of pH = 10 is

(a) 1 : 0·74

(b) 1 : 1

(c) 1 : 10

(d) 5 : 2

(e) None of the above

10. The kinetic energy of electrons ejected from potassium metal surface for an incident light of 325 nm will be how much? (Given that the threshold wavelength of potassium metal is 564 nm.)

(a) $1 \cdot 32 \times 10^{-19}$ J

(b) $1 \cdot 00 \times 10^{-15}$ J

(c) $2 \cdot 95 \times 10^{-16}$ J

(d) $1 \cdot 95 \times 10^{-19}$ J

(e) None of the above

11. The molar solubility of $PbBr_2$ is $2 \cdot 17 \times 10^{-3}$ M at a certain temperature. Then the K_{sp} for $PbBr_2$ is

(a) $6 \cdot 2 \times 10^{-6}$

(b) $6 \cdot 4 \times 10^{-7}$

(c) $4 \cdot 1 \times 10^{-8}$

(d) $3 \cdot 4 \times 10^{-6}$

(e) $1 \cdot 4 \times 10^{-5}$

12. If a light source emits radiation at 337 nm at a output power of 1 mW, then the total number of photons emitted per second from the source is calculated to be (given 1 W = 1 Js^{-1})

(a) $1{\cdot}37 \times 10^{3}$

(b) $3{\cdot}37 \times 10^{5}$

(c) $1{\cdot}70 \times 10^{15}$

(d) $3{\cdot}37 \times 10^{15}$

(e) $1{\cdot}37 \times 10^{15}$

13. What is the equilibrium constant for a reaction that has a value of $\Delta G^{\circ} = -41{\cdot}8$ kJ at 100 °C?

(a) 1·01

(b) $7{\cdot}1 \times 10^{5}$

(c) − 5·87

(d) $1{\cdot}4 \times 10^{-6}$

(e) 13·5

14. The basicity for the following compounds in an increasing order is

(a) aniline < pyridine < ethylamine < ethanamidine < guanidine

(b) pyridine < aniline < ethylamine < guanidine < ethanamidine

(c) guanidine < ethanamidine < ethylamine < aniline < pyridine

(d) ethanamidine < guanidine < ethylamine < aniline < pyridine

(e) pyridine < aniline < ethanamidine < ethylamine < guanidine

15. The decomposition of the hydroperoxide ($PhCMe_2OOH$) obtained by the air-oxidation of cumene is applied for the large scale preparation of

(a) toluene and acetic acid

(b) toluene and butanoic acid

(c) phenol and acetic acid

(d) toluene and acetone

(e) phenol and acetone

16. The reaction of *p*-chloromethyl benzene with $NaNH_2$ in liquid ammonia produces

(a) *p*-aminomethylbenzene (major) and *o*-aminomethylbenzene (minor)

(b) *m*-aminomethylbenzene (major) and *o*-aminomethylbenzene (minor)

(c) *m*-aminomethylbenzene (minor) and *o*-aminomethylbenzene (major)

(d) *p*-aminomethylbenzene (minor) and *o*-aminomethylbenzene (major)

(e) *m*-aminomethylbenzene (major) and *p*-aminomethylbenzene (minor)

17. Base induced elimination of HCN from cyanohydrins is an example of

(a) *E*1 elimination

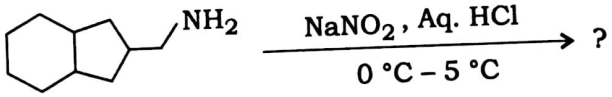
(b) pyrolytic *syn*-elimination

(c) *E*1*cB* elimination

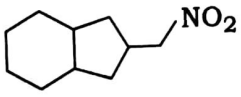
(d) *E*2 elimination

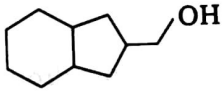
(e) pyrolytic *anti*-elimination

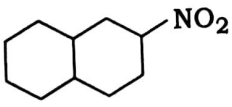
18. The major product formed in the reaction

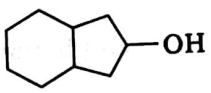


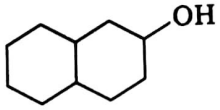
is

(a) 

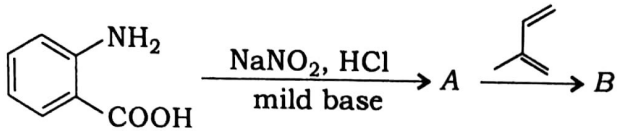
(b) 

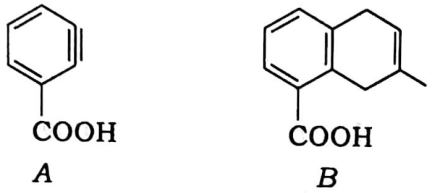
(c) 

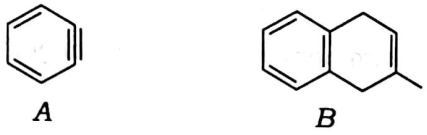
(d) 

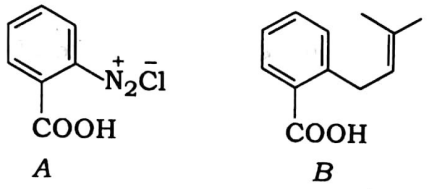
(e) 

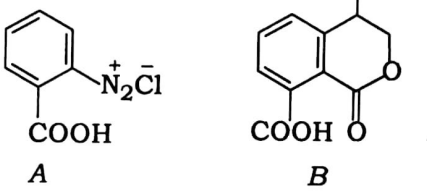
19. In the following reaction identify the products *A* and *B* :

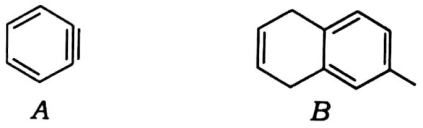


(a) 

(b) 

(c) 

(d) 

(e) 

20. Reaction of phenyl acetate with anhydrous aluminium chloride generates a mixture of

(a) *ortho-*, *meta-* and *para*-hydroxyacetophenones

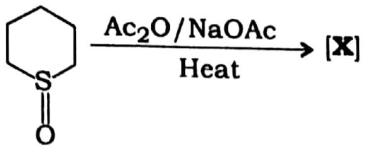
(b) *meta-* and *para*-hydroxyacetophenones

(c) *othro-* and *meta*-hydroxyacetophenones

(d) *ortho-* and *para*-hydroxyacetophenones

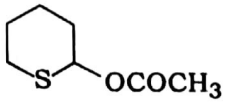
(e) only *para*-hydroxyacetophenone

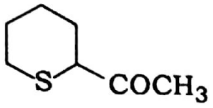
21. In the reaction

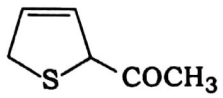


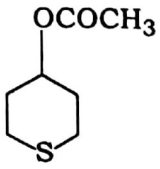
the major product [**X**] is

(a) 

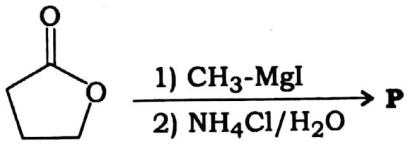
(b) 

(c) 

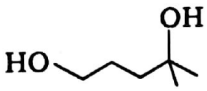
(d) 

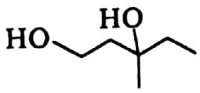
(e) 

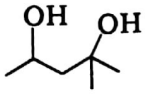
22. In the reaction

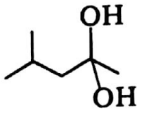


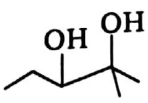
the correct structure of **P** is

(a) 

(b) 

(c) 

(d) 

(e) 

23. The textile polymer Nylon-6 can be prepared from cyclohexanone via which of the following products and applying which of the following well-known rearrangement reactions?

(a) A linear amide and Curtius rearrangement

(b) A cyclic amide and Curtius rearrangement

(c) A branched linear amide and Beckmann rearrangement

(d) A cyclic amide and Beckmann rearrangement

(e) A branched linear amide and Lossen rearrangement

24. Bimolecular nucleophilic substitution (S_N2) reactions are faster in

(a) nonpolar solvents

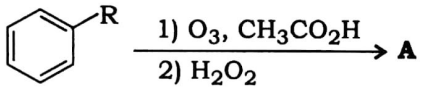
(b) polar protic solvents

(c) polar aprotic solvents

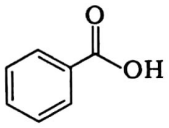
(d) a mixture of polar protic and polar aprotic solvents

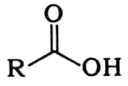
(e) a mixture of polar protic and nonpolar solvents

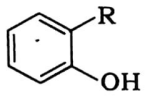
25. In the reaction

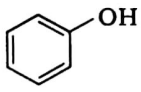


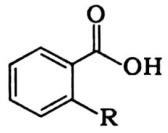
the correct structure of **A** is

(a) 

(b) 

(c) 

(d) 

(e) 

26. The increasing order of stability of the three main conformations of 2-fluoroethanol is

(a) eclipse, gauche, anti

(b) gauche, eclipse, anti

(c) eclipse, anti, gauche

(d) anti, gauche, eclipse

(e) anti, eclipse, gauche

27. Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried out in the presence of HCl because HCl

(a) gets oxidized by oxalic acid to chlorine

(b) furnishes H^+ ions in addition to those from oxalic acid

(c) reduces permanganate to Mn^{2+}

(d) oxidizes oxalic acid to carbon dioxide and water

(e) reduces oxalic acid

28. The bond orders for $[Re_2Cl_8]^{2-}$ and $[Re_2Cl_8]^{4-}$ are

(a) 3 and 4 respectively

(b) 2·5 and 3·5 respectively

(c) 4 and 3 respectively

(d) 3·5 and 2·5 respectively

(e) 2 and 3 respectively

29. Borax is commonly written as $Na_2B_4O_7 \cdot 4H_2O$. But structurally it is related to a borate. The formula of relevant borate is

(a) $[B_4O_9]^{6-}$

(b) $[B_5O_{10}]^{5-}$

(c) $[B_6O_{10}]^{2-}$

(d) $[B_4O_7]^{2-}$

(e) $[B_2O_3]$

30. In the context of coordination of the ligands, Me_3N and Me_3P with the metal ions Be^{2+} and Pd^{2+}, the correct statement is

(a) the ligands bind equally strong with both the metal ions as they are dicationic

(b) the ligands bind equally strong with both the metal ions as both the ligands are pyramidal

(c) the binding is stronger for Me_3N with Be^{2+} and for Me_3P with Pd^{2+}

(d) the binding is stronger for Me_3N with Pd^{2+} and for Me_3P with Be^{2+}

(e) the ligands bind only with Pd^{2+}

31. An archaeological specimen containing ^{14}C gives 40 counts in 5 minutes per gram of carbon. A specimen of freshly cut wood gives 20·3 counts per gram of carbon per minute. The counter used recorded a background count of 5 counts per minute in absence of any ^{14}C containing sample. The age of the specimen is

(a) 9258 years

(b) 7534 years

(c) 10000 years

(d) 5274 years

(e) 4629 years

32. The standard reduction potential values at 298 K for single electrodes are given below :

Electrode	*Electrode potential* (volt)
Mg^{2+}/Mg	− 2·34
Zn^{2+}/Zn	− 0·76
Fe^{2+}/Fe	− 0·44

The correct statement, one can infer from above, is

(a) Zn can reduce both Mg^{2+} and Fe^{2+}

(b) Fe can reduce both Mg^{2+} and Zn^{2+}

(c) Mg can reduce both Zn^{2+} and Fe^{2+}

(d) Mg can reduce Zn^{2+} but not Fe^{2+}

(e) Fe can reduce Zn^{2+} but not Mg^{2+}

33. Consider the half-reaction

$$MnO_4^- (aq) + 8H^+ (aq) + 5e \rightleftharpoons Mn^{2+} (aq) + 4H_2O (l), \quad E^\circ = +1{\cdot}51\,V$$

If the ratio of concentrations of MnO_4^- : Mn^{2+} is 100 : 1, then the reduction potential, E in a solution of pH 3·5 at 25 °C will be

(a) 1·86 V

(b) 1·49 V

(c) 1·39 V

(d) 1·20 V

(e) 1·16 V

34. Arrange the following complex ions in order of decreasing crystal filed stabilization energy (CFSE) :

(i) $[Fe(CN)_6]^{3-}$

(ii) $[Co(CN)_6]^{4-}$

(iii) $[RhCl_6]^{3-}$

(iv) $[Co(NH_3)_6]^{3+}$

(a) (ii) > (i) > (iii) > (iv)

(b) (iii) > (ii) > (i) > (iv)

(c) (iv) > (ii) > (i) > (iii)

(d) (iii) > (i) > (ii) > (iv)

(e) (iv) > (i) > (ii) > (iii)

35. Match the metalloproteins shown in **Column—A** with its biological function and metal centre given in **Column—B** :

Column—A	**Column—B**
I. Hemoglobin	A. Electron carrier and iron
II. Carbonic anhydrase	B. O_2 transport and iron
III. Vitamin B_{12}	C. O_2 transport and copper
IV. Hemocyanin	D. Group transfer reactions and cobalt
	E. O_2 storage and copper
	F. Conversion of CO_2 to H_2CO_3 and zinc

The correct match is

	I	II	III	IV
(a)	B	F	D	E
(b)	A	D	F	E
(c)	A	F	E	B
(d)	B	F	D	C
(e)	B	D	E	C

36. When a mixture of NaCl, conc. H_2SO_4 and $K_2Cr_2O_7$ is heated in a dry test tube, gives off deep red varpour of **A**. This vapour (**A**) dissolves in aqueous NaOH and turns into a yellow solution, which upon treatment with $AgNO_3$ forms a brick red precipitate (**B**). **A** and **B** are, respectively

(a) CrO_2Cl_2 and $Ag_2Cr_2O_7$

(b) $Na_2[CrOCl_5]$ and $Ag_2Cr_2O_7$

(c) $Na_2[CrOCl_5]$ and Ag_2CrO_4

(d) CrO_2Cl_2 and $AgCrO_4$

(e) CrOCl and $AgCrO_4$

37. Considering 18-electron rule as a guide, the values of n in the complexes

$$[Mn(CO)_nC_2H_4]^+ \text{ and } [(\eta^5\text{-}C_5H_5)_4Fe_4(CO)_n]$$

are

(a) 6 and 14

(b) 5 and 10

(c) 4 and 10

(d) 4 and 6

(e) 5 and 4

38. In the context of the reactions

(i) $[Cr(H_2O)_6]^{2+} + [CoCl(NH_3)_5]^{2+} \longrightarrow [Co(NH_3)_5(H_2O)]^{2+} + [CrCl(H_2O)_5]^{2+}$

(ii) $[Fe(CN)_6]^{4-} + [Mo(CN)_8]^{3-} \longrightarrow [Fe(CN)_6]^{3-} + [Mo(CN)_8]^{4-}$

the correct statement is

(a) both involve an inner sphere mechanism

(b) both involve an outer sphere mechanism

(c) reaction (i) follows inner sphere mechanism and reaction (ii) follows outer sphere mechanism

(d) reaction (i) follows outer sphere and reaction (ii) follows inner sphere mechanism

(e) reaction (i) is not a redox reaction and reaction (ii) follows outer sphere mechanism

39. The complexes $[Fe(phen)(H_2O)_4]^{2+}$, $[Fe(phen)_2(H_2O)_2]^{2+}$ and $[Fe(phen)_3]^{2+}$ are

(a) diamagnetic, paramagnetic and diamagnetic respectively

(b) paramagnetic, paramagnetic and diamagnetic respectively

(c) diamagnetic, diamagnetic and paramagnetic respectively

(d) paramagnetic, paramagnetic and paramagnetic respectively

(e) diamagnetic, diamagnetic and diamagnetic respectively

40. Prediction of pK_a values of oxoacids $HBrO_3$, H_3PO_4, H_2SO_4 and $HClO_4$ using Pauling's rules are, respectively

(a) 13, –2, 8, 16

(b) –2, 3, –2, –7

(c) –2, 13, 3, –7

(d) 3, 8, 13, 16

(e) 3, 13, 8, –2