121

QUESTION PAPER SERIES CODE
A

Registration No. : | | | | | |

Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

ENTRANCE EXAMINATION, 2017

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 25 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 4 marks. **There will be negative marking and 1 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

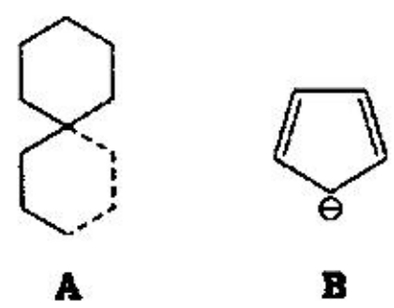
1. Use only Blue/Black Ballpoint Pen (Do not use pencil) to darken the appropriate Circle.
2. Please darken the whole Circle.
3. Darken ONLY ONE CIRCLE for each question as shown in the example below :

Wrong	Wrong	Wrong	Wrong	Correct
○ ⓑ ⓒ ○ ⓔ	⊘ ⓑ ⓒ ⓓ ⓔ	⊘ ⓑ ⓒ ⊘ ⓔ	ⓓ ⓑ ⓒ ○ ⓔ	ⓐ ⓑ ⓒ ○ ⓔ

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.**

Fundamental Constants	*Value*
Speed of light (c)	$2{\cdot}99792558 \times 10^{8}$ ms^{-1}
Elementary charge (e)	$1{\cdot}602176 \times 10^{-19}$ C
Boltzmann constant (k)	$1{\cdot}38065 \times 10^{-23}$ JK^{-1}
Gas constant ($R = N_A k$)	8·31 JK^{-1} mol^{-1} or 1·9872036 cal K^{-1} mol^{-1}
Planck constant (h)	$6{\cdot}62608 \times 10^{-34}$ Js
Avogadro's constant (N_A)	$6{\cdot}02214 \times 10^{23}$ mol^{-1}
Electron mass (m_e)	$9{\cdot}109390 \times 10^{-31}$ kg
Proton mass (m_p)	$1{\cdot}672623 \times 10^{-27}$ kg
Neutron mass (m_n)	$1{\cdot}674929 \times 10^{-27}$ kg
Bohr radius ($a_0 = 4\pi\varepsilon_0\hbar^2 / m_e e^2$)	$5{\cdot}3 \times 10^{-11}$ m
Ionization energy of H atom	13·6 eV

1. The point groups and the element/elements of symmetry in case of molecules **A** and **B**



A **B**

are

(a) **A** : D_{2d}; $3C_2$, $2\sigma_d$ and **B** : D_{5h}; C_5, $5C_2$, $5\sigma_v$, σ_h

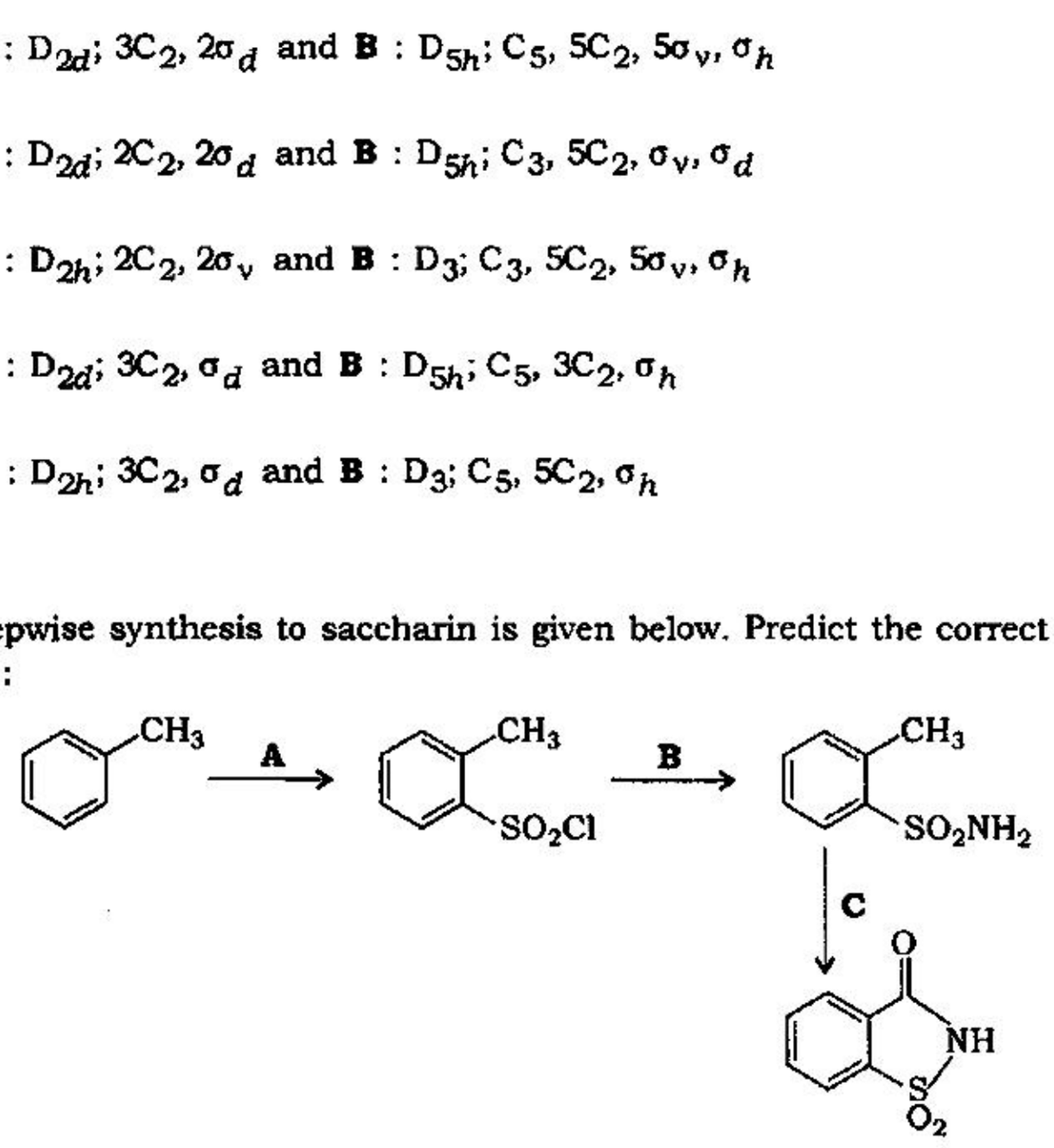
(b) **A** : D_{2d}; $2C_2$, $2\sigma_d$ and **B** : D_{5h}; C_3, $5C_2$, σ_v, σ_d

(c) **A** : D_{2h}; $2C_2$, $2\sigma_v$ and **B** : D_3; C_3, $5C_2$, $5\sigma_v$, σ_h

(d) **A** : D_{2d}; $3C_2$, σ_d and **B** : D_{5h}; C_5, $3C_2$, σ_h

(e) **A** : D_{2h}; $3C_2$, σ_d and **B** : D_3; C_5, $5C_2$, σ_h

2. The stepwise synthesis to saccharin is given below. Predict the correct reactants **A**, **B** and **C** :



(a) **A** : $SOCl_2$; **B** : NH_4OH; **C** : Na_2CO_3

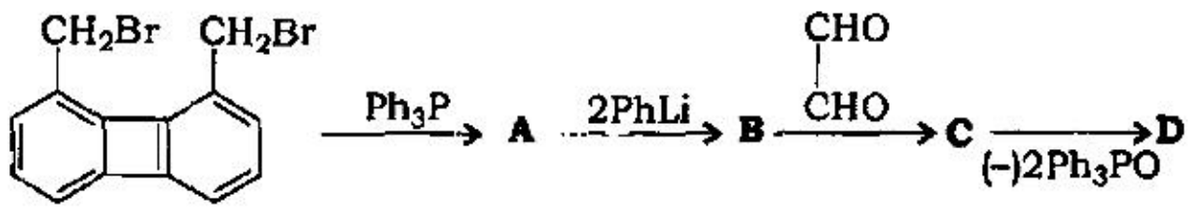
(b) **A** : $SOCl_2$; **B** : NH_3; **C** : Na_2CO_3

(c) **A** : $ClSO_3H$; **B** : NH_3; **C** : $KMnO_4$

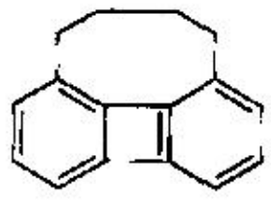
(d) **A** : $SOCl_2$; **B** : NH_4OH; **C** : $KMnO_4$

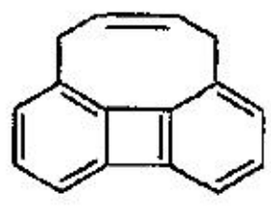
(e) **A** : $ClSO_3H$; **B** : NH_4OH; **C** : $KMnO_4$

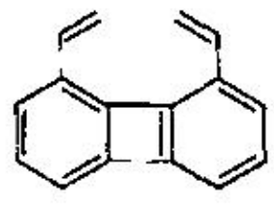
3. Predict the final product **D** of the following reaction :

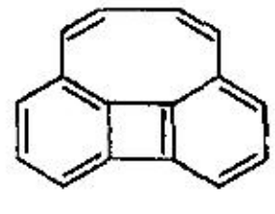


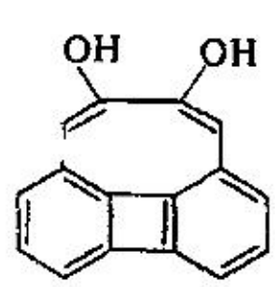
[**Note** : There is a loss of two molecules in the final step]

(a) 

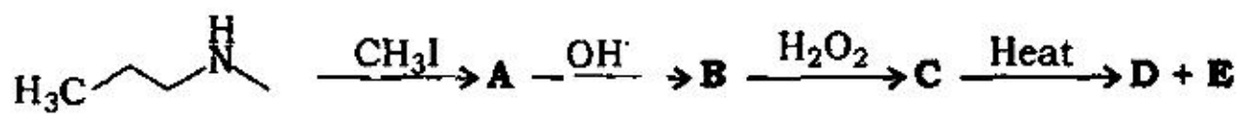
(b) 

(c) 

(d) 

(e) 

4. From the stepwise reactions, predict the final products **D** and **E** of the following reaction :



(a) **D** : Ethylene; **E** : *N,N*-Dimethyl-hydroxylamine

(b) **D** : Propylene; **E** : *N,N*-Dimethyl-hydroxylamine

(c) **D** : Propyne; **E** : Dimethylamine

(d) **D** : Propylene; **E** . Dimethylamine

(e) **D** : Propyne; **E** : *N,N*-Dimethyl-hydroxylamine

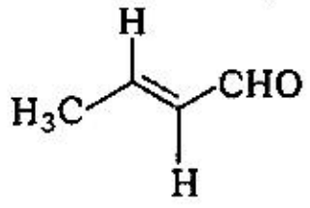
5. A compound C_4H_6O has the following spectral data :

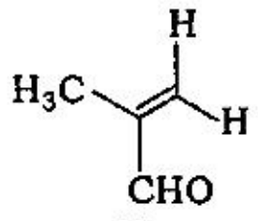
(a) Electronic absorption at $\lambda_{max} = 213\,nm$, $\varepsilon_{max} = 7100$ and $\lambda_{max} = 320\,nm$, $\varepsilon_{max} = 27$

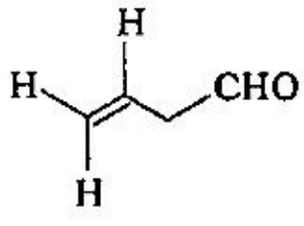
(b) Infrared bands at 3000 cm^{-1}, 2900 cm^{-1}, 1675 cm^{-1} and 1602 cm^{-1}

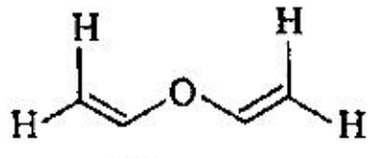
(c) NMR singlet at $\delta = 2 \cdot 1$ ppm (3H's), three multiplets each integrating for 1 H at $\delta = 5 \cdot 0 - 6 \cdot 0$ ppm

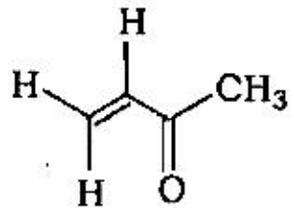
The structure of the compound is

(a) 

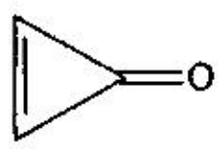
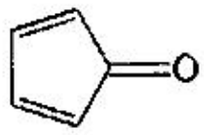
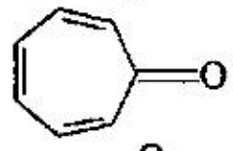
(b) 

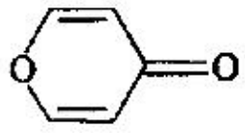
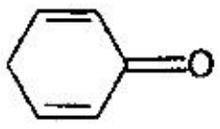
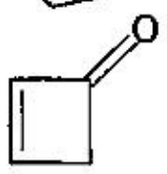
(c) 

(d) 

(e) 

6. Protonation of a carbonyl group forms a cation with significant charge on the carbon atom. Which of the following carbonyl compounds form an aromatic cation on protonation? Select the correct answer using the codes given below :

I.  II.  III. 

IV.  V.  VI. 

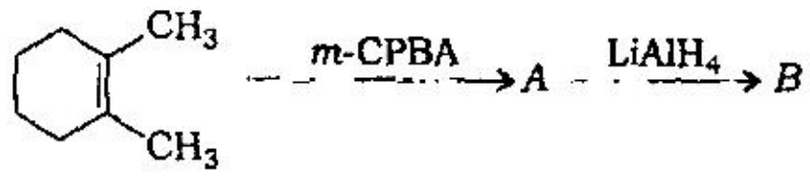
(a) **I, II, IV**

(b) **II, IV, VI**

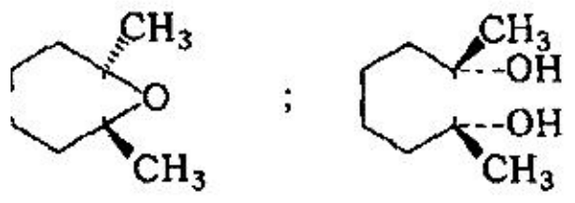
(c) **III, IV, V**

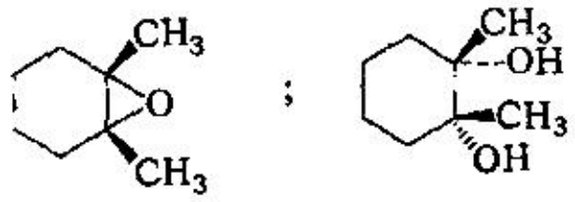
(d) **I, III, VI**

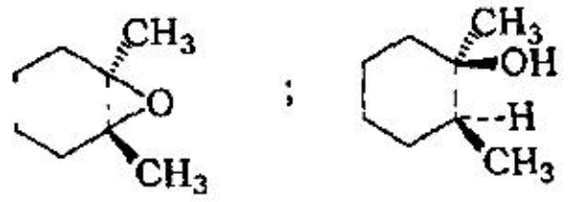
(e) **I, III, IV**

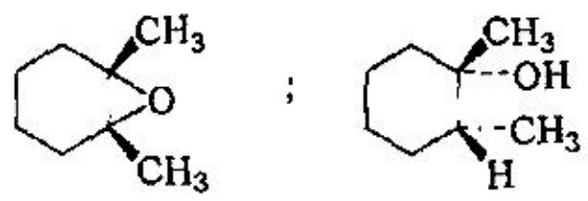
7. 

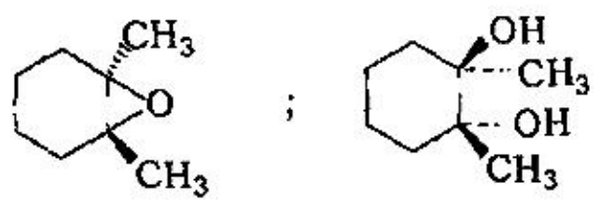
A and *B* respectively are

(a) 

(b) 

(c) 

(d) 

(e) 

8. A metal crystallizes into face-centred cubic (f.c.c.) and body-centred cubic (b.c.c.) lattices whose unit cell lengths are 3·5 Å and 3·0 Å respectively. The ratio of densities of unit cell of f.c.c. and b.c.c. is

(a) 0·26

(b) 1·26

(c) 2·26

(d) 1·76

(e) 2·76

9. Predict the structure of the following metal-oxide compounds using crystal field model :

(i) $NiAl_2O_4$

(ii) Fe_3O_4

(iii) $ZnMn_2O_4$

(a) (i) Normal spinel
(ii) Inverse spinel
(iii) Inverse spinel

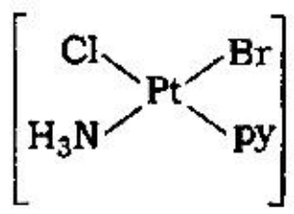
(b) (i) Inverse spinel
(ii) Normal spinel
(iii) Inverse spinel

(c) (i) Normal spinel
(ii) Inverse spinel
(iii) Normal spinel

(d) (i) Inverse spinel
(ii) Inverse spinel
(iii) Normal spinel

(e) (i) Normal spinel
(ii) Normal spinel
(iii) Inverse spinel

10. The correct order of addition of NH_3, pyridine (py) and Br^- to $[PtCl_4]^{2-}$ to obtain



is

(a) NH_3, py and Br^-

(b) Br^-, py and NH_3

(c) py, Br^- and NH_3

(d) NH_3, Br^- and py

(e) py, NH_3 and Br^-

11. Predict the shape of the following molecular species and account the number of lone pair(s) present on the central atom :

Column—I *Molecular species*	*Column—II* *Shape and lone pair(s)*
P. ICl_2^-	I. V-shaped, one
Q. $XeOF_4$	II. Square planar, two
R. BrF_4^-	III. T-shaped, two
S. SO_2	IV. Pyramidal, one
	V. Linear, three
	VI. Square-based pyramidal, one

The correct combination is

(a)	P	Q	R	S
	I	IV	III	V
(b)	P	Q	R	S
	V	VI	II	I
(c)	P	Q	R	S
	V	IV	II	I
(d)	P	Q	R	S
	I	II	IV	V
(e)	P	Q	R	S
	III	II	IV	V

12. A drug contains radioactive $_{11}Na^{24}$ and its half life is 14·8 hours. It is injected into the body of an animal. How many hours will be required for the activity to come to one-tenth of its original intensity assuming that none is excreted from the body of the animal?

(a) 1·48

(b) 148

(c) 49·2

(d) 4·92

(e) 0·49

13. All compounds in which one of the following options are diamagnetic?

(a) Cu(SCN), $Ni(CO)_4$ and $[PdCl_4]^{2-}$

(b) Cu(SCN), $[NiCl_4]^{2-}$ and $Ni(CO)_4$

(c) $[CoF_6]^{3-}$, $[Co(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$

(d) Cu(SCN), $[NiCl_4]^{2-}$, $Ni(CO)_4$ and $[PdCl_4]^{2-}$

(e) $[Ni(CN)_4]^{2-}$, $[NiCl_4]^{2-}$ and $Ni(CO)_4$

14. The metal ions associated with the metalloenzymes, carbonic anhydrase, sulphite oxidase, vitamin B_{12} coenzyme and haemocyanine are

(a) Co, Cu, Zn and Mo, respectively

(b) Zn, Co, Mo and Cu, respectively

(c) Zn, Mo, Co and Cu, respectively

(d) Co, Mo, Zn and Cu, respectively

(e) Mo, Zn, Cu and Co, respectively

15. 0·41 gm of iron containing mineral is dissolved in concentrated HCl acid and reduced to Fe(II) completely by $SnCl_2$ reagent. If the resulting solution is titrated with 0·112 (*N*) $KMnO_4$ solution, the titre value obtained is 5·1 mL. The percentage of iron in the given mineral is

(a) 7·5%

(b) 7·25%

(c) 7·00%

(d) 7·95%

(e) 7·75%

16. The number of skeletal electron pairs for the boranes $[B_4H_4]^{2-}$, B_4H_8, B_4H_{10} and B_5H_{11} are

(a) 5, 6, 7 and 8, respectively

(b) 4, 5, 6 and 7, respectively

(c) 5, 7, 8 and 9, respectively

(d) 5, 4, 7 and 8, respectively

(e) 8, 6, 6, and 8, respectively

17. If in the reaction $A + 2B \rightarrow$ products, the rate law was found to be rate = $k[A][B]^2$, predict by what factor the rate of reaction will increase, when the concentration of A is doubled and the concentration of B is also doubled.

(a) 2

(b) 4

(c) 6

(d) 8

(e) 16

18. In case of water, with increase in pressure, chemical potential of solid

(a) increases

(b) decreases

(c) remains unchanged

(d) increases and then decreases

(e) None of the above

19. If a system loses 250 kJ of heat at the same time it is doing 500 kJ of work, what is the change in the internal energy of the system?

(a) +250 kJ

(b) –250 kJ

(c) +750 kJ

(d) +1500 kJ

(e) –750 kJ

20. A dilute solution of NaCl is placed between two electrodes of 8 cm apart. If a potential difference of 5 volt is applied across the electrodes, then how far Na^+ ions can travel in 1 hour within the solution? (Given : Ionic conductivity of Na^+ at infinite dilution is 50·11 Ω^{-1} cm^2 mol^{-1} at 25 °C and 1 faraday = 96485·3 coulomb.)

(a) 11·270 cm

(b) 1·168 cm

(c) 0·019 cm

(d) 0·117 cm

(e) None of the above

21. If a measurement can provide the position of a (non-relativistic) proton with an accuracy of 2×10^{-11} m, then the uncertainty in the proton's position at 2s later is

(a) $\leq 1{\cdot}00 \times 10^3$ m

(b) $\geq 3{\cdot}16 \times 10^3$ m

(c) $\leq 9{\cdot}92 \times 10^3$ m

(d) $\geq 6{\cdot}31 \times 10^3$ m

(e) $\leq 7{\cdot}25 \times 10^3$ m

22. An electron collision with hydrogen atom promotes the hydrogen atom to its 2nd excited state from its ground state. The energy inserted by the electron in this inelastic collision is

(a) 13·6 eV

(b) 10·2 eV

(c) 3·4 eV

(d) 5·1 eV

(e) None of the above

23. The eigenvalues of the linear matrix operator $A = \begin{pmatrix} 6 & 2 \\ -1 & 3 \end{pmatrix}$ are

(a) 6 and 3

(b) –1 and 2

(c) 1 and –2

(d) 18 and –2

(e) 4 and 5

24. The half-life of a first-order reaction having activation energy 39·3 kcal mol^{-1} at 300 °C and largest frequency constant of $1{\cdot}11 \times 10^{11}$ Hz can be calculated as

(a) 0·9009 sec

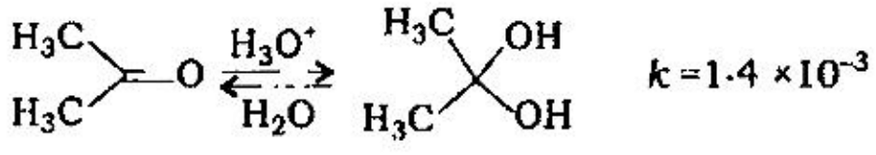
(b) $9{\cdot}009 \times 10^{10}$ sec

(c) 6050 sec

(d) 60·50 sec

(e) None of the above

25. Calculate the free energy differences between the carbonyl compound and its hydrate at 25 °C. [**Note** : at 25 °C, 2·3 $RT \approx 1{\cdot}364$ kcal/mol.]



(a) $\Delta G^\circ = +3{\cdot}9$ kcal/mol

(b) $\Delta G^\circ = -3{\cdot}9$ kcal/mol

(c) $\Delta G^\circ = +1{\cdot}4$ kcal/mol

(d) $\Delta G^\circ = -1{\cdot}4$ kcal/mol

(e) $\Delta G^\circ = 7{\cdot}8$ kcal/mol

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

★★★