Deeksha - CET

Subject	Topic	**Mock Test – 04**	Date
C + M + P	Complete Syllabus		2023

Max. Marks: 180 **Duration: 3 Hours**

1. **This paper consists of 180 questions with 3 parts of Chemistry, Mathematics and Physics**

    - **Chemistry:** *(Q. No. 1 to 60) Multiple Choice Questions with one correct answer. A correct answer carries 1 Mark. No Negative marks.*
    - **Mathematics:** *(Q. No. 61 to 120) Multiple Choice Questions with one correct answer. A correct answer carries 1 Mark. No Negative marks.*
    - **Physics:** *(Q. No. 121 to 180) Multiple Choice Questions with one correct answer. A correct answer carries 1 Mark. No Negative marks.*

2. **The OMR sheet for 200 questions is to be used**

3. **Use of calculators and log tables is prohibited**

4. **Darken the appropriate bubble using a pen in the OMR sheet provided to you. Once entered, the answer cannot be changed. Any corrections or modifications will automatically draw a penalty of 1 mark**

5. **No clarification will be entertained during the examination. Doubts in the paper can be reported to the coordinator after the exam**

6. **If the details in the OMR Sheet are not filled, If the OMR sheet is mutilated, torn, white Ink used, the circles filled and scratched, then the OMR sheet will not be graded**

All the best!!

Useful Data

At. Wt.:

$N = 14;\ O = 16;\ H = 1;\ S = 32;\ Cl = 35.5;\ Mn = 55;\ Na = 23;\ C = 12;\ Ag = 108;\ K = 39;\ Fe = 56;\ Pb = 207$

Physical Constants:

$h = 6.626 \times 10^{-34}\,\mathrm{Js}$, $\mathrm{N_a} = 6.022 \times 10^{23}\,\mathrm{mol^{-1}}$, $\mathrm{c} = 2.998 \times 10^{8}\,\mathrm{m\,s^{-1}}$, $\mathrm{m_e} = 9.1 \times 10^{-31}\,\mathrm{kg}$, $R = 8.314\ \mathrm{J\,mol^{-1}\,K^{-1}}$

Chemistry

Multiple Choice Questions with one correct answer. A correct answer carries 1 mark. No negative mark. **60 x 1 = 60**

1. Which of the following is not correct about Xenon difluoride?

   Options:

   (a) it has oxidation state of $+2$

   (b) the hybridization involved in XeF_2 is sp^3d^2

   (c) it is a linear molecule with three lone pairs

   (d) on hydrolysis it gives Xe, HF and O_2

   Sol: The hybridization involved in XeF_2 is sp^3d

   Ans: (b)

2. If chlorine passed through a solution of hydrogen sulphide in water, the solution turns turbid due to formation of

   Options:

   (a) free chlorine

   (b) free Sulphur

   (c) nascent oxygen

   (d) nascent hydrogen

   Sol: $H_2S + Cl_2 \rightarrow 2HCl + S$

   Ans: (b)

3. On heating $KClO_3$ we get

   Options:

   (a) $KClO_2 + O_2$

   (b) $KCl + O_2$

   (c) $KCl + O_3$

   (d) $KCl + O_2 + O_3$

   Sol: $2KClO_3 \rightarrow 2KCl + 3O_2$

   Ans: (b)

4. Which of the following hybrid is most stable?

   Options:

   (a) NH_3

   (b) PH_3

   (c) ASH_3

   (d) SbH_3

   Sol: Stability of hybrids decrease down the group $NH_3 > PH_3 > ASH_3 > SbH_3$

   Ans: (a)

5. The structure of $Fe(CO)_5$ is $(Z = 26 \text{ for } Fe)$

Options:

(a) octahedral

(b) tetrahedral

(c) square pyramidal

(d) trigonal bipyramidal

Sol: Fe in $Fe(CO)_5$ has sp^3d hybridization

Hence has trigonal bi pyramidal geometry

Ans: (d)

6. Which of the following descriptions about $[FeF_6]^{4-}$ is correct about complex ion?

Options:

(a) sp^3d, inner orbital complex, diamagnetic

(b) sp^3d^2, outer orbital complex, paramagnetic

(c) d^2sp^3, inner orbital complex, paramagnetic

(d) d^2sp^3, outer orbital complex, diamagnetic

Sol: $[FeF_6]^{4-} \rightarrow Fe$ has sp^3d^2 hybridization

It is an outer orbital complex and paramagnetic

Ans: (b)

7. Which of the following ligands will not show chelation?

Options:

(a) $EDTA$

(b) DMG

(c) Ethane $-1, 2-$diamine

(d) SCN^-

Sol: SCN^- is a monodentate ligand

Ans: (d)

8. The magnetic moment of a divalent ion in aqueous solution with atomic number 25 is

Options:

(a) $5.9\,BM$

(b) $2.9\,BM$

(c) $6.9\,BM$

(d) $9.9\,BM$

Sol: Atomic no $\rightarrow (Mn)$

Electronic configuration: $[Ar]3d^5 4s^2$

Its divalent will have configuration $[Ar]3d^5$

Number of unpaired electrons $=5$

$\therefore \quad u=\sqrt{n(n+2)}=\sqrt{5(7)}=\sqrt{35}=5.9\,BM$

Ans: (a)

9. Which of the following element has lowest melting point?

Options:

(a) Cr

(b) Fe

(c) Ni

(d) Cu

Sol: Cu has a lowest melting point as it has only one unpaired electron

Ans: (d)

10. Which of the following Lanthanoids is commonly used?

Options:

(a) Lanthanum

(b) Nobelium

(c) Thorium

(d) Cerium

Sol: Cerium used extensively

Ans: (d)

11. The trend of basicity of lanthanoid hydroxides

Options:

(a) increases across the lanthanoid series

(b) decrease across the lanthanoid series

(c) first increases and then decreases

(d) first decreases and then increases

Sol: It decreases across the lanthanoid series

Ans: (b)

12. Which of the following acts as the best coagulating agent for ferric hydroxide sol?

Options:

(a) potassium ferrocyanide

(b) potassium chloride

(c) potassium oxalate

(d) aluminium chloride

Sol: Ferric hydroxide sol is + vely charged $K_4\left[Fe(CN)_6\right] \to 4K^+ + \left[Fe(CN)_6\right]^{4-}$

Potassium Ferrocyanide is the best coagulating agent

Ans: (a)

13. White of an egg whipped with water acts as

Options:

(a) macromolecular colloid

(b) associated colloid

(c) molecular colloid

(d) normal electrolytic solution

Sol: It acts as macromolecular colloid

Ans: (a)

14. Which of the following gases is least absorbed on charcoal?

Options:

(a) HCl

(b) NH_3

(c) N_2

(d) CO_2

Sol: Molecule with lower intermolecular attractions is least adsorbed.

Ans: (c)

15. The rate constant for a first order reaction is $2\times10^{-2}\,\text{min}^{-1}$. The $t_{75\%}$ of reaction is

Options:

(a) 69.3

(b) 34.65

(c) 17.37

(d) 3.46

Sol: $t_{1/2} = \frac{0.693}{k} = \frac{0.693}{2\times10^{-2}} = 34.65\,\text{min}$;

$t_{75\%} = 2\times t_{1/2} = 2\times34.65 = 69.3\text{mins}$

Ans: (a)

16. The unit of rate constant for the reaction $2H_2 + 2NO \to 2H_2O + N_2$ which has rate $= k[H_2][NO]^2$ is

Options:

(a) $\text{mol}\,L^{-1}S^{-1}$

(b) S^{-1}

(c) $\text{mol}^{-2}L^2S^{-1}$

(d) $\text{mol}\,L^{-1}$

Sol: Order $=3$

$\therefore$ unit of rate constant is $\text{mol}^{-2}L^2S^{-1}$

Ans: (c)

17. Half-life of a first order reaction is 10 mins. What percentage of the reaction will be completed in 100 min?

Options:

(a) 25%

(b) 50%

(c) 99.9%

(d) 75%

Sol: $k=\frac{2.303}{t}\log\frac{9}{a-x}$

$\frac{0.693}{10}=\frac{2.303}{100}\log\frac{100}{100-x}$

$\log\frac{100}{100-x}=\frac{100\times 2.303\times 0.3}{2.303\times 10}=3$

$\frac{100}{100-x}=10^3=1000$; $\frac{100}{1000}=100-x$ or $100-x=0.1$

Or $x=100-0.1=99.9$

Ans: (c)

18. Limiting molar conductivity of NH_4OH is

Options:

(a) $\Lambda_m^\circ(NH_4OH)=\Lambda_m^\circ(NH_4Cl)+\Lambda_m^\circ(NaCl)$

(b) $\Lambda_m^\circ(NH_4OH)=\Lambda_m^\circ(NH_4Cl)+\Lambda_m^\circ(NaOH)-\Lambda_m^\circ(NaCl)$

(c) $\Lambda_m^\circ(NH_4OH)=\Lambda_m^\circ(NaOH)-\Lambda_m^\circ(NaCl)$

(d) $\Lambda_m^\circ(NH_4OH)=\Lambda_m^\circ(NaOH)+\Lambda_m^\circ(NaCl)-\Lambda_m^\circ(NH_4Cl)$

Sol: $\Lambda_m^\circ(NH_4OH)=\Lambda_m^\circ(NH_4Cl)+\Lambda_m^\circ(NaOH)-\Lambda_m^\circ(NaCl)$

Ans: (b)

19. The equivalent conductivity of $N/10$ solution of acetic acid at $25°\text{C}$ is $14.3\,\text{Scm}^2\,eq^{-1}$. What will be the degree of dissociation of acetic acid?

$\left(\Lambda_m^\circ(CH_3COOH)=390.71\,\text{Scm}^2\text{eq}^{-1}\right)$

Options:

(a) 3.66%

(b) 4.9%

(c) 2.12%

(d) 0.008%

Sol: % of dissociation $=\frac{\Lambda_m^c}{\Lambda_m^\circ}\times 100=\frac{14.3}{390.71}\times 100=3.66\%$

Ans: (a)

20. Maximum amount of a solid solute that can be dissolved in a specified amount of a given liquid solvent does not depend on _________

Options:

(a) temperature

(b) nature of solute

(c) pressure

(d) nature of solvent

Sol: Since solute is a solid, solubility is independent of pressure

Ans: (c)

21. Value of Henry's law constant K_H

Options:

(a) increases with increase in temperature

(b) decreases with increase in temperature

(c) remains constant

(d) first increases then decreases

Sol: Solubility decreases with increases in temperature for gaseous solute. $\therefore K_H$ Value increases

Ans: (a)

22. Osmotic pressure of a solution containing $2g$ dissolved protein per $300\,cm^3$ of solution is 20 mm of Hg at $27°C$. The molecular mass of protein is

Options:

(a) $5630\,g\,mol^{-1}$

(b) $6239.6\,g\,mol^{-1}$

(c) $7130\,g\,mol^{-1}$

(d) $5120\,g\,mol^{-1}$

Sol: $M_B=\frac{WB}{V}\times\frac{RT}{\Pi}$

$$=\frac{2}{300/1000}\times\frac{0.0821\times 300}{20/760}=6239.69\,g\,mol^{-1}$$

Ans: (b)

23. A plant cell shrinks when it is kept in a

Options:

(a) hypotonic solution

(b) hypertonic solution

(c) isotonic solution (d) pure water

Sol: Solution must be of higher concentration. Hence hypertonic solution

Ans: (b)

24. Mark the incorrect pair from the following

Options:

(a) Schottky defect – Equal number of cations and anions are missing

(b) Frenkel defect – Dislocation of cation from its normal site to an interstitial site

(c) Impurity defect - $CdCl_2$ in $AgCl$ crystal to create cationic vacancy

(d) Metal excess defect - $Fe_{0.93}O$

Sol: Metal deficiency defect - $Fe_{0.93}O$

Ans: (d)

25. Copper crystallizes in fcc with a unit cell length of 361pm. The radius of copper atom is

Options:

(a) $157\,\text{pm}$

(b) 181pm

(c) $127\,\text{pm}$

(d) $108\,\text{pm}$

Sol: $r = \frac{\sqrt{2}}{4} \times a = \frac{1.414}{4} \times 361 = 127\,\text{pm}$

Ans: (c)

26. The example which is not correctly matched is

Options:

(a) Ionic solids - $NaCl,\ ZnS$

(b) Covalent solid - $H_2,\ I_2$

(c) Molecular solid - $H_2O,\ SO_2$

(d) Metallic solid - $Cu,\ Sn$

Sol: $H_2,\ I_2$ are molecular solids

Ans: (b)

27. Which of the following ions have maximum stability?

Options:

(a) $CH_3 - \overset{+}{C}H - CH_3$

(b) $CH_3 - \overset{+}{C}H - OCH_3$

(c) $CH_3 - CH_2 - \overset{+}{C}H_2$

(d) $CH_3 - \overset{+}{C}H - CH_2 - OCH_3$

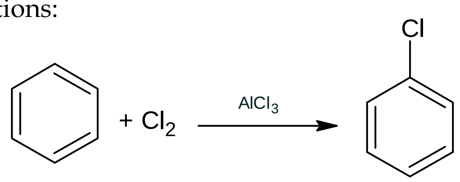
Sol: $CH_3-\overset{+}{C}H-OCH_3$ is stabilized by $+R$ effect.

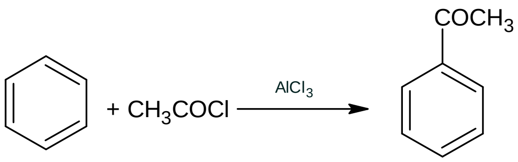
Hence more stable

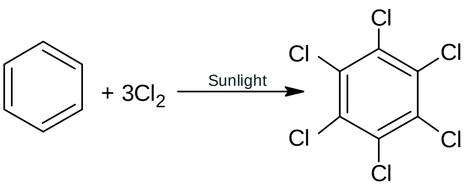
Ans: (b)

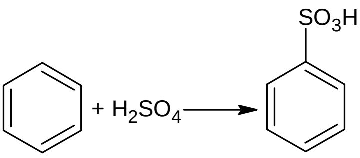
28. Which of the following reactions is not an example of electrophilic substitution in benzene ring?

Options:

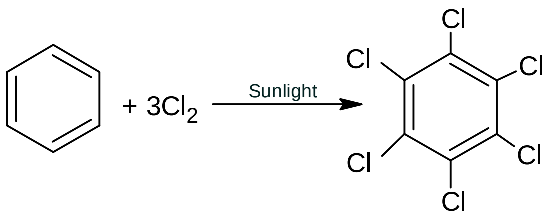
(a) 

(b) 

(c) 

(d) 

Sol:



Ans: (c)

29. The equilibrium constant at $717\,K$ for the reaction $H_2(g)+I_2(g) \rightleftharpoons 2HI(g)$ is $60.$ The equilibrium constant for the reaction: $2HI(g) \rightleftharpoons H_2(g)+I_2(g)$ is

Options:

(a) 1.6×10^{-2}

(b) 2×10^{-2}

(c) 2.56×10^{-2}

(d) 3×10^{-2}

Sol: $K'=\frac{1}{K}=\frac{1}{60}=1.6\times10^{-2}$

Ans: (a)

30. Which one of the following fairs do not import colour to the flame?

Options:

(a) $BeCl_2$ and $SrCl_2$

(b) $BeCl_2$ and $MgCl_2$

(c) $CaCl_2$ and $BaCl$

(d) $BaCl_2$ and $SrCl_2$

Sol: Both Be and Mg do not impart colour to the flame

Ans: (b)

31. Which of the following statements is not correct?

Options:

(a) the shape of an atomic orbital depends on the magnetic quantum number

(b) the orientation of an atomic orbital depends on the magnetic quantum number

(c) the energy of an electron in an atomic orbital of multi electron atom depends on principal quantum number

(d) the number of degenerate atomic orbitals of one type depends on the values of azimuthal and magnetic quantum numbers

Sol: The energy of an electron in an atomic orbital of multi electron atom depends on principal and azimuthal quantum numbers

Ans: (c)

32. Which of the following is incorrect for SF_4 ?

Options:

(a) it has sp^3d hybridization

(b) it has two lone pairs of electrons

(c) it has four bonding electrons

(d) it has see-saw shape

Sol: It has one lone pair of electron

Ans: (b)

33. For the reaction at $25°\text{C}$, $X_2O_4 \rightarrow 2XO_2$; $\Delta H = 211k\text{cal}$ and $\Delta S = 20\,\text{cal}\,K^{-1}$. The reaction would be

Options:

(a) Spontaneous

(b) Non-spontaneous

(c) At equilibrium

(d) unpredictable

Sol: $\Delta G = \Delta H - T\Delta S = 2.1 \times 10^3 - 298 \times 20$

$= 2100 - 5960 = -3860 = -3.8\,k\,\text{cal}$

The reaction is spontaneous

Ans: (a)

34. Which of the following statements is incorrect?

Options:

(a) H_2O_2 is a pale blue viscus liquid

(b) H_2O_2 cannot as an oxidizing as well as a reducing agent

(c) in H_2O_2 – the two hydroxyl groups lie on the same plane

(d) H_2O_2 has an open-book structure

Sol: In H_2O_2, the two hydroxyl groups lie on different plane

Ans: (c)

35. Carbon -60 contains _________ pentagons and ________hexagons

Options:

(a) 20, 12

(b) 12, 20

(c) 30, 30

(d) 24, 36

Sol: Number of pentagons : 12

Number of hexagons : 20

Ans: (b)

36. Which has maximum number of molecules?

Options:

(a) $7gN_2$

(b) $2gH_2$

(c) $16g\ NO_2$

(d) $16g\ O_2$

Sol: Mole of $N_2 = {}^{7}\!/_{28} = 0.25$

Mole of $H_2 = {}^{2}\!/_{2} = 1$

Mole of $NO_2 = {}^{16}\!/_{46} = 0.347$

Mole of $O_2 = {}^{16}\!/_{32} = 0.5$

Ans: (b)

37. The shape of ClF_3 according to $VSEPR$ theory is

Options:

(a) planar triangle

(b) $T-$shape

(c) tetrahedral

(d) square planar

Sol: ClF_3 has sp^3d hybridization with $T-$shape

Ans: (b)

38. The pH of $0.05M\ Ba(OH)_2$ solution is

Options:

(a) 12

(b) 13

(c) 1

(d) 10

Sol: $\left[OH^-\right] = 0.05\times 2 = 0.1 = 10^{-1}$

$\therefore POH = 1$

$\therefore\ PH = 13$

Ans: (b)

39. Which of the following elements will have highest second ionization enthalpy?

Options:

(a) $1s^2,\ 2s^2,\ 2p^6,\ 3s^2$

(b) $1s^2,\ 2s^2,\ 2p^6,\ 3s^1$

(c) $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^2$

(d) $1s^2,\ 2s^2,\ 2p^6, 3s^2,\ 3p^3$

Sol: $1s^2,\ 2s^2,\ 2p^6,\ 3s^1\ (Na)$ has highest second ionization enthalpy

Ans: (b)

40. Which of the following expression represents the value and unit of Vander Waal's constant a?

Options:

(a) $a = V/n,\ L\ \text{mol}^{-1}$

(b) $a = \dfrac{PV}{n},\ \text{atm}\ L^2\ \text{mol}^{-1}$

(c) $a = \dfrac{PV^2}{n^2},\ \text{atm}\ L^2\ \text{mol}^{-2}$

(d) $a = P/n,\ \text{atm mol}^{-1}$

Sol: $a = \dfrac{PV^2}{n^2}$

$\therefore$ unit is $\text{atm L}^2\text{mol}^{-2}$

Ans: (c)

41. For which of the process, ΔS is negative?

Options:

(a) $H_2(g) \rightarrow 2H(g)$

(b) $N_2(9, 1\text{atm}) \rightarrow N_2(9, 8\text{atm})$

(c) $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$

(d) $C(\text{diamond}) \rightarrow C(\text{graphite})$

Sol: $N_2(9, 1\text{ atm}) \rightarrow N_2(9, 8\text{ atm})$ $\Delta S = -ve$

Ans: (b)

42. Oxidation state of P in $Ba(H_2PO_2)_2$?

Options:

(a) +3

(b) +2

(c) +1

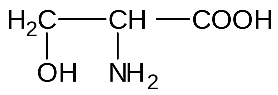
(d) −1

Sol: $Ba(H_2PO_2)_2 : +2 + (+2)2 + 2x + 4(-2) = 0$

$2x = 2$ or $x = +1$

Ans: (c)

43. The IUPAC name of the compound



Options:

(a) $2-$amino $-3-$hydroxypropanoic acid

(b) $1-$hydroxyl $-2-$aminoprop $-3-$oic acid

(c) $1-$amino $-2-$hydroxypropanoic acid

(d) $3-$hydroxyl $-2-$aminopropanoic acid

Sol: $2-$amino $-3-$hydroxypropanoic acid

Ans: (a)

44. The incorrect statement regarding glucose

Options:

(a) Glucose on reduction with HI/ red P forms $n-$hexane

(b) Glucose does not react with hydroxylamine (NH_2OH)

(c) Glucose on oxidation with Br_2 / H_2O given Gluconic acid

(d) Glucose on acetylation forms pentaacetyl derivative

Sol: Glucose reacts with hydroxylamine (NH_2OH) to form oxime

Ans: (b)

45. Each polypeptide in a protein has amino acids linked with each other in a specific sequence. This sequence of amino acids is said to be

Options:

(a) primary structure of proteins

(b) secondary structure of protein

(c) tertiary structure of protein

(d) quaternary structure of protein

Sol: It is referring to primary structure

Ans: (a)

46. In DNA, the complimentary bases are

Options:

(a) adenine and guanine : thymine and cytosine

(b) uracil and adenine : cytosine and guanine

(c) adenine and thymine : guanine and cytosine

(d) adenine and thymine : guanine and uracil

Sol: Adenine – thymine

Guanine - cytosine

Ans: (c)

47. The best reagent for converting $2-$phenylpropanamide into $2-$phenylpropanamine is

Options:

(a) excess of H_2

(b) Br_2 in aqueous $NaOH$

(c) iodine in presence of red P

(d) $LiAlH_4$ in ether

Sol:

Ans: (d)

48. The source of nitrogen in Gabriel synthesis of amine is

Options:

(a) sodium azide NaN_3

(b) sodium nitride $NaNO_2$

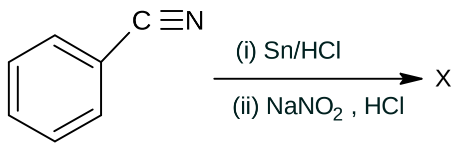
(c) potassium cyanide KCN

(d) potassium pthalimide $C_6H_4(CO)_2\,N^-K^+$

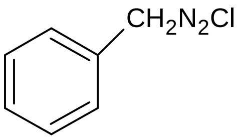
Sol: Potassium pthalimide - $C_6H_4(CO)_2\,N^-K^+$

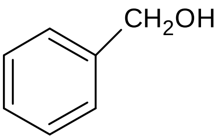
Ans: (d)

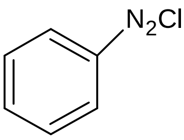
49. In the following reaction X is

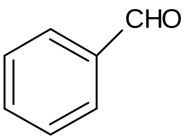


Options:

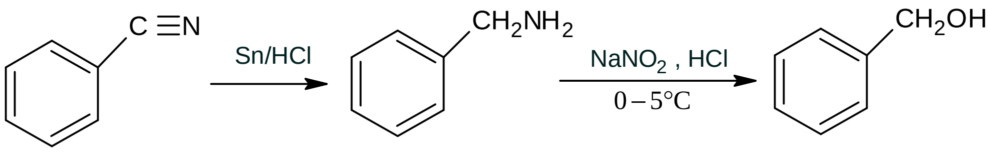
(a) 

(b) 

(c) 

(d) 

Sol:



Ans: (b)

50. Which of the following reagents are used for detecting the presence of carbonyl group?

Options:

(a) NH_2NH_2

(b) NH_2OH

(c) NH_4Cl

(d) Both (a) and (b)

Sol: Both NH_2-NH_2 and NH_2-OH react with carbonyl group.

Ans: (d)

51. Under Wolf Kishner reduction, the conversions which may be brought about are

Options:

(a) Benzophenone to diphenyl methanol

(b) Benzaldehyde into benzyl alcohol

(c) $2-$Hexanone into $n-$Hexane

(d) $2-$Hexanone into $2-$Hexanol

Sol:

$$CH_3-CH_2-CH_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3 \xrightarrow[KOH]{NH_2-NH_2} CH_3-(CH_2)_4-CH_3$$

Ans: (c)

52. Which of the following acids has the smallest dissociation constant?

Options:

(a) $CH_3CHFCOOH$

(b) FCH_2CH_2COOH

(c) $BrCH_2CH_2COOH$

(d) $CH_3CHBrCOOH$

Sol: Among the given acids $Br-CH_2CH_2COOH$ is the weakest. Hence it has smallest dissociation constant

Ans: (c)

53. Which among the following reactants and products not correctly matched

Options:

(a) $2CH_3CHO+NaOH$	$CH_3-\underset{}{\overset{\overset{\displaystyle OH}{\vert}}{CH}}-CH_2-CHO$
(b) $CH_3CHO+H_2N-NH_2$	$CH_3-CH=N-NH_2$
(c) $CH_3CHO+HCN$	$CH_3-CH(OH)CN$
(d) $2CH_3CHO+KOH$	$CH_3COOK+CH_3CH_2OH$

Sol:

$$2CH_3CHO \xrightarrow[\text{Aldol condensation}]{KOH} CH_3-\overset{\overset{\displaystyle OH}{\vert}}{CH}-CH_2-CHO$$

CH_3CHO does not undergo Cannizzaro reaction.

Ans: (d)

54. Iodoform can be prepared from all except

Options:

(a) isopropyl alcohol

(b) $3-$methyl $-2-$ butanone

(c) isobutyl alcohol

(d) ethyl methyl Ketone

Sol: Tertiary alcohol does not undergo iodoform reaction

Ans: (c)

55. From among the following alcohols the one that would react fastest with conc. HCl and anhydrous $ZnCl_2$ is

Options:

(a) $2-$Methyl Propanol

(b) $1-$Butanol

(c) $2-$Butanol

(d) $2-$Methyl propan $-2-$ol

Sol: $3°$ alcohols($2-$Methylpropan $-2-$ol) reacts faster.

Ans: (d)

56. Phenol on treatment with alcoholic KOH and chloroform gives

Options:

(a) Salicylaldehyde

(b) Salicylic acid

(c) Phthalic acid

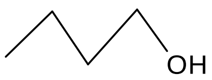
(d) benzoic acid

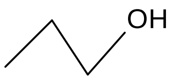
Sol: Phenol $\xrightarrow{\text{CHCl}_3\text{/KOH}}$ Salicylaldehyde

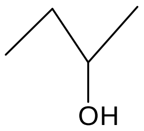
Ans: (a)

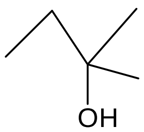
57. Which of the following has maximum pK_a value?

Options:

(a) 

(b) 

(c) 

(d) 

Sol: The acidic nature of alcohols decreases in the order $1° > 2° > 3°$. Higher the pK_a, lower is the acidic strength

Ans: (d)

58. Which of the following is an example of S_N2 reaction?

Options:

(a) $CH_3Br + OH^- \rightarrow CH_3OH + Br$

(b) $(CH)_2 CHBr + OH^- \rightarrow (CH_3)_2 CHOH + Br^-$

(c) $CH_3CH_2OH \xrightarrow{-H_2O} CH_2 = CH_2$

(d) $(CH_3)_3 C - Br + OH^- \rightarrow (CH_3)_3 C - OH + Br^-$

Sol: Primary halides undergo S_N2 reaction.

$1° > 2° > 3°$

Ans: (a)

59. In the following reaction

$$C_6H_5CH_2Br \xrightarrow[(ii)H_3O^+]{(i)\text{Mg.ether}} X$$

The product X is

Options:

(a) $C_6H_5CH_2OCH_2C_6H_5$

(b) $C_6H_5CH_2C_6H_5$

(c) $C_6H_5CH_3$

(d) $C_6H_5CH_2CH_2C_6H_5$

Sol: $C_6H_5CH_2Br \xrightarrow[(ii)H_3O^+]{(i)\text{Mg.ether}} C_6H_5CH_3$

Ans: (c)

60. Which of the following is the correct method of preparation of methyl fluoride?

Options:

(a) $CH_4 + HF \rightarrow$

(b) $CH_3OH + HF \rightarrow$

(c) $CH_4 + F_2 \rightarrow$

(d) $CH_3Br + AgF \rightarrow$

Sol: $CH_3Br + AgF \rightarrow CH_3F + AgBr$ (Swart's reaction)

Ans: (d)

Mathematics

Multiple Choice Questions with one correct answer. A correct answer carries 1 mark. No negative mark. **60 x 1 = 60**

61. If $n(U)=300, n(A)=115, n(B)=125$ and $n(A\cup B)=140$ then $n\left[(A\cap B)'\right]=$

Options:

(a) 100

(b) 150

(c) 200

(d) 175

Sol: We have,

$n\left[(A\cap B)'\right]=n(U)-n(A\cap B)=n(U)-\left[n(A)+n(B)-n(A\cup B)\right]=300-[115+125-140]=300-100=200$

Ans: (c)

62. In the set $A=\{1,2,3,4,5\}$, a relation R is defined by $R=\{x,y): x,\ y\in A,\ x<y\}$. Then R is

Options:

(a) Reflexive

(b) Symmetric

(c) Transitive

(d) None of these

Sol: The relation $'<"$ is only a transitive relation.

Ans: (c)

63. The domain of the function $f(x)=\sqrt{\left(2-2x-x^2\right)}$ is

Options:

(a) $-1\le x\le\sqrt{3}$

(b) $-1-\sqrt{3}\le x\le -1+\sqrt{3}$

(c) $-2\ \le x\ \le 2$

(d) None of these

Sol: $f(x)=\sqrt{2-2x-x^2}$ is defined for all x for which, $2-2x-x^2>0$

i.e., for which $x^2+2x-2<0$

Consider $x^2+2x-2=0$

$\Rightarrow\ x=\dfrac{-2\pm\sqrt{4+8}}{2}$

$\Rightarrow\ x=-1\pm\sqrt{3}$

Thus $x^2+2x-2<0,$ for $-1-\sqrt{3}\le x\le -1+\sqrt{3}$

$\left[ax^2+bx+c\le 0 \text{ for } \alpha\le x\le\beta, \text{where } \alpha \text{ and } \beta \text{ are the roots of } ax^2+bx+c=0,\ \alpha<\beta\right]$

Ans: (b)

64. The mapping $f: R^{+} \to R$ defined by $f(x) = \log_{10} x$, (where R^{+} is the set of all positive real numbers) is

Options:

(a) Only one-one mapping

(b) Only onto mapping

(c) Both one-one and onto

(d) None of these

Sol: $f(x) = \log_{10} x$ is defined for all $x > 0$.

Further, it is both one-one and onto function.

Ans: (c)

65. If $g(x) = 1 + \sqrt{x}$ and $f(g(x)) = 3 + 2\sqrt{x} + x$ then $f(x) =$

Options:

(a) $1 + 2x^2$

(b) $2 + x^2$

(c) $1 + x$

(d) $2 + x$

Sol: $f(g(x)) = 3 + 2\sqrt{x} + x = \left[\left(\sqrt{x}\right)^2 + 2\sqrt{x} + 1\right] + 2 = \left(\sqrt{x} + 1\right)^2 + 2 = [g(x)]^2 + 2$

$\Rightarrow f(x) = x^2 + 2$

Ans: (b)

66. Let, $f: R \to R$ be defined by $f(x) = \begin{cases} 2x & x > 3 \\ x^2 & 1 < x \le 3 \\ 3x & x \le 1 \end{cases}$ *Then* $f(-1) + f(2) + f(4) =$

Options:

(a) 9

(b) 14

(c) 5

(d) None of these

Sol: Now, $f(-1) = 3(-1) = -3 \qquad (\therefore -1 < 1)$

$f(2) = 2^2 = 4 \qquad (\because -1 < 2 < 3)$

$f(4) = 2(4) = 8 \qquad (\therefore 4 > 3)$

$f(-1) + f(2) + f(4) = -3 + 4 + 8 = 9$

Ans: (a)

67. "If $x-2=3$ and $y=-2$ then $2x+y=3$" The contrapositive of the statement is

Options:

(a) If $(x-2)\neq 3$ and $y=-2$ then $(2x+y=3)$

(b) If $(2x+y\neq 3)$ then $(x-2\neq 3$ or $y\neq -2)$

(c) If $(2x+y\neq 3)$ then $(x-2\neq 3)$ and $(y\neq -2)$

(d) If $(x-2\neq 3)$ and $(y\neq -2)$ then $(2x+y\neq 3)$

Sol: $p: x-2=3,\ q: y=-2, r: 2x+y=3$

Given statement is $(p\wedge q)\rightarrow r$

The contrapositive of this is

$\sim r\rightarrow \sim(p\wedge q)$

$\equiv \sim r\rightarrow(\sim p\vee\sim q)$

i.e., If $(2x+y\neq 3)$ then $[(x-2\neq 3)$ or $(y\neq -2)]$

Ans: (b)

68. If 9 times the 9^{th} elements of an $A.P$ is equal to 13 times the 13^{th} element, then the 22^{nd} element of the $A.P$ is

Options:

(a) 0

(b) 22

(c) 220

(d) 198

Sol: $9[a+8d]=13[a+12d]$

$\Rightarrow 4a+84d=0 \qquad \Rightarrow 4(a+21d)=0$

$\Rightarrow a+21d=0 \qquad \Rightarrow 22^{nd}$ element is 0

Ans: (a)

69. If one root of the equation $5x^2+13x+k=0$ is reciprocal of other, then the value of k is

Options:

(a) 0

(b) 5

(c) $\frac{1}{6}$

(d) 6

Sol: Let $\alpha, \frac{1}{\alpha}$ be the roots

$\Rightarrow \alpha+\frac{1}{\alpha}=-\frac{13}{5}$ and $\alpha.\frac{1}{\alpha}=\frac{k}{5}\Rightarrow\frac{k}{5}=1\Rightarrow k=5$

Ans: (b)

70. The number of ways in which ten candidates $A_1, A_2, ..., A_{10}$ be ranked, if A_1 is always above A_2 is

Options:

(a) $2\times 8!$

(b) $9!$

(c) $10!$

(d) $5\times 9!$

Sol: Ten candidates can be ranked in $10!$ ways. In half of there A_2 and in another half A_2 is ranked above A_1

$\therefore$ required number $=\frac{1}{2}\times 10! = 5\times 9!$

Ans: (d)

71. If the middle term of $\left(\frac{1}{x}+x\sin x\right)^{10}$ is equal to $7\frac{7}{8}$, then the value of x is

Options:

(a) $2n\pi+\frac{\pi}{6}, n\in Z$

(b) $n\pi+\frac{\pi}{6}, n\in Z$

(c) $n\pi+(-1)^n\frac{\pi}{6}, n\in Z$

(d) $n\pi+(-1)^n\frac{\pi}{3}, n\in Z$

Sol: The middle term is the 6^{th} term.

Now, $T_6 = 10C_5 \cdot \frac{1}{x^5} \cdot x^5 \sin^5 x$

$\Rightarrow \frac{63}{8} = \frac{10!}{5!\times 5!}\sin^5 x \Rightarrow \quad \sin^5 x = \frac{1}{2^5}$

$\Rightarrow \sin x = \frac{1}{2} \quad \Rightarrow \quad x = n\pi+(-1)^n\frac{\pi}{6}, n\in Z$

Ans: (c)

72. If $A=\begin{pmatrix} 0 & c & -b \\ -c & 0 & a \\ b & -a & 0 \end{pmatrix}$ and $B=\begin{pmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ac & bc & c^2 \end{pmatrix}$

Then $AB=$

Options:

(a) B

(b) A

(c) O, where O is null matrix

(d) I_3, where I_3 is unit matrix of order 3

Sol: $A\cdot B=\begin{pmatrix}0 & c & -b\\ -c & 0 & a\\ b & -a & 0\end{pmatrix}\begin{pmatrix}a^2 & ab & ac\\ ab & b^2 & bc\\ ac & bc & c^2\end{pmatrix}=\begin{pmatrix}abc-abc & b^2c-b^2c & bc^2-bc^2\\ -a^2c+a^2c & -abc+abc & -ac^2+ac^2\\ a^2b-a^2b & ab^2-ab^2 & abc-abc\end{pmatrix}=\begin{pmatrix}0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}=O$

Ans: (c)

73. If $A=\begin{pmatrix}x & 1\\ 0 & x\end{pmatrix}$, then $A^n=$

Options:

(a) $\begin{pmatrix}x^n & nx^{n-1}\\ 0 & x^n\end{pmatrix}$

(b) $\begin{pmatrix}nx^{n-1} & x^n\\ 0 & x^n\end{pmatrix}$

(c) $\begin{pmatrix}x^n & 0\\ nx^{n-1} & x^n\end{pmatrix}$

(d) $\begin{pmatrix}x^n & x^n\\ 0 & x^{n-1}\end{pmatrix}$

Sol: Consider, $A^2=\begin{pmatrix}x & 1\\ 0 & x\end{pmatrix}\begin{pmatrix}x & 1\\ 0 & x\end{pmatrix}=\begin{pmatrix}x^2 & 2x\\ 0 & x^2\end{pmatrix}=\begin{pmatrix}x^2 & 2x^{2-1}\\ 0 & x^2\end{pmatrix}$

$A^3=\begin{pmatrix}x & 1\\ 0 & x\end{pmatrix}\begin{pmatrix}x^2 & 2x\\ 0 & x^2\end{pmatrix}=\begin{pmatrix}x^3 & 3x^2\\ 0 & x^3\end{pmatrix}\begin{pmatrix}x^3 & 3x^{3-1}\\ 0 & x^3\end{pmatrix}$

$A^n=\begin{pmatrix}x^n & nx^{n-1}\\ 0 & x^n\end{pmatrix}$

Ans: (a)

74. $\Delta=\begin{vmatrix}1 & 1+ac & 1+bc\\ 1 & 1+ad & 1+bd\\ 1 & 1+ae & 1+be\end{vmatrix}$

Options:

(a) $a+b+c$

(b) 3

(c) 1

(d) 0

Sol: Consider $C_2\to C_2-C_1$ and $C_3\to C_3-C_1$ we get $\Delta=\begin{vmatrix}1 & ac & bc\\ 1 & ad & bd\\ 1 & ae & be\end{vmatrix}=ab\begin{vmatrix}1 & c & c\\ 1 & d & d\\ 1 & e & e\end{vmatrix}=0$

Ans: (d)

75. The value of $\Delta = \begin{vmatrix} 5^2 & 5^3 & 5^4 \\ 5^3 & 5^4 & 5^5 \\ 5^4 & 5^6 & 5^7 \end{vmatrix}$ is

Options:

(a) 5^2

(b) 0

(c) 5^{13}

(d) 5^9

Sol: $\Delta = 5^2 \cdot 5^3 \cdot 5^4 \begin{vmatrix} 1 & 1 & 1 \\ 5 & 5 & 5 \\ 25 & 25 & 25 \end{vmatrix} = 0$

Ans: (b)

76. The maximum value of $\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+\sin\theta & 1 \\ 1+\cos\theta & 1 & 1 \end{vmatrix}$ is

$(\theta \text{ is real numbers})$

Options:

(a) $\frac{1}{2}$

(b) $\frac{\sqrt{3}}{2}$

(c) $\sqrt{2}$

(d) $\frac{2\sqrt{3}}{4}$

Sol: We have, $\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+\sin\theta & 1 \\ 1+\cos\theta & 1 & 1 \end{vmatrix}$

$\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 0 & \sin\theta & 0 \\ \cos\theta & 0 & 0 \end{vmatrix} \begin{matrix} R_2 - R_1 \\ R_3 - R_1 \end{matrix}$

$\Delta = \sin\theta\cos\theta = \frac{1}{2}\sin 2\theta$

$\sin 2\theta$ is max $2\theta = \frac{\pi}{2} \Rightarrow \theta = \frac{\pi}{4}.$

$\therefore$ Max value is $\frac{1}{2}.$

Ans: (a)

77. Solution set of the inequation $\frac{1}{x+2} < \frac{3}{x-3}$ is

Options:

(a) $\left(-\frac{9}{2}, 2\right) \cup (3, \infty)$

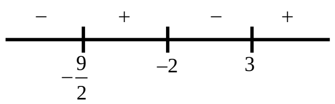
(b) $\left(-\infty, -\frac{9}{2}\right) \cup (2, 3)$

(c) $\left(-\frac{9}{2}, 2\right) \cup (2, 3)$

(d) $\left(-\infty, -\frac{9}{2}\right) \cup (3, \infty)$

Sol: $\frac{1}{x+2} < \frac{3}{x-3} \quad \Rightarrow \frac{1}{x+2} - \frac{3}{x-3} < 0 \quad \Rightarrow \frac{x-3-3x-6}{(x+2)(x-3)} < 0$

$\Rightarrow \frac{-(2x+9)}{(x+2)(x-3)} < 0 \quad \Rightarrow \frac{2x+9}{(x+2)(x-3)} > 0$



$\therefore$ Solution set is $\left(-\frac{9}{2}, -2\right) \cup (3, \infty)$.

Ans: (a)

78. If n is any positive integer then the value of $\frac{i^{4n+1} - i^{4n-1}}{2} =$

Options:

(a) 1

(b) -1

(c) i

(d) $-i$

Sol: $\frac{i^{4n+1} - i^{4n-1}}{2} = \frac{i - i^{-1}}{2} \qquad \left(\because i^{4n} = 1\right)$

$= \frac{i - \frac{1}{i}}{2} = \frac{i+i}{2} = i \qquad \left(\because \frac{1}{i} = -i\right)$

Ans: (c)

79. The equation of the diagonal through the origin of the quadrilateral formed by $x = 0,\ y = 0,\ x + y = 1$ and $6x + y = 3$ is

Options:

(a) $3x - 2y = 0$

(b) $3x - y = 0$

(c) $x - y = 0$

(d) $3x - 4y = 0$

Sol: The required line is the through the intersection of $x+y-1=0$ and $6x+y-3=0$ and passing thro' $(0,0)$ i.e., equation is of the form $x+y-1+\lambda(6x+y-3)=0$

This passes thro' $(0,0)$

$\Rightarrow -1-3\lambda=0 \Rightarrow \lambda=-\frac{1}{3}$

$\therefore$ line is $(1-2)x+\left(1-\frac{1}{3}\right)y=0$

i.e., $3x-2y=0$

Ans: (a)

80. The line $y=x$ is a tangent at $(0,0)$ to a circle of radius unity. The centre of the circle is

Options:

(a) $(1,0)$

(b) $\left(\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$

(c) $\left(-\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$

(d) $\left(-\frac{1}{\sqrt{2}},-\frac{1}{\sqrt{2}}\right)$

Sol: The centre lies on the line $\perp$ to $y=x$ and passing thro' $(0,0)$.

i.e., centre lies on $y=-x$.

$\therefore$ centre $=\left(-\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$

Ans: (c)

81. The major axis of an ellipse is three times the minor axis. Then the eccentricity is

Options:

(a) $\frac{2\sqrt{2}}{3}$

(b) $\frac{2}{3}$

(c) $\frac{\sqrt{2}}{3}$

(d) $\frac{1}{3}$

Sol: By data, $2a=3(2b)\Rightarrow a=3b$

Now, $e^2=\frac{a^2-b^2}{a^2}=\frac{9b^2-b^2}{9b^2}=\frac{8}{9}\Rightarrow e=\frac{2\sqrt{2}}{3}$

Ans: (a)

82. If $\operatorname{cosec} A+\cot A=\frac{11}{2}$, then $\tan A$ is

Options:

(a) $\frac{21}{22}$

(b) $\frac{15}{16}$

(c) $\frac{44}{117}$

(d) $\frac{117}{43}$

Sol: $\operatorname{cosec} A+\cot A=\frac{1}{\operatorname{cosec} A-\cot A}=\frac{11}{2}$

$\operatorname{cosec} A+\cot A=\frac{11}{2}$

$\operatorname{cosec} A-\cot A=\frac{2}{11}$

$\Rightarrow 2\cot A=\frac{11}{2}-\frac{2}{11}=\frac{117}{22}\Rightarrow \tan A=\frac{44}{117}$

Ans: (c)

83. Two posts are 25 meters and 15 meters high and the line joining their tops makes an angle of $45°$ with the horizontal. Then the distance between these posts in

Options:

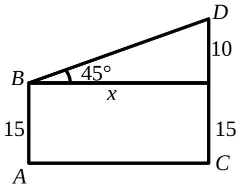
(a) $5\,\text{mts}$

(b) $\frac{10}{\sqrt{2}}\,\text{mts}$

(c) $10\,\text{mts}$

(d) $10\sqrt{2}\,\text{mts}$

Sol: From the figure we have,



$\tan 45°=\frac{10}{x}$

$\Rightarrow x=10\,\text{mts}$

Ans: (c)

84. The $A+B+C=180°$ then $\sin 2A+\sin 2B+\sin 2C=$

Options:

(a) $4\sin A\cdot\sin B\cdot\sin C$

(b) $4\cos A\cdot\cos B\cdot\cos C$

(c) $2\sin A\cdot\sin B\cdot\sin C$

(d) $8\sin A\cdot\sin B\cdot\sin C$

Sol: $GE = \sin 2A = \sin 2B + \sin 2C$

$= 2\sin(A+B)\cos(A-B) + 2\sin C\cos C$

$= 2\sin(\cos(A-B) + 2\sin C\cos C) \quad \sin(A+B) = \sin C \quad = 2\sin C[\cos(A-B) + \cos C]$

$= 2\sin C[\cos(A-B) - \cos(A+B)] \quad \cos C = -\cos(A+B)$

$= 2\sin C[-2\sin A\sin(-B)] = \sin A\sin B\sin C$

Ans: (a)

85. The general solution of the question $\tan 3\theta \cdot \tan\theta = 1$ is

Options:

(a) $(2n+1)\frac{\pi}{2}, n \in Z$

(b) $(2n+1)\frac{\pi}{4}, n \in Z$

(c) $(2n+1)\frac{\pi}{8}, n \in Z$

(d) $(2n+1)\frac{\pi}{6}, n \in Z$

Sol: $\tan 3\theta \cdot \tan\theta = 1 \Rightarrow \tan 3\theta = \cot\theta$

$\Rightarrow \tan 3\theta = \tan\left(\frac{\pi}{2} - \theta\right)$

$\Rightarrow 3\theta = n\pi + \frac{\pi}{2} - \theta \Rightarrow \theta = \frac{n\pi}{4} + \frac{\pi}{8} \Rightarrow \theta = (2n+1)\frac{\pi}{8}, n \in Z$

Ans: (c)

86. If $\cos\theta - 4\sin\theta = 1$, then $\sin\theta + 4\cos\theta =$

Options:

(a) ± 1

(b) 0

(c) ± 2

(d) ± 4

Sol: If $a\cos\theta - b\sin\theta = c$, then $b\cos\theta + a\sin\theta = \sqrt{a^2 + b^2 - c^2}$

Here we have, $\cos\theta - 4\sin\theta = 1$.

$a = 1, b = 4, c = 1. \quad \therefore 4\cos\theta + \sin\theta = \sqrt{1+16-1} = \pm 4$ or: $(4\cos\theta + \sin\theta)^2$

$= 16\cos^2\theta + \sin^2\theta + 8\sin\theta\cos\theta = 16(1-\sin^2\theta) + (1-\cos^2\theta) + 8\sin\theta\cos\theta$

$= 16 + 1 - [\cos^2\theta + 16\sin^2\theta - 8\sin\theta\cos\theta] = 17 - (\cos\theta - 4\sin\theta)^2 = 17 - 1 = 16$

$\therefore (4\cos\theta + \sin\theta) = \pm 4$

Ans: (d)

87. $\sin\left[\sin^{-1}\frac{2}{3}+2\cos^{-1}\frac{2}{3}\right]=$

Options:

(a) $\frac{2}{3}$

(b) $\frac{3}{2}$

(c) $-\frac{2}{3}$

(d) $-\frac{3}{2}$

Sol: $\sin\left[\sin^{-1}\frac{2}{3}+2\cos^{-1}\frac{2}{3}\right]=\sin\left[\frac{\pi}{2}+\cos^{-1}\frac{2}{3}\right]\left(\because \sin^{-1}x+\cos^{-1}x=\frac{\pi}{2}\right)=\cos\left(\cos^{-1}\frac{2}{3}\right)=\frac{2}{3}$

Ans: (a)

88. A solution of the equation $\tan^{-1}(1+x)+\tan^{-1}(1-x)=\frac{\pi}{2}$ is

Options:

(a) 1

(b) -1

(c) 0

(d) π

Sol: By inspection, $x=0$

Or $\tan^{-1}(1+x)+\tan^{-1}(1-x)=\frac{\pi}{2}$

$\Rightarrow 1+x=\frac{1}{1-x}\Rightarrow 1-x^2=1\Rightarrow x=0$

Ans: (c)

89. $\vec{u},\ \vec{v}$ and $\overline{w}$ are the three vectors non-coplanar vectors, then $\left(\vec{u}+\vec{v}-\vec{w}\right)\cdot\left[\left(\vec{u}-\vec{v}\right)\times\left(\vec{v}-\vec{w}\right)\right]=$

Options:

(a) 0

(b) $\vec{u}\cdot\left(\vec{v}\times\vec{w}\right)$

(c) $\vec{u}\cdot\left(\vec{w}\times\vec{v}\right)$

(d) $3\vec{u}\times\left(\vec{v}\times\vec{w}\right)$

Sol: $\left(\vec{u}+\vec{v}-\vec{w}\right)\cdot\left[\left(\vec{u}-\vec{v}\right)\cdot\left(\vec{v}-\vec{w}\right)\right]=\left(\vec{u}+\vec{v}-\vec{w}\right)\left[\left(\vec{u}\times\vec{v}\right)-\left(\vec{u}\times\vec{w}\right)+\left(\vec{v}\times\vec{w}\right)\right]$

$=\vec{u}\cdot\left(\vec{v}\times\vec{w}\right)-\vec{v}\cdot\left(\vec{u}\times\vec{w}\right)-\vec{w}\cdot\left(\vec{u}\times\vec{v}\right)=\vec{u}\cdot\left(\vec{v}\times\vec{w}\right)+\vec{u}\cdot\cancel{\left(\vec{v}\times\vec{w}\right)}-\vec{u}\cdot\cancel{\left(\vec{v}\times\vec{w}\right)}=\vec{u}\cdot\left(\vec{v}\cdot\vec{w}\right)$

(we have use $\vec{a}\times\vec{a}=\vec{0},\vec{a}\cdot\left(\vec{b}\times\vec{c}\right)=0$ if any two vector are equal)

Ans: (b)

90. If $\vec{a}=i-j+2k, \vec{b}=2i+3j+k$ and $\vec{c}=i-k$ then the magnitude of $\vec{a}+2\vec{b}-3\vec{c}$ is

Options:

(a) $\sqrt{87}$

(b) $\sqrt{78}$

(c) $\sqrt{89}$

(d) $\sqrt{101}$

Sol: $\vec{a}=i-j+2k, \vec{b}=2i+3j+k, \vec{c}=i-k$

$\vec{a}+2\vec{b}-3\vec{c}=(i+4i-3i)+(-j+6j)+(2k+2k+3k)=2i+5j+7k$; $|\vec{a}+2\vec{b}-3\vec{c}|=\sqrt{4+25+49}=\sqrt{78}$

Ans: (b)

91. If $|\vec{a}|=4, |\vec{b}|=2$ and angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$, then $(\vec{a}\times\vec{b})$ is

Options:

(a) 48

(b) 16

(c) $\vec{a}$

(d) 15

Sol: We have, $(\vec{a}\times\vec{b})^2=|\vec{a}\times\vec{b}|^2=|\vec{a}|^2\cdot|\vec{b}|^2\cdot\sin^2\theta=16\cdot4\cdot\frac{1}{4}=16$

Ans: (b)

92. The feasible solution for a LPP is shown in the following figure. Let $Z=3x-4y$, be the objective function. Maximum of Z occurs at

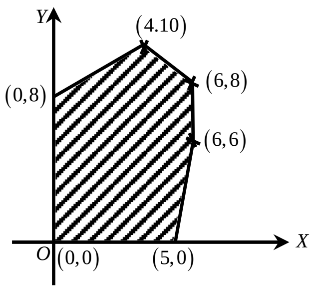
Options:

(a) $(5,0)$

(b) $(6,5)$

(c) $(6,8)$

(d) $(4,10)$



Sol: Clearly, $Z_{(5,0)}=3(5)-4(0)=15$ is maximum

Ans: (a)

93. The coordinates of the point $P=(3,4,5)$, then the direction cosines of $\vec{OP}$ are

Options:

(a) $3,4,5$

(b) $\frac{1}{3},\frac{1}{4},\frac{1}{5}$

(c) $\frac{3}{50},\frac{4}{50},\frac{1}{10}$

(d) $\frac{3}{5\sqrt{2}},\frac{4}{5\sqrt{2}},\frac{1}{\sqrt{2}}$

Sol: The direction ratios of $\vec{OP}$ are 3, 4, 5.

$\therefore$ the direction cosines are $\frac{3}{\sqrt{9+16+25}}, \frac{4}{\sqrt{9+16+25}}, \frac{5}{\sqrt{9+16+25}}$

i.e., $\frac{3}{5\sqrt{2}}, \frac{4}{5\sqrt{2}}, \frac{1}{\sqrt{2}}$

Ans: (d)

94. Foot of the perpendicular from $(1,3,4)$ on the plane $2x+3y+z+2=0$ is

Options:

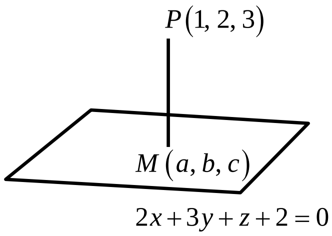
(a) $\left(\frac{-20}{14}, \frac{-9}{14}, \frac{39}{14}\right)$

(b) $\left(\frac{20}{14}, \frac{9}{14}, \frac{-39}{14}\right)$

(c) $\left(\frac{-20}{14}, \frac{9}{14}, \frac{-39}{14}\right)$

(d) None of these

Sol: Let the foot of perpendicular be (a, b, c)



Then $\frac{a-1}{2} = \frac{b-3}{3} = \frac{c-4}{1} = k$

$\Rightarrow a = 2k+1, b = 3k+3, c = k+4.$

$\therefore M = (2k+1, 3k+3, k+4)$ lies on plane

$\therefore 2a+3b+c+2=0 \Rightarrow k = \frac{-17}{14}$

$\Rightarrow M = \left(\frac{-20}{14}, \frac{-9}{14}, \frac{39}{14}\right)$

Ans: (a)

95. The angle between the lines $\frac{x+1}{2} = \frac{y-2}{5} = \frac{z+3}{4}$ and $\frac{x-1}{1} = \frac{y+2}{2} = \frac{z-3}{-3}$ is

Options:

(a) $45°$

(b) $30°$

(c) $60°$

(d) $90°$

Sol: The lines are $\frac{x+1}{2} = \frac{y-2}{5} = \frac{z+3}{4}$ and $\frac{x-1}{1} = \frac{y+2}{2} = \frac{z-3}{-3}$

The d.r's of the lines are $2, 5, 4$ and $1, 2, -3$

Clearly, $2\cdot(1)+5\cdot(2)+4\cdot(-3) = 2+10-12 = 0$

Thus the angle between the lines if $90°$

Ans: (d)

96. The sine of the angle between the straight line $\frac{x-2}{2}=\frac{y-3}{4}=\frac{z-4}{5}$ and the plane , $2x-2y+z=5$ is

Options:

(a) $\frac{10}{6\sqrt{5}}$

(b) $\frac{4}{5\sqrt{2}}$

(c) $\frac{2\sqrt{3}}{5}$

(d) $\frac{\sqrt{2}}{10}$

Sol: We have, $\frac{x-2}{3}=\frac{y-3}{4}=\frac{z-4}{5}$ and $2x+2y+z=5$

$$\sin\theta=\left|\frac{(3\times 2)+4(-2)+5(1)}{\sqrt{9+16+25}\ \sqrt{4+4+1}}\right|=\frac{3}{\sqrt{50}\sqrt{9}}=\frac{1}{5\sqrt{2}}=\frac{\sqrt{2}}{10}$$

Ans: (d)

97. $\lim\limits_{x\to 0}\frac{1-\cos 5x}{\sin 4x}=$

Options:

(a) $\frac{5}{4}$

(b) $\frac{4}{5}$

(c) 0

(d) $-\frac{5}{4}$

Sol: $\lim\limits_{x\to 0}\frac{1-\cos 3x}{\sin 4x}=\lim\limits_{x\to 0}\frac{5\sin 5x}{4\cos 4x}$ (LH Rule)

$=\frac{5}{4}\times\frac{0}{1}=0$

Ans: (c)

98. $\lim\limits_{x\to 0}\frac{e^x-(1+x)}{x^2}=$

Options:

(a) 0

(b) $\frac{1}{4}$

(c) $\frac{1}{2}$

(d) 1

Sol: $\lim\limits_{x\to 0}\dfrac{e^x-(1+x)}{x^2}$ $\left(\dfrac{0}{0}\text{form}\right)$

$=\lim\limits_{x\to 0}\dfrac{e^x-1}{2x}$ $\left(\dfrac{0}{0}\text{form}\right)$

$=\lim\limits_{x\to 0}\dfrac{e^x}{2}=\dfrac{1}{2}$

Ans: (c)

99. If $S_n=\dfrac{1}{1.4}+\dfrac{1}{4.7}+\dfrac{1}{7.10}+.....$ to n terms, then $\lim\limits_{x\to\infty} S_n=$

Options:

(a) $\dfrac{1}{5}$

(b) $\dfrac{1}{3}$

(c) ∞

(d) 3

Sol: We have, $S_n=\sum\dfrac{1}{(3n-2)(3n+1)}=\sum\dfrac{1}{3}\left(\dfrac{1}{3n-2}-\dfrac{1}{3n+1}\right)=\dfrac{1}{3}\left[\left(1-\dfrac{1}{4}\right)+\left(\dfrac{1}{4}-\dfrac{1}{7}\right)+....+\left(\dfrac{1}{3n-2}-\dfrac{1}{3n+1}\right)\right]$

$=\dfrac{1}{3}\left[1-\dfrac{1}{3n+1}\right]\to\dfrac{1}{3}$ as $n\to\infty$

Ans: (b)

100. Let $f(x)=\begin{cases}\dfrac{3}{x^2}\sin 2x^2 & x<0\\ \dfrac{x^2+2x+x}{1-3x^2} & x\ge 0, x\ne\dfrac{1}{\sqrt{3}},\\ 0 & x=\dfrac{1}{\sqrt{3}}\end{cases}$ f be continuous at $x=0$, then $c=$

Options:

(a) -6

(b) 6

(c) 5 (d) -5

Sol: f is continuous at $x=0$

$\Rightarrow\lim\limits_{x\to 0} f(x)=f(0)\Rightarrow\lim\limits_{x\to 0} f(x)=c$ $(\because f(0)=c)$

Now. $\lim\limits_{x\to 0} f(x)=\lim\limits_{x\to 0}\dfrac{3}{x^2}\cdot\sin 2x^2=\lim\limits_{x\to 0} 6\cdot\left(\dfrac{\sin 2x^2}{2x^2}\right)=6$

$\lim\limits_{x\to 0^+} f(x)=\lim\limits_{x\to 0}\dfrac{x^2+2x+c}{1-3x^2}=c$

$c=6$

Ans: (b)

101. Let $f(x)=|\cos x|$. Then

Options:

(a) f is every where differentiable

(b) f is every where continuous not differentiable at $x=n\pi, n\in Z$

(c) f is every continuous but not differentiable at $x=(2n+1)\frac{\pi}{2}, n\in Z$

(d) None of these

Sol: Clearly, $f(x)=|\cos x|$ is continuous at every points but not differentiable at $x=(2n+1)\frac{\pi}{2}, n\in Z$.

Ans: (c)

102. $\frac{d}{dx}\left(\frac{3e^x+4}{2e^x-3}\right)=$

Options:

(a) $\frac{-17e^x}{(2e^x-3)^2}$

(b) $\frac{17e^x}{(2e^x-3)^2}$

(c) $\frac{e^x}{(2e^x-3)^2}$

(d) $\frac{e^x}{2e^x-3}$

Sol: $y=\frac{3e^x+4}{2e^x-3}\therefore\frac{(2e^x-3)(3e^x)-(3e^x+4)(2e^x)}{(2e^x-3)^2}=\frac{-17e^x}{(2e^x-3)^2}$

Ans: (a)

103. If $y=\sin^{-1}\left[\frac{1-x^2}{1+x^2}\right]$, then $\frac{dy}{dx}=$

Options:

(a) $-\frac{2}{1+x^2}$

(b) $\frac{2}{1+x^2}$

(c) $\frac{1}{2+x^2}$

(d) $\frac{2}{2-x^2}$

Sol: $y = \sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$,

Put, $x = \tan\theta \Rightarrow \theta = \tan^{-1} x$

$\Rightarrow y = \sin^{-1}[\cos 2\theta) = \sin^{-1}\left[\sin\left(\frac{\pi}{2} - 2\theta\right)\right] \Rightarrow y = \frac{\pi}{2} - 2\tan^{-1} x \Rightarrow \frac{dy}{dx} = \frac{-2}{1+x^2}$

Ans: (b)

104.If $y = e^{\left(x^e\right)}$ then $\frac{dy}{dx} =$

Options:

(a) $e^{\left(x^2\right)} \cdot \left(x^2\right)$

(b) $e^{\left(x^2\right)} \cdot x^2 \log x$

(c) $e^{\left(x^e\right)} \cdot ex^{e-1}$

(d) none

Sol: $y = e^{\left(x^2\right)}$

$y = e^{\left(x^e\right)}$

$\therefore \frac{dy}{dx} = \frac{d}{dx}\left(e^{x^e}\right) = e^{x^e} \times \frac{d}{dx}\left(x^e\right)$

$= e^x \cdot e \cdot x^{e-1}$

Ans: (c)

105.If $y = (\sin x)^{\tan x}$, then $\frac{dy}{dx} =$

Options:

(a) $(\sin x)^{\tan x}\left[1 + \sec^2 x \cdot \log\sin x\right]$

(b) $\tan x \cdot (\sin x)^{\tan x - 1}$

(c) $\tan x \cdot (\sin x)^{\tan x - 1} \cdot \cos x$

(d) $(\sin x)^{\tan x} \cdot \log(\sin x) \cdot \sec^2 x$

Sol: $y = (\sin x)^{\tan x} \Rightarrow \frac{dy}{dx} = (\sin x)^{\tan x}\left[\frac{\tan x}{\sin x} \cdot \cos x + \log(\sin x) \cdot \sec^2 x\right]$

$\Rightarrow \frac{dy}{dx} = (\sin x)^{\tan x}\left[1 + \sec^2 x \cdot \log(\sin x)\right]$

Ans: (a)

106.The points on the curve $y=12x-x^3$, the tangent at which are parallel to $x=\text{axis}$ are

Options:

(a) $(2,16),(-2,16)$

(b) $(-2,16),(2,-16)$

(c) $(2,16),(-2,-16)$

(d) None of these.

Sol: $y=12x-x^3 \Rightarrow \frac{dy}{dx}=12-3x^2$

For tangent to be parallel to $x-\text{axis}, \frac{dy}{dx}=0$

$12-3x^2=0 \Rightarrow x=\pm 2 \Rightarrow y=16,-16$

$\therefore$ Points are $(2,16),(-2,-16)$

Ans: (c)

107.A rod of length 13 meters has one end P on the $x-\text{axis}$ and the other end Q on the $y-\text{axis}$. If P moves along the $x-\text{axis}$ with a speed of 12 m/sec, then the speed of the other end Q when it is 12 meters from the origin is

Options:

(a) $-3\,\text{m/sec}$

(b) $-4\,\text{m/sec}$

(c) $-5\,\text{m/sec}$

(d) $-4\,\text{m/sec}$

Sol: Let $OP=x, OQ=y \Rightarrow x^2+y^2=169 \Rightarrow x=\sqrt{169-y^2}$

$$\frac{dx}{dt}=\frac{-2y}{2\sqrt{169-y^2}}\frac{dy}{dt} \Rightarrow \frac{dy}{dt}=\frac{-\sqrt{169-y^2}}{y}\cdot(12) \quad \left(\because \frac{dx}{dt}=12\right)$$

$$\Rightarrow \left(\frac{dy}{dt}\right)_{y=12}=\frac{-\sqrt{169-144}}{12}\times 12=-5\,\text{m/sec}$$

Ans: (c)

108.The approximate value of $\tan(45°,30')$ given $1°=0.0175$ radians, is

Options:

(a) 1.0187

(b) 1.1870

(c) 1.0716

(d) 1.0175

Sol: Let $f(x)=\tan x \Rightarrow f'(x)=\sec^2 x$

Let $x=45°=\frac{\pi}{4}$ radians,

$h=30'=\frac{1°}{2}=\frac{1}{2}(0.0175)=(0.0087)$ radians

We have, $f(x+h)=h\cdot f'(x)+f(x)\Rightarrow f(45° \quad 30')=(0.00875)2+1=1.0715$

Ans: (d)

109. $\int_0^1 (x-1)e^{-x}\,dx=$

Options:

(a) 0

(b) e

(c) $\frac{1}{e}$

(d) $-\frac{1}{e}$

Sol: $I=\int_0^1 (x-1)e^{-x}\ dx=(x-1)\left(-e^{-x}\right)-1\cdot e^{-x}\Big]_0^1$

$-e^{-x}(x-1+1)\Big]_0^1=-\left[xe^{-x}\right]_0^1=-e^{-1}=-\frac{1}{e}$

Ans: (d)

110. $\int_{-\pi}^{\pi}\frac{\cos^2 x}{1+a^x}dx=(a>0)$

Options:

(a) 0

(b) π

(c) $\frac{\pi}{2}$

(d) 2π

Sol: $I=\int_{-\pi}^{0}\frac{\cos^2 x}{1+a^x}\,dx+\int_0^{\pi}\frac{\cos^2 x}{1+a^x}dx$

Put $x=-t$ in the first integral

$\Rightarrow dx=-t$

$I=-\int_{\pi}^{0}\frac{\cos^2 x}{1+a^{-x}}dx+\int_0^{\pi}\frac{\cos^2 x}{1+a^x}\,dx=\int_0^{\pi}\left(\frac{}{1+a^{-x}}+\frac{1}{1+a^x}\right)\cos^2 x\,dx$

$=\int_0^{\pi}\left(\frac{a^x}{1+a^x}+\frac{1}{1+a^x}\right)\cos^2 x\ dx=\int_0^{\pi}\cos^2 x\,dx=2\int_0^{\pi/2}\ \cos^2 x\,dx=2.\ \frac{\pi}{4}=\frac{\pi}{2}$

$\left(\because \cos^2 x \text{ is an even function}\right)$

Ans: (c)

111. $\int_1^2 \frac{dx}{x\left(1+x^4\right)}=$

Options:

(a) $\frac{1}{4}\log\left(\frac{17}{32}\right)$

(b) $\frac{1}{4}\log\left(\frac{17}{2}\right)$

(c) $\log\left(\frac{17}{2}\right)$

(d) $\frac{1}{4}\log\left(\frac{32}{17}\right)$

Sol: $\int \frac{dx}{x\left(1+x^n\right)}=\frac{1}{n}\log\left(\frac{x^n}{1+x^n}\right)$

$$\int_1^2 \frac{dx}{x\left(1+x^4\right)}=\frac{1}{4}\log\left(\frac{x^4}{1+x^4}\right)\Bigg]_1^2=\frac{1}{4}\left[\log\frac{16}{17}-\log\frac{1}{2}\right]=\frac{1}{4}\log\left(\frac{32}{17}\right)$$

Ans: (d)

112. The value of $\int_{-\pi/2}^{\pi/2}\left(x^3+x\cos x+\tan^5 x+1\right)dx$

Options:

(a) 0

(b) 2

(c) π

(d) 1

Sol: We have $I=\int_{-\pi/2}^{\pi/2}\left(x^3+x\cos x+\tan^5 x\right)dx+\int_{-\pi/2}^{\pi/2}1dx=0+[x]_{-\pi/2}^{\pi/2}=\frac{\pi}{2}+\frac{\pi}{2}=\pi$

$\left(\because f(x) \text{is odd function}\right)$

Ans: (c)

113. $\int \frac{\sin^6 x}{\cos^8 x}dx=$

Options:

(a) $-\frac{\tan^7 x}{7}+C$

(b) $\frac{\tan^7 x}{7}+C$

(c) $\frac{7}{\cos^7 x}+C$

(d) $\frac{1}{7\cos^7 x}+C$

Sol: $\int \frac{\sin^6 x}{\cos^8 x}\, dx = \int \frac{\sin^6 x}{\cos^6 x} \cdot \frac{1}{\cos^2 x}\, dx = \int \tan^6 x \cdot \sec^2 x\, dx = \frac{\tan^7 x}{7} + C$

Ans: (b)

114. $\int e^x \left(\frac{1+\sin x \cdot \cos x}{1+\cos 2x} \right) dx =$

Options:

(a) $e^x \tan x$

(b) $\frac{1}{2} e^x \tan x$

(c) $\frac{1}{2} e^x \cot x$

(d) $2e^x \tan x$

Sol: $I = \int e^x \left(\frac{1+\sin x \ \cos x}{2\cos^2 x} \right) dx = \frac{1}{2} \int e^x \left(\sec^2 x + \tan x \right) dx = \frac{1}{2} \int e^x \left(\tan x + \sec^2 \right) dx = \frac{1}{2} e^x \tan x + c$

Ans: (b)

115. $\int \frac{dx}{(x+3)(x-3)} =$

Options:

(a) $\frac{1}{3} \log \left(\frac{x+3}{x-3} \right) + C$

(b) $\frac{1}{6} \log (3x) + C$

(c) $\frac{1}{6} \log \left(\frac{x-3}{x} \right) + C$

(d) $\frac{1}{6} \log \left(\frac{x-3}{x+3} \right) + C$

Sol: $\int \frac{dx}{(x+3)(x-3)} = \int \frac{dx}{x^2-9} = \int \frac{dx}{x^2-3^2} = \frac{1}{2(3)} \log \left(\frac{x-3}{x+3} \right) + c = \frac{1}{6} \log \left(\frac{x-3}{x+3} \right) + c \left[\int \frac{dx}{x^2-a^2} = \frac{1}{2a} \log \left(\frac{x-a}{x+a} \right) \right]$

Ans: (d)

116. The differential equation for $y = A \cos \alpha x + B \sin \alpha x$ where A and B are arbitrary constants is

Options:

(a) $\frac{d^2 y}{dx^2} - \alpha^2 y = 0$

(b) $\frac{d^2 y}{dx^2} + \alpha^2 y = 0$

(c) $\frac{d^2 y}{dx^2} + \alpha y = 0$

(d) $\frac{d^2 y}{dx^2} - \alpha y = 0$

Sol: We have, $y = A\cos\alpha x + B\sin\alpha x$

$\Rightarrow \frac{dy}{dx} = \alpha(-A\sin\ \alpha x + B\ \cos\ \alpha x)$

$\Rightarrow \frac{d^2y}{dx^2} = \alpha^2(-A\cos\alpha x - B\sin\alpha x) = -\alpha^2 y \Rightarrow \frac{d^2y}{dx^2} + \alpha^2 y = 0$

Ans: (b)

117. The general solution of $\frac{dy}{dx} = 2xe^{x^2-y}$ is

Options:

(a) $e^{x^{2-y}} = c$

(b) $e^{-y} + e^{x^2} = c$

(c) $e^y = e^{x^2} + c$

(d) $e^{x^2+y} = c$

Sol: We have, $\frac{dy}{dx} = 2x\cdot e^{x^2}\cdot e^{-y}$

$\Rightarrow \int e^y dy = \int e^{x^2}\cdot 2x\ dx + c \Rightarrow e^y = e^{x^2} + c$

Ans: (c)

118. A die is thrown and a card is selected at random from a deck of 52 playing cards. The probability of getting an even number on the die and a spade card is

Options:

(a) $\frac{1}{2}$

(b) $\frac{1}{4}$

(c) $\frac{1}{8}$

(d) $\frac{167}{168}$

Sol: Required probability = $P(\text{an even number}) \times P(\text{a spade})\frac{3}{6}\times\frac{13}{52} = \frac{1}{8}$

($\because$ only even numbers are 2, 4, 6 and there are 13 spades out of 52 cards).

Ans: (c)

119.In a college of 30 students fail in physics, 25 fail in mathematics and 10 fail in both. One student is chosen at random. The probability that she fails in physics, if she failed in mathematics is

Options:

(a) $\frac{1}{10}$

(b) $\frac{2}{5}$

(c) $\frac{9}{20}$

(d) $\frac{1}{3}$

Sol: Set, $E:$ event student fails in physics

$F:$ event student fails in Mathematics

Now, $P(E)=\frac{30}{100}=\frac{3}{10}$ and $P(F)=\frac{25}{100}=\frac{1}{4}$

$P(E\cap F)=\frac{10}{100}=\frac{1}{10}$

Required probability $=P(E/F)=\frac{P(E\cap F)}{P(F)}=\frac{(1/10)}{1/4}=\frac{2}{5}$

Ans: (b)

120. A and B are two students. Their chances of solving a problem correctly are $\frac{1}{3}$ and $\frac{1}{4}$ respectively. If the probability of their making a common error is $\frac{1}{20}$ and they obtain the same answer, then the probability of their answer to be correct is

Options:

(a) $\frac{1}{12}$

(b) $\frac{1}{40}$

(c) $\frac{13}{120}$

(d) $\frac{10}{13}$

Sol: Let $E:$ event A and B obtain same answer

$F:$ event Both A and B obtain correct answer

$\Rightarrow F\subset E$;

$P(E)=P(F)+P$ (both A and B make same error and get same incorrect answer)

$$=\left(\frac{1}{3}\times\frac{1}{4}\right)+\left(1-\frac{1}{3}\right)\left(1-\frac{1}{5}\right)\times\frac{1}{20}=\frac{1}{12}+\frac{1}{40}=\frac{13}{120}$$

$$P(F)=\frac{1}{3}\times\frac{1}{4}=\frac{1}{12}$$

Required probability $=P(F/E)=\frac{P(E\cap F)}{P(E)}=\frac{P(F)}{P(E)} \quad (\because F\subset E)$

$$=\frac{(1/12)}{(13/120)}=\frac{10}{13}$$

Ans: (d)

Physics

Multiple Choice Questions with one correct answer. A correct answer carries 1 mark. No negative mark. **60 x 1 = 60**

121.The distance of the centres of moon and earth is D. The mass of earth is 81 times the mass of the moon. At what distance from the centre of the earth, the gravitational force will be zero?

Options:

(a) $\frac{D}{2}$

(b) $\frac{2D}{3}$

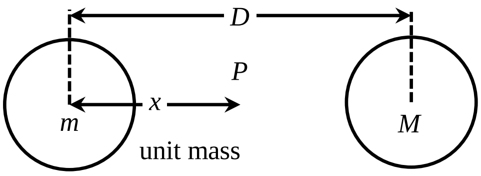
(c) $\frac{4D}{3}$

(d) $\frac{D}{10}$

Sol: Force will be zero at the point P, then $F_1 = F_2$ where,

$F_1 = \frac{Gm \cdot 1}{x^2}$ and $F_2 = \frac{GM \cdot 1}{(D-x)^2}$

and $F_1 = F_2$, so



$\Rightarrow \frac{Gm}{x^2} = \frac{GM}{(D-x)^2}$

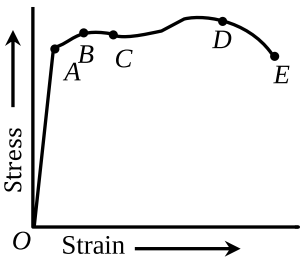
$\Rightarrow \frac{m}{x^2} = \frac{81m}{(D-x)^2}$ $[M = 81\text{ m}]$

$\Rightarrow \frac{(D-x)^2}{x^2} = 81$ $\Rightarrow D - x = 9x$

$\Rightarrow D = 10x$ $\Rightarrow \frac{D}{10} = x$

Ans: (d)

122.The stress-strain graph for a metal wire is as shown in the figure. In the graph, the region in which Hooke's law is obeyed, the ultimate strength and fracture points are represented by



Options:

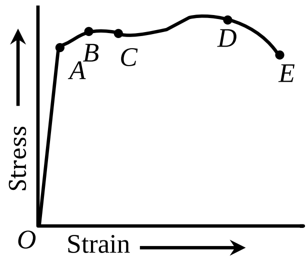
(a) *OA, C, D*

(b) *OB, D, E*

(c) *OA, D, E*

(d) *OB, C, D*

Sol: In the region OA, the graph is linear showing that stress is proportional to the strain. Thus, in this region Hooke's law is obeyed. The point D on the graph is known as ultimate tensile strength. The point E on the graph is known as fracture point.



Ans: (c)

123. A thin bar of length L is suspended from one end and rotated at a speed of n revolutions per second. The rotational kinetic energy of the bar is

Options:

(a) $2ML^2\pi^2n^2$

(b) $1/2ML^2\pi^2n^2$

(c) $2/3ML^2\pi^2n^2$

(d) $1/6ML^2\pi^2n^2$

Sol: $I = \frac{ML^2}{12} + M\left(\frac{L}{2}\right)^2 = \frac{ML^2}{3}$ and

$\omega = 2\pi n \text{ rad s}^{-1}$

So, rotational

$\text{KE} = \frac{1}{2}I\omega^2$

$= \frac{1}{2}\left(\frac{ML^2}{3}\right)\times(2\pi n)^2 = \frac{2}{3}ML^2\pi^2n^2$

Ans: (c)

124. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth $4y$ from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then, R is equal to

Options:

(a) $\frac{L}{\sqrt{2\pi}}$

(b) $2\pi L$

(c) L

(d) $\frac{L}{2\pi}$

Sol: Equating the rate of flow, we have

$$\sqrt{(2gy)}\times L^2=\sqrt{(2g\times 4y)}\pi R^2$$

[Flow $=(\text{area})\times(\text{velocity})$, velocity $=\sqrt{2gx}$]

where $x=$ height from top

$$\Rightarrow\ L^2=2\pi R^2\ \Rightarrow R=\frac{L}{\sqrt{2\pi}}$$

Ans: (a)

125.A clock with a metal pendulum beating seconds keeps correct time at $0°\text{C}$. If it loses 12.5s a day at $25°\text{C}$, the coefficient of linear expansion of metal pendulum is

Options:

(a) $\frac{1}{86400}/°\text{C}$

(b) $\frac{1}{43200}/°\text{C}$

(c) $\frac{1}{14400}/°\text{C}$

(d) $\frac{1}{28800}/°\text{C}$

Sol: Number of seconds lost in a day

$$\Delta t=\frac{1}{2}\alpha\Delta\theta\times 86400$$

The coefficient of linear expansion of metal pendulum

$$\alpha=\frac{2\Delta t}{\Delta\theta\times 86400}=\frac{2\times 12.5}{25\times 86400}$$

$$\alpha=\frac{1}{86400}/°\text{C}$$

Ans: (a)

126.The pressure is P, volume V and temperature T of a gas in jar A and the other gas in jar B is at pressure P, volume $V/4$ and temperature $2T$, then the ratio of the number of molecules in jar A and B will be

Options:

(a) $1:1$

(b) $1:2$

(c) $2:1$

(d) $8:1$

Sol: $PV = NkT \Rightarrow \frac{N_A}{N_B} = \frac{P_A V_A}{P_B V_B} \times \frac{T_B}{T_A}$

$\Rightarrow \frac{N_A}{N_B} = \frac{P \times V \times (2T)}{P \times \frac{V}{4} \times T} = \frac{8}{1}$

Ans: (d)

127.If ΔU and ΔW represent the increase in internal energy and work done by the system respectively in a thermodynamical process, which of the following is true?

Options:

(a) $\Delta U = -\Delta W$, in an adiabatic process

(b) $\Delta U = \Delta W$, in an isothermal process

(c) $\Delta U = \Delta W$, in adiabatic process

(d) $\Delta U = -\Delta W$, in an isothermal process

Sol: By first law of thermodynamics

$\Delta Q = \Delta U + \Delta W$

In adiabatic process, $\Delta Q = 0$

$\therefore \ \Delta U = -\Delta W$

In isothermal process, $\Delta U = 0$

$\therefore \ \Delta Q = \Delta W$

Ans: (a)

128.A particle is executing simple harmonic motion with frequency f. The frequency at which its kinetic energy change into potential energy is

Options:

(a) $\frac{f}{2}$

(b) f

(c) $2f$

(d) $4f$

Sol: In SHM frequency of KE and PE

$= 2 \times$ (Frequency of oscillating particle)

Ans: (c)

129.The speed of longitudinal wave in a wire is 100 times the speed of transverse wave. If Young's modulus of the wire material is $1 \times 10^{11}\ \text{Nm}^{-2}$ then the stress in the wire is

Options:

(a) $1 \times 10^{7}\ \text{Nm}^{-2}$

(b) $1.5 \times 10^{7}\ \text{Nm}^{-2}$

(c) $1 \times 10^{11}\ \text{Nm}^{-2}$ (d) $1.5 \times 10^{11}\ \text{Nm}^{-2}$

Sol: $v_{\text{long}} = 100 v_{\text{trans}}$

$$\sqrt{\frac{Y}{d}} = 100\sqrt{\frac{\text{stress}}{d}}$$

$$\sqrt{1\times 10^{11}} = 100\sqrt{\text{stress}}$$

$$\text{Stress} = \frac{10^{11}}{10^4} = 10^7 \ \text{Nm}^{-2}$$

Ans: (a)

130. Two equally charged, identical metal spheres A and B repel each other with a force $'F'$. The spheres are kept fixed with a distance $'r'$ between them. A third identical, but uncharged sphere C is brought in contact with A and then placed at the mid-point of the line joining A and B. The magnitude of the net electric force on C is

Options:

(a) F

(b) $\frac{3F}{4}$

(c) $\frac{F}{2}$

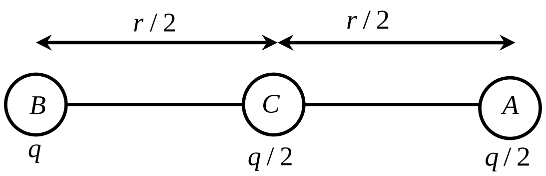
(d) $\frac{F}{4}$

Sol: Initial force between the two spheres carrying charge (say q) is

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}$$ (r is the distance between them)

Further when an uncharged sphere is kept in touch with the sphere of charge q, the net charge on both become $\frac{q+0}{2} = \frac{q}{2}$. Force on the 3rd charge, when placed in center of the 1st two

$$F_3 = \frac{1}{4\pi\varepsilon_0}\frac{q\left(\frac{q}{2}\right)}{\left(\frac{r}{2}\right)^2} - \frac{1}{4\pi\varepsilon_0}\frac{\left(\frac{q}{2}\right)^2}{\left(\frac{r}{2}\right)^2}$$



$$= \frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}[2-1] = F$$

Ans: (a)

131. If the electric flux entering and leaving an enclosed surface respectively ϕ_1 and ϕ_2 then the electric charge inside the surface will be

Options:

(a) $(\phi_1 + \phi_2)\varepsilon_0$

(b) $(\phi_2 - \phi_1)\varepsilon_0$

(c) $(\phi_1 - \phi_2)/\varepsilon_0$

(d) $(\phi_2 - \phi_1)/\varepsilon_0$

Sol: $\phi_{\text{net}} = \frac{1}{\varepsilon_0} \times Q_{\text{net}} \Rightarrow Q_{\text{enc}} = (\phi_2 - \phi_1)\varepsilon_0$

Ans: (b)

132. The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and area A, is

Options:

(a) independent of the distance between the plates

(b) linearly proportional to the distance between the plates

(c) inversely proportional to the distance between the plates

(d) proportional to the square root of the distance between the plates

Sol: Electrostatic force between the metal plates

$$F_{\text{plate}} = \frac{Q^2}{2A_{\varepsilon_0}}$$

For isolated capacitor $Q = \text{constant}$

Clearly, F is independent of the distance between plates.

Ans: (a)

133. Two point dipoles $p\hat{k}$ and $\frac{p}{2}\hat{k}$ are located at $(0,0,0)$ and $(1,0,2)$ respectively. The resultant electric field due to the two dipoles at the point $(1,0,0)$ is

Options:

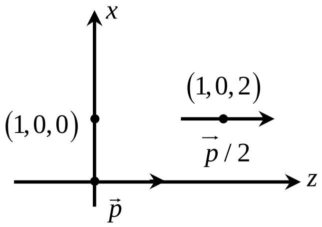
(a) $\frac{9p}{32\pi\varepsilon_0}\hat{k}$

(b) $\frac{-7p}{32\pi\varepsilon_0}\hat{k}$

(c) $\frac{7p}{32\pi\varepsilon_0}\hat{k}$

(d) none of these

Sol: The given point is at axis $\frac{\vec{p}}{2}$ dipole and at equatorial line of $\vec{p}$ dipole so that field at given point.



$$\vec{E} = -\frac{k\vec{p}}{(1)^3} + \frac{2k(\vec{p}/2)}{(2)^3} = \frac{-7\vec{p}}{32\pi\varepsilon_0} \qquad \left[\because \; k = \frac{1}{4\pi\varepsilon_0}\right]$$

Ans: (b)

134. Equal charges are given to two spheres of different radii. The potential will be

Options:

(a) more on smaller sphere

(b) more on bigger sphere

(c) equal on both sphere

(d) none of these

Sol: $V = \frac{Kq}{R}$ i.e., $V \propto \frac{1}{R}$

$\Rightarrow$ Potential on smaller sphere will be more

Ans: (a)

135. Two points P and Q are maintained at the potentials of $10\,\text{V}$ and $-4\,\text{V}$, respectively. The work done in moving 100 electrons from P to Q is

Options:

(a) 9.6×10^{-17} J

(b) -2.24×10^{-16} J

(c) 2.24×10^{-16} J

(d) -9.6×10^{-17} J

Sol: $\frac{W_{PQ}}{q} = \left(V_Q - V_P\right)$

$W_{PQ} = q\left(V_Q - V_P\right) = \left(-100\times1.6\times10^{-19}\right)\left(-4-10\right)$

$= +2.24\times10^{-16}$ J

Ans: (c)

136. Equal charges q are placed at the four corners, A, B, C, D of a square of length a. The magnitude of the force on the charge at B will be

Options:

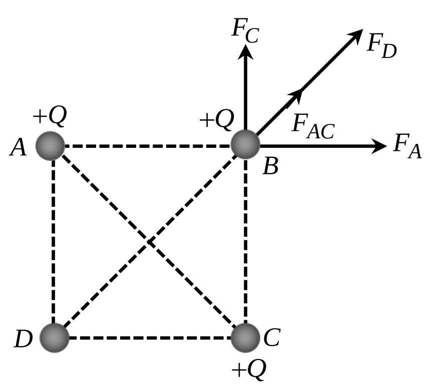
(a) $\frac{3q^2}{4\pi\varepsilon_0 a^2}$

(b) $\frac{4q^2}{4\pi\varepsilon_0 a^2}$

(c) $\left(\frac{1+2\sqrt{2}}{2}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$ (d) $\left(2+\frac{1}{\sqrt{2}}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$

Sol: $F_{\text{net}} = F_{AC} + F_D = \sqrt{F_A^2 + F_C^2} + F_D$

Since, $F_A = F_C = \frac{kq^2}{a^2}$ and $F_D = \frac{kq^2}{\left(a\sqrt{2}\right)^2}$



$F_{\text{net}} = \frac{\sqrt{2}kq^2}{a^2} + \frac{kq^2}{2a^2}$

$= \frac{kq^2}{a^2}\left(\sqrt{2}+\frac{1}{2}\right)$

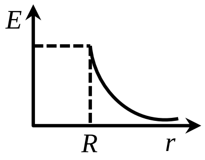
$= \frac{q^2}{4\pi\varepsilon_0 a^2}\left(\frac{1+2\sqrt{2}}{2}\right)$

Ans: (c)

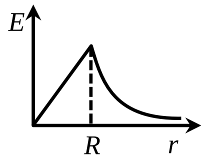
137. Which of the following graphs shows the variation of electric field E due to a hollow spherical conductor of radius R as a function of distance from the centre of the spherical conductor?

Options:

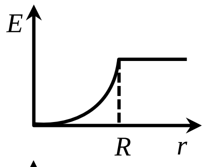
(a)



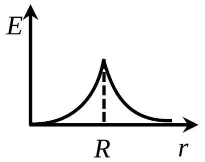
(b)



(c)



(d)



Sol: Electric field due to a hollow spherical conductor is governed by following equation,

$E = 0,$ for $r < R$ ... (i)

and $E = \dfrac{Q}{4\pi\varepsilon_0 r^2}$ for $r \geq R$

i.e. inside the conductor field will be zero and outside the conductor will vary according to $E \propto \dfrac{1}{r^2}$

Ans: (a)

138. Two wires have lengths, diameters and specific resistances all in the ratio of $1:2$. The resistance of the first wire is $10\,\text{ohm}$. Resistance of the second wire in ohm will be

Options:

(a) 5

(b) 10

(c) 20

(d) infinite

Sol: Given: $\dfrac{l_1}{l_2} = \dfrac{d_1}{d_2} = \dfrac{\rho_1}{\rho_2} = \dfrac{1}{2}$

Resistance of the wire,

$$R = \rho\frac{l}{A} = \rho\frac{l}{\pi(d/2)^2} = \frac{4\rho l}{\pi d^2} \qquad \left[\because\ A = \pi r^2 = \pi\left(\frac{d}{2}\right)^2\right]$$

$\therefore \ \dfrac{R_1}{R_2} = \dfrac{\rho_1 l_1}{d_1^2} \times \dfrac{d_2^2}{\rho_2 \ell_2} = \left(\dfrac{\rho_1}{\rho_2}\right)\left(\dfrac{l_1}{l_2}\right)\left(\dfrac{d_2}{d_1}\right)^2$, i.e. $\dfrac{10}{R_2} = \left(\dfrac{1}{2}\right)\left(\dfrac{1}{2}\right)(2)^2$

$\dfrac{10}{R_2} = 1 \ \Rightarrow \ R_2 = 10\,\Omega$

Ans: (b)

139.A primary cell has an e.m.f. of 1.5 volt, when short-circuited it gives a current of 3 ampere. The internal resistance of the cell is

Options:

(a) 4.5 ohm

(b) 2 ohm

(c) 0.5 ohm

(d) $1/4.5$ ohm

Sol: Short circuit current, $i_{SC} = \dfrac{E}{r} \ \Rightarrow \ 3 = \dfrac{1.5}{r} \ \Rightarrow \ r = 0.5\,\Omega$

Ans: (c)

140.How much heat is developed in 210 watt electric bulb in 5 minutes? (Chemical equivalent of heat $= 4.2\ \text{JC}^{-1}$)

Options:

(a) 30000 cal

(b) 22500 cal

(c) 15000 cal

(d) 7500 cal

Sol: $H = P \times t = \dfrac{210 \times 5 \times 60}{4.2} = 15000\,\text{cal}$

Ans: (c)

141.Two resistors of resistance R_1 and R_2 having $R_1 > R_2$ are connected in parallel. For equivalent resistance R, the correct statement is

Options:

(a) $R > R_1 + R_2$

(b) $R_1 < R < R_2$

(c) $R_2 < R < (R_1 + R_2)$

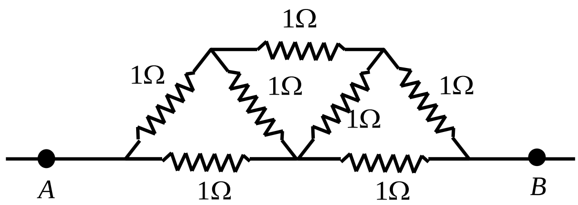
(d) $R < R_1$

Sol: Equivalent resistance of parallel resistors is always less than any of the member of the resistance system.

Ans: (d)

142. In the network shown in the figure, each resistance is 1Ω. The effective resistance between A and B is

Options:



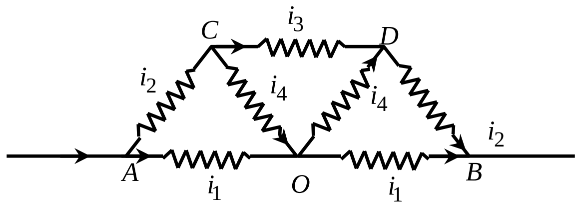
(a) $\frac{4}{3}\Omega$

(b) $\frac{3}{2}\Omega$

(c) 7Ω

(d) $\frac{8}{7}\Omega$

Sol: At A current is distributed and at B currents are collected. Between A and B, the distribution is symmetrical. It has been shown in the figure. It appears that current in AO and OB remains same. At O, current i_4 returns back without any change. If we detach O from AB there will not be any change in distribution. Now, CO and OD will be in series hence its total resistance $= 2\Omega$



It is in parallel with CD, so, equivalent resistance $= \frac{2\times1}{2+1} = \frac{2}{3}\Omega$

This equivalent resistance is in series with AC and DB, so, total resistance $= \frac{2}{3} + 1 + 1 = \frac{8}{3}\Omega$

Now $\frac{8}{3}\Omega$ is parallel to AB, that is, 2Ω, so total resistance $= \frac{8/3\times2}{8/3+2} = \frac{16/3}{14/3} = \frac{16}{14} = \frac{8}{7}\Omega$

Ans: (d)

143. The current through a bulb is increased by 1%. Assuming that the resistance of the filament remains unchanged the power of the bulb will

Options:

(a) increase by 1%

(b) decrease by 1%

(c) increase by 2%

(d) decrease by 2%

Sol: $P = I^2R$. Hence $\frac{dP}{P} = \frac{2dI}{I}$. Since $\frac{dI}{I} = 1\%$

Hence $\frac{dP}{P} = 2\%$

Ans: (c)

144. Two long parallel wires P and Q are held perpendicular to the plane of the paper at a separation of 5m. If P and Q carry currents of 2.5A and 5A respectively in the same direction, then the magnetic field at a point midway between P and Q is

Options:

(a) $\frac{\mu_0}{\pi}$

(b) $\sqrt{3}\frac{\mu_0}{\pi}$

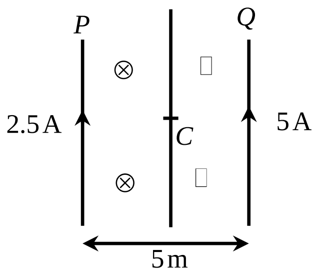
(c) $\frac{\mu_0}{2\pi}$

(d) $\frac{3\mu_0}{2\pi}$

Sol: When the current flows in both wires in the same direction then magnetic field at half way due to the wire P,

$\vec{B}_p = \frac{\mu_0 I_1}{2\pi \times 5/2} = \frac{\mu_0 I_1}{\pi \times 5} = \frac{\mu_0}{2\pi}$ (where $I_1 = 2.5\text{A}$)

The direction of $\vec{B}_p$ is downward □ . Magnetic field at half way due to wire Q



$\vec{B}_p = \frac{\mu_0 I_2}{2\pi \frac{5}{2}} = \frac{\mu_0}{\pi}$ [upward □]

[where $I_2 = 5\text{A}$]

Net magnetic field at half way, $\vec{B} = \vec{B}_P + \vec{B}_Q = -\frac{\mu_0}{2\pi} + \frac{\mu_0}{\pi} = \frac{\mu_0}{2\pi}$ (upward)

Hence, net magnetic field at midpoint $= \frac{\mu_0}{2\pi}$

Ans: (c)

145. A straight section PQ of a circuit lies along the $X-$axis from $x = -\frac{a}{2}$ to $x = \frac{a}{2}$ and carries a steady current i. The magnetic field due to the section PQ at a point $X = +a$ will be

Options:

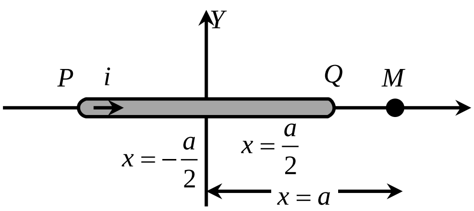
(a) proportional to a

(b) proportional to a^2

(c) proportional to $1/a$

(d) zero

Sol: Magnetic field at a point on the axis of a current carrying wire is always zero.



Ans: (d)

146. A uniform magnetic field acts at right angles to the direction of motion of electron. As a result, the electron moves in a circular path of radius 2 cm. If the speed of electron is doubled, then the radius of the circular path will be

Options:

(a) 2.0 cm

(b) 0.5 cm

(c) 4.0 cm

(d) 1.0 cm

Sol: $r = \frac{mv}{qB}$ or $r \propto v$

As v is doubled, he radius also becomes double. Hence radius $= 2 \times 2 = 4\text{ cm}$.

Ans: (c)

147. A charge moving with velocity v in $X-$direction is subjected to a field of magnetic induction in negative $X-$direction. As a result, the charge will

Options:

(a) remain unaffected

(b) start moving in a circular path $Y-Z$ plane

(c) retard along $X-$axis

(d) move along a helical path around $X-$axis

Sol: The force acting on a charged particle in magnetic field is given by

$F = q\left(\vec{v} \times \vec{B}\right)$ or $F = qvB\sin\theta$ when angle between v and B is $180°$, $F = 0$

Ans: (a)

148. Above Curie temperature

Options:

(a) a paramagnetic substance becomes diamagnetic

(b) a diamagnetic substance becomes paramagnetic

(c) a paramagnetic substance becomes ferromagnetic

(d) a ferromagnetic substance becomes paramagnetic

Sol: Above Curie temperature, a ferromagnetic substance becomes paramagnetic.

Ans: (d)

149. A moving coil galvanometer has N number of turns in a coil of effective area A, it carries a current I. The magnetic field B is radial. The torque acting on the coil is

Options:

(a) NA^2B^2I

(b) $NABI^2$

(c) N^2ABI

(d) $NABI$

Sol: $\tau = MB\sin\theta \Rightarrow \tau_{\max} = NIAB, \left(\theta = 90°\right)$

Ans: (d)

150.The materials suitable for making electromagnets should have

Options:

(a) high retentivity and low coercivity

(b) low retentivity and low coercivity

(c) high retentivity and high coercivity

(d) low retentivity and high coercivity

Sol: Electromagnet should be amendable to magnetisation and demagnetization

$\therefore$ Retentivity should be low and coercivity should be low.

Ans: (b)

151.A conducting circular loop is placed in a uniform magnetic field of $0.04\,\mathrm{T}$ with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at $2\ \mathrm{mm\,s^{-1}}$. The induced emf in the loop when the radius is $2\,\mathrm{cm}$ is

Options:

(a) $4.8\ \pi\mu\mathrm{V}$

(b) $0.8\ \pi\mu\mathrm{V}$

(c) $1.6\ \pi\mu\mathrm{V}$

(d) $3.2\ \pi\mu\mathrm{V}$

Sol: Induced emf in the loop is given by $e = -B\cdot\frac{dA}{dt}$ where A is the area of the loop.

$$e = -B\cdot\frac{d}{dt}\left(\pi r^2\right) = -B\pi 2r\frac{dr}{dt}$$

$$r = 2\,\mathrm{cm} = 2\times10^{-2}\,\mathrm{m}$$

$$dr = 2\,\mathrm{mm} = 2\times10^{-3}\,\mathrm{m}$$

$$dt = 1\mathrm{s}$$

$$e = -0.04\times3.14\times2\times2\times10^{-2}\times\frac{2\times10^{-3}}{1}\mathrm{V}$$

$$= 0.32\pi\times10^{-5}\mathrm{V} = 3.2\pi\times10^{-6}\mathrm{V} = 3.2\ \pi\mu\mathrm{V}$$

Ans: (d)

152.In an induction coil the current increases from 0 to $6\,\mathrm{A}$ in $0.3\mathrm{s}$ by which induced emf of 30 volts is produced in it. Then the value of coefficient of self-inductance of coil will be

Options:

(a) 3 henry

(b) 2 henry

(c) 1 henry

(d) 1.5 henry

Sol: $\Delta I = 6\,\text{A},\ \Delta t = 0.3\text{s},\ E = 30\,\text{V}$

$$E = L\frac{dI}{dt}$$

$$\therefore\ L = \frac{30\times 0.3}{6} = 1.6\ \text{H}$$

Ans: (d)

153.In LCR series a.c. circuit, the voltage across each of the components, L, C and R is $50\,\text{V}$. The voltage across the LC combination will be

Options:

(a) $100\,\text{V}$

(b) $50\sqrt{2}\ \text{V}$

(c) $50\ \text{V}$

(d) $0\ \text{V}$

Sol: Since the phase difference between L and C is π

$\therefore$ net voltage difference across $LC = 50 - 50 = 0$

Ans: (d)

154.In a series resonance LCR circuit, the voltage across R is 100 volt and $R = 1\text{k}\Omega$ with $C = 2\mu\text{F}$. The resonance frequency ω is $200\,\text{rad s}^{-1}$. At resonance the voltage across L is

Options:

(a) $2.5\times 10^{-2}\ \text{V}$

(b) $40\,\text{V}$

(c) $250\,\text{V}$

(d) $4\times 10^{-3}\,\text{V}$

Sol: Across resistor, $I = \frac{V}{R} = \frac{100}{1000} = 0.1\,\text{A}$

At resonance, $X_L = X_C = \frac{1}{\omega C} = \frac{1}{200\times 2\times 10^{-6}} = 2500$

Voltage across L is $IX_L = 0.1\times 2500 = 250\ \text{V}$

Ans: (c)

155.The value of alternating emf E in the given circuit will be

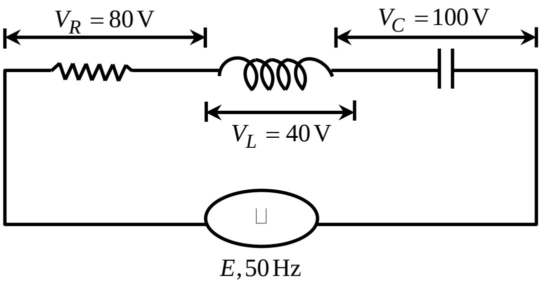
Options:

(a) $100\,\text{V}$

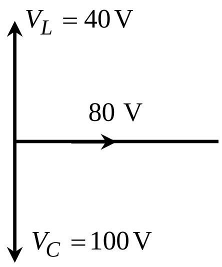
(b) $20\,\text{V}$

(c) $220\,\text{V}$

(d) $140\,\text{V}$



Sol: $\therefore\ E=\sqrt{80^2+(100-40)^2}=100\,\text{V}$



Ans: (a)

156.Match List-I (Electromagnetic wave type) with List-II (its association/application) and select the correct option from the from the choices given below the lists

List I		List II	
(1)	Infrared waves	(i)	To treat muscular strain
(2)	Radio waves	(ii)	For broadcasting
(3)	X-rays	(iii)	To detect fracture of bones
(4)	Ultraviolet rays	(iv)	Absorbed by the ozone layer of the atmosphere

Options:

	1	2	3	4
(a)	(iv)	(iii)	(ii)	(i)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(iii)	(ii)	(i)	(iv)
(d)	(i)	(ii)	(iii)	(iv)

Sol:

(1) Infrared rays are used to treat muscular strain because these are heat rays

(2) Radio waves are used for broadcasting because these waves have very long wavelength ranging from few centimeters to few hundred kilometres

(3) X-rays are used to detect fracture of bones because they have high penetrating power but they can't penetrate through denser medium like dones.

(4) Ultraviolet rays are absorbed by ozone of the atmosphere

Ans: (d)

157.When a plane face of planoconvex lens is silvered, it behaves as concave mirror of focal length $30\,\text{cm}$. But when its curved surface is silvered, it behaves as a concave mirror of focal length $10\,\text{cm}$. The refractive index of lens material is

Options:

(a) 1.25

(b) 1.33

(c) 1.732 (d) 1.5

Sol: $f_1 = \frac{R}{2(\mu-1)} = 30\,\text{cm}$; $f_2 = \frac{R}{2\mu} = 10\,\text{cm}$

Solving, $\mu = 1.5$ $\left[\because \frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2}\right]$

Ans: (d)

158.A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of $45°$. For which of the following value of μ the ray can undergo total internal reflection?

Options:

(a) $\mu = 1.33$

(b) $\mu = 1.40$

(c) $\mu = 1.50$

(d) $\mu = 1.25$

Sol: For total internal reflection,

$\mu \geq \frac{1}{\sin C} \geq \sqrt{2} \geq 1.414$

$\Rightarrow \mu = 1.50$

Ans: (c)

159.Minimum deviation is observed with a prism having angle of prism A, angle of deviation δ, angle of incidence i and angle of emergence e. We then have generally

Options:

(a) $i > e$

(b) $i < e$

(c) $i = e$

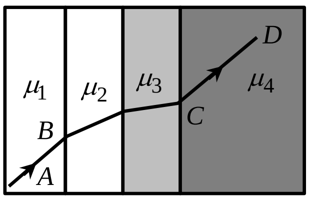
(d) $i = e = \delta$

Sol: In minimum deviation condition

$\angle i = \angle e, \angle r_1 = \angle r_2$

Ans: (c)

160.A ray of light passes through four transparent media with refractive indices μ_1, μ_2, μ_3 and μ_4 as shown in the figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, we must have



Options:

(a) $\mu_1 = \mu_2$

(b) $\mu_2 = \mu_3$

(c) $\mu_3 = \mu_4$

(d) $\mu_4 = \mu_1$

Sol: For successive refraction through different media $\mu \sin\theta = \text{constant}$. Here as θ is same in the two extreme media, $\mu_1 = \mu_4$.

Ans: (d)

161. A thin mica sheet of thickness 2×10^{-6} m and refractive index $(\mu = 1.5)$ is introduced in the path of the first wave. The wavelength of the wave used is $5000\,\text{Å}$. The central bright maximum will shift

Options:

(a) 2 fringes upward

(b) 2 fringes downward

(c) 10 fringes upward

(d) none of these

Sol: Shift $= \frac{\beta}{\lambda}(\mu - 1)t = \frac{\beta}{\left(5000\times10^{-10}\right)}\times(1.5-1)\times2\times10^{-6} = 2\beta$, i.e., fringes upwards.

Ans: (a)

162. Unpolarised light is incident on a dielectric of refractive index $\sqrt{3}$. What is the angle of incidence if the reflected beam is completely polarised?

Options:

(a) $30°$

(b) $45°$

(c) $60°$

(d) $75°$

Sol: $\mu = \tan i$

$\Rightarrow i = \tan^{-1}(\mu) = \tan^{-1}\left(\sqrt{3}\right) = 60°$

Ans: (c)

163. The momentum of a photon of wavelength λ is

Options:

(a) $h\lambda$

(b) h/λ

(c) λ/h

(d) $h/c\lambda$

Sol: The momentum of a photon is $p = \frac{h}{\lambda}$

Ans: (b)

164.In a photoelectric emission process from a metal of work function $1.8\,\text{eV}$, the kinetic energy of most energetic electrons is $0.5\,\text{eV}$. The corresponding stopping potential is

Options:

(a) 1.8 V

(b) 1.2 V

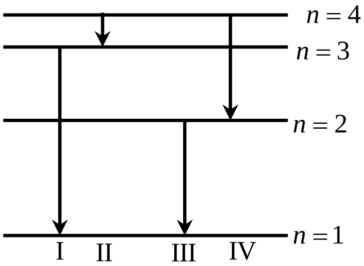
(c) 0.5 V

(d) 2.3 V

Sol: The stopping potential is equal to maximum kinetic energy.

Ans: (c)

165.The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy?



Options:

(a) IV

(b) III

(c) II

(d) I

Sol: $E = Rhc\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

E will be maximum for the transition for which $\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ is maximum. Here n_2 is the higher energy level.

Clearly, $\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ is maximum for the third transition, i.e., $2 \to 1$

I transition represents absorption of energy.

Ans: (b)

166.Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4 . Then the number of spectral lines in the emission spectra will be

Options:

(a) 2

(b) 3

(c) 5

(d) 6

Sol: For ground state, the principal quantum no $(n)=1$. There is a 3rd excited state for principal quantum number.

The possible number of the spectral line is given

$$=\frac{n(n-1)}{2}=\frac{4(4-1)}{2}=6$$

Ans: (d)

167.The ratio of the longest to shortest wavelengths in Bracket series of hydrogen spectra is

Options:

(a) $\frac{25}{9}$

(b) $\frac{17}{6}$

(c) $\frac{9}{5}$

(d) $\frac{4}{3}$

Sol: For Bracket series $\frac{1}{\lambda_{\max}}=R\left[\frac{1}{4^2}-\frac{1}{5^2}\right]=\frac{9}{25\times16}R$ and

$$\frac{1}{\lambda_{\min}}=R\left[\frac{1}{4^2}-\frac{1}{\infty^2}\right]=\frac{R}{16}\Rightarrow\frac{\lambda_{\max}}{\lambda_{\min}}=\frac{25}{9}$$

Ans: (a)

168.Fusion reaction takes place at high temperature because

Options:

(a) nuclei break up at high temperature

(b) atoms get ionised at high temperature

(c) kinetic energy is high enough to overcome the coulomb repulsion between nuclei

(d) molecules break up at high temperature

Sol: When the coulomb repulsion between the nuclei is overcome then nuclear fusion reaction takes place. This is possible when temperature is too high.

Ans: (c)

169.A radioactive nucleus A with a half life T, decays into a nucleus B. At $t=0$, there is no nucleus B. At sometime t, the ratio of the number of B to that of A is 0.3. Then, t is given by

Options:

(a) $t=T\log(1.3)$

(b) $t=\frac{T}{\log(1.3)}$

(c) $t=T\frac{\log 2}{\log 1.3}$ (d) $t=\frac{\log 1.3}{\log 2}T$

Sol: Let initially there are total N_0 number of nuclei

At time $t = \frac{N_B}{N_A} = 0.3$ (given)

$\Rightarrow N_B = 0.3 N_A$

$N_0 = N_A + N_B = N_A + 0.3N_A$

$\therefore\ N_A = \frac{N_0}{1.3}$

$N_t = N_0 e^{-\lambda t}$

or, $\frac{N_0}{1.3} = N_0 e^{-\lambda t}$

$\frac{1}{1.3} = e^{-\lambda t} \quad \Rightarrow\ \ln(1.3) = \lambda t$

or, $t = \frac{\ln(1.3)}{\lambda}$

$\Rightarrow\ t = \frac{\ln(1.3)}{\frac{\ln(2)}{T}} = \frac{\ln(1.3)}{\ln(2)} T$

Ans: (d)

170. A radioactive nucleus undergoes a series of decay according to the scheme

$A \xrightarrow{\alpha} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$. If the number and atomic number of 'A' are 180 and 72 respectively, then what are these numbers for A_4

Options:

(a) 172 and 69

(b) 174 and 70

(c) 176 and 69

(d) 176 and 70

Sol: ${}_{72}A^{180} \xrightarrow{\alpha} {}_{70}A_1^{166} \xrightarrow{\beta} {}_{71}A_2^{176} \xrightarrow{\alpha} {}_{69}A_3^{172} \xrightarrow{\gamma} {}_{69}A_4^{172}$

Ans: (a)

171. The barrier potential of a $p-n$ junction depends on

(A) type of semiconductor material

(B) amount of doping

(C) temperature

Options:

(a) (A) and (B) only

(b) (B) only

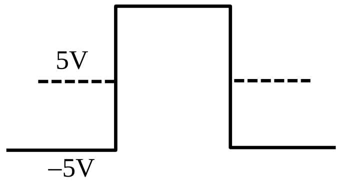
(c) (B) and (C) only

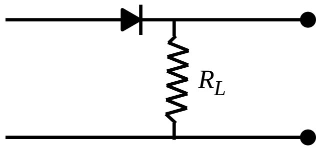
(d) (A), (B) and (C)

Sol: The barrier potential of $p-n$ junction depends on amount of doping, type of semiconductor material and temperature.

Ans: (d)

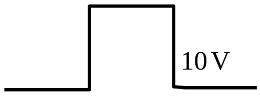
172.In a $p-n$ junction diode, a square input signal of $10\,\text{V}$ is applied as shown in fig.

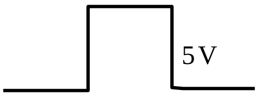


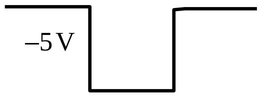


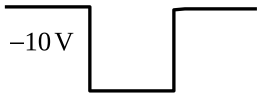
The output signal across R_L will be

Options:

(a) 

(b) 

(c) 

(d) 

Sol: The $p-n$ junction diode is a half wave rectifier which produces output in forward biased mode only. Thus, there will be no output corresponding to $-5\,\text{V}$ input. Hence, output will be obtained corresponding to $+5\,\text{V}$ only.

Ans: (b)

173.A d.c. battery of V volt is connected to a series combination of a resistor R and an ideal diode D as shown in the figure below. The potential difference across R will be

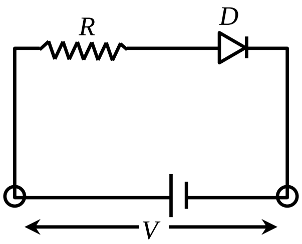
Options:

(a) $2\,\text{V}$ when diode is forward biased

(b) Zero when diode is forward biased

(c) V when diode is reverse biased

(d) V when diode is forward biased

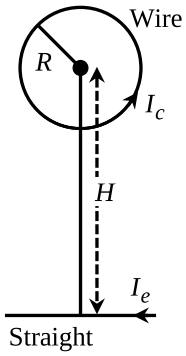


Sol: In forward biasing, the diode conducts. For ideal junction diode, the forward resistance is zero; therefore, entire applied voltage occurs across external resistance R i.e., there occurs no potential drop, so potential across R is V in forward biased.

Ans: (b)

174.Circular loop of a wire and a long straight wire carry currents I_c and I_e, respectively as shown in figure. Assuming that these are placed in the same plane. The magnetic fields will be zero at the centre of the loop when the separation H is

Options:



(a) $\frac{I_e R}{I_c \pi}$

(b) $\frac{I_c R}{I_e \pi}$

(c) $\frac{\pi I_c}{I_e R}$

(d) $\frac{I_e \pi}{I_c R}$

Sol: $\frac{\mu_0 I_c}{2R} = \frac{\mu_0 I_e}{2\pi H} \Rightarrow H = \frac{I_e R}{\pi I_c}$

Ans: (a)

175.Which of the following set have different dimensions?

Options:

(a) pressure, Young's modulus, stress

(b) EMF, potential difference, electric potential

(c) heat, work done, energy

(d) dipole moment, electric flux, electric field

Sol: Electric flux $\phi_E = \vec{E} \cdot \vec{S}$

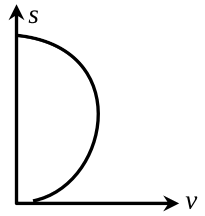
$\therefore$ Dimensionally $\phi_E \neq E$

Ans: (d)

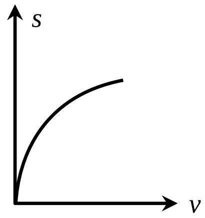
176. An object is moving with a uniform acceleration which is parallel to its instantaneous direction of motion. The displacements (s) – velocity (v) graph of this object is

Options:

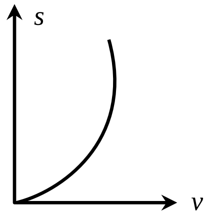
(a)



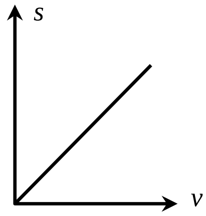
(b)



(c)



(d)



Sol: $v^2 = u^2 + 2aS$. If $u = 0$ then $v^2 \propto S$

i.e., graph should be parabola symmetric to displacement axis.

Ans: (b)

177. The speed of a projectile at its maximum height is $\frac{\sqrt{3}}{2}$ times its initial speed. If the range of the projectile is $'P'$ times the maximum height attained by it. P is –

Options:

(a) $\frac{4}{3}$

(b) $2\sqrt{3}$

(c) $4\sqrt{3}$

(d) $\frac{3}{4}$

Sol: Given, $u\cos\theta = \frac{\sqrt{3}u}{2}$ $\quad\Rightarrow\quad \cos\theta = \frac{\sqrt{3}}{2} \quad\Rightarrow\quad \theta = 30^\circ$

Range $(R) = \frac{u^2 \sin 2\theta}{g} = \frac{u^2 \sin 60^\circ}{g} = \frac{\sqrt{3}u^2}{2g}$

Maximum height $=\dfrac{u^2\sin^2\theta}{2g}=\dfrac{u^2\sin^2 30^\circ}{2g}=\dfrac{u^2}{8g}$

Now, range $=P\times H \Rightarrow \dfrac{\sqrt{3}u^2}{2g}=P\times\dfrac{u^2}{8g} \Rightarrow P=4\sqrt{3}$

Ans: (c)

178. A man weighing $80\,\text{kg}$, stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 ms^{-2}. What would be the reading on the scale? $\left(g=10\text{ ms}^{-2}\right)$

Options:

(a) $1200\,\text{N}$

(b) zero

(c) $400\,\text{N}$

(d) $800\,\text{N}$

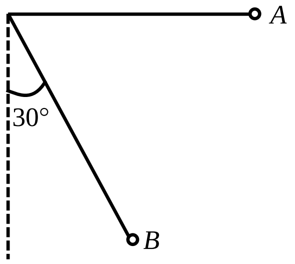
Sol: Reading of the scale $=$ Apparent weight of the mass $=m(g+a)$

$=80(10+5)=1200\,\text{N}$

Ans: (a)

179. A simple pendulum is released from A as shown. If m and l represent the mass of the bob and length of the pendulum, the gain in kinetic energy at B is

Options:



(a) $\dfrac{mgl}{2}$

(b) $\dfrac{mgl}{\sqrt{2}}$

(c) $\dfrac{\sqrt{3}}{2}mgl$

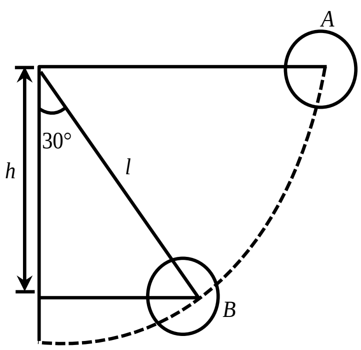
(d) $\dfrac{2}{\sqrt{3}}mgl$

Sol: Vertical height

$=h=l\cos 30^\circ$

Loss of potential energy $=mgh$

$=mgl\cos 30^\circ=\dfrac{\sqrt{3}}{2}mgl$

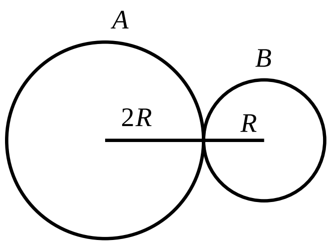


$\therefore$ Kinetic energy gained

$=\dfrac{\sqrt{3}}{2}mgl$

Ans: (c)

180.Two spheres A and B of masses m and $2m$, and radii $2R$ and R respectively are placed in contact as shown. The COM of the system lies



Options:

(a) inside A

(b) inside B

(c) at the point of contact

(d) none of these

Sol: Let centre of sphere A as origin then,

$$\text{COM} = \frac{m \times 0 + 2m \times 3R}{m + 2m} = 2R$$

$=$ At the point of contact.

Ans: (c)

Key Answers:

1. b	2. b	3. b	4. a	5. d	6. b	7. d	8. a	9. d	10. d
11. b	12. a	13. a	14. c	15. a	16. c	17. c	18. b	19. a	20. c
21. a	22. b	23. b	24. d	25. c	26. b	27. b	28. c	29. a	30. b
31. c	32. b	33. a	34. c	35. b	36. b	37. b	38. b	39. b	40. c
41. b	42. c	43. a	44. b	45. a	46. c	47. d	48. d	49. b	50. d
51. c	52. c	53. d	54. c	55. d	56. a	57. d	58. a	59. c	60. d
61. c	62. c	63. b	64. c	65. b	66. a	67. b	68. a	69. b	70. d
71. c	72. c	73. a	74. d	75. b	76. a	77. a	78. c	79. a	80. c
81. a	82. c	83. c	84. a	85. c	86. d	87. a	88. c	89. b	90. b
91. b	92. a	93. d	94. a	95. d	96. d	97. c	98. c	99. b	100.b
101.c	102.a	103.b	104.c	105.a	106.c	107.c	108.d	109.d	110.c
111.d	112.c	113.b	114.b	115.d	116.b	117.c	118.c	119.b	120.d
121.d	122.c	123.c	124.a	125.a	126.d	127.a	128.c	129.a	130.a
131.b	132.a	133.b	134.a	135.c	136.c	137.a	138.b	139.c	140.c
141.d	142.d	143.c	144.c	145.d	146.c	147.a	148.d	149.d	150.b
151.d	152.d	153.d	154.c	155.a	156.d	157.d	158.c	159.c	160.d
161.a	162.c	163.b	164.c	165.b	166.d	167.a	168.c	169.d	170.a
171.d	172.b	173.b	174.a	175.d	176.b	177.c	178.a	179.c	180.c