20 YEARS 2006–2025

KCET

KARNATAKA COMMON ENTRANCE TEST

Chapter-wise Solved Papers

PHYSICS • CHEMISTRY • MATHEMATICS • BIOLOGY

TREND ANALYSIS
Chapterwise Past 5 Year Papers Analysis

3500+
Past Year Questions

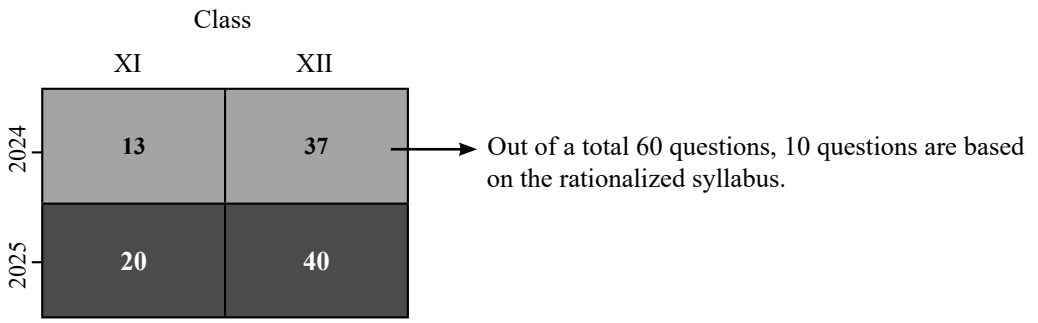
SOLUTIONS
Stepwise Detailed Solutions of each question

Chapter-wise Trend Analysis of Last 5 Years' Papers

PHYSICS

S. No.	Chapters' Name	2025	2024	2023	2022	2021
	Class-XI					
1.	Units and Measurements	1	0	0	0	1
2.	Motion in a Straight Line	1	1	1	1	2
3.	Motion in a Plane	2	1	1	1	4
4.	Laws of Motion	2	1	1	2	1
5.	Work, Energy & Power	2	1	1	1	2
6.	System of Particles and Rotational motion	2	2	1	2	0
7.	Gravitation	2	1	1	0	1
8.	Mechanical Properties of Solids	1	1	1	1	0
9.	Mechanical Properties of Fluids	2	1	1	0	1
10.	Thermal Properties of Matter	1	1	1	0	1
11.	Thermodynamics	1	1	1	1	1
12.	Kinetic Theory of Gases	1	1	2	0	1
13.	Oscillations	1	1	0	1	1
14.	Waves	1	0	0	0	1
	Class-XII					
1.	Electric Charges and Fields	5	4	4	4	4
2.	Electrostatic Potential and Capacitance	2	3	3	3	4
3.	Current Electricity	7	5	4	5	3
4.	Moving Charges and Magnetism	4	4	2	6	4
5.	Magnetism and Matter	1	0	0	0	0
6.	Electromagnetic Induction	2	4	3	2	1
7.	Alternating Current	3	2	2	2	1
8.	Electromagnetic Waves	1	0	1	2	2
9.	Ray Optics and Optical Instruments	6	4	4	5	4
10.	Wave Optics	1	1	3	2	3
11.	Dual Nature of Radiation and Matter	2	2	1	4	2
12.	Atoms	1	2	2	3	3
13.	Nuclei	2	3	1	2	0
14.	Semiconductor Electronics	3	3	2	2	0

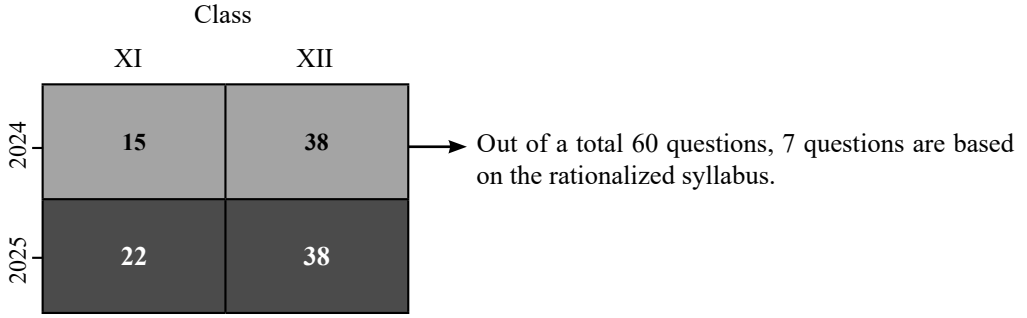
Class-wise Distribution of Questions



BIOLOGY

S. No.	Chapters' Name	2025	2024	2023	2022	2021
	Class-XI					
1.	The Living World	1	0	1	1	0
2.	Biological Classification	1	0	0	1	2
3.	Plant Kingdom	1	2	1	1	1
4.	Animal Kingdom	1	1	1	1	1
5.	Morphology of Flowering Plants	1	1	1	1	1
6.	Anatomy of Flowering Plants	2	0	1	0	0
7.	Structural Organisation in Animals	1	1	1	1	1
8.	Cell: The Unit of Life	2	1	1	1	1
9.	Biomolecules	1	1	1	1	1
10.	Cell Cycle and Cell Division	2	1	1	1	1
11.	Photosynthesis in Higher Plants	1	1	0	1	1
12.	Respiration in Plants	1	1	0	1	1
13.	Plant Growth and Development	1	1	0	0	1
14.	Breathing and Exchange of Gases	1	0	0	0	0
15.	Body Fluids and Circulation	1	1	2	1	2
16.	Excretory Products and their Elimination	1	1	1	1	0
17.	Locomotion and Movement	1	1	0	0	0
18.	Neural Control and Coordination	1	1	1	1	0
19.	Chemical Coordination and Integration	1	0	0	0	1
	Class-XII					
1.	Sexual Reproduction in Flowering Plants	3	3	3	4	6
2.	Human Reproduction	3	3	5	4	3
3.	Reproductive Health	3	2	3	2	2
4.	Principles of Inheritance and Variation	5	4	5	4	5
5.	Molecular Basis of Inheritance	3	4	4	5	5
6.	Evolution	3	3	2	1	0
7.	Human Health and Disease	3	3	4	4	5
8.	Microbes in Human Welfare	3	2	2	3	3
9.	Biotechnology: Principles and Processes	3	3	4	4	2
10.	Biotechnology and its Applications	3	2	0	3	4
11.	Organisms and Populations	2	3	2	5	5
12.	Ecosystem	2	3	2	1	0
13.	Biodiversity and Conservation	2	3	1	1	4

Class-wise Distribution of Questions



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II. Chemistry

CLASS-XI

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III. Mathematics

CLASS-XI

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IV. Biology

CLASS-XI

CLASS-XII

Solved Paper (CHEMISTRY) 2025

1. Match List-I with List-II and select the correct option:

List-I (Molecule/ion)		List-II (Bond order)	
A.	NO	(*i*)	1.5
B.	CO	(*ii*)	2.0
C.	O_2^-	(*iii*)	2.5
D.	O_2	(*iv*)	3.0

(*a*) A-(*iii*), B-(*iv*), C-(*i*), D-(*ii*)
(*b*) A-(*i*), B-(*iv*), C-(*iii*), D-(*ii*)
(*c*) A-(*ii*), B-(*iii*), C-(*iv*), D-(*i*)
(*d*) A-(*iv*), B-(*iii*), C-(*ii*), D-(*i*)

2. The electronic configuration of X and Y are given below:

X: $1s^2 2s^2 2p^6 3s^2 3p^3$

Y: $1s^2 2s^2 2p^6 3s^2 3p^5$

Which of the following is the correct molecular formula and type of bond formed between X and Y?

(*a*) X_3Y, ionic bond (*b*) X_2Y_3, coordinate bond
(*c*) XY_3, covalent bond (*d*) X_2Y, covalent bond

3. Match List-I with List-II

List-I (Types of redox reactions)		List-II (Examples)	
A.	Combination reaction	(*i*)	$Cl_{2(g)} + 2Br^-_{(aq)} \rightarrow 2Cl^-_{(aq)} + Br_{2(l)}$
B.	Decomposition reaction	(*ii*)	$2H_2O_{2(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$
C.	Displacement reaction	(*iii*)	$CH_{4(g)} + 2O_{2(g)} \xrightarrow{\Delta} CO_{2(g)} + 2H_2O_{(l)}$
D.	Disproportionation reaction	(*iv*)	$2H_2O_{(l)} \xrightarrow{\Delta} 2H_{2(g)} + O_{2(g)}$

Choose the correct answer from the options given below.

(*a*) A-(*iv*), B-(*iii*), C-(*i*), D-(*ii*)
(*b*) A-(*ii*), B-(*i*), C-(*iv*), D-(*iii*)
(*c*) A-(*iii*), B-(*iv*), C-(*i*), D-(*ii*)
(*d*) A-(*iii*), B-(*ii*), C-(*i*), D-(*iv*)

4. In the following pairs, the one in which both transition metal ions are colourless is

(*a*) Sc^{3+}, Zn^{2+} (*b*) V^{2+}, Ti^{3+}
(*c*) Zn^{2+}, Mn^{2+} (*d*) Ti^{4+}, Cu^{2+}

5. In the reaction between hydrogen sulphide and acidified permanganate solution,

(*a*) H_2S is reduced to S, MnO_4^- is oxidised to Mn^{2+}
(*b*) H_2S is oxidised to SO_2, MnO_4^- is reduced to MnO_2
(*c*) H_2S is reduced to SO_2, MnO_4^- is oxidised to Mn^{2+}
(*d*) H_2S is oxidised to S, MnO_4^- is reduced to Mn^{2+}

6. A member of the Lanthanoid series which is well known to exhibit +4 oxidation state is

(*a*) Samarium (*b*) Europium
(*c*) Erbium (*d*) Cerium

7. In which of the following pairs, both the elements do not have $(n-1)d^{10}ns^2$ configuration?

(*a*) Cu, Zn (*b*) Zn, Cd (*c*) Cd, Hg (*d*) Ag, Cu

8. A ligand which has two different donor atoms and either of the two ligates with the central metal atom/ion in the complex is called _____

(*a*) Chelate ligand (*b*) Unidentate ligand
(*c*) Polydentate ligand (*d*) Ambidentate ligand

9. Which of the following statements are true about $[NiCl_4]^{2-}$?

A. The complex has tetrahedral geometry
B. Co-ordination number of Ni is 2 and oxidation state is +4
C. The complex is sp^3 hybridised
D. It is a high spin complex
E. The complex is paramagnetic

(*a*) A, C, D and E (*b*) A, B, D and E
(*c*) B, C, D and E (*d*) A, B, C and D

10. Which formula and its name combination is incorrect?

(*a*) $K_3[Cr(C_2O_4)_3]$, Potassium trioxalatochromate (III)
(*b*) $[CoCl_2(en)_2]Cl$, Dichloridobis (ethane –1,2–diamine) cobalt (III) chloride
(*c*) $[Co(NH_3)_5(CO_3)]Cl$, Pentaamine carbonylcobalt (III) chloride
(*d*) $[Pt(NH_3)_2Cl(NO_2)]$ Diamine chloridonitrito –N– Platinum (II)

11. In the complex ion $[Fe(C_2O_4)_3]^{3-}$, the co-ordination number of Fe is

(*a*) 4 (*b*) 5 (*c*) 6 (*d*) 3

12. Match List-I with List-II for the following reaction pattern
Glucose $\xrightarrow{\text{Reagent}}$ Product $\rightarrow$ Structural prediction

List - I (Reagents)		List-II (Structural prediction)	
A.	Acetic anhydride	(*i*)	Glucose has an aldehyde group
B.	Bromine water	(*ii*)	Glucose has a straight chain of six carbon atoms
C.	Hydroiodic acid	(*iii*)	Glucose has five hydroxyl group
D.	Hydrogen cyanide	(*iv*)	Glucose has a carbonyl group

Choose the correct answer from the options given below.

(*a*) A-(*iv*), B-(*iii*), C-(*ii*), D-(*i*)

(*b*) A-(*iii*), B-(*i*), C-(*ii*), D-(*iv*)

(*c*) A-(*i*), B-(*ii*), C-(*iii*), D-(*iv*)

(*d*) A-(*iii*), B-(*ii*), C-(*i*), D-(*iv*)

13. The correct sequence of α-amino acids, hormone, vitamin, carbohydrates respectively is

(*a*) Thiamine, Thyroxine, Vitamin A, Glucose

(*b*) Glutamine, Insulin, Aspartic acid, Fructose

(*c*) Arginine, Testosterone, Glutamic acid, Fructose

(*d*) Aspartic acid, Insulin, Ascorbic acid, rhamnose

14. Which examples of carbohydrates exhibit α-link, (α-glycosidic link) in their structure?

(*a*) Maltose and Lactose (*b*) Amylose and Amylopectin

(*c*) Cellulose and Glycogen (*d*) Glucose and Fructose

15. In the titration of potassium permanganate ($KMnO_4$) against Ferrous ammonium sulphate (FAS) solution, dilute sulphuric acid but not nitric acid is used to maintain acidic medium, because

(*a*) It is difficult to identify the end point

(*b*) Nitric acid doesn't act as an indicator

(*c*) Nitric acid itself is an oxidizing agent

(*d*) Nitric acid is a weak acid than sulphuric acid

16. The group reagent NH_4Cl(s) and aqueous NH_3 will precipitate which of the following ion?

(*a*) NH_4^+ (*b*) Al^{3+} (*c*) Ba^{2+} (*d*) Ca^{2+}

17. In the preparation of sodium fusion extract, the purpose of fusing organic compound with a piece of sodium metal is to

(*a*) Convert the organic compound into vapour state

(*b*) Convert the elements of the compound from covalent form to ionic form

(*c*) Convert the elements of the compound from ionic form to covalent form

(*d*) Decrease the melting point of the compound

18. The sodium fusion extract is boiled with concentrated nitric acid while testing for halogens. By doing so, it

(*a*) helps in precipitation of AgCl

(*b*) increases the solubility of AgCl

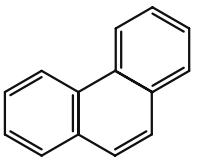
(*c*) increases the concentration of NO_3^- ion

(*d*) decomposes Na_2S and NaCN , if formed

19. Which of the following is not an aromatic compound

(*a*) 

(*b*) 

(*c*) 

(*d*) 

20. The IUPAC name of the given organic compound is
$HC \equiv C - CH = CH - CH = CH_2$

(*a*) Hexa - 1 - yn - 3,5 - diene

(*b*) Hexa - 5 - yn - 1,3 - diene

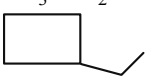
(*c*) Hexa -1,3 - dien - 5 - yne

(*d*) Hexa - 3,5 - dien - 1 - yne

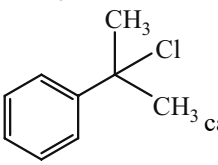
21. Among the following, identify the compound that is not an isomer of hexane

(*a*) $CH_3–CH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_3$

(*b*) $CH_3–CH_2–CH_2–CH_2–CH_2–CH_3$

(*c*) 

(*d*) $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_2–CH_3$

22. The organic compound 

can be classified as _____

(*a*) Allylic halide (*b*) Benzyl halide

(*c*) Aryl halide (*d*) Alkyl halide

23. Chlorobenzene reacts with bromine gas in the presence of Anhyd $AlBr_3$ to yield p-Bromochlorobenzene. This reaction is classified as

(*a*) Elimination reaction

(*b*) Nucleophilic substitution reaction

(*c*) Electrophilic substitution reaction

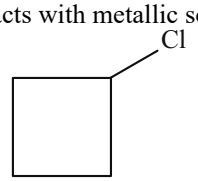
(*d*) Addition reaction

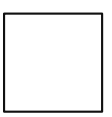
24. The organometallic compound $(CH_3)_3$ CMgBr on reaction with D_2O produces _____

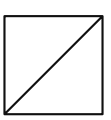
(*a*) $\left(CH_3\right)_3$ COD (*b*) $\left(CD_3\right)_3$ CD

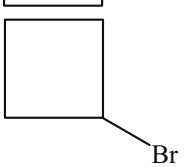
(*c*) $\left(CD_3\right)_3$ COD (*d*) $\left(CH_3\right)_3$ CD

25. The major product formed when 1- Bromo-3-Chlorocyclobutane reacts with metallic sodium in dry ether is

(*a*) 

(*b*) 

(*c*) 

(*d*) 

26. Ethyl alcohol is heated with concentrated sulphuric acid at 413 K. The major product

(*a*) $C_2H_5-O-C_2H_5$ (*b*) $CH_3-O-C_3H_7$

(*c*) $CH_2=CH_2$ (*d*) $CH_3COOC_2H_5$

27. Phenol can be distinguished from propanol by using the reagent

(*a*) Bromine water (*b*) Iron metal

(*c*) Iodine in alcohol (*d*) Sodium metal

28. Match the following with their pKa values

Acid		pKa	
A.	Phenol	(*i*)	16
B.	p-Nitrophenol	(*ii*)	0.78
C.	Ethyl alcohol	(*iii*)	10
D.	Picric acid	(*iv*)	7.1

(*a*) A- (*iii*), B-(*iv*), C-(*i*), D-(*ii*)

(*b*) A- (*i*), B-(*iv*), C-(*iii*), D-(*ii*)

(*c*) A- (*i*), B-(*ii*), C-(*iii*), D-(*iv*)

(*d*) A- (*ii*), B-(*i*), C-(*iv*), D-(*iii*)

29. $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-OCH_3 + HI \rightarrow A + B.$

A and B respectively are

(*a*) $A = CH_3OH$, $B = CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-OH$

(*b*) $A = CH_3-I$, $B = CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-OH$

(*c*) $A = CH_3OH$, $B = CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-I$

(*d*) $A = CH_3-I$, $B = CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-I$

30. Oxidation of Toluene with chromyl chloride followed by hydrolysis gives Benzaldehyde. This reaction is known as

(*a*) Etard Reaction (*b*) Kolbe reaction

(*c*) Stephen reaction (*d*) Cannizzaro Reaction

31. Statement-I: Reduction of ester by DIABL-H followed by hydrolysis gives aldehyde.

Statement-II: Oxidation of benzyl alcohol with aqueous $KMnO_4$ leads to the formation to Benzaldehyde.

Among the above statements, identify the correct statement.

(*a*) Both statements - I and II are false

(*b*) Statement - I is true but statement - II is false

(*c*) Statement - I is false but statement - II is true

(*d*) Both statements - I and II are true.

32. Arrange the following compounds in their decreasing order of reactivity towards Nucleophillic addition reaction.

$CH_3COCH_3, CH_3COC_2H_5, CH_3CHO$

(*a*) $CH_3CHO > CH_3COCH_3 > CH_3COC_2H_5$

(*b*) $CH_3COCH_3 > CH_3CHO > CH_3COC_2H_5$

(*c*) $CH_3COC_2H_5 > CH_3COCH_3 > CH_3CHO$

(*d*) $CH_3CHO > CH_3COC_2H_5 > CH_3COCH_3$

33. Which of the following has most acidic Hydrogen?

(*a*) Propanoic acid (*b*) Dichloroacetic acid

(*c*) Trichloroacetic acid (*d*) Chloroacetic acid

34. Which of the following reagents are suitable to differentiate Aniline and N-methylaniline chemical

(*a*) Acetic anhydride

(*b*) Br_2 water

(*c*) Conc. Hydrochloric acid and anhydrous zinc chloride

(*d*) Chloroform and Alcoholic potassium hydroxide

35. Which of the following reaction/s does not yield an amine?

I. $R-X+\underset{(alc)}{NH_3} \xrightarrow{\Delta}$

II. $R-C\equiv N \xrightarrow[Na(Hg)/C_2H_5OH]{H_2/Ni}$

III. $R-C\equiv N + H_2O \xrightarrow{H^+}$

IV. $R-\overset{\displaystyle O}{\overset{\|}{C}}-NH_2 + 4[H] \xrightarrow[(ii)\ H_3O^+]{(i)\ LiAlH_4}$

(*a*) Both I and III (*b*) Only II

(*c*) Only III (*d*) Both II and IV

36. Match the compounds given in List - I with the items given in List - II.

List - I		List - II	
A.	Benzenesulphonyl Chloride	(*i*)	Zwitterioin
B.	Sulphanilic acid	(*ii*)	Hinsberg reagent
C.	Alkyl Diazonium salts	(*iii*)	Dyes
D.	Aryl Diazonium salts	(*iv*)	Conversion to alcohol

(*a*) A-(*iii*), B-(*ii*), C-(*i*), D-(*iv*)

(*b*) A-(*i*), B-(*iii*), C-(*ii*), D-(*iv*)

(*c*) A-(*iii*), B-(*i*), C-(*iv*), D-(*ii*)

(*d*) A-(*ii*), B-(*i*), C-(*iv*), D-(*iii*)

37. The number of orbitals associated with 'N' shell of an atom is

(*a*) 16 (*b*) 32 (*c*) 3 (*d*) 4

38. According to the Heisenberg's Uncertainty principle, the value of $\Delta v.\Delta x$ for an object whose mass is 10^{-6} kg is ($h = 6.626 \times 10^{-34}$ Js)

(*a*) $3.0\times10^{-24}\ m^{-2}\ s^{-1}$ (*b*) $4.0\times10^{-26}\ m^{-2}\ s^{-1}$

(*c*) $3.5\times10^{-25}\ m^{-2}\ s^{-1}$ (*d*) $5.2\times10^{-29}\ m^{-2}\ s^{-1}$

39. Given below are two statements.

Statement-I: Adiabatic work done is positive when work is done on the system and internal energy of the system increases.

Statement-II: No work is done during free expansion of an ideal gas.

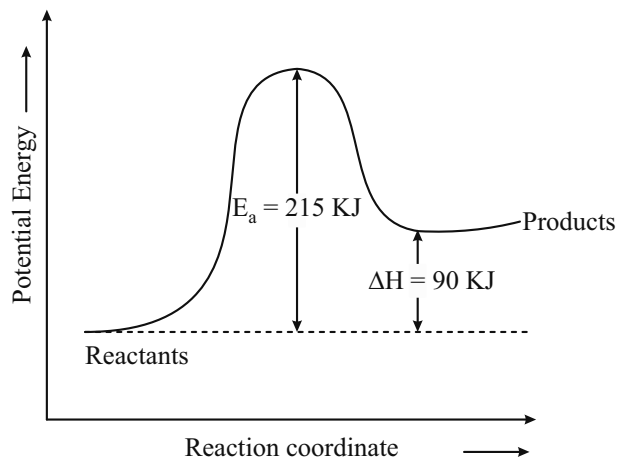
List-I		List-II	
A.	Ag^+	(*i*)	386000 $Cmol^{-1}$
B.	Mg^{2+}	(*ii*)	289500 $Cmol^{-1}$
C.	Al^{3+}	(*iii*)	96500 $Cmol^{-1}$
D.	Ti^{4+}	(*iv*)	193000 $Cmol^{-1}$

(*a*) A-(*ii*), B-(*i*), C-(*iv*), D-(*iii*)
(*b*) A-(*iii*), B-(*iv*), C-(*ii*), D-(*i*)
(*c*) A-(*iv*), B-(*iii*), C-(*i*), D-(*ii*)
(*d*) A-(*i*), B-(*ii*), C-(*iii*), D-(*iv*)

53. Catalysts are used to increase the rate of a chemical reaction. Because it
(*a*) Increases the activation energy of the reaction
(*b*) Decreases the activation energy of the reaction
(*c*) Brings about improper orientation of reactant molecules
(*d*) Increases the potential energy barrier

54. Half-life of a first order reaction is 20 seconds and initial concentration of reactant is 0.2 M. The concentration of reactant left after 80 seconds is
(*a*) 0.1 M (*b*) 0.05 M (*c*) 0.0125 M (*d*) 0.2 M

55. In the given graph, E_a for the reverse reaction will be



(*a*) 125 KJ (*b*) 215 KJ (*c*) 90 KJ (*d*) 305 KJ

56. For the reaction $2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$ initial concentration of N_2O_5 is 2.0 mol L^{-1} and after 300 min, it is reduced to 1.4 mol L^{-1}. The rate of production of NO_2(in mol L^{-1} min^{-1})is
(*a*) 2.5×10^{-4} (*b*) 4×10^{-4}
(*c*) 2.5×10^{-3} (*d*) 4×10^{-3}

57. Which of the following methods of expressing concentration are unitless?
(*a*) Mole fraction and Mass percent (W/W)
(*b*) Molality and Mole fraction
(*c*) Mass percent (W/W) and Molality
(*d*) Molality and Molarity

58. Select the INCORRECT statement/s from the following:
A. 22 books have infinite significant figures
B. In the answer of calculation 2.5 × 1.25 has four significant figures,.
C. Zero's preceding to first non-zero digit are significant
D. In the answer of calculation 12.11 + 18.0 + 1.012 has three significant figures
(*a*) B, C and D (*b*) B and C only
(*c*) B and D only (*d*) A and B only

59. Given below and the atomic masses of the elements:

Element:	Li	Na	Cl	K	Ca	Br	Sr	I	Ba
Atomic Mas (g mol^{-1}):	7	23	35.5	39	40	80	88	127	137

Which of the following doesn't form triad?
(*a*) Ba, Sr, Ca (*b*) Cl, Br, I
(*c*) Cl, K, Ca (*d*) Li, Na, K

60. The change in hybridization (if any) of the 'Al' atom in the following reaction is
$AlCl_3 + Cl^- \rightarrow AlCl_4^-$
(*a*) No change in the hybridization state
(*b*) sp^2 to sp^3
(*c*) sp^3 to sp^3d
(*d*) sp^3 to sp^2

Answer Key

1. (*a*)	**2.** (*c*)	**3.** (*c*)	**4.** (*a*)	**5.** (*d*)	**6.** (*d*)	**7.** (*d*)	**8.** (*d*)	**9.** (*a*)	**10.** (*c*)
11. (*c*)	**12.** (*b*)	**13.** (*d*)	**14.** (*b*)	**15.** (*c*)	**16.** (*b*)	**17.** (*b*)	**18.** (*d*)	**19.** (*a*)	**20.** (*c*)
21. (*c*)	**22.** (*b*)	**23.** (*c*)	**24.** (*d*)	**25.** (*c*)	**26.** (*a*)	**27.** (*a*)	**28.** (*a*)	**29.** (*c*)	**30.** (*a*)
31. (*b*)	**32.** (*a*)	**33.** (*c*)	**34.** (*d*)	**35.** (*c*)	**36.** (*d*)	**37.** (*a*)	**38.** (*d*)	**39.** (*d*)	**40.** (*c*)
41. (*b*)	**42.** (*c*)	**43.** (*a*)	**44.** (*b*)	**45.** (*d*)	**46.** (*d*)	**47.** (*a*)	**48.** (*c*)	**49.** (*c*)	**50.** (*b*)
51. (*d*)	**52.** (*b*)	**53.** (*b*)	**54.** (*c*)	**55.** (*a*)	**56.** (*d*)	**57.** (*a*)	**58.** (*b*)	**59.** (*c*)	**60.** (*b*)

Explanations

1. (*a*) Bond order (B.O) = $\frac{1}{2}[N_b - N_a]$

For the No molecule:

Where, N_b is number of bonding electrons and N_a is number of antibonding electrons.

For NO molecule:

Bond order = $\frac{1}{2} \times (8 - 3) = 2.5$

For CO molecule:

Bond order = $\frac{1}{2} \times (10 - 4) = 3.0$

For O_2^- :

Bond order = $\frac{1}{2} \times (6 - 3) = 1.5$

For O_2:

Bond order = $\frac{1}{2} \times (6 - 2) = 2.0$

2. (*c*) Given,

E.C of X :$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$. Hence, X represents Phosphorus (P).

E.C of Y :$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$. Hence, Y represents Chlorine (Cl).

The valency of X (i.e., P) is either 3 or 5

The valency of Y (i.e., Cl) is 1

Therefore, the possible molecules are PCl_3 or PCl_5

Both are covalent compounds.

Hence, the correct molecular formula of the compound is XY_3 and a covalent bond is formed between X and Y atoms.

3. (*c*) A-iii), B-iv), C-i), D-ii)

List-I
(Types of redox reactions)

A. Combination reaction

B. Decomposition reaction

C. Displacement reaction

D. Disproportionation reaction

List-II
(Examples)

(*iii*) $CH_{4(g)} + 2O_{2(g)} \xrightarrow{\Delta} CO_{2(g)} + 2H_2O_{(l)}$

(*iv*) $2H_2O_{(l)} \xrightarrow{\Delta} 2H_{2(g)} + O_{2(g)}$

(*i*) $Cl_{2(g)} + 2Br^-_{(aq)} \rightarrow 2Cl^-_{(aq)} + Br_{2(l)}$

(*ii*) $2H_2O_{2(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$

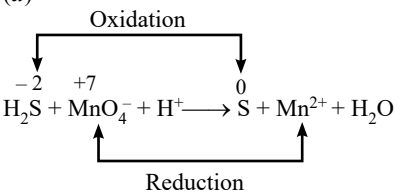
4. (*a*) The electronic configurations of the ions are represented as:

Sc^{3+} – [Ar]$3d^0\ 4s^0$

Zn^{+2} – [Ar]$3d^{10}\ 4s^0$

Sc^{3+} and Zn^{2+} ions are both colourless because they do not have any unpaired d-electrons for d-d transitions.

5. (*d*)



Hence, H_2S is oxidised to S and MnO_4^- is reduced to Mn^{2+}.

6. (*d*) Cerium (Ce) is known to exhibit a +4 oxidation state. This is because the electronic configuration of cerium in its +4 oxidation state results in a stable noble gas configuration.

E.C of Ce: [Xe] $4f^1 5d^1 6s^2$

E.C of Ce^{4+}: [Xe]$4f^0 5d^0\ 6s^0$

7. (*d*) The electronic configurations of the given elements may be represented as:

Cu: [Ar] $3d^{10}\ 4s^1$

Zn: [Ar] $3d^{10}\ 4s^2$

Cd: [Kr] $4d^{10} 5s^2$

Hg: [Xe] $4f^{14} 5d^{10}\ 6s^2$

Ag: [Kr] $4d^{10} 5s^1$

Hence, both Ag and Cu do not have $(n - 1)\ d^{10}\ ns^2$ configuration.

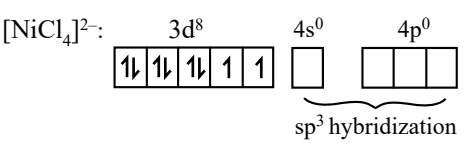
8. (*d*) Ligand which has two different donor atoms and either of the two ligates in the complex is called ambidentate ligand. Example: NO_2^-, SCN^-

9. (*a*) Oxidation state of Ni in $[NiCl_4]^{2-}$ complex is +2.

Coordination number of Ni in the complex is 4.

E.C of Ni^{2+} : [Ar] $3d^8\ 4s^0$

Since, Cl^- is a weak field ligand, therefore, pairing does not take place



(tetrahedral geometry)

$[NiCl_4]^{2-}$ is paramagnetic and high spin complex.

10. (*c*) $[Co(NH_3)_5(CO_3)]Cl$

IUPAC Name: Pentaammine carbonate cobalt (III) chloride.

11. (*c*) Since, oxalate ($C_2O_4^{2-}$) is a bidentate ligand, hence, the coordination no. of Fe in the given complex is 6.

12. (*b*)

List - I (Reagents)		List-II (Structural prediction)	
A.	Acetic anhydride	(*iii*)	Glucose has five hydroxyl group
B.	Bromine water	(*i*)	Glucose has an aldehyde group
C.	Hydroiodic acid	(*ii*)	Glucose has a straight chain of six carbon atoms
D.	Hydrogen cyanide	(*iv*)	Glucose has a carbonyl group

13. (*d*) Aspartic acid is an α-amino acid

Insulin is an example of hormone

Ascorbic acid, also known as Vitamin C is a Vitamin

Rhamnose is a carbohydrate

14. (*b*) Amylose and Amylopectin are the components of starch. They are linked by α-glycosidic bonds.

15. (*c*) In redox titration, nitric acid is not used because it is an oxidizing agent itself, which could interfere with the reaction by oxidizing the ferrous ions (Fe^{2+}) into ferric ion (Fe^{3+}), thus decreasing the titration value of Fe(II) by MnO_4^-

16. (*b*) The group reagent for the precipitation of group III cations (Al^{3+}, Fe^{3+}) is NH_4OH (aqueous NH_3) in the presence of NH_4Cl.

17. (*b*) In the preparation of sodium fusion extract, the purpose of fusing organic compound with a piece of sodium metal is to convert the elements present in the compound from covalent

form into the ionic form, so that the detection could become easier.

18. (*d*) When the sodium fusion extract is boiled with concentrated nitric acid during the test for halogens, it is done to decompose any sodium sulphides (Na_2S) or sodium cyanides (NaCN) that may have formed during the test.

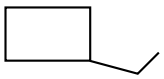
19. (*a*) Since, compound (1) has 4 π-electrons, therefore, it is antiaromatic compound.

20. (*c*) The IUPAC name of the given compound is Hexa-1,3 – dien – 5 – yne.

$\overset{6}{HC} \equiv \overset{5}{C} - \overset{4}{CH} = \overset{3}{CH} - \overset{2}{CH} = \overset{1}{CH_2}$

21. (*c*) $CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - CH_3$

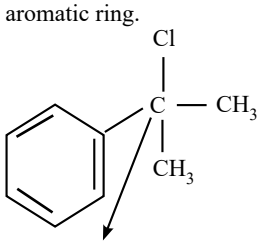
Molecular Formula: C_6H_{14}



Molecular Formula: C_6H_{12}

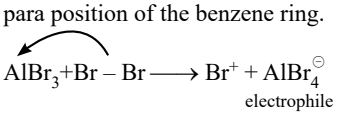
Hence, both these compounds are not isomers.

22. (*b*) Benzylic halides are the compounds in which the halogen atom is bonded to an sp^3- hybridised carbon atom attached to an aromatic ring.

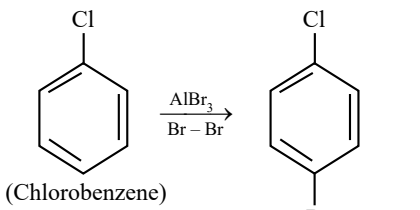


Benzyllic Position

23. (*c*) This is an electrophilic substitution reaction, where the bromine acts as the electrophile and the reaction occurs at the para position of the benzene ring.

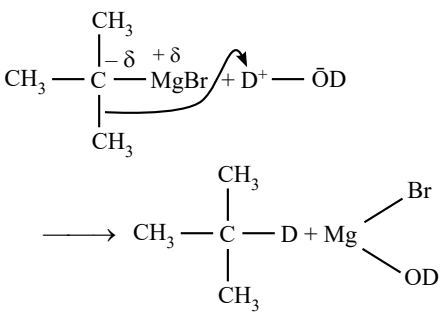


electrophile

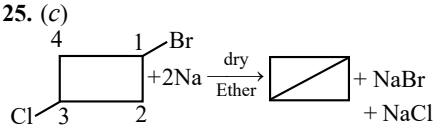


(Chlorobenzene) (p-Bromochlorobenzene)

24. (*d*) The reaction can be represented as:

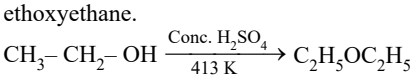


25. (*c*)

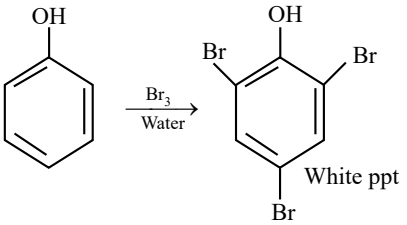


(1–Bromo–3–Chlorocyclobutane)

26. (*a*) At 413 K, the major product formed is ethoxyethane.



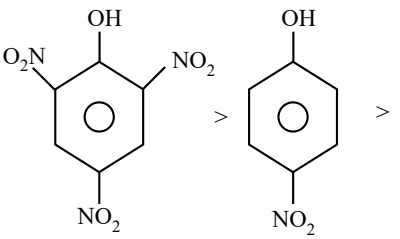
27. (*a*) When phenol reacts with bromine water, it forms a white precipitate of 2,4,6-tribromophenol. Propanol, however, does not form white precipitate with bromine water.



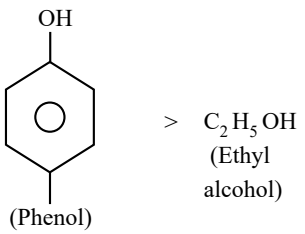
White ppt

28. (*a*) The lower the value of pK_a, the more acidic the compound is.

The decreasing order of acidic strength is:

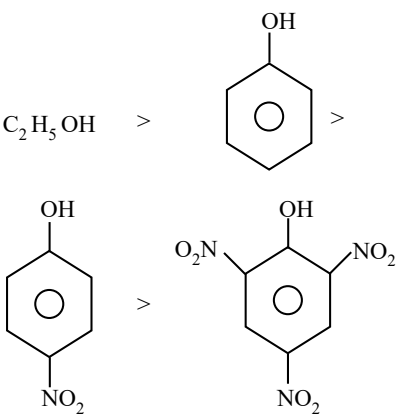


(Picric acid) (p-Nitrophenol)

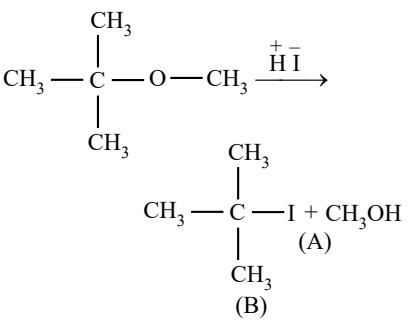


(Phenol) (Ethyl alcohol)

Therefore, the correct order of pK_a values is:

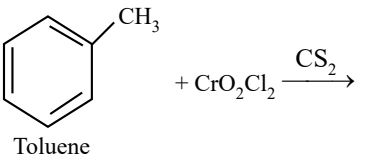


29. (*c*) In the given reaction, formation of tertiary halide will take place.

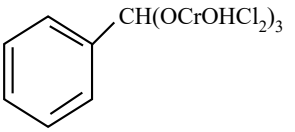


(A) (B)

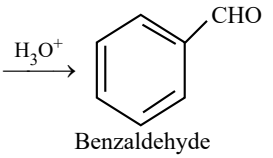
30. (*a*) This reaction is known as Etard reaction.



Toluene



Chromium complex



Benzaldehyde

31. (*b*) Reduction of an ester using DIBAL-H followed by hydrolysis produces an aldehyde.

Oxidation of benzyl alcohol with aqueous $KMnO_4$ leads to the formation of benzoic acid, not an aldehyde.

32. (*a*) Nucleophilic addition reaction is directly proportional to the presence of positive charge on the nucleophilic center and inversely proportional to the steric hindrance at nucleophilic center.

Hence, the correct order is:

$CH_3CHO > CH_3COCH_3 > CH_3COC_2H_5$

33. (*c*) More will be the number of withdrawing group more will be the acidity. CCl_3COOH is very acidic because the three chlorine atoms pull electron density away from the carboxyl group, making it easier to lose a proton (H^+). This helps stabilize the resulting negative ion, increasing its acidity.

34. (*d*) Only primary amines give positive carbylamine test. Hence, this reaction is used to distinguish aniline (primary amine) from N-methylaniline (secondary amine).

35. (*c*) Cyanides on hydrolysis form carboxylic acids, not amines. In rest other reactions, amines are produced.

36. (*d*)

	List-I		List-II
A.	Benzenesulphonyl Chloride	(*ii*)	Hinsberg reagent
B.	Sulphanilic acid	(*i*)	Zwitter ion
C.	Alkyl Diazonium salts	(*iv*)	Conversion to alcohols
D.	Aryl Diazonium salts	(*iii*)	Dyes

37. (*a*) Maximum number of orbitals in a shell $= n^2$

For N-shell, n = 4

Therefore, $n^2 = 16$

38. (*d*) According to Heisenberg's uncertainty principle,

$$\Delta x \times \Delta v_x \geq \frac{h}{4\pi m}$$

Given, $h = 6.626 \times 10^{-34}$ Js
$m = 10^{-6}$ kg

$$= \frac{6.625 \times 10^{-34}}{4 \times 3.14 \times 10^{-16}} = 5.2 \times 10^{-29} m^{-2} s^{-1}$$

39. (*d*) S-I: In an adiabatic process, the change in internal energy (ΔU) is equal to the work done (W). If the work is done on the system, it results in an increase in internal energy.
S-II: When the external pressure is zero, no work is done.

40. (*c*) As we know that,
$\Delta H = \Delta U + \Delta n_g RT$
For $2HI_{(g)} \rightleftharpoons H_{2(g)} + I_{2(g)}$

Δn_g = number of moles of gaseous products – number of moles of gaseous reactants
$= 2 - 2 = 0$
$\therefore \Delta H = \Delta U$

41. (*b*) B) The magnitude of enthalpy change do depends on the strength of the intermolecular interactions in the substance undergoing phase transformations.
Hence, the given statement is incorrect.
D) The change in enthalpy is independent of path between initial state (reactants) and final state (products).
Hence, the given statement is incorrect.
E) Incorrect

42. (*c*) All the given statements are true.

43. (*a*) Increasing the concentration of CO and decreasing the concentration of CH_4 favours the formation of methane as per Le Chatelier's principle.

44. (*b*)

	A	+	B	$\rightleftharpoons$	C	+	D
At t = 0	1		1		1		1
At t = eq.	1 – x		1 – x		1 + x		1 + x

$K_{eq} = [C][D]/[A][B]$

$$100 = \frac{(1+x)(1+x)}{(1-x)(1-x)} \Rightarrow \frac{1+x}{1-x} = 10$$

$\Rightarrow 11x = 9$
On solving,

$$x = \frac{9}{11} = 0.818$$

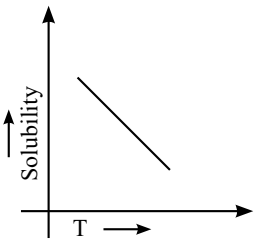
Also, $1 + x = 1 + 0.818 = 1.818 = [D]$

45. (*d*) The elevation in boiling point (ΔT_b) is directly proportional to the van't Hoff factor (i). More the value of i, more is the elevation in boiling point and vice-versa.
1. $AlCl_3$: i = 4
2. $Al_2(SO_4)_3$: i = 5
3. K_2SO_4: i = 3
4. NaCl: i = 2
Hence, NaCl with least i value has the least elevation in boiling point.

46. (*d*) The solubility of a gas is inversely proportional to the temperature, i.e.,

$$\text{Solubility} \propto \frac{1}{\text{Temperature}}$$

Hence, the correct graph is



47. (*a*) The elevation in boiling point (ΔT_b) is given by the equation:
$\Delta T_b = i.K_b.m$
where i = 1 (glucose is a non-electrolyte).
Now, using the formula:
$T_b - 373.15 = 1 \times 0.52 \times 180/180$
$T_b - 373.15 = 1 \times 0.52$
Simplifying:
$T_b = 373.15 + 0.52 = 373.67$ K

48. (*c*) According to the Henry's law,
$P = K_H X$
Given: $P_{N2} = 0.987$ bar
$K_H = 76.48$ K bar

$$X_{N_2} = \frac{P_{N_2}}{K_H}$$

$$= \frac{0.987}{76.48 \times 10^3} = 1.29 \times 10^{-5}$$

$$nH_2O = \frac{1000}{18} = 55.5 \text{ mol}$$

$$X_{N_2} = \frac{n_{N_2}}{n_{N_2} + n_{H_2O}} \text{ mol}$$

$$1.29 \times 10^{-5} = \frac{n}{n + 55.5} = \frac{n}{55.5}$$

On solving,

$n_{N_2} = 7.16 \times 10^{-4}$ mol

49. (*c*) Anode is negative terminal.
When $E_{cell} > 0$, then, the reaction is spontaneous reaction.

50. (*b*) The electronic conductance depends on the number of valence electrons per atom.

51. (*d*) The reaction is: $Al^{3+} + 3e^- \rightarrow Al(s)$
The reduction potential (E_{Red}) is given by the Nernst equation:
$E_{Red} = E^\circ_{Red} - 0.0591/3 \log([Al(s)]/[Al^{3+}])$
Since the active mass of the solid aluminium (Al) is taken as 1, the equation simplifies to:
$E_{Red} = E^\circ_{Red} - 0.0591/4 \log (1/[Al^{3+}])$
This simplifies further to:
$E_{Red} = E^\circ_{Red} + 0.0591/3 \log [Al^{3+}]$
Thus,
$E_{Red} \propto$ concentration of Al^{3+}

52. (*b*) For each reaction:
$Ag^+ + e^- \rightarrow Ag$
The charge required for 1 mole of Ag is:
1 × 96,500 C = 96,500 C (1 F)
$Mg^{2+} + 2e^- \rightarrow Mg$
The charge required for 1 mole of Mg is:
2 × 96,500 C=193,000 (2 F)
$Al^{3+} + 3e^- \rightarrow Al$
The charge required for 1 mole of Al is:
3 × 96,500 C=289,500 (3 F)
$Ti^{4+} + 4e^- \rightarrow Ti$
The charge required for 1 mole of Ti is:
4 × 96,500 C=386,000 (4 F)

53. (*b*) A positive catalyst works by lowering the activation energy required for a reaction to take place. By doing so, it increases the rate of reaction, allowing the reactants to convert to products more quickly without being consumed in the process.

54. (*c*) Number of half lives $\frac{t}{t_{\frac{1}{2}}} = \frac{80}{20} = 4$
According to first order reaction,

$$[A_1] = [A_0]\left(\frac{1}{2}\right)^n$$

As, n = 4

$$[A_t] = 0.2 \times \left(\frac{1}{2}\right)^4 = 0.0125$$

55. (*a*) $\Delta H = (E_a)_f - (E_a)_b$
From the graph,
$\Delta H = 90$ KJ
$(E_a)_f = 215$ KJ
$90 = 215 - (E_a)_b$
Hence, $(E_a)_b = 125$ KJ

56. (*d*) $$-\frac{1}{2}\frac{d[N_2O_5]}{dt} = \frac{1}{4}\frac{d[NO_2]}{dt}$$

$$-2\frac{d[N_2O_5]}{dt} = \frac{d[NO_2]}{dt}$$

$$-2\frac{[1.4 - 2.0]}{300} = 4 \times 10^{-3}$$

57. (*a*) Mass percent and mole fraction are the concentration terms that are unitless.

58. (*b*) (B) and (C) are incorrect statements.

59. (*c*) Potassium (K) and Calcium (Ca) are metals, while Chlorine (Cl) is a non-metal, which makes this triad a bit unusual. K and Ca share same similarities as reactive metals, but Cl stands apart due to its non-metallic nature.

60. (*b*) The reaction between $AlCl_3$ and Cl^- leads to the formation of $AlCl_4^-$. In this reaction:
$AlCl_3$ has sp^2 hybridization, with 3 σ bonds.
$AlCl_4^-$ has sp^3 hybridization, with 4 σ bonds.

Laws of Motion

4

1. For ordinary terrestrial experiments, the observer in an inertial frame in the following cases is ***(2006)***

(*a*) a child revolving in a giant wheel

(*b*) a driver in a sports car moving with a constant high speed of 200 km h^{-1} on a straight rod

(*c*) the pilot of an aeroplane which is taking off

(*d*) a cyclist negotiating a sharp curve

2. A simple pendulum is suspended from the ceiling of a lift. When the lift is at rest its time period is *T*. With what acceleration should the lift be accelerated upwards in order to reduce its period to *T*/2? (g is acceleration due to gravity) ***(2008)***

(*a*) $4g$ (*b*) g

(*c*) $2g$ (*d*) $3g$

3. A mass of 10 kg is suspended from a spring balance. It is pulled aside by a horizontal string so that it makes an angle of 60° with the vertical. The new reading of the balance is ***(2008)***

(*a*) $10\sqrt{3}$ kg wt (*b*) $20\sqrt{3}$ kg wt

(*c*) 20 kg wt (*d*) 10 kg wt

4. A body of mass 4 kg is accelerated upon by a constant force, travels a distance of 5 m in the first second and a distance of 2 m in the third second. The force acting on the body is ***(2008)***

(*a*) 6 N (*b*) 8 N

(*c*) 2 N (*d*) 4 N

5. A body of mass 0.05 kg is observed to fall with an acceleration of 9.5 m s^{-2}. The opposing force of air on the body is _____ (g = 9.8 m s^{-2}). ***(2009)***

(*a*) 0.015 N (*b*) 0.15 N

(*c*) 0.030 N (*d*) zero

6. Three concurrent co-planar forces 1 N, 2 N and 3 N acting along different directions on a body ***(2009)***

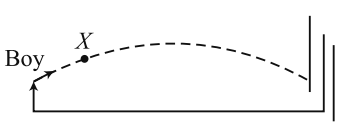
(*a*) can keep the body in equilibrium if 2 N and 3 N act at right angle

(*b*) can keep the body in equilibrium if 1 N and 2 N act at right angle

(*c*) cannot keep the body in equilibrium

(*d*) can keep the body in equilibrium if 1 N and 3 N act at an acute angle

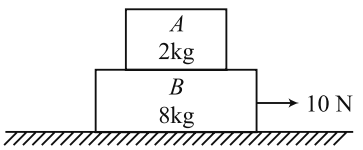
7. A boy throws a cricket ball from the boundary to the wicket-keeper. If the frictional force due to air cannot be ignored, the forces acting on the ball at the position *X* are represented by ***(2010)***



(*a*)  (*b*)

(*c*)  (*d*) 

8. Block *A* of mass 2 kg is placed over block *B* of mass 8 kg. The combination is placed over a rough horizontal surface. Coefficient of friction between *B* and the floor is 0.5. Coefficient of friction between *A* and *B* is 0.4. A horizontal force of 10 N is applied on block *B*. The force of friction between *A* and *B* is (g = 10 m s^{-1}) ***(2011)***



(*a*) 100 N (*b*) 40 N

(*c*) 50 N (*d*) zero

9. The resultant of two forces acting at an angle of 120° is 10 kg wt and is perpendicular to one of the forces. That force is ***(2011)***

(*a*) $10\sqrt{3}$ kg wt (*b*) $20\sqrt{3}$ kg wt

(*c*) 10 kg wt (*d*) $\frac{10}{\sqrt{3}}$ kg wt

10. A person throws balls into air vertically upward in regular intervals of time of one second. The next ball is thrown when the velocity of the ball thrown earlier becomes zero. The height to which the balls rise is _____ (Assume, g = 10 m s^{-2}) ***(2012)***

(*a*) 5 m (*b*) 10 m

(*c*) 7.5 m (*d*) 20 m

11. A body of mass '*m*' is travelling with a velocity '*u*'. When a constant retarding force '*F*' is applied, it comes to rest after travelling a distance 's_1'. If the initial velocity is '2*u*', with the same force '*F*', the distance travelled before it comes to rest is 's_2' Then ***(2012)***

(*a*) $s_2 = 2s_1$ (*b*) $s_2 = \frac{s_1}{2}$

(*c*) $s_2 = s_1$ (*d*) $s_2 = 4s_1$

12. A block kept on a rough surface starts sliding when the inclination of the surface is 'θ' with respect to the horizontal. The coefficient of static friction between the block and the surface is ***(2012)***

(*a*) sin θ (*b*) tan θ

(*c*) cos θ (*d*) sec θ

13. The X and Y components of a force F acting at 30° to x-aixs are respectively ***(2012)***

(*a*) $\frac{F}{\sqrt{2}}, F$ (*b*) $\frac{F}{2}, \frac{\sqrt{3}}{2}F$

(*c*) $\frac{\sqrt{3}}{2}F, \frac{1}{2}F$ (*d*) $F, \frac{F}{\sqrt{2}}$

14. In a lift moving up with an acceleration of 5 m s^{-2}, a ball is dropped from a height of 1.25 m. The time taken by the ball to reach the floor of the lift is _____ (nearly) (g = 10 m s^{-2}) ***(2013)***

(*a*) 0.3 second (*b*) 0.2 second

(*c*) 0.16 second (*d*) 0.4 second

15. A person is driving a vehicle at uniform speed of 5 m s^{-1} on a level curved track of radius 5 m. The coefficient of static friction between tyres and road is 0.1. Will the person slip while taking the turn with the same speed? Take g = 10 m s^{-2}.

Choose the correct statement. ***(2014)***

(*a*) A person will slip if $v^2 < 5$ m s^{-1}

(*b*) A person will slip if $v^2 = 5$ m s^{-1}

(*c*) A person will not slip if $v^2 > 10$ m s^{-1}

(*d*) A person will slip if $v^2 > 5$ m s^{-1}

16. An aeroplane executes a horizontal loop at a speed of 720 kmph with its wings banked at 45° What is the radius of the loop? Take g = 10 m s^{-2}. ***(2014)***

(*a*) 7.2 km (*b*) 4 km

(*c*) 2 km (*d*) 4.5 km

17. A stone of mass 0.05 kg is thrown vertically upwards. What is the direction and magnitude of net force on the stone during its upward motion? ***(2015)***

(*a*) 0.49 N vertically downwards

(*b*) 9.8 N vertically downwards

(*c*) 0.49 N vertically upwards

(*d*) 0.98 N vertically downwards

18. Maximum acceleration of the train in which a 50 kg box lying on its floor will remain stationary (Given: Coefficient of static friction between the box and the train's floor 0.3 and g = 10 m s^{-2}) ***(2016)***

(*a*) 5.0 m s^{-2} (*b*) 3.0 m s^{-2}

(*c*) 1.5 m s^{-2} (*d*) 15 m s^{-2}

19. A body of mass 50 kg is suspended using a spring balance inside a lift at test. If the list starts falling freely, the reading of the spring balance is ***(2017)***

(*a*) = 0 (*b*) < 50 kg

(*c*) = 50 kg (*d*) > 50 kg

20. A block rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block is (g = 10 m s^{-2}) ***(2018)***

(*a*) 1 kg (*b*) 2 kg

(*c*) 3 kg (*d*) 4 kg

21. A man weighing 60 kg is in a lift moving down with an acceleration of 1.8 m s^{-2}. The force exerted by the floor on him is ***(2018)***

(*a*) 588 N (*b*) 480 N

(*c*) zero (*d*) 696 N

22. An object with mass 5 kg is acted upon by a force, $\vec{F} = (-3\hat{i} + 4\hat{j})$ N. If its initial velocity at $t = 0$ is $\vec{v} = (6\hat{i} - 12\hat{j})$ m s^{-1}, the time at which it will just have a velocity along y-axis is ***(2019)***

(*a*) 2 s (*b*) 5 s

(*c*) 15 s (*d*) 10 s

23. One end of a string of length l is connected to a particle of mass m and the other to a small peg on a smooth horizontal table. If the particle moves in a circle with speed v, the net force on the particle (directed towards the centre) is

(T is the tension in the string) ***(2020)***

(*a*) $T + \frac{mv^2}{l}$ (*b*) 0

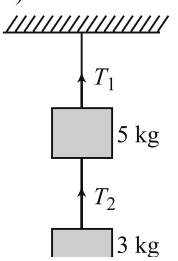
(*c*) T (*d*) $T - \frac{mv^2}{l}$

24. A coin placed on a rotating turn table just slips if it is placed at a distance of 4 cm from the centre. If the angular velocity of the turn table is doubled it will just slip at a distance of ***(2021)***

(*a*) 1 cm (*b*) 2 cm

(*c*) 4 cm (*d*) 8 cm

25. Two masses of 5 kg and 3 kg are suspended with the help of massless inextensible strings as shown in figure. When whole system is going upwards with acceleration 2 m/s^2, the value of T_1 is (use g = 9.8 m/s^2) ***(2022)***



(*a*) 23.6 N (*b*) 94.4 N

(*c*) 59 N (*d*) 35. 4 N

26. A car is moving in a circular horizontal track of radius 10 m with a constant speed of 10 m s^{-1}. A bob is suspended from the roof of the car by a light wire of length 1.0 m. The angle made by the wire with the vertical is (in radian) ***(2022)***

(*a*) 0 (*b*) $\frac{\pi}{6}$

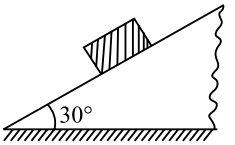
(*c*) $\frac{\pi}{3}$ (*d*) $\frac{\pi}{4}$

27. A body of mass 10 kg is kept on a horizontal surface. The coefficient of kinetic friction between the body and the surface is 0.5. A horizontal force of 60 N is applied on the body. The resulting acceleration of the body is about ***(2023)***

(*a*) 1 m s^{-2} (*b*) 5 m s^{-2}

(*c*) 6 m s^{-2} (*d*) zero

28. A block of certain mass is placed on a rough inclined plane. The angle between the plane and the horizontal is 30°. The coefficients of static and kinetic frictions between the block and the inclined plane are 0.6 and 0.5 respectively. Then the magnitude of the acceleration of block is [Take $g = 10$ m s^{-2}] ***(2024)***



(*a*) 2 m s^{-2} (*b*) zero

(*c*) 0.196 m s^{-2} (*d*) 0.67 m s^{-2}

Answer Key

1. (*b*)	**2.** (*d*)	**3.** (*c*)	**4.** (*a*)	**5.** (*a*)	**6.** (*c*)	**7.** (*c*)	**8.** (*d*)	**9.** (*d*)	**10.** (*a*)
11. (*d*)	**12.** (*b*)	**13.** (*c*)	**14.** (*d*)	**15.** (*d*)	**16.** (*b*)	**17.** (*a*)	**18.** (*b*)	**19.** (*a*)	**20.** (*b*)
21. (*b*)	**22.** (*d*)	**23.** (*c*)	**24.** (*a*)	**25.** (*b*)	**26.** (*d*)	**27.** (*a*)	**28.** (*b*)		

Explanations

1. (*b*) Frames in uniform motion are inertial, frames in circular motion are accelerating so they are non inertial frames.

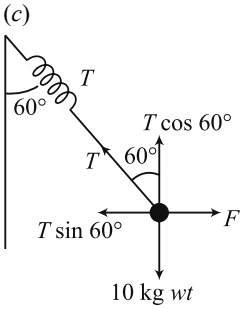
2. (*d*) $T_1 = 2\pi\sqrt{\frac{l}{g}}$

$\frac{T_1}{2} = 2\pi\sqrt{\frac{l}{g'}}$

$\Rightarrow g' = 4g$

The lift should be accelerated up by $3g$ so that effective acceleration becomes $4g$.

3. (*c*)



$T \cos 60° = 10$

$\Rightarrow T = 20$ kg wt

4. (*a*) For 1st second

$u \cdot 1 - (1/2)\, a \cdot 1 = 5$ m ...(i)

For 3rd second

$u \cdot 3 - (1/2)\, a \cdot 9 - (u \times 2 - (1/2)a \cdot 4) = 2$ m

$\therefore u \cdot 1 - (1/2)\, a \cdot 5 = 3$ ...(ii)

(i) – (ii) gives

$a = 1.5$ m/s^2

$\therefore$ Constant force $= ma = 4 \times 1.5 = 6$ N

5. (*a*) $m = 0.05$ kg, f = air resistance

Acceleration (a) = 9.5 m s^{-2}, $g = 9.8$ m s^{-2}

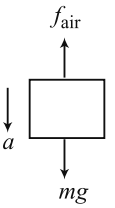
From Newton's 2nd law

$\therefore mg - f = ma$

or $f = m(g - a)$

$= 0.05\,(9.8 - 9.5)$

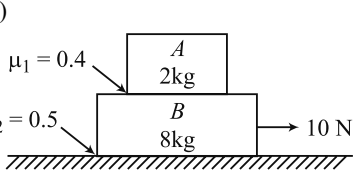
$= 0.015$ N



6. (*c*) Equilibrium is not possible in option (*a*), (*b*) & (*d*). Calculate net force.

7. (*c*) Air resistance acts in opposite direction to motion of the ball.

8. (*d*)



Here,

$m_A = 2$ kg, $m_B = 8$ kg, $\mu_1 = 0.4$, μ_2, 0.5, $F = 10$ N

The frictional force between block B and surface can be

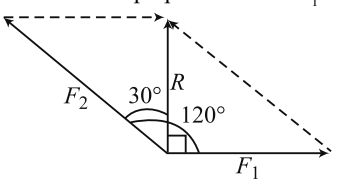
$f = \mu_2 R = \mu_2 (m_A + m_B)\, g = 0.5 \times (2 + 8) \times 10$

$= 50$ N

As applied force F (= 10 N) < f (= 50 N), the system will not move.

Hence, the force of friction between A and B is zero.

9. (*d*) Let F_1 and F_2 be two forces and resultant R is perpendicular to F_1.



Here, $R = 10$ kg wt

From figure, $\tan 30° = \frac{F_1}{R}$

$F_1 = R \tan 30° = \frac{10}{\sqrt{3}}$ kg wt

10. (*a*) Time taken by the ball to reach highest point is $t = 1$ s

As the person throws the second ball, when the velocity of the first ball becomes zero, *i.e.*, $v = 0$ or when the first ball reach the highest point.

Using, $v = u + at$

Here, $v = 0$, $a = -g$, $t = 1$ s

$\therefore 0 = u - (10)\,(1)$

$u = 10$ m/s

Using $v^2 - u^2 = 2ah$, we get

$(0)^2 - (10)^2 = 2\,(-10)\,(h)$

$h = \frac{(10)^2}{20} = 5$ m

11. (*d*) By applying constant retarding force F the body is brought to rest so $v = 0$.

Retardatoin, $a = \frac{F}{m}$

If s be distance travelled by the body before it comes to rest (called stopping distnace).

Using 3rd equation of motion

$v^2 - u^2 = 2as$

$(0)^2 - u^2 = 2 \times \frac{-F}{m} \times s$

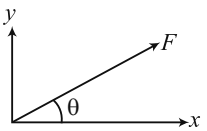
$s = \frac{u^2 m}{2F}$

$s \propto u^2$ for the same m, F.

$\therefore \frac{s_1}{s_2} = \frac{u^2}{(2u)^2} = \frac{1}{4}$ or $s_2 = 4s_1$

12. (*b*) Sliding begins when $\mu_s = \tan\theta$

13. (*c*)



The x component of force F is

$F\cos\theta = F\cos 30° = F \times \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{2}F$

The y component of force F is

$F\sin\theta = F\sin 30° = F \times \frac{1}{2} = \frac{F}{2}$

14. (*d*) In lift effective acceleration due to gravity is $a + g$.

ball reaches lift's floor at time t.

$t = \sqrt{\frac{2h}{a+g}}$

Given, $h = 1.25$ m, $g = 10$ m s^{-2}, $a = 5$ m s^{-2}

$\therefore t = \sqrt{\frac{2 \times 1.25\text{ m}}{(5+10)\text{ m s}^{-2}}} = 0.4$ s

15. (*d*) Not slip conditoin is $v^2 \le \mu_s Rg$

$= 0.1 \times 5\text{ m} \times 10\text{ m s}^{-2} = 5\text{ m}^2\text{ s}^{-2}$

($\mu_s = 0.1$, $R = 5$, $g = 10$ m s^{-2})

So, $v^2 \le 5\text{ m}^2\text{ s}^{-2}$

$\Rightarrow$ the person will slip if $v^2 > 5\text{ m}^2\text{ s}^{-2}$.

16. (*b*) Velocity of the aeroplane, $v = 720$ kmph

$v = 200$ m s^{-1}

For banking of road

As $\tan\theta = \frac{v^2}{Rg}$, Angle of banking, $\theta = 45°$

$\therefore R = \frac{v^2}{g\tan\theta} = \frac{(200)^2}{10 \times \tan 45°} = \frac{4 \times 10^4}{10 \times 1}$

$= 4000$ m $= 4$ km

17. (*a*) Weight acts on body.

Mass of the stone, $m = 0.05$ kg

Weight on the stone is

$mg = (0.05\text{ kg})(9.8\text{ m s}^{-2}) = 0.49$ N

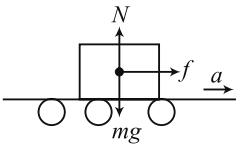
Direction: Vertically downwards.

18. (*b*) $m = 50$ kg

$\mu = 0.3$

$g = 10$ m s^{-2}

Limiting friction on block is eqaul to ma



$\therefore f_l = ma \Rightarrow \mu N = ma$

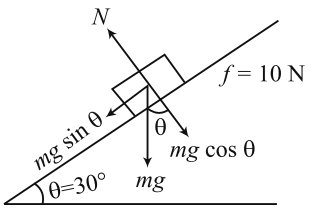
$\Rightarrow \mu mg = ma \Rightarrow a = \mu g$

$\therefore a = 0.3 \times 10 = 3$ m s^{-2}.

19. (*a*) Spring balance reads apparent weight of body = Apparent weight of mass

$= m(g - a) = 50(g - g) = 0$

20. (*b*)



As the block is at rest ,

friction force, $f = mg\sin\theta$

or $m = \frac{\text{friction force}}{g\sin\theta} = \frac{10N}{(10\text{ m s}^{-2})\sin 30°} = 2\,kg$

21. (*b*) Given

Mass (man) $m = 60$ kg

Acceleration of the lift, $a = 1.8$ m s^{-2}

From newton 2nd law of motion,

$mg - N = ma$

$\Rightarrow N = mg - ma = m(g - a)$

$= (60\text{ kg})(9.8\text{ m s}^{-2} - 1.8\text{ m s}^{-2})$

Force by floor $= (60\text{ kg})(8.0\text{ m s}^{-2}) = 480$ N

22. (*d*) $u_x = 6$ m s^{-1}

$a_x = \frac{-3}{5}$ m s^{-2}

From $v_x = u_x + a_x t$

$\Rightarrow 0 = 6 - 3/5\, t$

$t = 10$ s

23. (*c*) Tension is providing centripetal force here.

24. (*a*) Frictional force = centripetal force

$\therefore mr\omega^2 = \mu mg$

$\Rightarrow r \propto \frac{1}{\omega^2} \Rightarrow \frac{r_1}{r_2} = \frac{\omega_2^2}{\omega_1^2}$

We have, $\omega_2 = 2\omega_1$, $r_1 = 4$ cm

$\therefore \frac{4}{r_2} = \frac{(2\omega_1)^2}{\omega_1^2}$

$\Rightarrow r_2 = 1$ cm

25. (*b*) The FBD of 3 kg block is as shown in the figure (*a*).

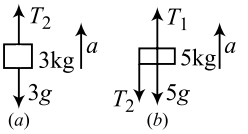
From 2nd law of motion of 3 kg block is

$T_2 - 3g = 3a$

$\Rightarrow T_2 - 3 \times 9.8 = 3 \times 2$

$T_2 = 35.4$ N ...(i)

The free body diagram of 5 kg is as shown in the figure (*b*).



For 5 kg block is

$T_1 - T_2 - 5g = 5a$

$= 5(2 + 9.8) + 35.4 = 94.4$ N (Using (i))

26. (*d*) Angle made by the wire with the vertical is given by

$\therefore \tan\theta = \frac{v^2}{rg}$ [θ is angle]

Given, $v = 10$ m/s, $r = 10$ m, $g = 10$ m/s^2

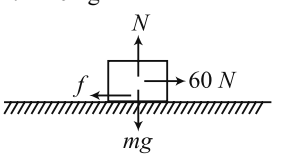
$\therefore \tan\theta = \frac{(10\text{ m/s})^2}{10\text{ m}(10\text{ m/s}^2)} = 1$

$\theta = \frac{\pi}{4}$

27. (*a*) Given, coefficient of kinetic friction,

$\mu_k = 0.5$

$m = 10$ kg



Applied force = 60 N

From 2nd law friction, $f = \mu_k N$

$= \mu_k mg$

$\therefore f = 0.5 \times 10 \times 10 = 50$ N

From Newton's 2nd law,

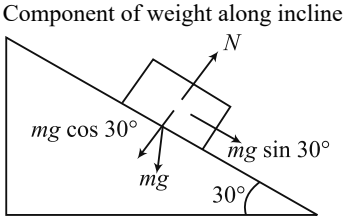
$F' = 60 - f = 60 - 50 = 10\text{ N} = ma$

$\Rightarrow a = 1$ m s^{-2}

28. (*b*) Limiting friction $= \mu_s mg\cos\theta$

$= 0.6 \times mg \times \cos 30° = 0.52\, mg$

Component of weight along incline



$mg\sin\theta = mg\sin 30°$

$= mg \times 0.5$

So, limiting friction > $mg\sin\theta$

So, the block will be at rest, thus acceleration = 0.

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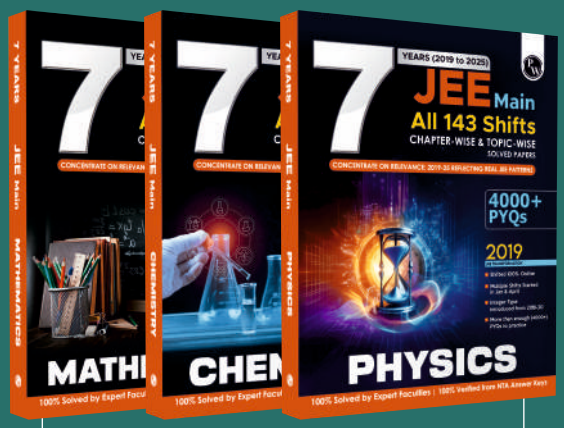

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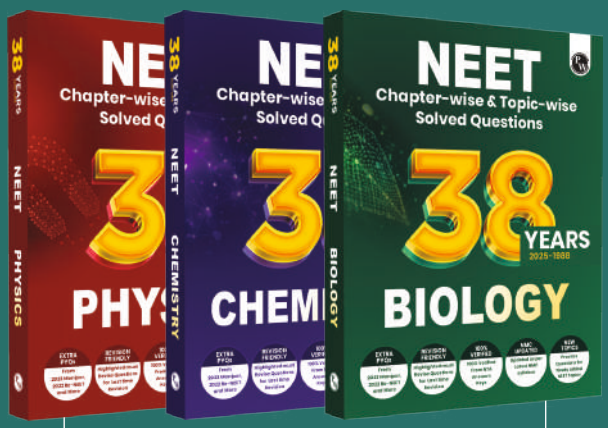

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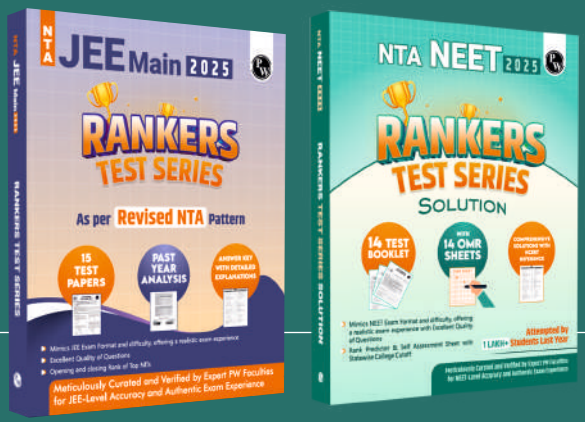

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