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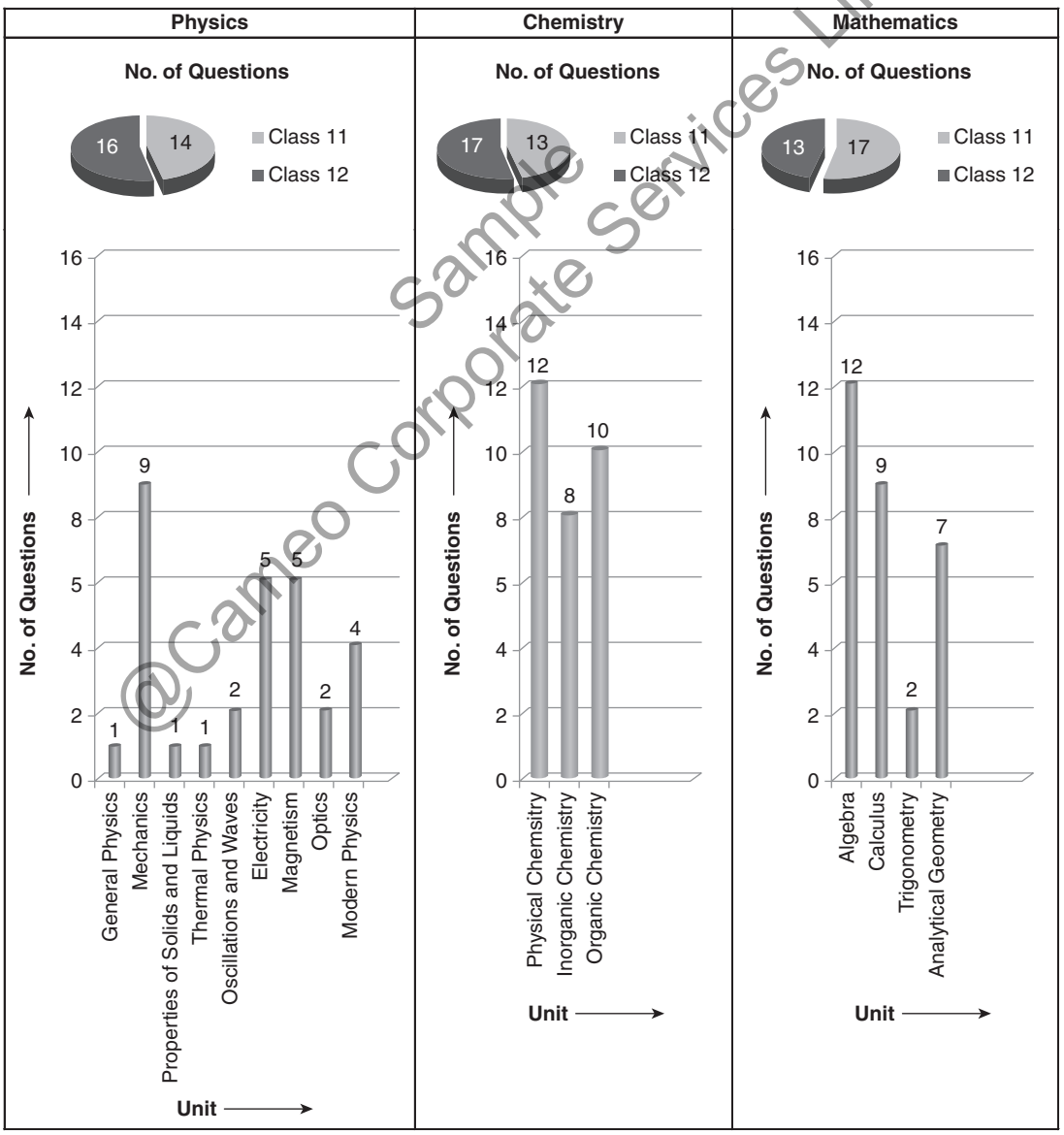
JEE MAIN ANALYSIS 2009-2018

Joint Entrance Examination Main (JEE Main) score is used as an eligibility/merit criteria for admission into Undergraduate Engineering Programs at NITs, IITs and other Center and State (participating) funded Technical Institutions. The JEE (Main) is also an eligibility test for the Joint Entrance Examination Advanced [JEE (Advanced)], which is mandatory for the candidate if he/she is aspiring for admission to the undergraduate program offered by the IITs. The JEE (Advanced) scores are used as an eligibility criteria for admission into IITs.

Hence, it becomes very important to get well-versed with the pattern of examination, the level of questions asked and the concept distribution in the examination. This section shows the unit-wise as well as chapter-wise analysis of previous years (2009-2017) and current year (2018) papers. The distribution of questions on Class 11 and Class 12 syllabus is also provided. This will help students focus their preparation on important and frequently asked topics.



PHYSICS

S.No.	Unit	Class	Chapter	AIEEE 2009	AIEEE 2010	AIEEE 2011	AIEEE 2012	JEE Main 2013	JEE Main 2014 (Offline)	JEE Main 2015 (Offline)	JEE Main 2016 (Offline)	JEE Main 2017 (Offline)	JEE Main 2018 (Offline)
1	General Physics	11	Physical World										
2		11	Units and Measurements	1	1	1	1	1	1	1	2		1
			Total Questions	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**0**	**1**
3	Mechanics	11	Motion in a Straight Line	1		1	1		1			1	1
4		11	Motion in a Plane	1	1	1	1	1		1			
5		11	Laws of Motion		3			1	1	1	1	1	3
6		11	Work, Energy and Power	1	3		1	1	1	1	1	2	3
7		11	System of Particles and Rotational Motion	1	1	4	1	1	2	2	2	2	2
8		11	Gravitation	1		1	1	1	1	1	1	1	
			Total Questions	**5**	**8**	**7**	**5**	**5**	**6**	**6**	**5**	**7**	**9**
9	Properties of Solids and Liquids	11	Mechanical Properties of Solids	1					1	1		2	1
10		11	Mechanical Properties of Fluids		1	2	1	1	3			1	
			Total Questions	**1**	**1**	**2**	**1**	**1**	**4**	**1**	**0**	**3**	**1**
11	Thermal Physics	11	Thermal Properties of Matter	1		1	2	1	1	1	2	2	
12		11	Thermodynamics	4	1	2	2	1	1	2	1		1
13		11	Kinetic Theory			1						1	
			Total Questions	**5**	**1**	**4**	**4**	**2**	**2**	**3**	**3**	**3**	**1**
14	Oscillations and Waves	11	Oscillations	1		1	1	2	1	1	1	2	2
15		11	Waves	2	1	1	1	1	1	1	2	1	
			Total Questions	**3**	**1**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**
	TOTAL QUESTIONS FROM CLASS 11			**15**	**12**	**16**	**13**	**12**	**15**	**13**	**13**	**16**	**14**

S.No.	Unit	Class	Chapter	AIEEE 2009	AIEEE 2010	AIEEE 2011	AIEEE 2012	JEE Main 2013	JEE Main 2014 (Offline)	JEE Main 2015 (Offline)	JEE Main 2016 (Offline)	JEE Main 2017 (Offline)	JEE Main 2018 (Offline)
1	Electricity	12	Electric Charges and Fields	2	3	1	1	1		2	1	1	
2		12	Electrostatic Potential and Capacitance	1		1	1	2	2	2	1	2	2
3		12	Current Electricity	1	2	2	2	2	2	2	1	1	3
			Total Questions	**4**	**5**	**4**	**4**	**5**	**4**	**6**	**3**	**4**	**5**
4	Magnetism	12	Moving Charges and Magnetism	2	1	1	2	1	1	1	1	2	2
5		12	Magnetism and Matter					1	1		1		
6		12	Electromagnetic Induction	1	2	1	1	2		1		1	
7		12	Alternating Current		1	1				2	1		2
8		12	Electromagnetic Waves		1		1		2	1	1		1
			Total Questions	**3**	**5**	**3**	**4**	**4**	**4**	**5**	**4**	**3**	**5**
9	Optics	12	Ray Optics and Optical Instruments	2	3	2	2	2	2	3	2	1	
10		12	Wave Optics	1		1	1	2	1		1	1	2
			Total Questions	**3**	**3**	**3**	**3**	**4**	**3**	**3**	**3**	**2**	**2**
11	Modern Physics	12	Dual Nature of Radiation and Matter	1	1	1	1	1	1	1	1	2	
12		12	Atoms	1		1	2	1	1	1			2
12		12	Nuclei	1	3		1				1	1	
14		12	Semiconductor Electronics: Materials, Devices and Simple Circuits	2	1	1	1	1	2		4	1	1
15		12	Communication Systems			1	1	2		1	1	1	1
			Total Questions	**5**	**5**	**4**	**6**	**5**	**4**	**3**	**7**	**5**	**4**
	TOTAL QUESTIONS FROM CLASS 12			**15**	**18**	**14**	**17**	**18**	**15**	**17**	**17**	**14**	**16**

CHEMISTRY

S.No.	Unit	Class	Chapter	AIEEE 2009	AIEEE 2010	AIEEE 2011	AIEEE 2012	JEE Main 2013	JEE Main 2014 (Offline)	JEE Main 2015 (Offline)	JEE Main 2016 (Offline)	JEE Main 2017 (Offline)	JEE Main 2018 (Offline)
1	Physical Chemistry	11	Some Basic Concepts of Chemistry			1	1	2	1	4		1	
2		11	Structure of Atom	2	2	2	1	1	1	1	1	2	
3		11	Chemical Bonding and Molecular Structure	2		3	3	3	2			1	2
4		11	States of Matter		1	1	1	2	1	1			
5		11	Thermodynamics	2	3	1	1	1	1	2	2	2	2
6		11	Equlibrium	1	5	1	2	1	1		1	1	4
7		11	Redox Reactions					1				1	
			Total Questions	**7**	**11**	**9**	**9**	**11**	**7**	**8**	**4**	**8**	**8**
8	Inorganic Chemistry	11	Classification of Elements and Periodicity	2	1	1	1	2					
9		11	Hydrogen				1		1	1	1	1	1
10		11	The *s*-Block Elements				1		1	1	2	1	
11		11	Environmental Chemistry							1	1		1
			Total Questions	**2**	**1**	**1**	**3**	**2**	**2**	**3**	**4**	**2**	**2**
12	Organic Chemistry	11	Organic Chemistry - Some Basic Principles and Techniques	4	2	2		2	1	1	2	1	2
13		11	Hydrocarbons		1	1	2	1	2	1	2	3	1
			Total Questions	**4**	**3**	**3**	**2**	**3**	**3**	**2**	**4**	**4**	**3**
	TOTAL QUESTIONS FROM CLASS 11			**13**	**15**	**13**	**14**	**16**	**12**	**13**	**12**	**14**	**13**

S.No.	Unit	Class	Chapter	AIEEE 2009	AIEEE 2010	AIEEE 2011	AIEEE 2012	JEE Main 2013	JEE Main 2014 (Offline)	JEE Main 2015 (Offline)	JEE Main 2016 (Offline)	JEE Main 2017 (Offline)	JEE Main 2018 (Offline)
1	Physical Chemistry	12	The Solid State	1	2	1	1	2	1	1		1	1
2		12	Solutions	2	2	2	1		1		1	1	1
3		12	Electrochemistry	1		1	1	1	3	1	1	1	1
4		12	Chemical Kinetics	1	2	1	1		1	1	1	1	1
5		12	Surface Chemistry	1			1	1			1	1	
			Total Questions	**6**	**6**	**5**	**5**	**4**	**6**	**3**	**4**	**5**	**4**
6	Inorganic Chemistry	12	General Principles and Processes of Isolation of Elements				1		1		1		
7		12	The *p*-Block Elements	1		3		3	1	4	3	1	4
8		12	The *d*- and *f*-block Elements	2	1	1	1		1		2	1	
9		12	Coordination Compounds	2	2	2	1	1	2	3	2	1	2
			Total Questions	**5**	**3**	**6**	**3**	**4**	**5**	**7**	**8**	**3**	**6**
10	Organic Chemistry	12	Haloalkanes and Haloarenes		1		2	1	1	1	1	3	1
11		12	Alcohols, Phenols and Ethers	2	2	2	1	1	1				2
12		12	Aldehydes, Ketones and Carboxylic Acids	2		3	2	2	1	1		2	1
13		12	Amines		1			1	2	1	1		1
14		12	Biomolecules	1	1		2		1	1	2	1	2
15		12	Polymers	1	1	1	1		1	2	1	1	
16		12	Chemistry in Everyday Life					1		1	1	1	
			Total Questions	**6**	**6**	**6**	**8**	**6**	**7**	**7**	**6**	**8**	**7**
	TOTAL QUESTIONS FROM CLASS 12			**17**	**15**	**17**	**16**	**14**	**18**	**17**	**18**	**16**	**17**

MATHEMATICS

S.No.	Unit	Class	Chapter	AIEEE 2009	AIEEE 2010	AIEEE 2011	AIEEE 2012	JEE Main 2013	JEE Main 2014 (Offline)	JEE Main 2015 (Offline)	JEE Main 2016 (Offline)	JEE Main 2017 (Offline)	JEE Main 2018 (Offline)
1	Algebra	11	Principle of Mathematical Induction										1
2		11	Complex Numbers and Quadratic Equations	2	2	2	2	3	3	2	2	1	1
3		11	Linear Inequalities										
4		11	Permutations and Combinations	1	1	1	1	1		2	1	2	1
5		11	Binomial Theorem	1		1	1	1	1		1		1
6		11	Sequences and Series	1	2	1	2	1	2	2	2	3	2
7		11	Statistics	2	1	1	1	1	1	1	1	1	1
8		11	Mathematical Reasoning	1	1	1	1	1	1		1		
			Total Questions	**8**	**7**	**7**	**8**	**8**	**8**	**7**	**8**	**7**	**7**
9	Calculus	11	Sets	1	1	1	1	1	1	2			2
10		11	Limits and Derivatives	1	1	2		2	2	2	2	2	1
			Total Questions	**2**	**2**	**3**	**1**	**3**	**3**	**4**	**2**	**2**	**3**
11	Trigonometry	11	Trigonometric Functions	1	2	1	1	2	2	2	2	2	2
			Total Questions	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**
12	Analytical Geometry	11	Conic Sections	2	2	2	3	3	3	4	5	3	5
13			Introduction to Three-Dimensional Geometry	1			1	1		2			
			Total Questions	**3**	**2**	**2**	**4**	**4**	**3**	**6**	**5**	**3**	**5**
	TOTAL QUESTIONS FROM CLASS 11			**14**	**13**	**13**	**14**	**17**	**16**	**19**	**17**	**14**	**17**

S.No.	Unit	Class	Chapter	AIEEE 2009	AIEEE 2010	AIEEE 2011	AIEEE 2012	JEE Main 2013	JEE Main 2014 (Offline)	JEE Main 2015 (Offline)	JEE Main 2016 (Offline)	JEE Main 2017 (Offline)	JEE Main 2018 (Offline)
1	Algebra	12	Matrices	2	3	2	2	2	2	2	2	3	3
2		12	Determinants										
3		12	Vector Algebra	1	2	2	2	1	1	1	1	1	1
4		12	Probability	2	2	2	1	1	1	1	1	2	1
5		12	Linear Programming										
			Total Questions	**5**	**7**	**6**	**5**	**4**	**4**	**4**	**4**	**6**	**5**
6		12	Relations and Functions	2		1					1	2	
7	Calculus	12	Continuity and Differentiability	1	2	1	2		1	1			1
8		12	Application of Derivatives	1	1	1	3	1	2			2	1
9		12	Integrals	1	1	2	2	3	2	2	1	2	2
10		12	Application of Integrals	1	1	1	1	1	1		1	1	1
11		12	Differential Equations	1	1	1				1	2	1	1
			Total Questions	**7**	**6**	**7**	**8**	**5**	**6**	**4**	**5**	**8**	**6**
12	Trigonometry	12	Inverse Trigonometric Functions					1		1	1		
			Total Questions	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**0**
13	Analytical Geometry	12	Three-Dimensional Geometry	4	4	4	3	3	4	2	3	2	2
			Total Questions	**4**	**4**	**4**	**3**	**3**	**4**	**2**	**3**	**2**	**2**
	TOTAL QUESTIONS FROM CLASS 12			**16**	**17**	**17**	**16**	**13**	**14**	**11**	**13**	**16**	**13**

CONTENTS

AIEEE 2002

QUESTION PAPER

Physics

1. Which statement is incorrect?

(1) All reversible cycles have same efficiency

(2) Reversible cycle has more efficiency than an irreversible one

(3) Carnot cycle is a reversible one

(4) Carnot cycle has the maximum efficiency in all cycles

2. Length of a string tied to two rigid supports is 40 cm. Maximum length (wave length in cm) of stationary wave produced on it is

(1) 20 (2) 80

(3) 40 (4) 120

3. The power factor of an AC circuit having resistance (R) and inductance (L) connected in series and an angular velocity ω is

(1) $R/\omega L$ (2) $R/(R^2+\omega^2L^2)^{1/2}$

(3) $\omega L/R$ (4) $R/(R^2-\omega^2L^2)^{1/2}$

4. An astronomical telescope has a large aperture to

(1) reduce spherical aberration

(2) have high resolution

(3) increase span of observation

(4) have low dispersion

5. The kinetic energy needed to project a body of mass m from the earth surface (radius R) to infinity is

(1) $mgR/2$ (2) $2mgR$

(3) mgR (4) $mgR/4$

6. If an ammeter is to be used in place of a voltmeter, then we must connect with the ammeter a

(1) low resistance in parallel

(2) high resistance in parallel

(3) high resistance in series

(4) low resistance in series

7. If in a circular coil A of radius R, current I is flowing and in another coil B of radius $2R$ a current $2I$ is flowing, then the ratio of the magnetic fields B_A and B_B, produced by them will be

(1) 1 (2) 2

(3) 1/2 (4) 4

8. If two mirrors are kept at 60° to each other, then the number of images formed by them is

(1) 5 (2) 6

(3) 7 (4) 8

9. A wire when connected to 220 V mains supply has power dissipation P_1. Now the wire is cut into two equal pieces which are connected in parallel to the same supply. Power dissipation in this case is P_2. Then $P_2 : P_1$ is

(1) 1 (2) 4

(3) 2 (4) 3

10. If 13.6 eV energy is required to ionize the hydrogen atom, then the energy required to remove an electron from $n = 2$ is

(1) 10.2 eV (2) 0 eV

(3) 3.4 eV (4) 6.8 eV

11. Tube A has both ends open while tube B has one end closed, otherwise they are identical. The ratio of fundamental frequency of tube A and B is

(1) 1 : 2 (2) 1 : 4

(3) 2 : 1 (4) 4 : 1

12. A tuning fork arrangement (pair) produces 4 beats/sec with one fork of frequency 288 cps. A little wax is placed on the unknown fork and it then produces 2 beats/sec. The frequency of the unknown fork is

(1) 286 cps (2) 292 cps
(3) 294 cps (4) 288 cps

13. A wave $y = a \sin(\omega t - kx)$ on a string meets with another wave producing a node at $x = 0$. Then the equation of the unknown wave is

(1) $y = a \sin(\omega t + kx)$ (2) $y = -a \sin(\omega t + kx)$
(3) $y = a \sin(\omega t - kx)$ (4) $y = -a \sin(\omega t - kx)$

14. On moving a charge of 20 coulombs by 2 cm, 2 J of work is done, then the potential difference between the points is

(1) 0.1 V (2) 8 V
(3) 2 V (4) 0.5 V

15. If an electron and a proton having same momenta enter perpendicular to a magnetic field, the

(1) curved path of electron and proton will be same (ignoring the sense of revolution)
(2) they will move undeflected
(3) curved path of electron is more curved than that of the proton
(4) path of proton is more curved

16. In a simple harmonic oscillator, at the mean position

(1) kinetic energy is minimum, potential energy is maximum
(2) both kinetic and potential energies are maximum
(3) kinetic energy is maximum, potential energy is minimum
(4) both kinetic and potential energies are minimum

17. Initial angular velocity of a circular disc of mass M is ω_1. Then two small spheres of mass m are attached gently to diametrically opposite points on the edge of the disc. What is the final angular velocity of the disc?

(1) $\left(\frac{M+m}{M}\right)\omega_1$ (2) $\left(\frac{M+m}{m}\right)\omega_1$
(3) $\left(\frac{M}{M+4m}\right)\omega_1$ (4) $\left(\frac{M}{M+2m}\right)\omega_1$

18. The minimum velocity (in ms^{-1}) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction 0.6 to avoid skidding is

(1) 60 (2) 30
(3) 15 (4) 25

19. A cylinder of height 20 m is completely filled with water. The velocity of efflux of water (in ms^{-1}) through a small hole on the side wall of the cylinder near its bottom is

(1) 10 (2) 20
(3) 25.5 (4) 5

20. A spring of force constant 800 N/m has an extension of 5 cm. The work done is extending it from 5 cm to 15 cm is

(1) 16 J (2) 8 J
(3) 32 J (4) 24 J

21. Two identical particles move towards each other with velocity $2v$ and v respectively. The velocity of centre of mass is

(1) v (2) $v/3$
(3) $v/2$ (4) zero

22. If a current is passed through a spring then the spring will

(1) expand (2) compress
(3) remains same (4) none of these

23. Heat given to a body which raises its temperature by 1°C is

(1) water equivalent
(2) thermal capacity
(3) specific heat
(4) temperature gradient

24. At absolute zero, Si acts as

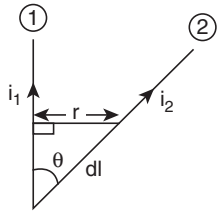
(1) non metal (2) metal
(3) insulator (4) none of these

25. Electromagnetic waves are transverse in nature is evident by

(1) polarization (2) interference
(3) reflection (4) diffraction

26. Wires 1 and 2 carrying currents i_1 and i_2 respectively are inclined at an angle θ to each other. What is the force on a small element dl of wire 2 at a distance of r from wire 1 (as shown in the figure) due to the magnetic field of wire 1?

(1) $\frac{\mu_0}{2\pi r} i_1 i_2 dl \tan\theta$ (2) $\frac{\mu_0}{2\pi r} i_1 i_2 dl \sin\theta$
(3) $\frac{\mu_0}{2\pi r} i_1 i_2 dl \cos\theta$ (4) $\frac{\mu_0}{4\pi r} i_1 i_2 dl \sin\theta$



27. At a specific instant emission of radioactive compound is deflected in a magnetic field. The compound can emit

(i) electrons (ii) protons (iii) He^{2+} (iv) neutrons

The emission at instant can be

(1) i, ii, iii (2) i, ii, iii, iv
(3) iv (4) ii, iii

28. Sodium and copper have work functions 2.3 eV and 4.5 eV respectively. Then the ratio of the wave lengths is nearest to

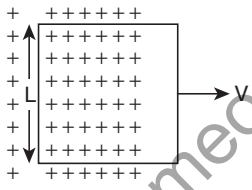
(1) 1 : 2 (2) 4 : 1
(3) 2 : 1 (4) 1 : 4

29. Formation of covalent bonds in compounds exhibits

(1) wave nature of electron
(2) particle nature of electron
(3) both wave and particle nature of electron
(4) none of these

30. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane at the loop exists everywhere with half the loop outside the field, as shown in figure. The induced emf is

(1) zero (2) RvB
(3) VBL/R (4) VBL



31. Infra red radiation is detected by

(1) spectrometer (2) pyrometer
(3) nanometer (4) photometer

32. If N_0 is the original mass of the substance of half-life period $t_{1/2} = 5$ years, then the amount of substance left after 15 years is

(1) $N_0/8$ (2) $N_0/16$
(3) $N_0/2$ (4) $N_0/4$

33. By increasing the temperature, the specific resistance of a conductor and a semiconductor

(1) increases for both (2) decreases for both
(3) increases, decreases (4) decreases, increases

34. If there are n capacitors in parallel connected to V volt source, then the energy stored is equal to

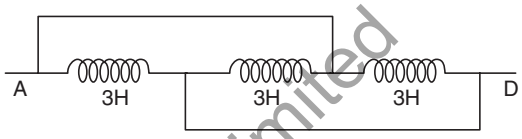
(1) CV (2) $\frac{1}{2}nCV^2$
(3) CV^2 (4) $\frac{1}{2n}CV^2$

35. Which of the following is more closed to a black body?

(1) black board paint (2) green leaves
(3) black holes (4) red roses

36. The inductance between A and D is

(1) 3.66 H (2) 9 H
(3) 0.66 H (4) 1 H



37. A ball whose kinetic energy is E, is projected at an angle of 45° to the horizontal. The kinetic energy of the ball at the highest point of its flight will be

(1) E (2) $E/\sqrt{2}$
(3) $E/2$ (4) zero

38. From a building two balls A and B are thrown such that A is thrown upwards A and B downwards (both vertically). If v_A and v_B are their respective velocities on reaching the ground, then

(1) $v_B > v_A$
(2) $v_A = v_B$
(3) $v_A > v_B$
(4) their velocities depend on their masses

39. If a body looses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest?

(1) 1 cm (2) 2 cm
(3) 3 cm (4) 4 cm

40. If suddenly the gravitational force of attraction between Earth and a satellite revolving around it becomes zero, then the satellite will

(1) continue to move in its orbit with same velocity
(2) move tangentially to the originally orbit in the same velocity
(3) become stationary in its orbit
(4) move towards the earth.

41. Cooking gas containers are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will

(1) increase
(2) decrease
(3) remain same
(4) decrease for some, while increase for others

42. When temperature increases, the frequency of a tuning fork

(1) increases
(2) decreases
(3) remains same
(4) increases or decreases depending on the material

43. If mass-energy equivalence is taken into account, when water is cooled to form ice, the mass of water should

(1) increase
(2) remain unchanged
(3) decrease
(4) first increase then decrease

44. The energy band gap is maximum in

(1) metals (2) superconductors
(3) insulators (4) semiconductors

45. The part of a transistor which is most heavily doped to produce large number of majority carriers is

(1) emmiter
(2) base
(3) collector
(4) can be any of the above three

46. Energy required to move a body of mass m from an orbit of radius $2R$ to $3R$ is

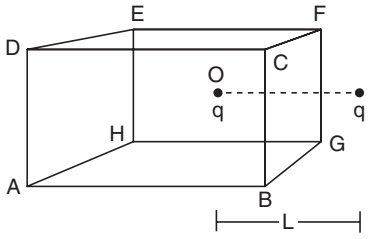
(1) $GMm/12R^2$ (2) $GMm/3R^2$
(3) $GMm/8R$ (4) $GMm/6R$

47. If a spring has time period T, and is cut into n equal parts, then the time period of each part will be

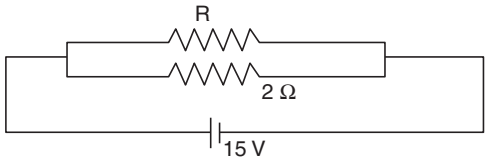
(1) $T\sqrt{n}$ (2) $T/\sqrt{n}$
(3) nT (4) T

48. A charged particle q is placed at the centre O of cube of length L (ABCDEFGH). Another same charge q is placed at a distance L from O. Then the electric flux through ABCD is

(1) $q/4\pi\in_0 L$ (2) zero
(3) $q/2\pi\in_0 L$ (4) $q/3\pi\in_0 L$



49. If in the circuit, power dissipation is 150 W, then R is



(1) 2 Ω (2) 6 Ω
(3) 5 Ω (4) 4 Ω

50. Wavelength of light used in an optical instrument are $\lambda_1 = 4000$ Å and $\lambda_2 = 5000$ Å, then ratio of their respective resolving powers (corresponding to λ_1 and λ_2) is

(1) 16 : 25 (2) 9 : 1
(3) 4 : 5 (4) 5 : 4

51. A child swinging on a swing in sitting position, stands up, then the time period of the swing will

(1) increase
(2) decrease
(3) remains same
(4) increases if the child is tall and decreases if the child is short

52. A lift is moving down with acceleration a. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are respectively

(1) g, g (2) $g-a, g-a$
(3) $g-a, g$ (4) a, g

53. The mass of product liberated on anode in an electrochemical cell depends on

(1) $(It)^{1/2}$ (2) It
(3) I/t (4) I^2t

(where t is the time period, for which the current is passed)

54. At what temperature is the r.m.s. velocity of a hydrogen molecule equal to that of an oxygen molecule at 47°C?

(1) 80 K (2) −73 K
(3) 3 K (4) 20 K

55. The time period of a charged particle undergoing a circular motion in a uniform magnetic field is independent of its

(1) speed (2) mass
(3) charge (4) magnetic induction

56. A solid sphere, a hallow sphere and a ring are released from top of an inclined plane (frictionless) so that they slide down the plane. Then maximum acceleration down the plane is for (no rolling)

(1) solid sphere (2) hollow sphere
(3) ring (4) all same

57. In a transformer, number of turns in the primary coil are 140 and that in the secondary coil are 280. If current in primary coil is 4 A, then that in the secondary coil is

(1) 4 A (2) 2 A
(3) 6 A (4) 10 A

58. Even Carnot engine cannot give 100% efficiency because we cannot

(1) prevent radiation
(2) find ideal sources
(3) reach absolute zero temperature
(4) eliminate friction

59. Moment of inertia of a circular wire of mass M and radius R about its diameter is

(1) $MR^2/2$ (2) MR^2
(3) $2MR^2$ (4) $MR^2/4$

60. When forces F_1, F_2, F_3 are acting on a particle of mass m such that F_2 and F_3 are mutually perpendicular, then the particle remains stationary. If the force F_1 is now removed then the acceleration of the particle is

(1) F_1/m (2) F_2F_3/mF_1
(3) $(F_2 - F_3)/m$ (4) F_2/m

61. Two forces are such that the sum of their magnitudes is 18 N and their resultant is 12 N which is perpendicular to the smaller force. Then the magnitudes of the forces are

(1) 12 N, 6 N (2) 13 N, 5 N
(3) 10 N, 8 N (4) 16 N, 2 N

62. Speeds of two identical cars are u and $4u$ at the specific instant. The ratio of the respective distances in which the two cars are stopped from that instant is

(1) 1 : 1 (2) 1 : 4
(3) 1 : 8 (4) 1 : 16

63. 1 mole of a gas with $\gamma = 7/5$ is mixed with 1 mole of a gas with $\gamma = 5/3$, then the value of γ for the resulting mixture is

(1) 7/5 (2) 2/5
(3) 24/16 (4) 12/7

64. If a charge q is placed at the centre of the line joining two equal charges Q such that the system is in equilibrium then the value of q is

(1) $Q/2$ (2) $-Q/2$
(3) $Q/4$ (4) $-Q/4$

65. Capacitance (in F) of a spherical conductor with radius 1 m is

(1) 1.1×10^{-10} (2) 10^{-6}
(3) 9×10^{-9} (4) 10^{-3}

66. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (vertically). If the acceleration of the system is $g/8$, then the ratio of the masses is

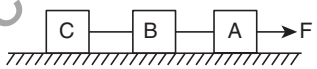
(1) 8 : 1 (2) 9 : 7
(3) 4 : 3 (4) 5 : 3

67. Two spheres of the same material have radii 1 m and 4 m and temperatures 4000 K and 2000 K respectively. The ratio of the energy radiated per second by the first sphere to that by the second is

(1) 1 : 1 (2) 16 : 1
(3) 4 : 1 (4) 1 : 9

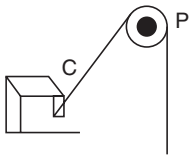
68. Three identical blocks of masses $m = 2$ kg are drawn by a force $F = 10.2$ N with an acceleration of 0.6 ms^{-2} on a frictions surface, then what is the tension (in N) in the string between the blocks B and C?

(1) 9.2 (2) 7.8
(3) 4 (4) 9.8



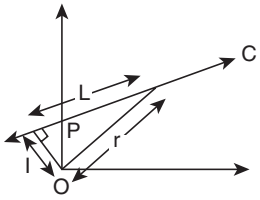
69. One end of a massless rope, which passes over a massless and frictionless pulley P is tied to a hook C while the other end is free. Maximum tension that the rope can bear is 360 N. With what value of maximum safe acceleration (in ms^{-2}) can a man of 60 kg climb on the rope?

(1) 16 (2) 6
(3) 4 (4) 8



70. A particle of mass m moves along line PC with velocity v as shown. What is the angular momentum of the particle about P?

(1) mvL (2) mvl
(3) mvr (4) zero



71. Which of the following is used in optical fibres ?

(1) total internal reflection (2) scattering
(3) diffraction (4) refraction

72. The escape velocity of a body depends upon mass as
(1) m^0 (2) m^1
(3) m^2 (4) m^3

73. Which of the following are not electromagnetic waves?
(1) cosmic rays (2) gamma rays
(3) β-rays (4) X-rays

74. Identify the pair whose dimensions are equal
(1) torque and work (2) stress and energy
(3) force and stress (4) force and work

75. If θ_i, is the inversion temperature, θ_n the neutral temperature, θ_c is the temperature of the cold junction, then
(1) $\theta_i + \theta_c = \theta_n$ (2) $\theta_i - \theta_c = 2\theta_n$
(3) $\frac{\theta_i + \theta_c}{2} = \theta_n$ (4) $\theta_c - \theta_i = 2\theta_n$

Chemistry

76. Which of the following is redox reaction?
(1) $NaCl + KNO_3 \rightarrow NaNO_3 + KCl$
(2) $CaC_2O + 2HCl \rightarrow CaCl_2 + H_2C_2O_4$
(3) $Ca(OH)_2 + 2NH_4Cl \rightarrow CaCl_2 + 2NH_3 + 2H_2O$
(4) $2K[Ag(CN)_2] + Zn \rightarrow 2Ag + K_2[Zn(CN)_4]$

77. For an ideal gas, number of mol per litre in terms of its pressure P, temperature T and gas constant R is:
(1) $\frac{PT}{R}$ (2) PRT
(3) $\frac{P}{RT}$ (4) $\frac{RT}{P}$

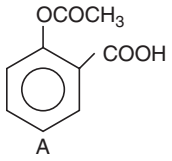
78. Number of P — O bonds in P_4O_{10} is:
(1) 17 (2) 16
(3) 15 (4) 6

79. KO_2 is used in space and submarines because it:
(1) absorbs CO_2 and increase O_2 concentration
(2) absorbs moisture
(3) absorbs CO_2
(4) produces ozone

80. Which of the following ions has the maximum magnetic moment?
(1) Mn^{2+} (2) Fe^{2+}
(3) Ti^{2+} (4) Cr^{2+}

81. Acetylene does not react with:
(1) Na (2) ammoniacal $AgNO_3$
(3) HCl (4) NaOH

82. Compound A given below is:



A

(1) antiseptic (2) antibiotic
(3) analgesic (4) pesticide

83. For the following cell with hydrogen electrodes at two different pressures P_1 and P_2

$Pt(H_2)|H^+(aq)|\ Pt(H_2)$
$P_1 \quad 1M \quad P_2$

emf is given by:
(1) $\frac{RT}{F}\log_e\frac{P_1}{P_2}$ (2) $\frac{RT}{2F}\log_e\frac{P_1}{P_2}$
(3) $\frac{RT}{F}\log_e\frac{P_2}{P_1}$ (4) $\frac{RT}{2F}\log_e\frac{P_2}{P_1}$

84. Acetylene reacts with hypochlorous acid to form:
(1) Cl_2CHCHO (2) $ClCH_2COOH$
(3) CH_3COCl (4) $ClCH_2CHO$

85. On heating benzyl amine with chloroform and ethanolic KOH, product obtained is:
(1) benzyl alcohol (2) benzaldehyde
(3) benzonitrile (4) benzyl isocyanide

86. Which of the following reaction is possible at anode?
(1) $F_2 + 2e^- \rightarrow 2F^-$
(2) $2H^+ + \frac{1}{2}O_2 + 2e^- \rightarrow H_2O$
(3) $2Cr_2^{3+} + 7H_2O \rightarrow Cr_2O_7^{2-} + 14H^+ + 6e^-$
(4) $Fe^{2+} \rightarrow Fe^{3+} + e^-$

87. Which of the following concentration factor is affected by change in temperature?
(1) Molarity (2) Molality
(3) Mole fraction (4) Weight fraction

88. Cyanide process is used for the extraction of:
(1) barium (2) silver
(3) boron (4) zinc

89. Following reaction $(CH_3)_3CBr + H_2O \rightarrow (CH_3)_3COH +$ HBr is an example of:
(1) elimination reaction
(2) free radical substitution
(3) nucleophilic substitution
(4) electrophilic substitution

90. A metal M forms water soluble MSO_4 and inert MO. MO in aqueous solution forms insoluble $M(OH)_2$ soluble in NaOH. Metal M is:

(1) Be (2) Mg
(3) Ca (4) Si

91. Half-life of a substance A following first order kinetics is 5 days. Starting with 100 g of A, amount left after 15 days is:

(1) 25 g (2) 50 g
(3) 12.5 g (4) 6.25 g

92. The most stable ion is :

(1) $[Fe(OH)_5]^{3-}$ (2) $[FeCl_6]^{3-}$
(3) $[Fe(CN)_6]^{3-}$ (4) $[Fe(H_2O)_6]^{3+}$

93. A substance forms zwitter ion. It can have functional groups:

(1) $—NH_2$, —COOH (2) $—NH_2$, $—SO_3H$
(3) both (1) and (2) (4) none of these

94. If Fe^{3+} and Cr^{3+} both are present in group III of qualitative analysis, then distinction can be made by:

(1) addition of NH_4OH in presence of NH_4Cl when only $Fe(OH)_3$ is precipitated.
(2) addition of NH_4OH in presence of NH_4Cl when $Cr(OH)_3$ and $Fe(OH)_3$ both are precipitated and on adding Br_2 water and NaOH, $Cr(OH)_3$ dissolves
(3) Precipitate of $Cr(OH)_3$ and $Fe(OH)_3$ as obtained in (2) are treated with conc. HCl when only $Fe(OH)_3$ dissolves
(4) both (2) and (3)

95. In an organic compound of molar mass 108 g mol^{-1} C, H and N atoms are present in 9 : 1 : 3.5 by weight. Molecular formula can be:

(1) $C_6H_8N_2$ (2) $C_7H_{10}N$
(3) $C_5H_6N_3$ (4) $C_4H_{18}N_3$

96. Solubility of $Ca(OH)_2$ is mol L^{-1}. The solubility product (K_{sp}) under the same condition is:

(1) $4s^3$ (2) $3s^4$
(3) $4s^2$ (4) s^3

97. Heat required to raise the temperature of 1 mole of substance by 1° is called:

(1) specific heat (2) molar heat capacity
(3) water equivalent (4) specific gravity

98. β-particle is emitted in a radioactive reaction when:

(1) a proton changes to neutron
(2) a neutron changes to proton
(3) a neutron changes to electron
(4) an electron changes to neutron

99. In a mixture of A and B, components show negative deviation when:

(1) A – B interaction is stronger than A – A and B – B interaction
(2) A – B interaction is weaker than A – A and B – B interaction
(3) $\Delta V_{mix} > 0, \Delta S_{mix} > 0$
(4) $\Delta V_{mix} = 0, \Delta S_{min} > 0$

100. Refining of impure copper with zinc impurity is to be done by electrolysis using electrodes as:

	Cathode	Anode
(1)	pure copper	pure zinc
(2)	pure zinc	pure copper
(3)	pure copper	impure copper
(4)	pure zinc	impure zinc

101. Aluminium is extracted by the electrolysis of :

(1) alumina
(2) bauxite
(3) molten cryolite
(4) alumina mixed with molten cryolite

102. For an aqueous solution, freezing point is −0.186°C. Elevation of the boiling point of the same solution is ($K_f = 1.86°C\ mol^{-1}$ kg and $K_b = 0.512°C\ mol^{-1}$ kg):

(1) 0.186°C (2) 0.0512°C
(3) 1.86°C (4) 5.12°C

103. Underlined carbon is sp^3 hybridised in:

(1) $CH_3\underline{C}H = CH_2$ (2) $CH_3\underline{C}H_2NH_2$
(3) $CH_3\underline{C}ONH_2$ (4) $CH_3CH_2\underline{C}N$

104. Bond angle of 109°28 is found in:

(1) NH_3 (2) H_2O
(3) $\overset{+}{C}H_3$ (4) $\overset{+}{N}H_4$

105. For a reaction A + 2B → C, rate is given by $+\frac{d[C]}{dt} = k[A][B]$, hence the order of the reaction is:

(1) 3 (2) 2
(3) 1 (4) 0

106. CH_3MgI is an organometallic compound due to:

(1) Mg — I bond (2) C — I bond
(3) C — Mg bond (4) C — H bond

107. One of the following species acts as both Bronsted acid and base:

(1) $H_2PO_2^-$ (2) HPO_3^{2-}
(3) HPO_4^{2-} (4) all of these

108. Hybridisation of the underline atom changes in:

(1) $\underline{Al}H_3$ changes to AlH_4^-

(2) $H_2\underline{O}$ changes to H_2O^+

(3) $\underline{N}H_3$ changes to NH_4^+

(4) in all cases

109. Racemic mixture is formed by mixing two:

(1) isomeric compounds

(2) chiral compounds

(3) meso compounds

(4) enantiomers with chiral carbon

110. The number of lone pairs of Xe in XeF_2, XeF_4 and XeF_6 respectively are:

(1) 3, 2, 1 (2) 2, 4, 6

(3) 1, 2, 3 (4) 6, 4, 2

111. An aqueous solution of 1M NaCl and 1M HCl is:

(1) not a buffer but pH < 7

(2) not a buffer but pH > 7

(3) a buffer with pH < 7

(4) a buffer with pH > 7

112. Consider following two reactions

$$A \rightarrow \text{Product} \; -\frac{d[A]}{dt} = k_1[A]^0$$

$$B \rightarrow \text{Product} \; -\frac{d[B]}{dt} = k_2[B]$$

k_1 and k_2 are expressed in terms of molarity (mol L^{-1}) and time(s^{-1}) as:

(1) s^{-1}, M s^{-1} L^{-1} (2) M s^{-1}, M s^{-1}

(3) s^{-1}, M^{-1} s^{-1} (4) M s^{-1}, s^{-1}

113. RNA contains:

(1) ribose sugar and thymine

(2) ribose sugar and uracil

(3) deoxyribose sugar and uracil

(4) deodyribose sugar and thymine

114. For a cell given below:

Ag $|Ag^+|$ $|Cu^{2+}|$ Cu

$Ag^+ + e^- \rightarrow Ag$ $E^o = x$

$Cu^{2+} + 2e^- \rightarrow Cu$, $E^o = y$

E^o cell is:

(1) $x + 2y$ (2) $2x + y$

(3) $y - x$ (4) $y - 2x$

115. Based on kinetic theory of gases following laws can be proved:

(1) Boyle's law (2) Charles' law

(3) Avogadro's law (4) all of these

116. MnO_4^- is a good oxidizing agent in different medium changing to

$MnO_4^- \rightarrow Mn^{2+}$

$\rightarrow MnO_4^{2-}$

$\rightarrow MnO_2$

$\rightarrow Mn_2O_3$

Changes in oxidation number respectively are:

(1) 1, 3, 4, 5 (2) 5, 4, 3, 2

(3) 5, 1,3, 4 (4) 2, 6, 4, 3

117. For the reaction: $H_2 + I_2 \rightarrow 2HI$, the differential rate law is:

(1) $-\frac{d[H_2]}{dt} = -\frac{d[I_2]}{dt} = 2\frac{d[HI]}{dt}$

(2) $-2\frac{d[H_2]}{dt} = -2\frac{d[I_2]}{dt} = \frac{d[HI]}{dt}$

(3) $-\frac{d[H_2]}{dt} = \frac{d[I_2]}{dt} = \frac{d[HI]}{dt}$

(4) $-\frac{d[H_2]}{2dt} = -\frac{d[I_2]}{2dt} = \frac{d[HI]}{dt}$

118. Number of atoms in 560 g of Fe (atomic mass 56 g mol^{-1}) is:

(1) twice that of 70 g N (2) half that of 20 g H

(3) both (1) and (2) (4) none of the above

119. Geometrical isomerism is not shown by:

(1) 1, 1-dichloro-1-pentene

(2) 1, 2-dichloro-1-pentene

(3) 1, 3-dichloro-2-pentene

(4) 1, 4-dichloro-2-pentene

120. Number of atoms in the unit cell of Na (BCC type crystal) and Mg (FCC type crystal) are respectively:

(1) 4, 4 (2) 4, 2

(3) 2, 4 (4) 1, 1

121. Which of the following compounds has incorrect IUPAC nomenclature?

(1) $CH_3CH_2CH_2\overset{\overset{O}{\|}}{C}OC_2H_5$ (Ethylbuanoate)

(2) $CH_3\underset{\underset{CH_3}{|}}{CH}CH_2CHO$ 3-methyl butanal

(3) $CH_3\underset{\underset{CH_3}{|}}{CH}\overset{\overset{O}{\|}}{C}CH_2CH_3$ 2-methyl 3-pentanone

(4) $CH_3\underset{\underset{H_3C}{|}}{CH}\underset{\underset{OH}{|}}{CH}CH_3$ 2-methyl -3-butanol

122. End product of the following reaction is:

$$CH_2CH_2COOH \xrightarrow[\text{red P}]{Cl_2} \xrightarrow{\text{alcoholic KOH}}$$

(1) $CH_3\underset{\underset{OH}{|}}{C}HCOOH$ (2) $CH_2\underset{\underset{OH}{|}}{C}H_2COOH$

(3) $CH_2{=}CHCOOH$ (4) $CH_2\underset{\underset{Cl}{|}}{C}H\underset{\underset{OH}{|}}{C}OOH$

123. For the following reaction in gaseous phase $CO + \frac{1}{2}O_2 \rightarrow CO_2$ K_c/K_p is:

(1) $(RT)^{1/2}$ (2) $(RT)^{-1/2}$

(3) (RT) (4) $(RT)^{-1}$

124. Energy of H-atom in the ground state is −13.6 eV, hence energy in the second excited state is:

(1) −6.8 eV (2) −3.4 eV

(3) −1.51 eV (4) −4.53 eV

125. A square planar complex is formed by hybridisation of the following atomic orbitals:

(1) $s, p_x, p_y + p_x$ (2) s, p_x, p_y, p_z, d

(3) d, s, p_x, p_y (4) s, p_x, p_y, p_z, d

126. Type of isomerism shown by $[Cr(NH_3)_5NO_2]Cl_2$ is:

(1) optical (2) ionisation

(3) geometrical (4) linkage

127. One of the following equilibrium is not affected by change in volume of the flask:

(1) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(2) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(3) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

(4) $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$

128. Uncertainty in position of a particle of 25 g in space is 10^{-5}m. Hence, uncertainty in velocity (ms^{-1}) is (Planck's constant $h = 6.6 \times 10^{-34}$ Js):

(1) 2.1×10^{-25} (2) 2.1×10^{-34}

(3) 0.5×10^{-34} (4) 5.0×10^{-24}

129. Consider the following reactions at 1100°C

(I) $2C + O_2 \rightarrow 2CO$, $\Delta G° = -460$ kJ mol^{-1}

(II) $2Zn + O_2 \rightarrow 2ZnO$, $\Delta G° = -360$ kJ mol^{-1}

Based on these, select correct alternate:

(1) zinc can be oxidized by CO

(2) zinc oxide can be reduced by carbon

(3) both (1) and (2)

(4) none is the correct.

130. A reaction is non-spontaneous at the freezing point of water but is spontaneous at the boiling point of water then:

	ΔH	ΔS
(1)	+ve	+ve
(2)	–ve	–ve
(3)	–ve	+ve
(4)	+ve	–ve

131. Monomers are converted to polymer by:

(1) hydrolysis of monomers

(2) condensation reaction between monomers

(3) protonation of monomers

(4) none of the above

132. Increasing order of bond strength of O_2, O_2^- O_2^{2-} and O_2^+ is:

(1) $O_2^+ < O_2 < O_2^- < O_2^{2-}$

(2) $O_2 < O_2^+ < O_2^- < O_2^{2-}$

(3) $O_2^- < O_2^{2-} < O_2^+ < O_2$

(4) $O_2^{2-} < O_2^- < O_2 < O_2^+$

133. Most common oxidation states of Ce (Cerium) are:

(1) +3, +4 (2) +2, +3

(3) +2, +4 (4) +3, +5

134. Ce^{3+}, La^{3+}, Pm^{3+} and Yb^{3+} have ionic radii in the increasing order as:

(1) $La^{3+} < Ce^{3+} < Pm^{3+} < Yb^{3+}$

(2) $Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$

(3) $La^{3+} = Ce^{3+} < Pm^{2+} < Yb^{3+}$

(4) $Yb^{3+} < Pm^{3+} < La^{3+} < Ce^{3+}$

135. pH of 0.005 M calcium acetate (pK_a of CH_3COOH = 4.74) is:

(1) 7.04 (2) 9.37

(3) 9.26 (4) 8.37

136. H_2 gas is absorbed on the metal surface like tungsten. This follows ….. order reaction.

(1) third (2) second

(3) zero (4) first

137. Rate constant k of the first order reaction when initial concentration C_0 and concentration C_1 at time t is given by equation

$kt = \log C_0 - \log C_t$

Graph is a straight line if we plot:

(1) t vs $\log C_0$ (2) t vs $\log C_t$

(3) t^{-1} vs $\log C_1$ (4) $\log C_0$ vs $\log C_1$

138. Alum is widely used to purify water since:

(1) it forms complex with day particles

(2) it coagulates the mud particles

(3) it exchanges Ca^{2+} and Mg^{2+} ions present in hard water

(4) its sulphate ion is water purifier.

139. On vigorous oxidation by permanganate solution $((CH_3)_2C = CHCH_2CHO$ gives:

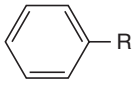
(1) $(CH_3)_2CO$ and $OHCCH_2CHO$

(2) $(CH_3)_2C(OH)-CH(OH)CH_2CHO$

(3) $(CH_3)_2CO$ and $OHCCH_2COOH$

(4) $(CH_3)_2CO$ and $CH_2(COOH)_2$

140. In the following benzyl/allyl system



$R - CH = CH_2$ or

(R is alkyl group)

decreasing order of inductive effect is:

(1) $(CH_3)_3C \rightarrow (CH_3)_2CH \rightarrow CH_3CH_2 -$

(2) $CH_3CH_2 \rightarrow (CH_3)_2CH \rightarrow (CH_3)_3C -$

(3) $(CH_3)_2CH \rightarrow CH_3CH_2 \rightarrow (CH_3)_3CH -$

(4) $(CH_3)_2C \rightarrow CH_3CH_2 \rightarrow (CH_3)_3CH -$

141. PCl_3 and PCl_5 both exist; NCl_3 exists but NCl_5 does not exist. It is due to:

(1) lower electronegativity of P than N

(2) lower tendency of N to form covalent bond

(3) availability of vacant d-orbital in P but not in N

(4) statement is itself incorrect.

142. Following types of compounds (as I, II)

(I) $CH_3CH=CHCH_3$ (II) $CH_3-CH(OH)-CH_2CH_3$

are studied in terms of isomerism in:

(1) chain isomerism

(2) position isomerism

(3) conformers

(4) stereoisomerism

143. Conductivity (Seimen's S) is directly proportional to area of the vessel and the concentration of the solution in it and is inversely proportional to the length of the vessel, then constant of proportionality is expressed in:

(1) S m mol^{-1} (2) S^2 m^2 mol^{-2}

(3) S m^2 mol^{-1} (4) S^2 m^2 mol

144. A heat engine absorbs heat q_0 from a source at temperature T_1 and heat q_2 from a source at temperature T_2. Work done is found to be $J(q_0 + q_2)$. This is in accordance with:

(1) first law of thermodynamics

(2) second law of thermodynamics

(3) Joules equivalent law

(4) none of the above

145. Select correct statement:

(1) When a covalent bond is formed, transfer of electrons takes place

(2) pure H_2O does not contain any ion

(3) a bond is formed when attractive forces overcome repulsive forces

(4) HF is less polar than HBr

146. The metallic sodium dissolves in liquid ammonia to form a deep blue coloured solution. The deep blue colour is due to formation of:

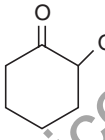
(1) solvated electron, $e^-(NH_3)_x^-$

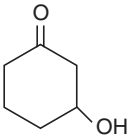
(2) solvated atomic sodium, $Na(NH_3)_y$

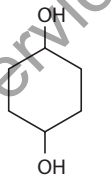
(3) $(Na^+ + Na^-)$

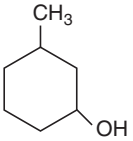
(4) $NaNH_2 + H_2$

147. Maximum dehydration takes place that of:

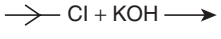
(1) 

(2) 

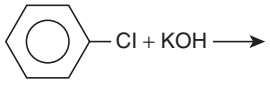
(3) 

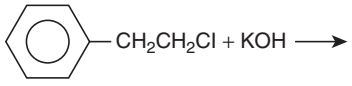
(4) 

148. S_N1 reaction is feasible in:

(1) 

(2) 

(3) 

(4) 

149. Oxidation number of Cl in $CaOCl_2$ (bleaching powder) is:

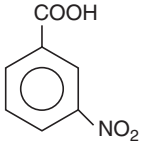
(1) zero, since it contains Cl_2

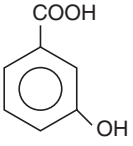
(2) −1, since it contains Cl^-

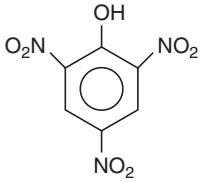
(3) +1, since it contains ClO^-

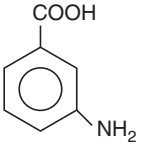
(4) +1 and −1 since it contains ClO^- and Cl^-

150. Picric acid is:

(1) 

(2) 

(3) 

(4) 

Mathematics

151. If $\alpha \neq \beta$ and $\alpha^2 - 3$, $\beta^2 = 5\beta - 3$, then the equation having α/β and β/α as its roots, is

(1) $3x^2 + 19x + 13 = 0$ (2) $3x^2 - 19x + 3 = 0$

(3) $3x^2 - 19x - 3 = 0$ (4) $x^2 - 16x + 1 = 0$

152. If $y = (x + \sqrt{1+x^2})^n$, then $(1+x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx}$ is

(1) n^2y (2) $-n^2y$

(3) $-y$ (4) $2x^2y$

153. If 1, $\log\sqrt{(3^{1-x}+2)}$, $\log_3(4\cdot 3^x - 1)$ are in AP, then x equals

(1) $\log_3 4$ (2) $1 - \log_3 4$

(3) $1 - \log_4 3$ (4) $\log_4 3$

154. A problem in mathematics is given to three students A, B and C and their respective probability of solving the problem is $\frac{1}{2}, \frac{1}{3}$ and $\frac{1}{4}$. Probability that the problem is solved, is

(1) 3/4 (2) 1/2

(3) 2/3 (4) 1/3

155. The period of $\sin^2\theta$ is

(1) π^2 (2) π

(3) 2π (4) $\pi/2$

156. l, m and n are the pth, qth and rth terms of an GP and all positive, then $\begin{vmatrix} \log l & p & 1 \\ \log m & q & 1 \\ \log n & r & 1 \end{vmatrix}$ equals

(1) 3 (2) 2

(3) 1 (4) zero

157. $\lim_{x\to 0}\frac{\sqrt{1-\cos 2x}}{\sqrt{2}x}$ is

(1) λ (2) -1

(3) zero (4) does not exist

158. A triangle with vertices (4, 0), (−1, −1), (3, 5) is

(1) isosceles and right angled

(2) isosceles but not right angled

(3) right angled but not isosceles

(4) neither right angled nor isosceles

159. In a class of 100 students, there are 70 boys whose average marks in a subject are 75. If the average marks of the complete class are 72, then what is the average of the girls?

(1) 73 (2) 65

(3) 68 (4) 74

160. $\cot^{-1}(\sqrt{\cot\alpha}) - \tan^{-1}(\sqrt{\cos x}) = x$, then $\sin x$ is equal to

(1) $\tan^2\left(\frac{\alpha}{2}\right)$ (2) $\cot^2\left(\frac{\alpha}{2}\right)$

(3) $\tan\alpha$ (4) $\cot\left(\frac{\alpha}{2}\right)$

161. The order and degree of the differential equation $\left(1+3\frac{dy}{dx}\right)^{2/3} = 4\frac{d^3y}{dx^3}$ are

(1) $\left(1, \frac{2}{3}\right)$ (2) (3, 1)

(3) (3, 3) (4) (1, 2)

162. A plane which passes through the point (3, 2, 0) and the line $\frac{x-4}{1} = \frac{y-7}{5} = \frac{z-4}{4}$ is

(1) $x - y + z = 1$ (2) $x + y + z = 5$

(3) $x + 2y - z = 1$ (4) $2x - y + z = 5$

163. The solution of the equation $\frac{d^2y}{dx^2} = e^{-2x}$ is

(1) $\frac{e^{-2x}}{4}$ (2) $\frac{e^{-2x}}{4} + cx + d$

(3) $\frac{1}{4}e^{-2x} + cx^2 + d$ (4) $\frac{1}{4}e^{-2x} + c + d$

164. $\lim_{x\to\infty}\left(\frac{x^2+5x+3}{x^2+x+2}\right)$ is equal to

(1) e^4 (2) e^2

(3) e^3 (4) e

165. The domain of $\sin^{-1}[\log_3(x/3)]$ is

(1) [1, 9] (2) [−1, 9]

(3) [−9, 1] (4) [−9, −1]

166. The value of $2^{1/4}, 4^{1/8}, 8^{1/16} \ldots \infty$ is

(1) 1 (2) 2

(3) 3/2 (4) 4

167. Fifth term of a GP is 2, then the product of its 9 terms is

(1) 256 (2) 512

(3) 1024 (4) none of these

168. $\int_0^{10\pi}|\sin x|\,dx$ is

(1) 20 (2) 8

(3) 10 (4) 18

169. $I_n = \int_0^{\pi/4}\tan^n x\,dx$, then $\lim_{n\to\infty} n[I_n + I_{n+2}]$ equals

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

(3) ∞ (4) zero

170. $\int_0^2 [x^2]\,dx$ is

(1) $2-\sqrt{2}$ (2) $2+\sqrt{2}$

(3) $\sqrt{2}-1$ (4) $-\sqrt{2}-\sqrt{3}+5$

171. $\int_{-\pi}^{\pi} \frac{2x(1+\sin x)}{1+\cos^2 x}\,dx$ is

(1) $\frac{\pi^2}{4}$ (2) π^2

(3) zero (4) $\frac{\pi}{2}$

172. The period of the function $f(x) = \sin^4 x + \cos^4 x$ is

(1) π (2) $\frac{\pi}{2}$

(3) 2π (4) none of these

173. The domain of definition of the function $f(x) = \sqrt{\log_{10}\left(\frac{5x-x^2}{4}\right)}$ is

(1) [1, 4] (2) [1, 0]

(3) [0, 5] (4) [5, 0]

174. If $\sin y = x \sin(\alpha + y)$, then $\frac{dy}{dx}$ is

(1) $\frac{\sin a}{\sin^2(a+y)}$ (2) $\frac{\sin^2(a+y)}{\sin a}$

(3) $\sin a \sin^2(a+y)$ (4) $\frac{\sin^2(a-y)}{\sin a}$

175. If $x^y = e^{x-y}$, then $\frac{dy}{dx}$ is

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

(3) not defined (4) $\frac{\log x}{(1+\log x)^2}$

176. The two curves $x^3 - 3xy^2 + 2 = 0$ and $3x^2y - y^3 - 2 = 0$

(1) cut at right angle (2) touch each other

(3) cut at an angle $\frac{\pi}{3}$ (4) cut at an angle $\frac{\pi}{4}$

177. The function $f(x) = \cot^{-1} x + x$ increases in the interval

(1) $(1, \infty)$ (2) $(-1, \infty)$

(3) $(-\infty, \infty)$ (4) $(0, \infty)$

178. The greatest value of $f(x) = (x+1)^{1/3} - (x-1)^{1/3}$ on [0, 1] is:

(1) 1 (2) 2

(3) 3 (4) 1/3

179. Evaluate $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x}+\sqrt{\cos x}}\,dx$

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{2}$

(3) zero (4) 1

180. $\int \frac{dx}{x(x^n+1)}$ is equal to

(1) $\frac{1}{n}\log\left(\frac{x^n}{x^n+1}\right)+c$ (2) $\frac{1}{n}\log\left(\frac{x^n+1}{x^n}\right)+c$

(3) $\log\left(\frac{x^n}{x^n+1}\right)+c$ (4) none of these

181. The area bounded by the curve $y = 2x - x^2$ and the straight line $y = -x$ is given by

(1) $\frac{9}{2}$ sq unit (2) $\frac{43}{6}$ sq unit

(3) $\frac{35}{6}$ sq unit (4) none of these

182. The differential equation of all non-vertical lines in a plane is

(1) $\frac{d^2y}{dx^2} = 0$ (2) $\frac{d^2x}{dy^2} = 0$

(3) $\frac{dy}{dx} = 0$ (4) $\frac{dx}{dy} = 0$

183. Given two vectors are $\hat{i} - \hat{j}$ and $\hat{i} + 2\hat{j}$ the unit vector coplanar with the two vectors and perpendicular to first is:

(1) $\frac{1}{\sqrt{2}}(\hat{i} + \hat{j})$ (2) $\frac{1}{\sqrt{5}}(2\hat{i} + \hat{j})$

(3) $\pm\frac{1}{\sqrt{2}}(\hat{i} + \hat{k})$ (4) none of these

184. The vector $\hat{i} + x\hat{j} + 3\hat{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\hat{i} + (4x-2)\hat{j} + 2\hat{k}$. The values of x are

(1) $\left\{-\frac{2}{3}, 2\right\}$ (2) $\left\{\frac{1}{3}, 2\right\}$

(3) $\left\{\frac{2}{3}, 0\right\}$ (4) {2, 7}

185. A parallelepiped is formed by planes drawn through the points (2, 3, 5) and (5, 9, 7), parallel to the co-ordinate planes. The length of a diagonal of the parallelepiped is:

(1) 7 unit (2) $\sqrt{38}$ unit

(3) $\sqrt{155}$ unit (4) none of these

186. The equation of the plane containing the line $\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$ is $a(x-x_1) + b(y-y_1) + c(z-z_1) = 0$, where:

(1) $ax_1 + by_1 + cz_1 = 0$ (2) $al + bm + cn = 0$

(3) $\frac{a}{l} = \frac{b}{m} = \frac{c}{n}$ (4) $lx_1 + my_1 + nz_1 = 0$

187. A and B play a game where each is asked to select a number from 1 to 25. If the two numbers match, both of them win a prize. The probability that they will not win a prize in a single trial, is:

(1) $\frac{1}{25}$ (2) $\frac{24}{25}$

(3) $\frac{2}{25}$ (4) none of these

188. If A and B are two mutually exclusive events, then:

(1) $P(A) < P(\bar{B})$ (2) $P(A) > P(\bar{B})$

(3) $P(1) < P(2)$ (4) none of these

189. The equation of the directrix of the parabola $y^2 + 4y + 4x + 2 = 0$ is

(1) $x = -1$ (2) $x = 1$

(3) $x = -3/2$ (4) $x = 3/2$

190. Let T_n denote the number of triangles which can be formed using the vertices of a regular polygon on n sides. If $T_{n-1} - T_n = 21$, then n equals:

(1) 5 (2) 7

(3) 6 (4) 4

191. In a triangle ABC, $2ca \sin\frac{A-B+C}{2}$ is equal to:

(1) $a^2 + b^2 - c^2$ (2) $c^2 + a^2 - b^2$

(3) $b^2 - c^2 - a^2$ (4) $c^2 - a^2 - b^2$

192. For $x \in R$, $\lim\limits_{x\to\infty}\left(\frac{x-3}{x+2}\right)^x$ is equal to

(1) e (2) e^{-1}

(3) e^{-5} (4) e^5

193. The incentre of the triangle with vertices $(1, \sqrt{3})$, (0, 0) and (2, 0) is

(1) $\left(1, \frac{\sqrt{3}}{2}\right)$ (2) $\left(\frac{2}{3}, \frac{1}{\sqrt{3}}\right)$

(3) $\left(\frac{2}{3}, \frac{\sqrt{3}}{2}\right)$ (4) $\left(1, \frac{1}{\sqrt{3}}\right)$

194. If the vectors $\vec{a}, \vec{b}$ and $\vec{c}$ from the sides BC, CA and AB, respectively, of a triangle ABC, then

(1) $\vec{a}\cdot\vec{b} = \vec{b}\cdot\vec{c} = \vec{c}\cdot\vec{b} = 0$

(2) $\vec{a}\times\vec{b} = \vec{b}\times\vec{c} = \vec{c}\times\vec{a}$

(3) $\vec{a}\cdot\vec{b} = \vec{b}\cdot\vec{c} = \vec{c}\cdot\vec{a} = 0$

(4) $\vec{a}\times\vec{a} + \vec{a}\times\vec{c} + \vec{c}\times\vec{a} = 0$

195. If ω is an imaginary cube root of unity, then $(1 + \omega - \omega^2)^7$ equals

(1) $128\,\omega$ (2) $-128\,\omega$

(3) $128\,\omega^2$ (4) $-128\,\omega^2$

196. If $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x + iy$, then

(1) $x = 3, y = 1$ (2) $x = 1, y = 3$

(3) $x = 0, y = 3$ (4) $x = 0, y = 0$

197. $\sin^2\theta = \frac{4xy}{(x+y)^2}$ is true if and only if

(1) $x + y \neq 0$ (2) $x = y, x \neq 0, y \neq 0$

(3) $x = y$ (4) $x \neq 0, y \neq 0$

198. The radius of the circle passing through the foci of the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ and having its centre at (0, 3), is:

(1) 4 unit (2) 3 unit

(3) $\sqrt{12}$ unit (4) $\frac{7}{2}$ unit

199. The probability of India winning a test match against West Indies is ½ assuming independence from match to match. The probability that in a match series India's second win occurs at the third test is:

(1) $\frac{1}{8}$ (2) $\frac{1}{4}$

(3) $\frac{1}{2}$ (4) $\frac{2}{3}$

200. If $(\omega \neq 1)$ is a cubic root of unity, then

$\begin{vmatrix} 1 & 1+i+\omega^2 & \omega^2 \\ 1-i & -1 & \omega^2 - 1 \\ -i & -1+\omega-i & -1 \end{vmatrix}$ equals

(1) zero (2) 1

(3) i (4) ω

201. A biased con with probability p, $0 < p < 1$, of heads is tossed until a head appears for the first time. If the probability that the number of tosses required is even, is 2/5, then p equals

(1) 1/3 (2) 2/3

(3) 2/5 (4) 3/5

202. A fair die is tossed eight times. The probability that a third six is observed on the eight throw, is

(1) $\frac{{}^7C_2 \times 5^5}{6^7}$ (2) $\frac{{}^7C_2 \times 5^5}{6^8}$

(3) $\frac{{}^7C_2 \times 5^5}{6^6}$ (4) none of these

203. Let $f(2) = 4$ and $f'(2) = 4$. Then $\lim\limits_{x\to 2}\frac{xf(2) - 2f(x)}{x-2}$ is given by

(1) 2 (2) −2

(3) −4 (4) 3

204. Three straight lines $2x + 11y - 5 = 0$, $24x + 7y - 20 = 0$ and $4x - 3y - 2 = 0$

(1) form a triangle
(2) are only concurrent
(3) are concurrent with one line bisecting the angle between the other two
(4) none of the above

205. A straight line through the point (2, 2) intersects the lines $\sqrt{3}x + y = 0$ and $\sqrt{3}x - y = 0$ at the points A and B. The equation to the line AB so that the triangle OAB is equilateral, is

(1) $x - 2 = 0$ (2) $y - 2 = 0$
(3) $x + y - 4 = 0$ (4) none of these

206. The greatest distance of the point $P(10, 7)$ from the circle $x^2 + y^2 - 4x - 2y - 20 = 0$ is

(1) 10 unit (2) 15 unit
(3) 5 unit (4) none of these

207. The equation of the tangent to the circle $x^2 + y^2 + 4x - 4y + 4 = 0$ which make equal intercepts on the positive coordinate axes, is

(1) $x + y = 2$ (2) $x + y = 2\sqrt{2}$
(3) $x + y = 4$ (4) $x + y = 8$

208. The equation of the ellipse whose foci are $(\pm 2, 0)$ and eccentricity is 1/2, is

(1) $\frac{x^2}{12} + \frac{y^2}{16} = 1$ (2) $\frac{x^2}{16} + \frac{y^2}{12} = 1$
(3) $\frac{x^2}{16} + \frac{y^2}{8} = 1$ (4) none of these

209. The equation of the chord joining two points (x_1, y_1) and (x_2, y_2) on the rectangular hyperbola $xy = c^2$ is:

(1) $\frac{x}{x_1 + x_2} + \frac{y}{y_1 + y_2} = 1$
(2) $\frac{x}{x_1 - x_2} + \frac{y}{y_1 - y_2} = 1$
(3) $\frac{x}{y_1 + y_2} + \frac{y}{x_1 + x_2} = 1$
(4) $\frac{x}{y_1 - y_2} + \frac{y}{x_1 - x_2} = 1$

210. If the vectors $\vec{a} = x\hat{i} + y\hat{j} + z\hat{k}$ and such that $\vec{a}$, $\vec{c}$ and $\vec{b}$ form a right handed system, then $\vec{c}$ is

(1) $z\hat{i} - x\hat{k}$ (2) $\vec{0}$
(3) $y\hat{j}$ (4) $-2\hat{i} + x\hat{k}$

211. The centre of the circle given by $\vec{r} \cdot (\hat{i} + 2\hat{j} + 2\hat{k}) = 15$ and $|\vec{r} - (\hat{j} + 2\hat{k})| = 4$ is

(1) (0, 1, 2) (2) (1, 3, 4)
(3) (−1, 3, 4) (4) none of these

212. The value of $\frac{1 - \tan^2 15°}{1 + \tan^2 15°}$ is

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

213. If $\tan\theta = -\frac{4}{3}$, then $\sin\theta$ is

(1) $-\frac{4}{5}$ but not $\frac{4}{5}$ (2) $-\frac{4}{5}$ or $\frac{4}{5}$
(3) $\frac{4}{5}$ but not $-\frac{4}{5}$ (4) none of these

214. If $\sin(\alpha + \beta) = 1$, $\sin(\alpha - \beta) = \frac{1}{2}$, then $\tan(\alpha + 2\beta)\tan(2\alpha + \beta)$ is equal to

(1) 1 (2) −1
(3) zero (4) none of these

215. If $y = \sin^2\theta + \operatorname{cosec}^2\theta$, $\theta \neq 0$, then

(1) $y = 0$ (2) $y \leq 2$
(3) $y \geq -2$ (4) $y > 2$

216. In a triangle ABC, $a = 4$, $b = 3$, $\angle A = 60°$, then c is the root of the equation

(1) $c^2 - 3c - 7 = 0$ (2) $c^2 + 3c + 7 = 0$
(3) $c^2 - 3c + 7 = 0$ (4) $c^2 + 3c - 7 = 0$

217. In a ΔABC, $\tan\frac{A}{2} = \frac{5}{6}$, $\tan\frac{C}{2} = \frac{2}{5}$, then

(1) a, c, b are in AP (2) a, b, c are in AP
(3) b, a, c are in AP (4) a, b, c are in GP

218. The equation $a \sin x + b \cos x = c$ where $|c| > \sqrt{a^2 + b^2}$ has

(1) a unique solution
(2) infinite number of solutions
(3) no solution
(4) none of the above

219. If α is a root of $25\cos^2\theta + 5\cos\theta - 12 = 0$ $\frac{\pi}{2} < \alpha < \pi$, then $\sin 2\alpha$ is equal to

(1) $\frac{24}{25}$ (2) $-\frac{24}{25}$
(3) $\frac{13}{18}$ (4) $-\frac{13}{18}$

220. $\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{2}{9}\right)$ is equal to

(1) $\frac{1}{2}\cos^{-1}\left(\frac{3}{5}\right)$ (2) $\frac{1}{2}\sin^{-1}\left(\frac{3}{5}\right)$
(3) $\frac{1}{2}\tan^{-1}\left(\frac{3}{5}\right)$ (4) $\tan^{-1}\left(\frac{1}{2}\right)$

221. $\sum_{n=0}^{\infty} \frac{(\log_e x)^n}{n!}$ is equal to

(1) $\log_e x$ (2) x

(3) $\log_x e$ (4) none of these

222. $e^{(x-1)-\frac{1}{2}(x-1)^2+\frac{(x-1)^3}{3}-\frac{(x-1)^4}{4}+\cdots}$ equal to

(1) $\log (x-1)$ (2) $\log x$

(3) x (4) none of these

223. The coefficient of x^5 in $(1 + 2x + 3x^2 + \cdots)^{-3/2}$ is

(1) 21 (2) 25

(3) 26 (4) none of these

224. If $|x| < 1$, then the coefficient of x^n in expansion of $(1 + x + x^2 + x^3 + \cdots)^2$ is :

(1) n (2) $n - 1$

(3) $n + 2$ (4) $n + 1$

225. The number of real roots of $3^{2x^2-7x+7} = 9$ is

(1) zero (2) 2

(3) 1 (4) 4

Answer Key

1.	(4)	**26.**	(3)	**51.**	(2)	**76.**	(4)	**101.**	(4)	**126.**	(4)	**151.**	(2)	**176.**	(1)	**201.**	(1)
2.	(2)	**27.**	(1)	**52.**	(3)	**77.**	(3)	**102.**	(2)	**127.**	(3)	**152.**	(1)	**177.**	(3)	**202.**	(2)
3.	(2)	**28.**	(3)	**53.**	(2)	**78.**	(2)	**103.**	(2)	**128.**	(1)	**153.**	(4)	**178.**	(2)	**203.**	(3)
4.	(2)	**29.**	(1)	**54.**	(4)	**79.**	(1)	**104.**	(2)	**129.**	(2)	**154.**	(2)	**179.**	(1)	**204.**	(3)
5.	(3)	**30.**	(2)	**55.**	(1)	**80.**	(1)	**105.**	(2)	**130.**	(1)	**155.**	(1)	**180.**	(1)	**205.**	(2)
6.	(3)	**31.**	(2)	**56.**	(1)	**81.**	(4)	**106.**	(3)	**131.**	(2)	**156.**	(2)	**181.**	(1)	**206.**	(3)
7.	(1)	**32.**	(1)	**57.**	(2)	**82.**	(3)	**107.**	(3)	**132.**	(4)	**157.**	(4)	**182.**	(1)	**207.**	(2)
8.	(1)	**33.**	(3)	**58.**	(3)	**83.**	(2)	**108.**	(1)	**133.**	(1)	**158.**	(1)	**183.**	(1)	**208.**	(2)
9.	(2)	**34.**	(2)	**59.**	(1)	**84.**	(1)	**109.**	(4)	**134.**	(2)	**159.**	(2)	**184.**	(1)	**209.**	(1)
10.	(3)	**35.**	(1)	**60.**	(1)	**85.**	(4)	**110.**	(1)	**135.**	(4)	**160.**	(1)	**185.**	(1)	**210.**	(1)
11.	(3)	**36.**	(4)	**61.**	(2)	**86.**	(3)	**111.**	(1)	**136.**	(3)	**161.**	(3)	**186.**	(2)	**211.**	(2)
12.	(2)	**37.**	(3)	**62.**	(4)	**87.**	(1)	**112.**	(4)	**137.**	(1)	**162.**	(1)	**187.**	(2)	**212.**	(3)
13.	(2)	**38.**	(2)	**63.**	(3)	**88.**	(2)	**113.**	(2)	**138.**	(2)	**163.**	(2)	**188.**	(4)	**213.**	(2)
14.	(1)	**39.**	(4)	**64.**	(4)	**89.**	(3)	**114.**	(4)	**139.**	(4)	**164.**	(1)	**189.**	(4)	**214.**	(1)
15.	(1)	**40.**	(2)	**65.**	(1)	**90.**	(1)	**115.**	(4)	**140.**	(1)	**165.**	(1)	**190.**	(2)	**215.**	(4)
16.	(3)	**41.**	(3)	**66.**	(2)	**91.**	(3)	**116.**	(3)	**141.**	(3)	**166.**	(2)	**191.**	(2)	**216.**	(1)
17.	(3)	**42.**	(1)	**67.**	(1)	**92.**	(3)	**117.**	(2)	**142.**	(4)	**167.**	(2)	**192.**	(3)	**217.**	(1)
18.	(2)	**43.**	(1)	**68.**	(2)	**93.**	(3)	**118.**	(1)	**143.**	(3)	**168.**	(1)	**193.**	(4)	**218.**	(3)
19.	(2)	**44.**	(3)	**69.**	(3)	**94.**	(4)	**119.**	(1)	**144.**	(2)	**169.**	(2)	**194.**	(2)	**219.**	(2)
20.	(2)	**45.**	(1)	**70.**	(2)	**95.**	(1)	**120.**	(3)	**145.**	(4)	**170.**	(4)	**195.**	(4)	**220.**	(4)
21.	(3)	**46.**	(4)	**71.**	(1)	**96.**	(1)	**121.**	(4)	**146.**	(1)	**171.**	(2)	**196.**	(4)	**221.**	(2)
22.	(2)	**47.**	(2)	**72.**	(1)	**97.**	(2)	**122.**	(3)	**147.**	(2)	**172.**	(2)	**197.**	(1)	**222.**	(3)
23.	(2)	**48.**	(2)	**73.**	(3)	**98.**	(2)	**123.**	(1)	**148.**	(4)	**173.**	(1)	**198.**	(1)	**223.**	(4)
24.	(3)	**49.**	(2)	**74.**	(1)	**99.**	(1)	**124.**	(3)	**149.**	(4)	**174.**	(2)	**199.**	(2)	**224.**	(4)
25.	(1)	**50.**	(4)	**75.**	(3)	**100.**	(3)	**125.**	(3)	**150.**	(3)	**175.**	(4)	**200.**	(1)	**225.**	(2)

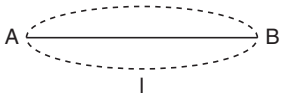
ANSWERS WITH EXPLANATION

Physics

1. $n = \left(1 - \frac{T_2}{T_1}\right)$; $n = 1$ if $T_2 = 0$ K

Answer: (4)

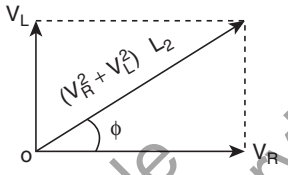
2.



$l = \frac{\lambda}{2}$ or $\lambda = 2l = 2 \times 40 \Rightarrow \lambda = 80$ cm

Answer: (2)

3.



$\cos\phi = \frac{R}{Z} \Rightarrow Z = \sqrt{R^2 + L^2\omega^2}$. Therefore, $\cos\phi = \frac{R}{[R^2 + L^2\omega^2]^{1/2}}$

Answer: (2)

4. Resolving power = $\frac{D}{1.22\lambda}$ larger the diameter, more is resolving power.

Answer: (2)

5. It can be shown that

Loss is K.E. = Gain in P.E. $\Rightarrow \frac{1}{2}mv^2 - 0 = 0 - \left[-\frac{GMm}{R}\right] = \left[\frac{GMm}{R}\right] \Rightarrow g = \frac{GM}{R^2} \Rightarrow GM = gR^2 = \frac{gR^2 m}{R} = mgR$

Answer: (3)

6. $V = I_g\,[R + G] \Rightarrow (R + G) = \frac{V}{I_g}$ or $R = \frac{V}{I_g} - G$

Answer: (3)

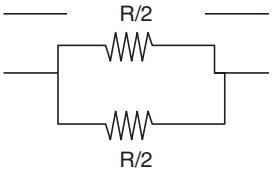
7. $\frac{B_1}{B_2} = \frac{\mu_0/4\pi \cdot 2\pi I/R}{\mu_0/4\pi \cdot 2\pi (2I)/2R} = 1$

Answer: (1)

8. $n = \left[\frac{360°}{60°} - 1\right] = 6 - 1 = 5$

Answer: (1)

9. $P_1 = \frac{220^2}{R}$; $P_2 = \frac{220^2}{(R/4)}$



$P_2 = \frac{220^2}{R/4} = 4P_1$; $R_P \Rightarrow \frac{R}{4}$

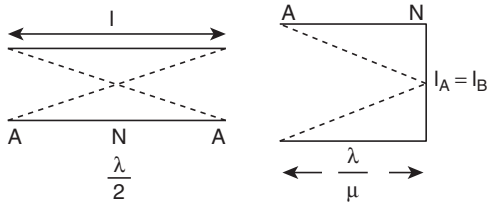
Answer: (2)

10. $W_n = -\frac{13.6}{n^2}\text{eV}$ $\quad W_1 = -\frac{13.6}{12} = -13.6\,\text{eV}$. Energy required = +13.6 eV.

$W_2 = -\frac{13.6}{2^2} = -3.4\,\text{eV}$, Energy required = +3.4 eV.

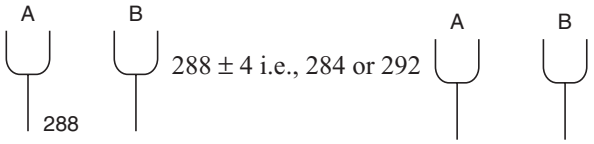
Answer: (3)

11. $v = n_1\lambda_1 = n_2\lambda_2$



$l_A = \frac{\lambda_A}{2}$; $l_B = \frac{\lambda_B}{4}$ or $\lambda_A = 2l_A$, $\lambda_B = 4l_A \Rightarrow \frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1} = \frac{4l}{2l} = \frac{2}{1}$ $\quad n_1 : n_2 = 2 : 1$

Answer: (3)

12. 

288 ± 4 i.e., 284 or 292

At $n = 2$, frequency of B is 292, on waxing it decreases to 290 and gives 2 beats.

Answer: (2)

13. $\xi = \xi_1 + \xi_2 = -2a \sin kx \cos \omega t$. At $x = 0$; y becomes 0. Displacement is zero and node is formed

Answer: (2)

14. $dv = \frac{dw}{q_0} \Rightarrow dv = \frac{2}{20} = 0.1$ V.

Answer: (1)

15. $\frac{mv^2}{r} = qvB \Rightarrow mv = qBr$ or $\frac{mv}{qB} = r$. Since momentum, mv, charge q, and field B is same.

Therefore, radius of curve is same, but direction is opposite.

Answer: (1)

16. $K = \frac{1}{2}m\omega^2(r^2 - \xi^2) = \frac{1}{2}m\omega^2 r^2 \Rightarrow V = \frac{1}{2}m\omega^2\xi^2 = \frac{1}{2}m\omega^2 \times 0 = 0$

Answer: (3)

17. $I_1 w_1 = I_2\omega_2 \Rightarrow \frac{1}{2}MR^2\omega = \left[\frac{1}{2}MR^2 + mR^2 + mR^2\right]\omega' \Rightarrow \frac{1}{2}MR^2\omega = \frac{1}{2}[M + 4m]R^2\omega'$ or $\omega' = \left(\frac{M}{M+4m}\right)\cdot\omega$

Answer: (3)

18. $\frac{mv^2}{r} = \mu mg$ or $v = \sqrt{\mu gr} \Rightarrow \sqrt{0.6 \times 9.8 \times 150} \simeq 30\ \text{m s}^{-1}$

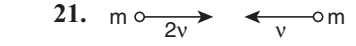
Answer: (2)

19. Velocity of efflux $v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 20} = \sqrt{392} \simeq 20\ \text{m s}^{-1}$ (for $g = 10\ \text{m s}^{-2}$)

Answer: (2)

20. $W = \frac{1}{2}kl_2^2 - \frac{1}{2}kl_1^2 = \frac{1}{2} \times 800[0.15^2 - 0.05^2] = 400[225 \times 10^{-4} - 25 \times 10^{-4}] = 400 \times 200 \times 10^{-4} = 8$ J

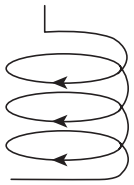
Answer: (2)

21. 

$\vec{v}_{cm} = \frac{m_1\vec{v}_1 + m_2\vec{v}_2}{m_1 + m_2} \Rightarrow \frac{m \cdot 2v - m \cdot v}{m + m} = \frac{mv}{2m} = \frac{v}{2}$

Answer: (3)

22. When current is passed through a spring, every current carrying loop of a spring behaves like a tiny magnet and loop of a spring faces another loop are form magnet of different poles which attract one another. Therefore, spring is compressed.



Answer: (2)

23. $Q = ms\theta$, if $\theta = 1°C$. $Q = ms$ is called thermal capacity.

Answer: (2)

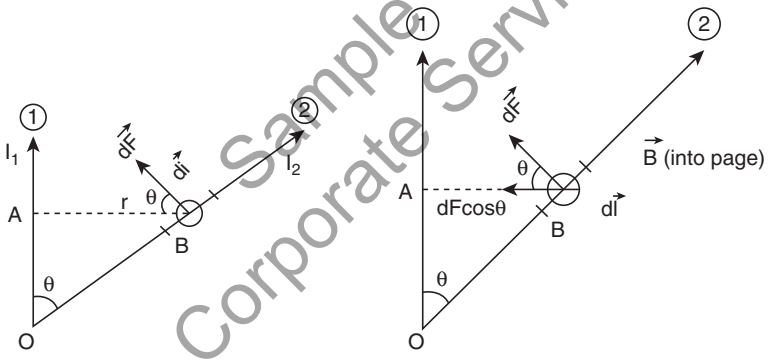
24. Temperature coefficient of resistance of semiconductor is negative; mean on decreasing temperature of a semiconductor, its resistance will increase therefore at absolute zero temperature, Si (semiconductor) acts as an insulator.

Answer: (3)

25. Longitudinal wave does not give polarization effect but participate in other phenomenon like interference diffraction, reflection, refraction etc. Electromagnetic wave gives polarization – there it is confirm it is an electromagnetic wave

Answer: (1)

26. Magnetic field B due to wire 1 is $B = \frac{\mu_0}{4\pi} \cdot \frac{2i_1}{r}$



Force on element $d\vec{l}$ is $B \cdot d\vec{F} = i_2(d\vec{l} \times \vec{B}) \Rightarrow dF = i_2 dlB \sin 90° = i_2 dlB = \frac{\mu_0}{4\pi} \cdot \frac{2i_1}{r} i_2 dl$. This is $\perp$ to wire 2.

Component of force along $BA = dF\cos\theta = \frac{\mu_0}{2\pi r} i_1 i_2 dl \cos\theta$

Answer: (3)

27. Electrons, protons and helium atoms are deflected in magnetic field, so the compound can emit electrons, protons and He^{2+}.

Answer: (1)

28. $\frac{\omega_{01}}{\omega_{02}} = \frac{hc/\lambda_1}{hc/\lambda_2} = \frac{\lambda_2}{\lambda_1} \Rightarrow \frac{2.3}{4.5} = \frac{\lambda_2}{\lambda_1} \Rightarrow \frac{1}{2}$ or $\lambda_1 : \lambda_2 = 2 : 1\lambda$ is threshold wavelength.

Answer: (3)

29. Formation of covalent bond is explained by molecular orbital theory.

Answer: (1)

30. We know that: $e = -Blv$: $|e| = BRv$ **Answer: (2)**

31. Pyrometer **Answer: (2)**

32. $T = 15$ years $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T} \Rightarrow \left[\frac{1}{2}\right]^{15/5}$; $T = 5$ years $\frac{N}{N_0} = \left(\frac{1}{2}\right)^3 = \frac{1}{8} \Rightarrow N = \frac{N_0}{8}$

Answer: (1)

33. For conductors, $\rho = \frac{m}{ne^2T}$.

At high temperature, velocity of electrons increases, collisions are more and average relaxation time is less.
For semiconductors, increase in temperature makes more electrons free and thus increasing conductivity.

Answer: (3)

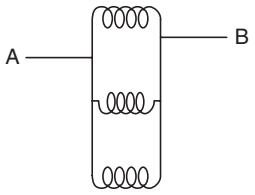
34. $C' = C + C + C + \ldots\ldots n \text{ times} = nc \Rightarrow U = \frac{1}{2}C^1V^2 = \frac{1}{2}nCV^2$

Answer: (2)

35. Blackboard point will absorb whole of radiation and then emit.

Answer: (1)

36.



Three coils are in parallel. $\frac{1}{L} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1$ or $L = 1$ H.

Answer: (4)

37. At highest, only velocity is horizontal component. $E = \frac{1}{2}mu^2$; $u_x = u\cos\theta = u\cos 45° = \frac{u}{\sqrt{2}} \Rightarrow K_2 = \frac{1}{2}m\frac{u^2}{2} = \frac{E}{2}$

Answer: (3)

38. As displacement is same in both the case, therefore, final velocity $v = \sqrt{u^2 + 2gh}$ is same.

Answer: (2)

39. $\frac{1}{2}m\left[v^2 - \left(\frac{v}{x}\right)^2\right] = F \cdot S = m \cdot a \cdot \frac{3}{100}$ (1)

$\frac{1}{2}m[v^2 - 0^2] = m \cdot a \cdot s$ (2)

Dividing Equation (2) by (1), $\frac{1/2mv^2}{1/2m\frac{3v^2}{4}} = \frac{m \cdot as}{ma(3/100)} \Rightarrow \frac{4}{3} = \frac{S \times 100}{3} \Rightarrow S = \frac{4}{100}$ m = 4 cm

Answer: (4)

40. Only centrifugal force will prevail.

Answer: (2)

41. Speed of bus has nothing to do with rms velocity of gas molecules. Moreover, gas is liquefied. $C = \sqrt{\frac{3kT}{m}}$

Answer: (3)

42. $n = \frac{v}{\lambda}$. Increase is temperature causes increase in the velocity of sound.

Answer: (1)

43. $\Delta m = \frac{E}{C^2}$. Dissipated loss in energy will cause increase in mass.

Answer: (1)

44. More the gap, more is resistivity

Answer: (3)

45. Emitter is most heavily doped, which sends the majority charge carriers towards the collector.

Answer: (1)

46. Total energy = K.E + P.E $= \frac{1}{2}mv^2 + \left(-\frac{GMm}{r}\right) = \frac{1}{2}m\left[\sqrt{\frac{GM}{r}}\right]^2 - \frac{GMm}{r} \Rightarrow W_r = -\frac{GMm}{2r}$

$$W_{3R} - W_{2R} = -\frac{GMm}{3R} - \left(-\frac{GMm}{2R}\right) = \frac{GMm}{R}\left[\frac{1}{2} - \frac{1}{3}\right] = \frac{1}{6}\cdot\frac{GMm}{R}$$

Answer: (4)

47. $T = 2\pi\sqrt{\frac{m}{k}};\ T' = 2\pi\sqrt{\frac{m}{k'}};\ k' = nk = 2\pi\sqrt{\frac{m}{nk}} \Rightarrow \frac{1}{\sqrt{n}}.2\pi\sqrt{\frac{m}{k}} \Rightarrow T' = \frac{T}{\sqrt{n}}$

Answer: (2)

48. A, C and D are dimensionally incorrect, $\frac{q}{\epsilon_0}$ has dimensions of ϕ. No term has dimensions in $\left(\frac{q}{\epsilon_0}\right)$

Answer: (2)

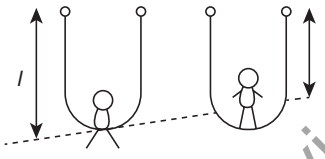
49. $P = \frac{V^2}{R}$ or $150 = \frac{15\times15}{R}$ or $R = \frac{225}{150} = \frac{3}{2}\ \Omega; R = \frac{R_1R_2}{R_1+R_2}$ or $1.5 = \frac{R\times2}{R+2}$ or $1.5R + 3 = 2R \Rightarrow 0.5R = 3 \Rightarrow R = 6\ \Omega$

Answer: (2)

50. $R\cdot P \propto \frac{1}{\lambda} \Rightarrow \frac{R_1}{R_2} = \frac{\lambda_2}{\lambda_1} = \frac{5000\times10^{-10}}{4000\times10^{-10}} = \frac{5}{4} \Rightarrow 5:4$

Answer: (4)

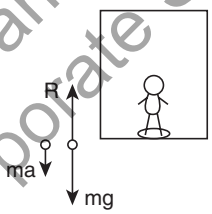
51.



$T = 2\pi\sqrt{\frac{l}{g}}$. C.G rises upwards. l will decrease, T will be less.

Answer: (2)

52.



The accelerations will be respectively, $(g - a)$ and g.
$mg - ma = R \Rightarrow R = m(g - a) \Rightarrow mg' = m(g - a) \Rightarrow g' = (g - a)$

Answer: (3)

53. $m = ZIt$ where Z is *E.C.E* of substance. $m \propto Q$ or It

Answer: (2)

54. $v_{0_2} = v_{H_2}$ or $\sqrt{\frac{YRT_0}{M_0}} = \sqrt{\frac{YRT_H}{M_H}} \Rightarrow \frac{T_0}{M_0} = \frac{T_H}{M_H} \Rightarrow \frac{273+47}{32} = \frac{T_1}{2} \Rightarrow \frac{320}{16} = T_H$ or $T_H = 20$ K.

Answer: (4)

55. $\frac{mv^2}{r} = qvB \Rightarrow v = \frac{qBr}{m} \Rightarrow T = \frac{2\pi r}{v} \Rightarrow \frac{2\pi r}{qBr}\cdot m \Rightarrow \frac{2\pi m}{qB}$

Answer: (1)

56. $a = \frac{g\sin\theta}{(1+k^2/r^2)}$. For ring $k^2 = r^2$. For hollow sphere $k^2 = \frac{2}{3}r^2$. For solid sphere $k^2 = \frac{2}{5}r^2$. k^2 is minimum for solid sphere.

Answer: (1)

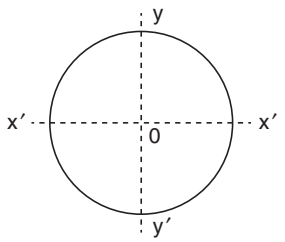
57. $\frac{E_s}{E_p} = \boxed{\frac{n_s}{n_p} = \frac{I_p}{I_s}} \Rightarrow \frac{280}{140} = \frac{4}{I_s} \Rightarrow I_s = 2$ A

Answer: (2)

58. $\eta = \left(1 - \frac{T_2}{T_1}\right)$; if $T_2 = 0$ K$\Rightarrow \eta = 1$

Answer: (3)

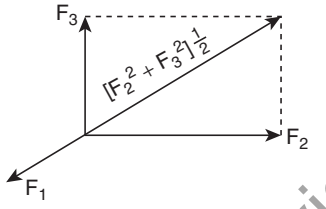
59.



$I_{dia} = \frac{1}{2}MR^2$ for ring. **Answer: (1)**

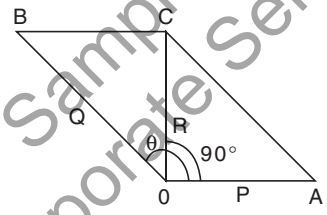
60. For $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \vec{0}$. We have $F_1 = \sqrt{F_2^2 + F_3^2}$ on removal of F_1, the only force is $\sqrt{F_2^2 + F_3^2}$ or F_1

Therefore, $a = \frac{\sqrt{F_2^2 + F_3^2}}{m} \Rightarrow a = \frac{F_1}{m}$



Answer: (1)

61.



$(P + Q) = 18 \Rightarrow \tan 90° = \frac{Q\sin\theta}{(P + Q\cos\theta)} = \infty$

Therefore, $P + Q\cos\theta = 0$ or $P = i \Rightarrow -Q\cos\theta \Rightarrow \frac{P}{Q} = -\cos\theta \Rightarrow \cos\theta = -\frac{P}{Q}$

$R^2 = P^2 + Q^2 + 2PQ\cos\theta = P^2 + Q^2 + 2PQ\left[-\frac{P}{Q}\right] = Q^2 - P^2 \Rightarrow R = (Q - P)(Q + P) \Rightarrow 12\times12 = (Q - P)\cdot18$

or $Q - P = \frac{12}{18}\times12 \Rightarrow P + Q = 18;\ Q - P = 8 \Rightarrow P = 5$ N; $Q = 13$ N.

Answer: (2)

62. Using $v^2 - u^2 = 2as \Rightarrow 0^2 - u^2 = 2(-a)s \Rightarrow u^2 = 2as$ or $u^2 = 2as_1$ (1)

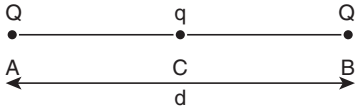
$(4u)^2 = 2as_2$ (2)

Divide Equation (1) by (2), we get: $\frac{1}{16} = \frac{s_1}{s_2}$ or $s_2 = 16s_1$ **Answer: (4)**

63. $\frac{n_1 + n_2}{y - 1} = \frac{n_1}{y_1 - 1} + \frac{n_2}{y_2 - 1} \Rightarrow \frac{1+1}{y-1} = \frac{1}{5/3-1} + \frac{1}{7/5-1}$ or $y = \frac{24}{16}$

Answer: (3)

64.



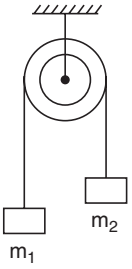
For system to be in equilibrium, $F_{BA} + F_{CA} = 0 \Rightarrow \frac{1}{4\pi\varepsilon_0}\cdot\frac{QQ}{d^2} + \frac{1}{4\pi\varepsilon_0}\cdot\frac{Qq}{(d/2)^2} = 0 \Rightarrow Q + 4q = 0$ or $q = -\frac{Q}{4}$

Answer: (4)

65. $C = 4\pi\varepsilon_0 R = \dfrac{1}{9\times10^9}\times1 = 0.11\times10^{-9} = 1.1\times10^{-10}\,\text{F}$

Answer: (1)

66.



$a = \left(\dfrac{D}{S}\right)g.D$ is the difference in masses and S is the sum of masses.

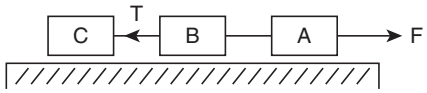
$\dfrac{g}{8} = \dfrac{m_1 - m_2}{m_1 + m_2}\cdot g$ or $\dfrac{1}{8} = \dfrac{m_1 - m_2}{m_1 + m_2} \Rightarrow m_1 + m_2 = 8m_1 - 8m_2 \Rightarrow 9m_2 = 7m_1$ or $\dfrac{m_1}{m_2} = \dfrac{9}{7}$

Answer: (2)

67. $\dfrac{E_1}{E_2} = \dfrac{A_1 e\sigma T_1^4}{A_2 e\sigma T_2^4} = \dfrac{4\pi(1)^2}{4\pi(4)^2}\cdot\dfrac{(4000)^4}{(2000)^4} = \dfrac{1}{16}\times2^4 = 1$

Answer: (1)

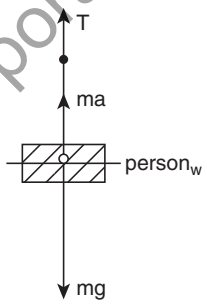
68.



$F - T = (m_A + m_B)a \Rightarrow T = F - (m_A + m_B)a = 10.2 - (2+2)\times0.6 \Rightarrow 10.2 - 2.4 = 7.8$ N

Answer: (2)

69.



$m = \dfrac{360}{10} = 36$ kg $mg - 1 = ma \Rightarrow T = m(g - a) \Rightarrow 360 = 60(10 - a) \Rightarrow 6 = 10 - a$ or $a = 4$ ms^{-2}

Answer: (3)

70. $L = p\cdot d = mv\cdot l$ where d is perpendicular distance from axis of rotation on the direction of motion.

Answer: (2)

71. Total internal reflection

Answer: (1)

72. $v = \sqrt{\dfrac{2GM}{R}}$, does not depend on mass 'm' of the body.

Answer: (1)

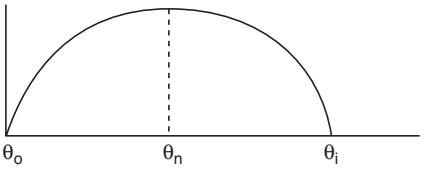
73. β-rays, a beam of electrons has rest mass for electrons

Answer: (3)

74. $T = rF\sin\theta \Rightarrow \text{L.MLT}^{-2} \Rightarrow \text{ML}^2\text{T}^{-2} \Rightarrow W = F\cdot S\cdot\cos\theta \Rightarrow \text{MLT}^{-2}\text{L} \Rightarrow \text{ML}^2\text{T}^{-2}$

Answer: (1)

75.

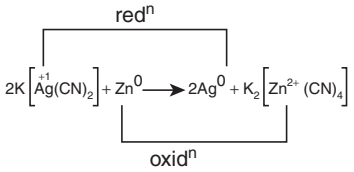


$$\theta_n - \theta_0 = \theta_i - \theta_n \Rightarrow 2\theta_n = (\theta_i + \theta_0) \Rightarrow \theta_n = \left[\frac{\theta_0 + \theta_i}{2}\right]$$

Answer: (3)

Chemistry

76. Redox is a reaction where reduction and oxidation both occurs simultaneously.



Answer: (4)

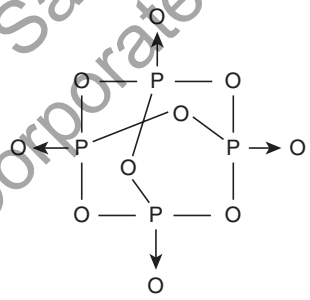
77. $PV = nRT$ (ideal gas equation)

If $V = 1\,l \Rightarrow n = \dfrac{P}{RT}$

Answer: (3)

78. Structure of P_4O_{10}

Number of P – O bonds = 16



Answer: (2)

79. $4KO_2 + 2CO_2 \longrightarrow 2K_2CO_3 + 3O_2$

Answer: (1)

80. $\mu = \sqrt{n(n+2)}BM$

$Mn^{2+} \rightarrow n = 5$ $\quad Ti^{2+} \rightarrow n = 2$

$Fe^{2+} \rightarrow n = 4$ $\quad Cr^{2+} \rightarrow n = 4$

Answer: (1)

81. Acetylene is a very weak acid, does not form salt with metal hydroxide

Answer: (4)

82. Given is acetyl salicylic acid (Aspirin) which acts as pain reliever.

Answer: (3)

83. $Pt(H_2)\,|H^+(aq)|\,Pt(H_2)$

P_1 $\quad$ 1M $\quad$ P_2 $\quad$ if $P_1 > P_2$, then

$$E_{cell} = \frac{RT}{nF}\log_e\left(\frac{P_1}{P_2}\right)$$

Answer: (2)