JCECE

Engineering Entrance Exam

Solved Paper 2013

Physics

1. A boat can go across a lake and return in time T_0 at a speed v. On a rough day there is a uniform current at speed v_1 to help the onward journey and impede the return journey. If the time taken to go across and return on the same day be T, then T / T_0 will be

(a) $\frac{1}{(1 - v_1^2/v^2)}$ (b) $\frac{1}{(1 + v_1^2/v^2)}$

(c) $(1 - v_1^2/v^2)$ (d) $\left(1 + \frac{v_1^2}{v^2}\right)$

2. If a balloon of mass M is descending down with an acceleration a ($< g$), then what is the value of mass m (of its contents) that must be removed so that it starts moving up with an acceleration a?

(a) $\frac{Ma}{(g + a)}$ (b) $\frac{2Ma}{(g + a)}$

(c) $\frac{M}{(g + a)}$ (d) Not possible

3. If for a spherical mirror object distance, $u = (50.1 \pm 0.5)$ cm and image distance $v = (20.1 \pm 0.2)$ cm, then focal length of the spherical mirror will be

(a) (14.3 ± 0.1) cm (b) (14.3 ± 0.5) cm

(c) (30.1 ± 0.1) cm (d) (25.3 ± 0.5) cm

4. The susceptibility and permeability of a perfectly diamagnetic substance is

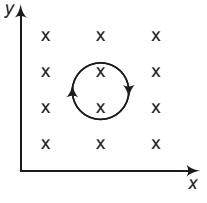
(a) 1 and 0

(b) 0 and 1

(c) – 1 and 0

(d) – 1 and 1

5. If a current carrying circular loop is placed in a x-y plane as shown in adjoining figure and a magnetic field is applied along z-axis, then the loop will



(a) contract

(b) expand

(c) move towards – x-axis

(d) move towards + x-axis

6. If the three vectors $\mathbf{A}, \mathbf{B}$ and $\mathbf{C}$ satisfy the relation $\mathbf{A} \cdot \mathbf{B} = 0$ and $\mathbf{A} \cdot \mathbf{C} = 0$, then vector $\mathbf{A}$ is parallel to

(a) $\mathbf{A}$ (b) $\mathbf{B}$

(c) $\mathbf{A} \times \mathbf{B}$ (d) $\mathbf{B} \times \mathbf{C}$

7. A car weighing 2×10^3 kg and moving at 20 m/s along a main road collides with a lorry of mass 8×10^3 kg which emerges at 5 m/s from a cross road at right angle to the main road. If the two vehicles lock, what will be their velocity after the collision?

(a) $4/\sqrt{2}$ m/s, 45° with cross road

(b) $4/\sqrt{2}$ m/s, 45° with main road

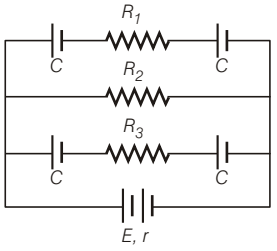
(c) $4/\sqrt{2}$ m/s, 60° with cross road

(d) $4/\sqrt{2}$ m/s, 60° with main road

8. If a water particle of mass 10 mg and having a charge of 1.5×10^{-6} C stays suspended in a room, then the magnitude and direction of electric field in the room is

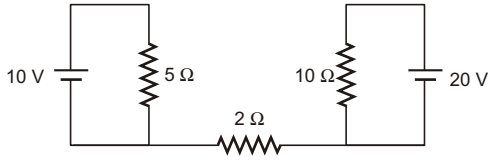
(a) 15 N/C, vertically upwards
(b) 15 N/C, vertically dowards
(c) 65.3 N/C, vertically upwards
(d) 65.3 N/C, vertically downwards

9. In the adjoining figure, $E = 5$ V, $r = 1\ \Omega$, $R_2 = 4\ \Omega$, $R_1 = R_3 = 1\ \Omega$ and $C = 3\ \mu$F. The numerical value of the charge on each plate of the capacitor is



(a) 3 μC (b) 6 μC
(c) 12 μC (d) 24 μC

10. Find out the value of current through 2 Ω resistance for the given circuit

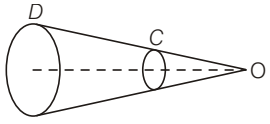


(a) zero (b) 2 A
(c) 4 A (d) 5 A

11. A pure resistive circuit element X when connected to an AC supply of peak voltage 200 V gives a peak current of 5 A. A second current element Y when connected to same AC supply gives the same value of peak current but the current lags behind by 90°. If series combination of X and Y is connected to the same supply, what is the impedance of the circuit?

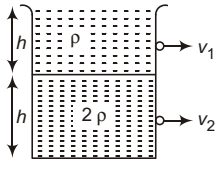
(a) 40 Ω (b) 80 Ω
(c) $40\sqrt{2}\ \Omega$ (d) $2\sqrt{40}\ \Omega$

12. Two circular coils C and D have equal number of turns and carry equal currents in the same direction in the same sense and subtend same solid angle at point O as shown in figure. The smaller coil C is midway between O and D. If we represent magnetic field induction due to bigger coil and smaller coil C as B_D and B_C respectively, then B_D / B_C is



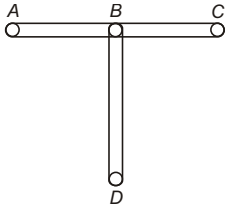
(a) 1 : 4 (b) 1 : 2
(c) 2 : 1 (d) 1 : 1

13. Equal volume of two immiscible liquids of densities ρ and 2ρ are filled in a vessel as shown in figure. Two small holes are made at depth $\frac{h}{2}$ and $\frac{3h}{2}$ from the surface of lighter liquid. If v_1 and v_2 are the velocities of efflux at these two holes, then v_1/v_2 will be



(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{2\sqrt{2}}$ (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

14. Three conducting rods of same material and cross-section are connected as shown in figure. Temperatures of A, D and C are maintained at 20° C, 90°C and 0°C. If there is no flow of heat in AB, then ratio of the lengths of BC and BD is



(a) 2/9 (b) 9/2
(c) 2/7 (d) 7/2

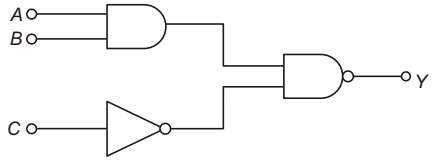
15. If two air columns of lengths 100 cm and 101 cm sounding in their fundamental note gave 17 beats in 20 seconds, then the velocity of sound will be

(a) 277.8 m/s (b) 300 m/s
(c) 250 m/s (d) 343.4 m/s

16. If two springs of spring constants k_1 and k_2 while executing SHM have equal highest velocities, then the ratio of their amplitudes will be (their masses are in ratio 1 : 2)

(a) $\sqrt{2\ k_2/k_1}$ (b) $\sqrt{2\ k_1/k_2}$
(c) $2\ k_1/k_2$ (d) $2\ k_2/k_1$

17. In the adjoining circuit of logic gate, the output Y becomes zero if the inputs are



(a) $A = 1, B = 1, C = 0$ (b) $A = 0, B = 0, C = 0$
(c) $A = 0, B = 1, C = 1$ (d) $A = 1, B = 0, C = 0$

18. LANDSAT series of satellites move in near polar orbits at an altitude of

(a) 512 km (b) 918 km
(c) 3000 km (d) 3600 km

19. The intensity of gamma radiation from a given source is I. If on passing through 36 mm of lead its intensity is reduced to $\frac{I}{8}$, then what will be the thickness of lead which reduces its intensity to $\frac{I}{2}$?

(a) 6 mm (b) 9 mm
(c) 12 mm (d) 18 mm

20. An unpolarized beam of light is incident on a group of four polarizing sheets, which are arranged in such a way that the characteristic direction of each polarizing sheet makes an angle of 30° with that of the preceding sheet. The fraction of incident unpolarized light transmitted is

(a) $\frac{27}{128}$ (b) $\frac{128}{27}$
(c) $\frac{37}{128}$ (d) $\frac{128}{37}$

21. Two coherent sources of intensity ratio β interfere. Then, the value $(I_{max} - I_{min})/(I_{max} + I_{min})$ is

(a) $\frac{1+\beta}{\sqrt{\beta}}$ (b) $\sqrt{\frac{1+\beta}{\beta}}$
(c) $\frac{1+\beta}{2\sqrt{\beta}}$ (d) $\frac{2\sqrt{\beta}}{1+\beta}$

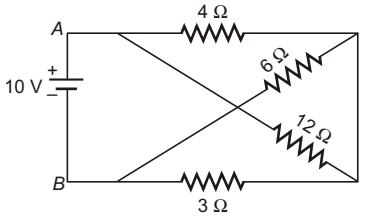
22. A luminous object is placed at a distance of 30 cm from the convex lens of focal length 20 cm. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature 10 cm be placed in order to have an upright image of the object coincident with it?

(a) 60 cm (b) 50 cm
(c) 30 cm (d) 20 cm

23. If a charge – 150 nC is given to a concentric spherical shell and a charge + 50 nC is placed at its centre, then the charge on inner and outer surface of the shell is

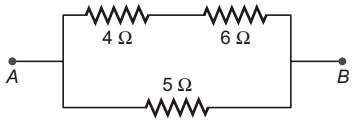
(a) 50 nC, 100 nC (b) – 50 nC, – 100 nC
(c) 50 nC, 200 nC (d) – 50 nC, – 200 nC

24. Find out the equivalent resistance between A and B in the network of resistances shown in adjoining figure



(a) 25 Ω (b) 10 Ω
(c) 5 Ω (d) None of these

25. In the adjoining figure, if 10 calorie heat is produced per second in 5 Ω resistor due to the flow of current through it, then the heat produced in 6 Ω resistor is



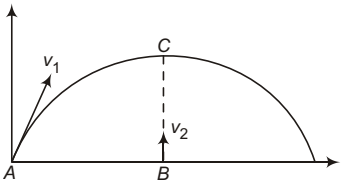
(a) 1 cal/s (b) 2 cal/s
(c) 3 cal/s (d) 4 cal/s

26. A rod of length L rotates about an axis passing through one of its ends and perpendicular to its plane. If the linear mass density of the rod varies as $\rho = (Ar^3 + B)$ kg/m, then the moment of inertia of the rod about the given axis of rotation is

(a) $\frac{L^3}{3}\left[\frac{AL^3}{2} + B\right]$ (b) $\frac{L}{3}\left[\frac{AL^2}{2} + B\right]$
(c) $\frac{L^3}{3}\left[\frac{A}{2} + B\right]$ (d) None of the above

27. If a force of 4 N is applied on a body of mass 20 kg, then the work done in 3rd second will be
(a) 1.2 J (b) 2 J
(c) 4 J (d) 16 J

28. A body is projected with velocity v_1 from the point A, another body at the same time is projected vertically upwards from B with velocity v_2 as shown in adjoining figure. If the point B lies vertically below the highest point C, then for both bodies to collide the ratio $\frac{v_2}{v_1}$ should be



(a) 0.5 (b) 1
(c) $\frac{\sqrt{3}}{2}$ (d) $\frac{2}{\sqrt{3}}$

29. A police van moving on a highway with a speed of 30 km/h fires a bullet at a thief's car speeding away in the same direction with a speed of 192 km/h. If the muzzle speed of the bullet is 150 km/h, with what speed does the bullet hit the thief's car?
(a) 105 m/s (b) 205 m/s
(c) 210 m/s (d) 250 m/s

30. A machine gun of mass 10 kg fires 30 g bullets at the rate of 6 bullets/s with a speed of 400 m/s. The force required to keep the gun in position will be
(a) 30 N (b) 40 N
(c) 72 N (d) 400 N

31. A body of mass 0.1 kg when rotated in a circular path of diameter 1.0 m on a frictionless horizontal plane by means of string, makes 10 revolutions in 31.4 seconds. The centripetal force acting on the body will be
(a) 0.2 N (b) 0.1 N
(c) 2 N (d) 1 N

32. A plane electromagnetic wave propagating in x (–) direction as a wave function (in SI units) is given as
$\psi(x, t) = 10^3 \sin \pi (3 \times 10^6 x - 9 \times 10^{14} t)$
The speed of the wave is
(a) 3×10^6 m/s (b) 3×10^7 m/s
(c) 3×10^8 m/s (d) 9×10^{14} m/s

33. A thin lens of focal length f and aperture diameter d forms an image of intensity I. If the central part of the aperture upto diameter $d/2$ is blocked by an opaque paper, then the new focal length and intensity of image will be
(a) $\frac{f}{2}, \frac{I}{2}$ (b) $\frac{f}{2}, \frac{3}{4}I$
(c) $f, \frac{I}{2}$ (d) $f, \frac{3}{4}I$

34. Light of wavelength λ strikes a photo sensitive surface and electrons are ejected with kinetic energy E. If the kinetic energy is to be increased to $2E$, then the wavelength must be changed to λ', where
(a) $\lambda' > \lambda$ (b) $\lambda' = \frac{\lambda}{2}$
(c) $\lambda' = 2\lambda$ (d) $\frac{\lambda}{2} < \lambda' < \lambda$

35. In a photo electric effect experiment, the maximum kinetic energy of the emitted electrons is 1eV for incoming radiation of frequency ν_0 and 3 eV for incoming radiation of frequency $3\nu_0/2$. What is the maximum kinetic energy of the electrons emitted for incoming radiations of frequency $9\nu_0/4$?
(a) 3 eV (b) 4.5 eV
(c) 6 eV (d) 9 eV

36. If the energy of hydrogen atom in the ground state is – 13.6 eV, then energy of He^+ ion in first excited state will be
(a) 6.8 eV (b) – 13.6 eV
(c) – 27.2 eV (d) – 54.4 eV

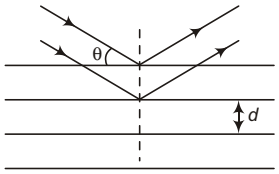
37. In a nuclear fission, 0.1% mass is converted into energy. The energy released by the fission of 1 kg mass will be
(a) 9×10^{13} J (b) 9×10^{16} J
(c) 9×10^{17} J (d) 9×10^{19} J

38. For a transistor in common base, the current gain is 0.95. If the load resistance is 400 kΩ and input resistance is 200 Ω, then the voltage gain and power gain will be
(a) 1900 and 1800 (b) 1900 and 1805
(c) 5525 and 3591 (d) 1805 and 1900

39. In the middle of the depletion layer of a reverse biased *p-n* junction, the
(a) potential is zero
(b) potential is maximum
(c) electric field is maximum
(d) electric field is zero

40. In amplitude modulation, the total modulation index should not exceed one because
(a) the signal will be distorted
(b) the amplifier will be damaged
(c) the signal will die out quickly
(d) the system will fail

41. Let a beam of wavelength λ falls on parallel reflecting planes with separation d, then the angle θ that the beam should make with the planes so that reflected beams from successive planes may interfere constructively should be (where, $n = 1, 2, \ldots$)



(a) $\cos^{-1}\left(\frac{n\lambda}{2d}\right)$ (b) $\sin^{-1}\left(\frac{n\lambda}{2d}\right)$
(c) $\sin^{-1}\left(\frac{n\lambda}{d}\right)$ (d) $\tan^{-1}\left(\frac{n\lambda}{d}\right)$

42. The dimensions of angular momentum/ magnetic moment are
(a) $[MA^{-1}T^{-1}]$ (b) $[M^{-1}AT^{-1}]$
(c) $[MAT^{-1}]$ (d) $[MA^{-1}T]$

43. A weight mg is suspended from the middle of a rope whose ends are at same level. If the rope is no longer horizontal, the minimum tension required to completely straighten the rope will be
(a) mg (b) $\sqrt{mg}$
(c) Infinite (d) zero

44. Two triodes having amplification factors 30 and 21 and plate resistances 5 kΩ and 4 kΩ respectively are connected in parallel. The composite amplification factor of the system is
(a) 25 (b) 50
(c) 75 (d) 100

45. A deflection magnetometer works on
(a) Coulomb's law
(b) Tangent law
(c) Curie law
(d) The law of vibration of a magnet

46. If a magnet is dropped along the axial line of a horizontally held copper ring, then the acceleration of the magnet while it passing through the ring will
(a) less than that due to gravity
(b) equal to that due to gravity
(c) more than that due to gravity
(d) depend on the size of the ring and magnet

47. A clock which keeps correct time at 20°C, is subjected to 40°C. If coefficient of linear expansion of the pendulum is 12×10^{-6} /°C, then how much will it gain or loss in time?
(a) 5 s/day (b) 10.3 s/day
(c) 20.6 s/day (d) 20 min/day

48. The resistance of a resistance thermometer have values 2.71 and 3.70 ohms at 10°C and 100°C respectively. The temperature at which the resistance is 3.26 ohm is
(a) 40°C (b) 50°C
(c) 60°C (d) 70°C

49. If the earth were to rotate faster than its present speed, the weight of an object will
(a) increase at the equator but remain unchanged at the poles
(b) decrease at the equator but remain unchanged at the poles
(c) decrease at the poles but remain unchanged at the equator
(d) increase at the pole but remain unchanged at the equator

50. A coil is wound on a transformer of rectangular cross-section. If all the linear dimensions of the transformer are increased by a factor 2 and the number of turns per unit length of the coil remains the same, the self inductance increases by a factor of
(a) 4
(b) 8
(c) 12
(d) 16

Chemistry

1. A drop of water is about 0.05 mL. The density of water at room temperature is about 1.0 mL^{-1}. The number of water molecules present in a drop of water are
(a) 1.67×10^{21} H_2O molecules
(b) 1.67×10^{26} H_2O molecules
(c) 1.806×10^{23} H_2O molecules
(d) 1.806×10^{21} H_2O molecules

2. Which of the following forms acidic halides?
(a) HF (b) HCl
(c) HBr (d) H I

3. The maximum covalency of nitrogen is
(a) 3 (b) 4
(c) 5 (d) 6

4. A black compound of manganese reacts with a halogen acid to give greenish yellow gas. When excess of this gas reacts with NH_3 an unstable trihalide is formed. In this process, the oxidation state of nitrogen changes from
(a) 0 to – 3 (b) – 3 to 0
(c) – 3 to + 5 (d) – 3 to + 3

5. Which of the following is isoelectronic pair?
(a) CN^-, O_3 (b) ClO_2, BrF_2
(c) BrO_2^-, BrF_2^+ (d) ICl_2, ClO_3

6. Bond dissociation enthalpy of E—H (E = element) bonds is given below. Which of the compounds will act as strongest reducing agent?

Compound	=	NH_3	PH_3	AsH_3	SbH_3
$\Delta_{diss\,(E—H)}{}^{H}$ (kJmol^{-1})	=	389	322	297	255

(a) NH_3 (b) PH_3
(c) AsH_3 (d) SbH_3

7. The electronic configuration of a transition element 'X' in + 3 oxidation state is [Ar] $3d^5$. What is its atomic number?
(a) 24 (b) 25
(c) 26 (d) 27

8. Spin only magnetic moment value of Cr^{3+} ion is
(a) 2.87 BM (b) 3.87 BM
(c) 3.47 BM (d) 3.67 BM

9. There are 14 elements in actinoid series. Which of the following elements does not belong to this series?
(a) U (b) Np (c) Tm (d) Fm

10. When 0.1 mol $CoCl_3(NH_3)_5$ is treated with excess of $AgNO_3$, 0.2 mole of AgCl are obtained. The conductivity of solution will correspond to
(a) 1 : 3 electrolyte (b) 1 : 2 electrolyte
(c) 1 : 1 electrolyte (d) 3 : 1 electrolyte

11. The correct IUPAC name of $[Pt(NH_3)_2Cl_2]$ is
(a) diammine dichlorido platinum (II)
(b) diammine dichlorido platinum (IV)
(c) diammine dichlorido platinum (0)
(d) dichlorido, diammine platinum (IV)

12. Which of the following is a network solid?
(a) SO_2 (solid) (b) I_2
(c) Diamond (d) H_2O (ice)

13. Which kind of defects are introduced by doping?
(a) Dislocation defects (b) Schottky defects
(c) Electronic defects (d) Frenkel defects

14. The unit of ebullioscopic constant is
(a) K or K (molality)$^{-1}$
(b) mol kg K^{-1} or K^{-1} (molality)
(c) kg mol^{-1} K^{-1} or K^{-1} (molality)$^{-1}$
(d) K mol kg^{-1} or K (molality)

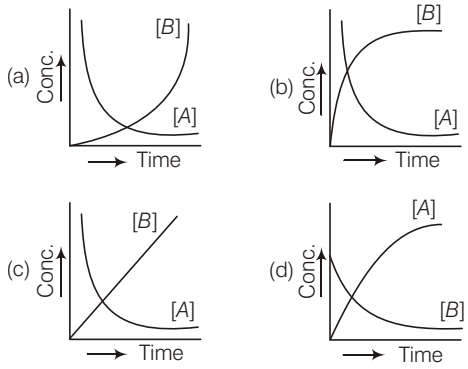
15. A beaker contains a solution of substance 'A'. On dissolving substance 'A' in small amount in this solution, precipitation of substance 'A' takes place. The solution is
(a) concentrated (b) saturated
(c) unsaturated (d) super saturated

16. 4L of 0.02 M aqueous solution of NaCl was diluted by adding 1 L of water. The molality of the resultant solution is
(a) 0.004 (b) 0.008 (c) 0.012 (d) 0.016

17. At high concentration of soap in water, soap behave as
(a) molecular solid
(b) associated colloid
(c) macromolecular colloid
(d) lyophilic colloid

18. Physical adsorption of a gaseous species may change to chemical adsorption with
(a) decrease in temperature
(b) increase in temperature
(c) increase in surface area of adsorbent
(d) decrease in surface area of adsorbent

19. Consider the reaction $A \longrightarrow B$; the concentration of both the reactants and the products varies exponentially with time. Which of the following figures correctly describes the change in concentration of reactants and products with time?



20. Activation energy of a chemical reaction can be determined by
(a) determining the rate constants at standard temperature
(b) determining the rate constants at two temperatures
(c) determining probability of collision
(d) using catalyst

21. In the extraction of copper from its sulphide ore, the metal is formed by the reduction of Cu_2O with
(a) FeS (b) CO
(c) Cu_2S (d) SO_2

22. Which of the following is not a target molecule for drug function in body?
(a) Vitamins (b) Proteins
(c) Lipids (d) Carbohydrates

23. Which of the following statements is not true about low density polythene?
(a) Tough
(b) Highly branched structure
(c) Poor conductor of electricity
(d) Hard

24. Biotin is an organic compound present in yeast. Its deficiency in diet causes dermatitis and paralysis. It is also known as
(a) vitamin B_1 (b) vitamin B_{12}
(c) vitamin D (d) vitamin H

25. Methyl α-D-glucoside and methyl β-D-glucoside are
(a) epimers (b) anomers
(c) conformational diastereomers (d) enantiomers

26. The number of disulphide linkages present in insulin are
(a) 1 (b) 2
(c) 3 (d) 4

27. The source of nitrogen in Gabriel synthesis of amines is
(a) sodium azide NaN_3
(b) potassium phthalimide $C_6H_4(CO)_2N^-K^+$
(c) sodium cyanide
(d) potassium nitrate

28. Which is the most suitable reagent for the following conversion?

$$CH_3-CH=CH-CH_2-\overset{\overset{O}{\|}}{C}-CH_3 \longrightarrow$$

$$CH_3-CH=CH-CH_2-\overset{\overset{O}{\|}}{C}-OH$$

(a) Zn-Hg + HCl (b) I_2 + NaOH
(c) Fehling's reagent (d) Sn + NaOH solution

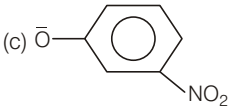
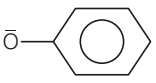
29. $CH_3-C\equiv CH \xrightarrow[1\%\ HgSO_4]{40\%\ H_2SO_4} A \xrightarrow{\text{Isomerisation}} CH_3COCH_3$

Structure of *A* and the type of isomerism in the above reaction are respectively.
(a) prop-1-en-2-ol, metamerism
(b) prop-1-en-1-ol, tautomerism
(c) prop-2-en-2-ol, *cis* and *trans* isomerism
(d) prop-2-en-1-ol, tautomerism

30. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44u. The alkene is
(a) ethene
(b) propene
(c) but-1-ene
(d) but-2-ene

31. Which of the following species can act as the strongest base?

(a) OH^- (b) OR^-

(c)  (d) 

32. IUPAC name of *m*-cresol is

(a) benzene-1,3-diol (b) 3-chlorophenol
(c) 3-methyl phenol (d) 3-methoxyphenol

33. The order of reactivity of following alcohols with halogen acids is

I. $CH_3CH_2CH_2OH$

II. $CH_3CH_2—\underset{\displaystyle OH}{\underset{|}{CH}}—CH_3$

III. $CH_3CH_2—\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}—OH$

(a) II > I > III (b) I > III > II
(c) III > II > I (d) I > II > III

34. The position of –Br in the compound in $CH_3CH=CHC(Br)(CH_3)_2$ can be classified as

(a) vinyl (b) secondary
(c) allyl (d) aryl

35. Benzene does not undergo addition reactions easily because

(a) it has a cyclic structure
(b) it has 6H-atoms
(c) double bonds in it are very strong
(d) resonance stabilized system is to be preserved

36. Alkynes occur in nature in

(a) free state (b) partially free state
(c) not in free state (d) None of these

37. Which of the following reagents converts both acetaldehyde and acetone to alkanes?

(a) Ni/H_2 (b) $LiAlH_4$
(c) I_2 / NaOH (d) Zn-Hg / HCl

38. $C_6H_6 + Cl_2$ (excess) $\xrightarrow[\text{dark, cold}]{\text{Anhy. } AlCl_3} P$

Product, *P* is

(a) C_6H_5Cl (b) $C_6H_4Cl_2$
(c) $C_6H_6Cl_6$ (d) C_6Cl_6

39. An alkene '*A*' contains three C—C, eight C—H σ-bonds and one C—C-π bond. '*A*' on ozonolysis gives two moles of an aldehyde of molar mass 44 u. IUPAC name of *A* is

(a) but-1-ene (b) but-2-ene
(c) 2-methylpropane (d) None of these

40. Among the following which one can have a *meso*- form?

(a) $CH_3CH(OH)CH(Cl)C_2H_5$
(b) $CH_3CH(OH)CH(OH)CH_3$
(c) $C_2H_5CH(OH)CH(OH)CH_3$
(d) $HOCH_2\ CH(Cl)CH_3$

41. Calculate pH of 1 M $NaHCO_3$. Given

$H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$; $pK_1 = 6.38$

$HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$; $pK_2 = 10.26$

(a) 8.73 (b) 8.32
(c) 6.73 (d) 6.32

42. Elements Se, Cl and S have been arranged in the order of increasing ionisation energies. Identify the correct order.

(a) S < Se < Cl (b) Se < S < Cl
(c) Cl < S < Se (d) Se = S < Cl

43. Which of the following is correct for number of electrons, number of orbitals and type of orbitals respectively in *N*–orbit?

(a) 4, 4 and 8 (b) 4, 8 and 16
(c) 32, 16 and 4 (d) 4, 16 and 32

44. The de-Broglie wavelength of helium atom at room temperature is

(a) 6.6×10^{-34} m (b) 4.39×10^{-10} m
(c) 7.34×10^{-11} m (d) 2.335×10^{-20} m

45. In which of the following pairs of molecules/ions, the central atoms have sp^2 hydridisation?

(a) BF_3 and NH_2^-
(b) NO_2^- and NH_3
(c) BF_3 and NO_2^-
(d) NH_2^- and H_2O

46. If a gas expands at constant temperature, it indicates that

(a) kinetic energy of molecules decreases
(b) pressure of the gas increases
(c) kinetic energy of molecules remains same
(d) number of the molecules of gas increases

47. For the reaction,

$C_3H_8\ (g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$

at constant temperature, $\Delta H - \Delta E$ is

(a) + $3RT$

(b) – RT

(c) + RT

(d) – $3RT$

48. In which of the following equilibrium K_c and K_p are not equal?

(a) $2C(s) + O_2(g) \rightleftharpoons 2CO_2(g)$

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

(c) $SO_2(g) + NO_2(g) \rightleftharpoons SO_3\ (g) + NO(g)$

(d) $H_2(g) + I_2\ (g) \rightleftharpoons 2HI(g)$

49. On adding 0.1 M solution each of $[Ag^+]$, $[Ba^{2+}]$, $(Ca^{2+}]$ in Na_2SO_4 solution, species first precipitated is

$[K_{sp}\ BaSO_4 = 10^{-11}$, $K_{sp}\ CaSO_4 = 10^{-6}$ and $K_{sp}\ Ag_2SO_4 = 10^{-5}]$

(a) Ag_2SO_4

(b) $BaSO_4$

(c) $CaSO_4$

(d) All of these

50. Heat of neutralisation of HF (a weak acid) with strong base is – 16.4 kcal. Calculate heat of ionisation of HF in water.

(a) – 13.7 kcal (b) – 2.7 kcal

(c) + 30.1 kcal (d) + 3.01 kcal

Mathmatics

1. If the slope of one of the lines represented by the equation $ax^2 + 2hxy + by^2 = 0$ be square of the other, then the value of $\frac{a+b}{h} + \frac{8h^2}{ab}$ is

(a) 4 (b) – 6 (c) 6 (d) – 4

2. If θ is real and z_1, z_2 are connected by $z_1^2 + z_2^2 + 2z_1z_2\ \cos\theta = 0$, then triangle with vertices 0, z_1 and z_2 is

(a) equilateral (b) right angled

(c) isosceles (d) None of these

3. Total number of values of 'a', so that $x^2 - x - a = 0$ has integral roots, where $a \in N$ and $6 \le a \le 100$, is equal to

(a) 2 (b) 4

(c) 8 (d) 6

4. Total number of n-digit numbers (where, $n > 1$), having the property that no two consecutive digits are same, is

(a) 8^n (b) 9^n

(c) $9 \cdot 10^{n-1}$ (d) None of these

5. If any tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ intercepts equal lengths 'l' on the axes, then l is equal to

(a) $a^2 + b^2$ (b) $\sqrt{a^2 + b^2}$

(c) $(a^2 + b^2)^2$ (d) None of these

6. The equation of plane containing the line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ and the point (0, 7, – 7) is

(a) $x + y + z = 1$

(b) $x + y + z = 2$

(c) $x + y + z = 0$

(d) None of these

7. If $f(x) = \sqrt[n]{x^m}$, $n \in N$ is an even function, then m is

(a) even integer

(b) odd integer

(c) any integer

(d) $f(x)$ even is not possible

8. Period of the function $\left|\sin^3\frac{x}{2}\right| + \left|\cos^5\frac{x}{2}\right|$ is

(a) 2π (b) 10π

(c) 8π (d) 5π

9. If $f(x) = \frac{x}{1+x} + \frac{x}{(1+x)(1+2x)} + \frac{x}{(1+2x)(1+3x)} + \ldots\infty$,

then

(a) $f(x)$ is continuous for all x

(b) $f(x)$ is discontinuous for finite number of points

(c) $f(x)$ is discontinuous for finite number of points

(d) None of the above

10. The value of 'p' such that the length of subtangent and subnormal is equal for the curve $y = e^{px} + px$ at the point $(0, 1)$ is

(a) $p = \pm 1$ (b) $p = \pm 2$

(c) $p = \pm \frac{1}{2}$ (d) None of these

11. If the function $f(x) = 2x^3 - 9ax^2 + 12a^2x + 1$, where $a > 0$ attains its maximum and minimum at p and q respectively, such that $p^2 = q$, then a equals to

(a) 1 (b) 2

(c) $\frac{1}{2}$ (d) 3

12. If $\mathbf{a} = x\mathbf{i} + (x-1)\mathbf{j} + \mathbf{k}$ and $\mathbf{b} = (x+1)\mathbf{i} + \mathbf{j} + a\mathbf{k}$ always make an acute angle with each other for every value of $x \in R$, then

(a) $a \in (-\infty, 2)$ (b) $a \in (2, \infty)$

(c) $a \in (-\infty, 1)$ (d) $a \in (1, \infty)$

13. The number of straight lines that are equally inclined to the three-dimensional coordinate axes, is

(a) 2 (b) 4

(c) 6 (d) 8

14. A variable plane passes through the fixed point (a, b, c) and meets the axes at A, B, C. The locus of the point of intersection of the planes through A, B, C and parallel to the coordinates planes is

(a) $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 2$ (b) $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 1$

(c) $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = -2$ (d) $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = -1$

15. If PQ is a double of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ such that OPQ is an equilateral triangle, O being the centre of the hyperbola, then the eccentricity 'e' of the hyperbola satisfies

(a) $1 < e < \frac{2}{\sqrt{3}}$

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

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

(d) $e > \frac{2}{\sqrt{3}}$

16. $\int \frac{1 + x^4}{(1 - x^4)^{3/2}}\, dx$ is equal to

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

(c) $\frac{1}{\sqrt{\frac{1}{x^2} + x^2}} + C$ (d) None of these

17. In a geometric series, the first term $= a$, common ratio $= r$. If S_n denotes the sum of the n terms and $U_n = \sum_{n=1}^{n} S_n$, then $rS_n + (1 - r)U_n$ equals to

(a) 0 (b) n

(c) na (d) nar

18. If x_1 and x_2 are two distinct roots of the equation $a\cos x + b\sin x = c$, then $\tan\frac{x_1 + x_2}{2}$ is equal to

(a) $\frac{a}{b}$ (b) $\frac{b}{a}$

(c) $\frac{c}{a}$ (d) $\frac{a}{c}$

19. If $(1 + \sqrt{1+x})\tan y = 1 + \sqrt{1-x}$, then $\sin 4y$ is equal to

(a) $4x$ (b) $2x$

(c) x (d) None of these

20. If $|\cos\theta\{\sin\theta + \sqrt{\sin^2\theta + \sin^2\alpha}\}| \le K$, then the value of K is

(a) $\sqrt{1 + \cos^2\alpha}$ (b) $\sqrt{1 + \sin^2\alpha}$

(c) $\sqrt{2 + \sin^2\alpha}$ (d) $\sqrt{2 + \cos^2\alpha}$

21. A vertical pole PS has two marks at Q and R such that the portions PQ, PR and PS subtend angles α, β and γ at a point on the ground distance x from the bottom of pole. If $PQ = a$, $PR = b$, $PS = c$ and $\alpha + \beta + \gamma = 180°$, then x^2 is equal to

(a) $\frac{a^3}{a + b + c}$ (b) $\frac{b^3}{a + b + c}$

(c) $\frac{c^3}{a + b + c}$ (d) $\frac{abc}{a + b + c}$

22. The term independent of x in the expansion of $\left(x+\frac{1}{x}\right)^{2n}$ is

(a) $\frac{1\cdot 3\cdot 5\ldots(2n-1)}{n!}$ (b) $\frac{1\cdot 3\cdot 5\ldots(2n-1)}{n!}2^n$

(c) $\frac{1\cdot 3\cdot 5\ldots(2n+1)}{(n+1)!}$ (d) None of these

23. The value of

$$\int_0^{\sin^2 x}\sin^{-1}\sqrt{t}\,dt+\int_0^{\cos^2 x}\cos^{-1}\sqrt{t}\,dt \text{ is}$$

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

(c) $\frac{\pi}{4}$ (d) None of these

24. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3+\left(\frac{dy}{dx}\right)^2+\sin\left(\frac{dy}{dx}\right)+1=0$ is

(a) 3 (b) 2

(c) 1 (d) None of these

25. The solution of the differential equation $\frac{dy}{dx}=e^{x-y}(e^x-e^y)$ is

(a) $e^y=(e^x+1)+Ce^{-x}$ (b) $e^y=(e^x-1)+C$

(c) $e^y=(e^x-1)+Ce^{-x}$ (d) None of these

26. The range of α, for which the point (α,α) lies inside the region bounded by the curves $y=\sqrt{1-x^2}$ and $x+y=1$ is

(a) $\frac{1}{2}<\alpha<\frac{1}{\sqrt{2}}$ (b) $\frac{1}{2}<\alpha<\frac{1}{3}$

(c) $\frac{1}{3}<\alpha<\frac{1}{\sqrt{3}}$ (d) $\frac{1}{4}<\alpha<\frac{1}{2}$

27. Find the length of the line segment joining the vertex of the parabola $y^2=4ax$ and a point on the parabola where the line segment makes an angle 'θ' to the x-axis.

(a) $\frac{2a\cos\theta}{\sin^2\theta}$ (b) $\frac{4a\cos\theta}{\sin^2\theta}$

(c) $\frac{4a\cos\theta}{3\sin^2\theta}$ (d) None of these

28. If $y=\sin^{-1}\left(\frac{2x}{1+x^2}\right)+\sec^{-1}\left(\frac{1+x^2}{1-x^2}\right)$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{7}{1+x^2}$ (b) $\frac{4}{1+x^2}$

(c) $\frac{1}{x}$ (d) None of the above

29. If $a_1, a_2, \ldots, a_{n-1}$ are the nth roots of unity, then the value of $(1-a_1)(1-a_2)\ldots(1-a_{n-1})$ is equal to

(a) $\sqrt{3}$ (b) $\frac{1}{2}$

(c) n (d) 0

30. If the equation $z^2+(p+iq)z+r+\text{is}=0$, where p, q, r and s are real and non-zero roots, then

(a) $pqr=r^2+p^2s$ (b) $prs=q^2+r^2p$

(c) $qrs=p^2+s^2q$ (d) $pqs=s^2+q^2r$

31. A person writes a letter to four of his friends. He asks each one of them, to copy the letter and mail to four different persons with instructions that they move the chain similarly. Assuming that the chain is not broken and that it costs 50 paise to mail one letter. When the 8th set of letter is mailed, then the amount on postage will be

(a) ₹ 42780 (b) ₹ 43690

(c) ₹ 43680 (d) None of these

32. If 'a' be the AM between b and c and GM's are G_1 and G_2, then $G_1^3+G_2^3$ is equal to

(a) abc (b) $2abc$

(c) $3abc$ (d) $4abc$

33. If $x>0$, then solution of $\left|x+\frac{1}{x}\right|<4$ is

(a) $-2-\sqrt{3}<x<-2+\sqrt{3}$

(b) $2-\sqrt{3}<x<7+\sqrt{3}$

(c) $2-\sqrt{3}<x<2+\sqrt{3}$

(d) None of the above

34. Matrix M_r is defined as $M_r=\begin{bmatrix} r & r-1 \\ r-1 & r \end{bmatrix}$, $r\in N$ value of $\det(M_1)+\det(M_2)+\det(M_3)+\ldots+\det(M_{2007})$ is

(a) 2007 (b) 2008

(c) $(2008)^2$ (d) $(2007)^2$

35. If $A=\begin{bmatrix} \frac{-1+i\sqrt{3}}{2i} & \frac{-1-i\sqrt{3}}{2i} \\ \frac{1+i\sqrt{3}}{2i} & \frac{1-i\sqrt{3}}{2i} \end{bmatrix}$, $i=\sqrt{-1}$ and $f(x)=x^2+2$, then $f(A)$ is equal to

(a) $\left(\frac{5-i\sqrt{3}}{2}\right)\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ (b) $\left(\frac{3-i\sqrt{3}}{2}\right)\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

(c) $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ (d) $(2+i\sqrt{3})\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

36. If $x_1, x_2, \ldots, x_n$ be n observations such that $\Sigma x_i^2 = 400$ and $\Sigma x_i = 80$. Then, a possible value of n among the following is

(a) 9 (b) 12

(c) 15 (d) 18

37. The number of integral values of k for which the equation $7\cos x + 5\sin x = 2k+1$ has a solution is

(a) 4 (b) 8

(c) 10 (d) 12

38. If $a\sin x + b\cos(x+\theta) + b\cos(x-\theta) = d$, then the value of $|\cos\theta|$ is equal to

(a) $\frac{1}{2|b|}\sqrt{d^2-a^2}$ (b) $\frac{1}{2|a|}\sqrt{d^2-a^2}$

(c) $\frac{1}{2|d|}\sqrt{d^2-a^2}$ (d) None of these

39. The value of 'a' for which the function $f(x)=(4a-3)(x+\log 5)+2(a-7)\cot\frac{x}{2}\cdot\sin^2\frac{x}{2}$ does not possess critical points is

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

(c) $[1, \infty)$ (d) $\left(-\infty, \frac{-4}{3}\right)\cup(2, \infty)$

40. $\mathbf{a}$ and $\mathbf{c}$ are unit vectors and $|\mathbf{b}|=4$. If angle between $\mathbf{b}$ and $\mathbf{c}$ is $\cos^{-1}\left(\frac{1}{4}\right)$ and $\mathbf{a}\times\mathbf{b}=2\mathbf{a}\times\mathbf{c}$, then $\mathbf{b}=\lambda\mathbf{a}+2\mathbf{c}$, where λ is equal to

(a) $\pm\frac{1}{4}$

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

(c) ± 1

(d) None of these

41. If the planes $x-cy-bz=0$, $cx-y+az=0$ and $bx+ay-z=0$ pass through a straight line, then the value of $a^2+b^2+c^2+2abc$ is

(a) – 1 (b) 2

(c) 1 (d) 0

42. The plane $ax+by=0$ is rotated through an angle α about its line of intersection with the plane $z=0$, then the equation to the plane in new position is

(a) $ax-by\pm z\sqrt{a^2+b^2}\cdot\cot\alpha=0$

(b) $ax-by\pm z\sqrt{a^2+b^2}\cdot\tan\alpha=0$

(c) $ax+by\pm z\sqrt{a^2+b^2}\cdot\cot\alpha=0$

(d) $ax+by\pm z\sqrt{a^2+b^2}\cdot\tan\alpha=0$

43. If $y=a\cos(\log x)-b\sin(\log x)$, then the value of $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+y$ is

(a) 0 (b) 1

(c) 2 (d) 3

44. The inverse of the function $f(x)=\log(x^2+3x+1)$, $x\in[1,3]$, assuming it to be an onto function, is

(a) $\frac{-3+\sqrt{5+4e^x}}{2}$ (b) $\frac{-3\pm\sqrt{5+4e^x}}{2}$

(c) $\frac{-3-\sqrt{5+4e^x}}{2}$ (d) None of these

45. $\lim\limits_{x\to 0}\frac{\sqrt{1-\cos x}}{x}$ is equal to

(a) $-\frac{1}{\sqrt{2}}$ (b) $\frac{1}{\sqrt{2}}$

(c) 0 (d) Does not exist

46. The sum of two numbers is z, the maximum value of the product of the first and the square of second is

(a) 4 (b) 1

(c) 3 (d) 0

47. If $(1+x-2x^2)^6=1+a_1x+a_2x^2+\ldots+a_{12}x^{12}$, then the expression $a_2+a_4+a_6+\ldots+a_{12}$ has the value

(a) 32

(b) 63

(c) 64

(d) 31

48. If $f:\left[0, \frac{\pi}{2}\right] \to [0, \infty]$ be a function defined by $y = \sin\left(\frac{x}{2}\right)$, then f is

(a) injective
(b) surjective
(c) bijective
(d) None of these

49. If the function $f(x)$ is defined by $f(x) = a + bx$ and $f^r = fff \ldots$ (repeated r times), then $\frac{d}{dx}\{f^r(x)\}$ is equal to

(a) $a + b^r x$ (b) $ar + b^r x$
(c) ar (d) b^r

50. The statement $p \to (q \to p)$ is equivalent to
(a) $p \to (p \leftrightarrow q)$ (b) $p \to (p \to q)$
(c) $p \to (p \vee q)$ (d) $p \to (p \wedge q)$

Answers

Physics

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

Chemistry

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

Mathematics

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