UPSEE - 2011

Physics

1. In a Carnot's cycle, the working substance absorbs heat Q_1 at temperature T_1 and rejects heat Q_2 at temperature T_2. The change of entropy during the Carnot's cycle is
   (a) $\frac{Q_1}{T_1}$ (b) $\frac{Q_2}{T_2}$
   (c) $\frac{Q_1}{T_1} + \frac{Q_2}{T_2}$ (d) Zero

2. A person standing near a train, which is moving with high speed, is pulled towards the train due
   (a) pressure difference
   (b) temperature difference
   (c) gravitational force of the train
   (d) speed of the train

3. Two parallel wires carrying currents I_1 and I_2 in opposite directions and separated by a distance d experience a
   (a) repulsive force $\mu_0 I_1 I_2 / 2\pi d$
   (b) attractive force $\mu_0 I_1 I_2 / 2\pi d$
   (c) repulsive force $\mu_0 I_1 I_2 / 2\pi d^2$
   (d) attractive force $\mu_0 I_1 I_2 / 2\pi d^2$

4. A closed surface S encloses a magnet of magnetic moment 2 ml. The magnetic flux emerging from the surface is
   (a) $\mu_0 m$ (b) Zero
   (c) $2\mu_0 m$ (d) $2m/\mu_0$

5. The clouds remain suspended in the sky due to
   (a) viscosity of air
   (b) viscosity of water in cloud
   (c) negligible weight of cloud
   (d) Sun's gravitational force on cloud

6. In an isothermal expansion the work done in increasing the volume of one mole of a gas by 10% at a temperature of 100 K is
   (a) 79J (b) Zero (c) 8.31J (d) –79 J

7. The intensity of radiation emitted by two stars A and B are in the ratio of 16 : 1. The wavelength corresponding to their peak emission of radiation will be in the ratio of
   (a) 2 : 1 (b) 4 : 1 (c) 1 : 2 (d) 16 : 1

8. If unpolarized light falls on a glass plate ($\mu = 1.54$) at an incidence angle of 57°, the reflected light is
   (a) unpolarized
   (b) completely polarized with dot vibrations
   (c) completely polarized with dash vibrations
   (d) partially polarized with 15% dot and 85% dash vibrations

9. In the dispersion of white light from a prism, the violet light is deviated more than the red light because
   (a) velocity of violet rays of light is more
   (b) wavelength of violet rays of light is more
   (c) the frequency of violet rays of light is more
   (d) the refractive index of prism for violet rays of light is more

10. If an alternating voltage $V = V_0 \sin \omega t$ is applied across an inductance L, the current through the inductance will be
    (a) $I = I_0 \sin \omega t$
    (b) $I = I_0 \sin (\omega t - \pi/2)$
    (c) $I = I_0 \sin (\omega t + \pi/2)$
    (d) $I = I_0 \sin(\omega t + \pi)$

11. Two infinite sheets of charge carry equal and opposite uniform charge densities $\pm\sigma$. The electric field in the free space between the two sheets is

(a) $\frac{\sigma}{\varepsilon_0}$ (b) $\frac{\sigma}{2\varepsilon_0}$ (c) $\frac{2\sigma}{\varepsilon_0}$ (d) Zero

12. In the diffraction from a single slit of width 2.5λ, the total number of minimas and secondary maximum (maxima) on either side of the central maximum are
(a) 4 minimas, 2 secondary maximas
(b) 2 minimas, 2 secondary maximas
(c) 2 minimas, 4 secondary maximas
(d) 2 minimas, 3 secondary maximas

13. A Wheatstone bridge consisting of four arms of resistances P, Q, R, S is most sensitive when
(a) all the resistances are equal
(b) all the resistances are unequal
(c) the resistances P and Q are equal but $R >> P$ and $S >> Q$
(d) the resistances P and Q are equal but $R << P$ and $S << Q$

14. X-rays are produced due to
(a) electron transition in the outer shells of the atom
(b) electron transition in the inner shells of the atom
(c) proton transition in nucleus
(d) radioactivity in the nucleus

15. The use of mirrors in laser cavity helps in
(a) population inversion
(b) spontaneous emission
(c) stimulated emission
(d) absorption

16. In reverse biased p-n junction, the junction region consists of
(a) holes
(b) electrons
(c) donor ions and acceptor ions
(d) the intrinsic material

17. The Fermi level in intrinsic semi-conductors at 0 K temperature lies
(a) near the conduction band
(b) near the valence band
(c) in the middle of valence and conduction band
(d) inside the conduction band

18. A dielectric introduced between the plates of a parallel plate condenser
(a) decreases the electric field between the plates
(b) decreases the capacity of the condenser
(c) increases the charge stored in the condenser
(d) increases the capacity of the condenser

19. Particles having half integral spin are
(a) electron (b) photon
(c) proton (d) neutron

20. Wave nature of light is demonstrated by
(a) interference phenomenon of light
(b) diffraction of light
(c) polarization of light
(d) photoelectric effect

21. Nuclear fission in uranium isotopes occurs when
(a) slow neutrons strike ${}_{92}U^{235}$ isotope
(b) fast neutrons strike ${}_{92}U^{238}$ isotope
(c) slow neutrons strike ${}_{92}U^{238}$ isotope
(d) fast neutrons strike ${}_{92}U^{235}$ isotope

22. The wavelength of the wave associated with a moving electron depends on
(a) charge of the electron
(b) spin of the electron
(c) mass of the electron
(d) velocity of the electron

23. In Young's double slit experiment interference fringes will be observed on the screen when, the initial phase difference between lights originating from the two coherent sources separated vertically by distance d, is equal to
(a) Zero (b) π
(c) kd (d) $wt + 2\pi$

24. A choke coil is a
(a) device to reduce current in DC circuits
(b) device to reduce current in AC circuits
(c) coil of large inductance
(d) coil of negligible resistance

25. If the longitudinal strain in a cubical body is three times the lateral strain then the bulk modulus K, Young's modulus Y and rigidity η are related by
(a) $K = Y$ (b) $\eta = \frac{3Y}{8}$
(c) $Y = \frac{3\eta}{8}$ (d) $Y = \eta$

26. A rigid body of mass m rotates about an axis passing through its centre. If the angular velocity of the body is unity, the moment of inertia of the body will be equal to
(a) kinetic energy of the body
(b) twice the kinetic energy of the body
(c) angular momentum of the body
(d) twice the angular momentum of the body

27. An electron and an alpha particle having equal velocities pass at right angles to the magnetic field. In this field
(a) both the particles describe a circular path
(b) both the particles move in straight path
(c) the radius of the path of alpha particle is greater than that of electron
(d) the velocity of electron becomes more than that of alpha particle

28. The magnetic moment of an electron in an atom arises due to
(a) orbital motion of the electron around the nucleus
(b) intrinsic motion of electron around its own axis
(c) motion of protons in the nucleus
(d) motion of neutrons in the nucleus

29. A spherical object of density ρ is immersed in a fluid of density σ. The object will move
(a) downwards if $\rho > \sigma$
(b) downwards if $\sigma > \rho$
(c) upwards if $\sigma > \rho$
(d) upwards if $\rho > \sigma$

30. The wavelengths of the lines emitted in the Lyman series of the spectrum of hydrogen atom correspond to transitions between energy levels with total quantum numbers
(a) $n = 3$ to $n = 1$ (b) $n = 3$ to $n = 2$
(c) $n = 4$ to $n = 1$ (d) $n = 4$ to $n = 2$

31. For wireless communication of voice signal through the atmosphere, we use electromagnetic waves in the
(a) ultraviolet region of spectrum
(b) visible region of spectrum
(c) microwave region of spectrum
(d) radiowave region of spectrum

32. A solenoid of length l and having n turns carries a current i in anticlockwise direction. The magnetic field is
(a) $\mu_0 ni$
(b) $\mu_0 ni/l$
(c) along the axis of solenoid
(d) perpendicular to the axis of coil

33. Water rises in a glass capillary tube due to
(a) surface tension of water
(b) cohesive force of glass molecules
(c) temperature of water
(d) adhesive force between water molecules and the walls of the glass tube

34. An electric wire of resistance R carries a current I. When a magnetic field is applied perpendicular to the wire, the
(a) current I will decrease
(b) current I will increase
(c) resistance R will increase
(d) resistance R will decrease

35. Electromagnetic radiations consisting of photons each of energy greater than the work function of metal falls on the surface of metal. If the intensity of radiation is increased
(a) velocity of ejected electrons increases
(b) the number of photons increases
(c) the ejected electron flux increases
(d) the ejected electron flux decreases

36. Einstein's mass-energy conversion relation $E = mc^2$ is illustrated by
(a) nuclear fission (b) nuclear fusion
(c) rocket propulsion (d) steam engine

37. A hollow cylinder of length L and radius R having surface area A is placed horizontally with its axis parallel to an external field E. The electric flux through the surface of the cylinder is
(a) Zero (b) $2\pi RLE$
(c) $2\pi R^2 E$ (d) $E \cdot A$

38. In the β-decay of a radioactive nucleus
(a) the atomic number is decreased by one
(b) a neutron is changed into a proton
(c) a proton is changed into a neutron
(d) the mass number is unchanged

39. The propulsion of rocket illustrates that
(a) linear momentum is conserved
(b) angular momentum is not conserved
(c) Newton's third law is applicable
(d) linear momentum is not conserved

40. Electron hole recombination at p-n junction may lead to emission of
(a) photon (b) heat
(c) sound (d) radioactive rays

41. Two springs one of force constant 100 N/m and the other of 300 N/m are joined vertically one above the other and hung from a support at top. A mass of 3 kg is attached to the lower spring. The time period for simple harmonic motion of such a system is
(a) $40\pi / 100$ (b) $20\pi\sqrt{3} / 200$
(c) $20\pi/\sqrt{3}$ (d) $40\pi/\sqrt{3}$

42. Two identical coils each of radius R and each carrying a current I in the same direction are placed along a common axis and separated by distance R. At the midpoint between the two coils the
(a) magnetic field is zero
(b) magnetic field is $0.8\sqrt{0.8}\,\mu_0 I/R$
(c) second derivative of magnetic field $d^2B/dx^2 = 0$
(d) first derivative of magnetic field $dB/dx = 0$

43. The resistance of a metal increases with the increase of temperature due to increase in the
(a) number of electrons
(b) velocity of electrons
(c) scattering of electrons with core ions
(d) thermal motion of core ions

44. The moment of inertia of an annular disc of mass M, outer and inner radii R and r, about its diameter is
(a) $M(R^2 + r^2)/2$
(b) MR^2
(c) Mr^2
(d) $M(R^2 + r^2)/4$

45. The dimensions of coefficient of viscosity η are
(a) $[ML^{-1}T^{-1}]$ (b) $[MLT^{-2}]$
(c) $[MLT^{-1}]$ (d) $[ML^2T^{-2}]$

46. A photon of energy $h\nu$ and momentum $h\nu/c$ collides with an electron at rest. After the collision, the scattered electron and the scattered photon each make an angle of 45° with the initial direction of motion. The ratio of frequency of scattered and incident photon is
(a) $\sqrt{2}$ (b) $\sqrt{2} - 1$ (c) 2 (d) $1/\sqrt{2}$

47. Heat flows through two rods having same temperature difference at the ends. One rod is of length l_1, radius r_1 and thermal conductivity K_1 and the other rod of l_2, r_2 and K_2. The heat flow rate through the two rods will be equal, if
(a) $K_1 l_2 = K_2 l_1$ (b) $K_1 r_1^2 = K_2 r_2^2$
(c) $K_1 l_2 r_1 = K_2 l_1 r_2$ (d) $K_1 l_2 r_1^2 = K_2 l_1 r_2^2$

48. If the torque acting on a rigid body, under the application of a force, is zero then it's
(a) linear momentum is conserved
(b) angular momentum is not conserved
(c) energy is conserved
(d) angular momentum is conserved

49. Two waves $y_1 = 2\sin\omega t$ and $y_2 = 4\sin(\omega t + \delta)$ superimpose. The ratio of the maximum to the minimum intensity of the resultant wave is
(a) 9 (b) 3
(d) infinity (c) Zero

50. The velocity of a satellite moving in an orbit about earth at a distance equal to radius R of earth will be
(a) $\sqrt{gR}$ (b) $\sqrt{0.5gR}$
(c) $\sqrt{2gR}$ (d) $\sqrt{3gR}$

Chemistry

1. Which of the O_2^-, O_2^{2-}, BN and NN is/are paramagnetic?
(a) NN (b) O_2^{2-} (c) BN (d) O_2^-

2. Arrange Na^+, Mg^{2+} and Al^{3+} in increasing order of energy of hydration.
(a) $Na^+ < Mg^{2+} < Al^{3+}$
(b) $Al^{3+} < Mg^{2+} < Na^+$
(c) $Al^{3+} < Na^+ < Mg^{2+}$
(d) $Mg^{2+} < Al^{3+} < Na^+$

3. The electrolyte in lead storage battery is dilute sulpguric acid. The concentration of sulphuric acid in a lead-storage battery must be between 4.8 M and 5.3 M for most efficient functioning. A 5 mL sulphuric acid sample of a particular battery requires 50 mL of 1.0 M

NaOH for complete neutralisation. Which of the following statements about the functioning of battery is the most appropriate?

(a) The acid concentration in the battery is not in the most effective range
(b) The acid concentration in the battery is in the most effective range
(c) The acid concentration in the battery is hardly in the most effective range
(d) Only a good mechanic can tell whether or not the acid concentration in the battery is in the most effective range

4. Which of the following statements is/are true about the P—Cl bonds in PCl_5?
(a) Three bonds are of one type and two of another type
(b) Two bonds are of one type and three of another type
(c) All the bonds are of the same type
(d) Each P—Cl bonds is unique

5. There is a general understanding of ionic radius based on the nuclear charges and the number of electrons surrounding the nucleus which generally works very well. Which one of the following represents the correct decreasing order of ionic radius for C^{4-}, N^{3-}, O^{2-} and F^-?
(a) $C^{4-} > N^{3-} > O^{2-} > F^-$
(b) $F^- > O^{2-} > N^{3-} > C^{4-}$
(c) $O^{2-} > N^{3-} > C^{4-} > F^-$
(d) $F^- > N^{3-} > C^{4-} > O^{2-}$

6. Nuclear attraction is often the deciding control factor for the association of neutral molecules to a given metal ion. Which one of the following represents the correct order of stability of the ions?
$[Be(H_2O)_4]^{2+}$, $[Mg(H_2O)_4]^{2+}$, $[Ca(H_2O)_4]^{2+}$ and $[Sr(H_2O)_4]^{2+}$?
(a) $[Be(H_2O)_4]^{2+} > [Sr(H_2O)_4]^{2+}] > [Mg(H_2O)_4]^{2+} > [Ca(H_2O)_4]^{2+}$
(b) $[Ca(H_2O)_4]^{2+} > [Mg(H_2O)_4]^{2+} > [Be(H_2O)_4]^{2+} > [Sr(H_2O)_4]^{2+}$
(c) $[Sr(H_2O)_4]^{2+} > [Ca(H_2O)_4]^{2+} > [Mg(H_2O)_4]^{2+} > [Be(H_2O)_4]^{2+}$
(d) $[Be(H_2O)_4]^{2+} > [Mg(H_2O)_4]^{2+} > [Ca(H_2O)_4]^{2+} > [Sr(H_2O)_4]^{2+}$

7. Which of the following represents correct acidity order Li_2O, BeO and B_2O_3?
(a) $Li_2O < BeO < B_2O_3$
(b) $B_2O_3 < BeO < Li_2O$
(c) $BeO < Li_2O < B_2O_3$
(d) $BeO < B_2O_3 < Li_2O$

8. Which one of K, I, Cl and Li will display the highest first ionisation energy?
(a) K (b) I (c) Cl (d) Li

9. Which one of the following represents the correct state of hybridisation of P in PCl_5?
(a) s^0p^3 (b) sp^3d (c) s^2p^3 (d) sp^2d^2

10. Which one of the following represents the correct number of types of P—O bonds in P_4O_{10}?
(a) 1 (b) 2 (c) 3 (d) 4

11. One mole of P_4O_{10} is allowed to react fully with dust and salt-free doubly distilled water and the volume is made up to 1L. What is the normality of the so-generated orthophosphoric acid?
$P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$
(a) 1.0 N (b) 8.0 N
(c) 12.0 N (d) 4.0 N

12. You may have noticed that chicken-egg is very strong along its long axis so much so that it does not break even when pressed very hard. Which of the following is the main constituent of egg-shell?
(a) $CaSO_4 \cdot 2H_2O$ (b) $CaSO_4 \cdot \frac{1}{2}H_2O$
(c) $CaSiO_3$ (d) $CaCO_3$

13. Which of the following statements about the monomer and dimer of NO_2 is/are not true?
(a) Both are diamagnetic
(b) Both are paramagnetic
(c) The monomer is paramagnetic and the dimer is not
(d) The dimer is paramagnetic and the monomer is not

14. What is the wavelength associated with a tennis ball of mass 10^3g and travelling at a velocity of 6.626 ms^{-1}?
[$h = 6.626 \times 10^{-34}$ Js^{-1}]

(b) 10^{-31} m
(c) 6.626 m
(d) 6.626×10^{-31} m

15. What is the energy required to move the electron from ground state of H atom to the first excited state? Given that the ground state energy of H atom is 13.6 eV and that the energy E_n of an electron in nth orbital of an atom or ion of atomic number Z is given by the equation
$E_n = -(13.6Z^2/n^2)$.
(a) 13.6 eV
(b) 3.4 eV
(c) 10.2 eV
(d) −10.2 eV

16. Which electron orbitals are designated by
(i) $n = 2, l = 1, m = 0$;
(ii) $n = 3, l = 2, m = 0$;
(iii) $n = 4, l = 2, m = 1$ and
(iv) $n = 5, l = 3, m = 3$ respectively?
(a) 2*p*, 3*d*, 4*d* and 5*f*, respectively
(b) 2*p*, 3*d*, 4*d* and 5*d*, respectively
(c) 2*p*, 3*d*, 4*f* and 5*f*, respectively
(d) 2*p*, 3*p*, 4*d* and 5*f*, respectively

17. Which of the following represents the smallest quantity?
(a) 1230 g
(b) 1.230×10^{-4} g
(c) 1.230×10^{-6} kg
(d) 1.230×10^{4} μg

18. How is 0.0120 written as a scientific notation?
(a) 120×10^{-4}
(b) 1.2×10^{-2}
(c) 12×10^{-3}
(d) 12.0×10^{-3}

19. Which one of the following represents the correct ratio of the energy of electron in ground state of H atom to that of the electron in the first excited state of Li^{+}?
(a) 4 : 9
(b) 9 : 4
(c) 1 : 4
(d) 4 : 1

20. Which of the following does not/do not represent the correct equivalent mass of $Cr_2O_7^{2-}$ in the reaction
$Cr_2O_7^{2-} + 14H^{+} + 6e^{-} \longrightarrow 2Cr^{3+} + 7H_2O$?
(a) The molar mass of dichromate
(b) One third of the molar mass of dichromate
(c) One sixth of the molar mass of dichromate
(d) One half of the molar mass of dichromate

21. In the following Haber synthesis of NH_3, the equilibrium constant for NH_3 formation, on increase in temperature, is
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + \text{heat energy}$
(a) decreased
(b) increased
(c) first decreased and then increased
(d) not altered

22. 'No two electrons in an atom can have the same set of quantum numbers.' This principle is known by which one of the following?
(a) Zeeman's exclusion principle
(b) Stark's exclusion principle
(c) Pauli's exclusion principle
(d) Hersbach's exclusion principle

23. The unit of equilibrium constant for the following reaction is
$2NO_2(g) \rightleftharpoons N_2O_4(g)$
(a) mol L^{-1}
(b) L mol^{-1}
(c) $mol^{-1}L^{-1}$
(d) equilibrium constant is unitless

24. If the equilibrium constant for reaction (i) is 2, what is the equilibrium constant for reaction (ii)?
$CO_2 \rightleftharpoons CO + \frac{1}{2}O_2$ ...(i)
$2CO + O_2 \rightleftharpoons 2CO_2$ ...(ii)
(a) $\frac{1}{4}$
(b) $\frac{1}{2}$
(c) 1
(d) 2

25. Given the following in Eq. (i) and (ii), calculate the EMF of the cell given in Eq. (iii)
$CuI(s) + e^{-} \longrightarrow Cu(s) + I^{-}$
$E^{\circ} = -0.16$ ...(i)
$Zn^{2+}(aq) + 2e^{-} \longrightarrow Zn(s)$
$E^{\circ} = -0.76$ ...(ii)
$\overset{\ominus}{Zn}|Zn^{2+}(1.0\ M)||I^{-}(1.0\ M)|CuI|\overset{\oplus}{Cu}$ ...(iii)
(a) 1.08 V
(b) 0.44 V
(c) 0.92 V
(d) 0.60 V

26. Which of the following comments about the following equilibrium reaction is the most correct?
$H_2SO_4(aq) + NH_3(aq) \rightleftharpoons$
$HSO_4^{-}(aq) + NH_4^{+}(aq)$

(a) The equilibrium lies mostly to the right
(b) The equilibrium lies mostly to the left
(c) The equilibrium is exactly in between where the concentration of each of the reactants is exactly equal to the concentration of each of the products
(d) The equilibrium depends on the temperature of the equilibrium reaction

27. Which of the following represents the correct pH of a 10^{-7} M HCl in doubly distilled air-free water?
(a) 6.6990 (b) 7.0000
(c) 7.3010 (d) 6.3980

28. Which of the following compounds will give red colour on Lassaigne test?
(a) NaCNS
(b) NH_2CSNH_2 (thiourea)
(c) NH_2CONH_2 (urea)
(d) p-$NH_2C_6H_4SO_3H$ (p-aminobenzene sulphonic acid)

29. Detection of sulphur in sodium extract (Lassaigne test) is not done by which of the following reagents?
(a) $Pb(OAc)_2$
(b) Sodium nitroprusside
(c) Both $Pb(OAc)_2$ and sodium nitroprusside
(d) Silver nitrate

30. Octane number of petrol can be improved by admixing it with which of the following chemicals?
(a) Et_4Pb
(b) $CH_3OC(CH_3)_3$
(c) 1-methyl naphthalene
(d) Pyrene

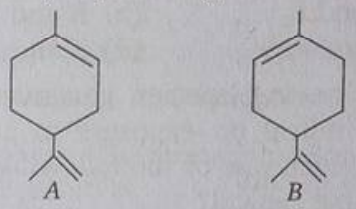
31. Consider the formal charges on N and B in $H_3N—BF_3$ and indicate which of the following is true?
(a) N is +ve and B is –ve
(b) N is –ve and B is +ve
(c) both N and B carry similar +ve or –ve charges
(d) charge discrimination is difficult to make

32. Consider (i) CO_2, (ii) CCl_4, (iii) C_6Cl_6 and (iv) CO and tell which of the following statements is correct?
(a) (i), (ii) and (iii) only have zero dipole moment
(b) (i), (ii) and (iv) only have zero dipole moment
(c) only (iv) has zero dipole moment
(d) All have zero dipole moment

33. Cyclohexane, methylcyclopentane, 1, 3-dimethyl cyclobutane and 1, 2, 3-trimethyl cyclopropane are examples of which one of the following?
(a) Constitutional isomers
(b) Positional isomers
(c) Structural isomers
(d) Structural as well as positional isomers

34. How many structural isomers are possible for a molecule of C_6H_{12} composition but having at least one carbocyclic ring?
(a) Seven (b) Six
(c) Five (d) Three

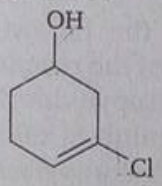
35. The configurations of the chiral centres in *A* and *B* are, respectively, as



(a) *R* and *S* (b) *S* and *R*
(c) *R* and *R* (d) *S* and *S*

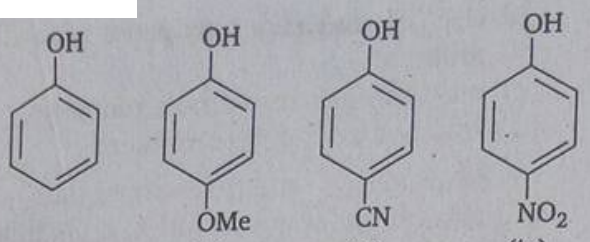
36. Which of the following is the correct IUPAC name of $CH_3CHBrCCCHO$?
(a) 4-bromo-2-pentynal
(b) 2-bromo-3-pentynal
(c) 1-bromo-1-methyl-2-butynal
(d) 4-bromo-4-methyl-butynal

37. Which one is the correct IUPAC name of the following compound?



(a) 1-chloro-5-hydroxycyclohexane
(b) 2-chloro-4-hydroxycyclohexane
(c) 3-chloro-3-cyclohexenol
(d) 5-hydroxycyclohexenyl chloride

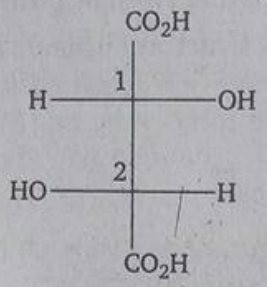
38. Which of the following represents the correct decreasing order of acidity of the following compounds?



(i) (ii) (iii) (iv)

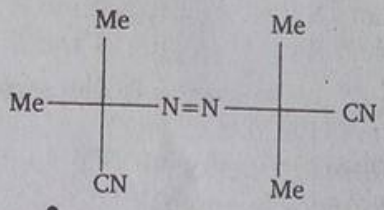
(a) ii > i > iii > iv (b) iv > iii > ii > i
(c) iii > iv > i > ii (d) iv > iii > i > ii

39. The configurations at C_1 and C_2 in the following compound are, respectively



(a) *R* and *R* (b) *R* and *S*
(c) *S* and *R* (d) *S* and *S*

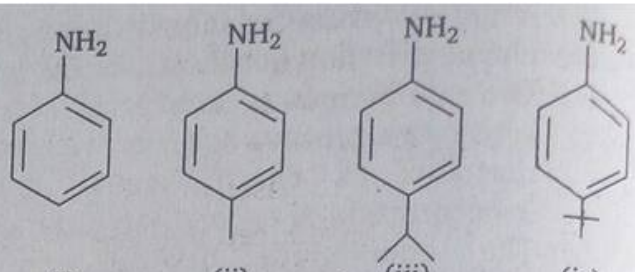
40. The following species generates a highly stable radical on exposure to 100 W bulb light. Which one of the following represents this stable radical?



(a) $Me_2\dot{C}(CN)$
(b) $\dot{C}H_3$
(c) $\dot{C}N$
(d) $Me_2C(CN)N=\dot{C}$

41. Which one of the following represents the major product of the reaction of benzene with 2, 2-dimethylpropyl chloride in presence of anhydrous aluminium chloride?
(a) 2, 2-dimethylpropylbenzene
(b) 1, 1-dimethylpropylbenzene
(c) 1, 2-dimethylpropylbenzene
(d) 1, 2-dimethyl-1-propenylbenzene

42. Which of the following represents the correct increasing order of electron pair availability on nitrogen based on hyperconjugation and + *I* and – *I* effects arising from alkyl groups?



(i) (ii) (iii) (iv)

(a) iv < iii < ii < i (b) iv < i < iii < ii
(c) i < ii < iii < iv (d) i < iv < iii < ii

43. An alkyl bromide is formed as the major product on reaction of 3-methyl-2-butene with hydrobromic acid under thermodynamic conditions. Which of the following is the correct IUPAC name of this product?
(a) 2-bromo-3-methylbutane
(b) 1-bromo-3-methylbutane
(c) 2-bromo-2-methylbutane
(d) 1-bromo-3-methyl-2-butene

44. Which of the following is/are formed on reaction of benzaldehyde with aqueous NaOH followed by acidification with dilute hydrochloric acid?
(a) Benzoic acid
(b) Benzyl alcohol
(c) Benzoic acid and benzyl alcohol
(d) *p*-hydroxybenzaldehyde

45. Wacker process is an industrial process for the oxidation of terminal alkenes. Which of the following represents a true statement about the product?
(a) The product is an aldehyde with same number of carbon atoms as in the alkene
(b) The product is a ketone with same number of carbon atoms as in the alkene
(c) The product is an oxirane with same number of carbon atoms as in the alkene
(d) The product is a terminal alcohol as the net reaction is hydration of an alkene

46. Which of the following chemicals does/do not generate shiny deposits on admixture with ammoniacal silver nitrate?
(a) Acetaldehyde (b) Cyclohexanone
(c) Butyraldehyde (d) Acetaldoxime

47. Which of the following is/are incorrect representation(s) of bleaching powder?
(a) $Ca^{2+}(ClO^-)Cl^-$ (b) $Ca^{2+}(ClO_2)^{2-}$
(c) $Ca^{2+}(ClO^+)Cl^-$ (d) $Ca^{2+}(Cl_2O)^{2-}$

48. Silver metal is recovered industrially by using the chemistry shown below. Which of the following statements is/are not true?
$2K[Ag(CN)_2] + Zn \longrightarrow K_2[Zn(CN)_4] + 2Ag$
(a) Ag has been oxidised and Zn reduced
(b) Ag has been reduced and Zn oxidised
(c) Both Ag and Zn have been oxidised
(d) Both Ag and Zn have been reduced

49. Which one of the pairs $C_6H_5CO_2Me$ and $2,6\text{-}Me_2C_6H_3CO_2Me$, $C_6H_5CO_2Me$ and $C_6H_5CH_2CO_2Me$, CH_3COCH_3 and CF_3COCH_3 and $p\text{-}NO_2C_6H_4CO_2Me$ and $p\text{-}MeOC_6H_4CO_2Me$, in that order, will react faster than the other with a nucleophile at the carbonyl carbon?
(a) $C_6H_5CO_2Me$, $C_6H_5CH_2CO_2Me$, CF_3COCH_3 and $p\text{-}NO_2C_6H_4CO_2Me$
(b) $2,6\text{-}Me_2C_6H_3CO_2Me$, $C_6H_5CH_2Me$, CF_3COCH_3 and $p\text{-}NO_2C_6H_4CO_2Me$
(c) $2,6\text{-}Me_2C_6H_3CO_2Me$, $C_6H_5CO_2Me$, CH_3COCH_3 and $p\text{-}MeOC_6H_4CO_2Me$
(d) $C_6H_5CO_2Me$, $C_6H_5CO_2Me$, CF_3COCH_3 and $p\text{-}NO_2C_6H_4CO_2Me$

50. Which of the following classes of compounds do glucose and fructose represent?
(a) Aldoses and ketoses, respectively
(b) Polyols
(c) Monosaccharides
(d) Aldoses

Mathematics

1. A card is drawn from a well shuffled pack of playing cards. The probability that it is a heart of a king is
(a) $\frac{4}{13}$ (b) $\frac{15}{52}$ (c) $\frac{18}{52}$ (d) $\frac{19}{52}$

2. If A and B are independent events such that $P(A) > 0$ and $P(B) > 0$, then
(a) $P(A \cup B) = P(A) \cdot P(B)$
(b) $P(A \cap B) = P(A) \cdot P(B)$
(c) $P(A|B) = P(A)$
(d) $P(B|A) = P(B)$

3. The value of $\left(\frac{\cos\left(\frac{\pi}{2}+x\right)+\sin\left(\frac{\pi}{2}+x\right)}{\cos\left(\frac{\pi}{2}-x\right)-\sin\left(\frac{\pi}{2}-x\right)}\right)^2$ is
(a) $\frac{1-\sin 2x}{1+\sin 2x}$ (b) $\frac{1+\sin 2x}{1-\sin 2x}$
(c) 1 (d) None of these

4. If A and B are two non-empty sets with B^c denoting the complement of set B such that $B \subset A$, then which of the following probability statements hold true?
(a) $P(A \cap B^c) = P(B) - P(A)$
(b) $P(A \cap B^c) = P(A) - P(B)$
(c) $P(B) \le P(A)$
(d) $P(A) \le P(B)$

5. The probabilities of solving a problem by three students A, B and C are $\frac{1}{2}, \frac{3}{4}$ and $\frac{1}{4}$ respectively. The probability that the problem will be solved is
(a) $\frac{3}{32}$ (b) $\frac{3}{16}$
(c) $\frac{29}{32}$ (d) None of these

6. The solution of trigonometric equation $\cos^4 x + \sin^4 x = 2\cos(2x+\pi)\cos(2x-\pi)$ is
(a) $x = \frac{n\pi}{2} \pm \sin^{-1}\left(\frac{1}{5}\right)$
(b) $x = \frac{n\pi}{4} + \frac{(+1)^n}{4}\sin^{-1}\left(\frac{1}{5}\right)$
(c) $x = \frac{n\pi}{2} \pm \cos^{-1}\frac{1}{5}$
(d) $x = \frac{n\pi}{4} - \frac{(-1)^n}{4}\cos^{-1}\left(\frac{1}{5}\right)$

7. The solution of equation $\sin^{-1}\left(1-\frac{x}{2}\right) - 2\sin^{-1}\frac{x}{2} = \frac{\pi}{2}$ is
(a) $x = 0$ (b) $x = \frac{1}{2}$
(c) $x = 0$ and $\frac{1}{2}$ (d) None of these

8. In any ΔABC, if $\sec A = 2\,\text{cosec}\,B \sin C$, then triangle is
(a) equilateral (b) isosceles
(c) scalene (d) None of these

9. If A, B and C are the angles of a triangle such that $\sec(A-B)$, $\sec(A)$ and $\sec(A+B)$ are in arithmetic progression, then
(a) $\text{cosec}^2 A = 2\text{cosec}^2 \frac{B}{2}$
(b) $2\sec^2 A = \sec^2 \frac{B}{2}$
(c) $2\text{cosec}^2 A = \text{cosec}^2 \frac{B}{2}$
(d) $2\sec^2 B = \sec^2 \frac{A}{2}$

10. If A, B and C are the angles of a triangle, then $\tan\left(\frac{B}{4}+\frac{C}{4}\right)$ equals to
(a) $\frac{\cos\left(\frac{A}{2}\right)}{1+\sin\left(\frac{A}{2}\right)}$ (b) $\frac{1+\sin\left(\frac{A}{2}\right)}{\cos\left(\frac{A}{2}\right)}$
(c) $\frac{\cos\left(\frac{A}{2}\right)}{1-\sin\left(\frac{A}{2}\right)}$ (d) $\frac{1-\sin\left(\frac{A}{2}\right)}{\cos\left(\frac{A}{2}\right)}$

11. For the parabola $y^2 + 8x - 12y + 20 = 0$
(a) vertex is (2, 6)
(b) focus is (0, 6)
(c) latusrectum 4
(d) axis $y = 6$

12. The value of $\lim_{x\to\frac{\pi}{2}} \frac{\sin(\cos x)\cos x}{\sin x - \text{cosec}\,x}$ is
(a) ∞ (b) 1 (c) 0 (d) -1

13. Let $f(x) = \begin{cases} -2\sin x, & -\pi \le x \le -\frac{\pi}{2} \\ a\sin x + b, & -\frac{\pi}{2} < x < \frac{\pi}{2} \\ \cos x, & \frac{\pi}{2} \le x \le \pi \end{cases}$
If $f(x)$ is continuous on $[-\pi, \pi]$, then
(a) $a = 1, b = 1$
(b) $a = -1, b = -1$
(c) $a = -1, b = 1$
(d) $a = 1, b = -1$

14. If $f(x) = \begin{cases} \frac{x}{1+\exp(1/x)}, & x \neq 0 \\ 0, & x = 0 \end{cases}$, then $f(x)$ at $x = 0$ is
(a) continuous (b) not continuous
(c) differentiable (d) not differentiable

15. For the circle $x^2 + y^2 - 2x - 4y + 3 = 0$, the point
(a) (0, 1) lies on the circle
(b) (3, 1) lies outside the circle
(c) (1, 3) lies inside the circle
(d) (1, 1) lies outside the circle

16. The circles $x^2 + y^2 + 2kx + 2y + 6 = 0$ and $x^2 + y^2 + 2kx + k = 0$ intersect orthogonally when k equals to
(a) 2 (b) $\frac{1+\sqrt{193}}{16}$
(c) $\frac{1-\sqrt{193}}{16}$ (d) $-\frac{3}{2}$

17. The maximum value of $f(x) = 2\sin x + \cos 2x, 0 \le x \le \frac{\pi}{2}$ occurs at x is equal to
(a) 0 (b) $\pi/6$
(c) $\pi/2$ (d) None of these

18. The value of integral $I = \int \frac{\sin x + \cos x}{\sqrt{1+\sin 2x}}\,dx$ is
(a) $\sqrt{1+\cos 2x}$ (b) $\sqrt{x}$
(c) x (d) $\sqrt{1+2x}$

19. The value of integral $\int_{-3/2}^{3/2} \sin^3 x \cos^2 x\,dx$ is
(a) 0 (b) 1/2
(c) 1 (d) None of these

20. A hemispherical bowl of radius unity is filled up with water upto the depth $\frac{1}{2}$. The volume of water in the bowl is
(a) $\frac{27\pi}{24}$ (b) $\frac{5\pi}{24}$
(c) $\frac{3\pi}{4}$ (d) None of these

21. The solution of differential equation $4xy\frac{dy}{dx} = \frac{3(1+x)^2(1+y^2)}{(1+x^2)}$ is
(a) $\log(1+y) = \log x + 2\tan x$ +constant

(b) $\log(1+y^2) = 3\log\left(\frac{1}{x}\right) + 6\tan^{-1}x +$ constant

(c) $2\log(1+y^2) = 3\log x + 6\tan^{-1}x +$ constant

(d) None of the above

22. If $f(x) = |x-2|$ and $g(x) = f(f(x))$, then $\frac{dg(x)}{dx}$ for $x > 10$ is

(a) 1 or −1 (b) 1

(c) −1 (d) None of these

23. If $y = \sin^{-1}\left(\frac{\sqrt{1+x}+\sqrt{1-x}}{2}\right)$, then the value of $\frac{dy}{dx}$ at $x = 0$ is

(a) 1/2 (b) −1/2

(c) 0 (d) None of these

24. The area of a parallelogram whose adjacent sides are represented by the vectors $\mathbf{a} = -\hat{i} - 2\hat{j} - 3\hat{k}$ and $\mathbf{b} = -\hat{i} + 2\hat{j} - 3\hat{k}$ is

(a) $\sqrt{14}$ (b) $\sqrt{6}$ (c) $\frac{49}{36}$ (d) $4\sqrt{10}$

25. The resultant of two forces of 3 kg-wt and 4 kg-wt which are inclined at 30° angles to each other is

(a) $\sqrt{25+6\sqrt{3}}$ (b) $\sqrt{25+12\sqrt{3}}$

(c) $\sqrt{37}$ (d) $\sqrt{13}$

26. Let two like parallel forces are acting, at points A and B such that the force at A is double than the force at B. If C is the point of action of the resultant, then AC/BC is

(a) 2 (b) 1/2

(c) 1/3 (d) 1/4

27. Let $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$ represent vector quantities. Which of the following points are collinear?

(a) $\mathbf{a} - 2\mathbf{b} + 3\mathbf{c}, 2\mathbf{a} + 3\mathbf{b} - 4\mathbf{c}, -7\mathbf{b} + 10\mathbf{c}$

(b) $-2\mathbf{a} + 3\mathbf{b} + 5\mathbf{c}, \mathbf{a} + 2\mathbf{b} + 3\mathbf{c}, 7\mathbf{a} - \mathbf{c}$

(c) $\mathbf{a}, \mathbf{b}, 3\mathbf{a} - 2\mathbf{b}$

(d) $\mathbf{a} + \mathbf{b} - \mathbf{c}, 3\mathbf{a} - 4\mathbf{c}, 2\mathbf{a} + \mathbf{b} + 3\mathbf{c}$

28. The values of λ and μ for which the vectors $\mathbf{a} = 2\hat{i} + \lambda\hat{j} - \hat{k}$ is perpendicular to the vector $\mathbf{b} = 3\hat{i} + \hat{j} + \mu\hat{k}$ with $|\mathbf{a}| = |\mathbf{b}|$ are

(a) $\lambda = \frac{41}{12}, \mu = \frac{31}{12}$ (b) $\lambda = \frac{41}{12}, \mu = -\frac{31}{12}$

(c) $\lambda = -\frac{41}{12}, \mu = \frac{31}{12}$ (d) None of these

29. A force of 25 N is applied to two objects A and B. This force produces the accelerations in the ratio 4 : 3. If the force is increased to 30 N, then the difference in the ratios of new and earlier accelerations is

(a) zero (b) 4/3

(c) 8/3 (d) 3/4

30. Two stones A and B are thrown at an angle of 50° from the horizontal. The velocity of B is twice of the velocity of A. The ratio in the greatest heights attained by A and B is

(a) 1/2 (b) 1/4

(c) 1/8 (d) None of these

31. Three forces A, B and C acting at a point are in equilibrium. The ratio of angles between A and B; B and C; and A and C is 1 : 2 : 3. Then, $A : B : C$ is

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

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

32. Two parallel unlike forces of magnitudes 15 N and 10 N are acting at points A and B respectively. If C is the point of action of resultant, then AB/BC is

(a) 2/1 (b) 1/2

(c) 2/3 (d) 3/2

33. The distance (in metre) travelled by a vehicle in time t (in seconds) is given by the equation $s = 3t^3 + 2t^2 + t + 1$. The difference in the acceleration between $t = 2$ and $t = 4$ is

(a) 36 m/s^2 (b) 38 m/s^2

(c) 45 m/s^2 (d) 46 m/s^2

34. If a person A is moving with velocity 2 km/h, person B is moving with velocity 3 km/h and the angle between the direction of movements of A and B is 60°, then the velocity of A relative to B in the direction of A is

(a) $\sqrt{13-6\sqrt{3}}$ (b) $\sqrt{13+6\sqrt{3}}$

(c) $\sqrt{7}$ (d) $\sqrt{19}$

35. The sum of n terms of the series $\sum_{x=1}^{n} \log\frac{2^x}{3^{x-1}}$ is

(a) $\log\left(\frac{2^{n-1}}{3^{n+1}}\right)^{n/2}$ (b) $\log\left(\frac{2^{n+1}}{3^{n-1}}\right)^{n/2}$

(c) $\log\left(\frac{3^{n-1}}{2^{n+1}}\right)^{n/2}$ (d) $\log\left(\frac{3^{n+1}}{2^{n-1}}\right)^{n/2}$

36. If x, y and z are in geometric progression, then $\log_x 10$, $\log_y 10$ and $\log_z 10$ are in
(a) arithmetic progression
(b) geometric progression
(c) harmonic progression
(d) None of these

37. If one of the root of $2x^2 - cx + 3 = 0$ is 3 and another equation $2x^2 - cx + d = 0$ has equal roots where c and d are real numbers, then d is
(a) 3 (b) 49/8
(c) 8/49 (d) −3

38. The value of r for which the coefficients of $(r-5)$th and $(3r+1)$th terms in the expansion of $(1+x)^{12}$ are equal, is
(a) 4 (b) 9
(c) 12 (d) None of these

39. If $x = \frac{-3+i\sqrt{3}}{2}$ is a complex number, then the value of $(x^2+3x)^2(x^2+3x+1)$ is
(a) $-\frac{9}{8}$ (b) 6
(c) −18 (d) 36

40. $\left[\frac{1+\cos\left(\frac{\theta}{2}\right)-i\sin\left(\frac{\theta}{2}\right)}{1+\cos\left(\frac{\theta}{2}\right)+i\sin\left(\frac{\theta}{2}\right)}\right]^{4n}$ is equal to
(a) $\cos n\theta - i\sin n\theta$ (b) $\cos n\theta + i\sin n\theta$
(c) $\cos 2n\theta - i\sin 2n\theta$ (d) $\cos 2n\theta + i\sin 2n\theta$

41. The value of
$$\begin{bmatrix} 1 & -\tan\frac{\theta}{4} \\ \tan\frac{\theta}{4} & 1 \end{bmatrix}\begin{bmatrix} 1 & \tan\frac{\theta}{4} \\ -\tan\frac{\theta}{4} & 1 \end{bmatrix}^{-1}$$ is
(a) $\begin{bmatrix} \cos\frac{\theta}{2} & \sin\frac{\theta}{2} \\ -\sin\frac{\theta}{2} & \cos\frac{\theta}{2} \end{bmatrix}$ (b) $\begin{bmatrix} \cos\frac{\theta}{2} & -\sin\frac{\theta}{2} \\ \sin\frac{\theta}{2} & \cos\frac{\theta}{2} \end{bmatrix}$

(c) $\begin{bmatrix} \sin\frac{\theta}{2} & \cos\frac{\theta}{2} \\ -\cos\frac{\theta}{2} & \sin\frac{\theta}{2} \end{bmatrix}$ (d) $\begin{bmatrix} \sin\frac{\theta}{2} & -\cos\frac{\theta}{2} \\ \cos\frac{\theta}{2} & \sin\frac{\theta}{2} \end{bmatrix}$

42. The value of λ and μ for which the simultaneous equation $x+y+z=6$, $x+2y+3z=10$ and $x+2y+\lambda z=\mu$ have a unique solution are
(a) $\lambda \neq 3$
(b) $\mu = 3$ only
(c) $\lambda = 3$ and $\mu = 3$
(d) $\lambda \neq 3$ and μ can take any value

43. Let $C_0, C_1, \ldots, C_n$ denotes the binomial coefficients in the expansion of $(1+x)^n$. The value of $C_1 - 2C_2 + 3C_3 - 4C_4 + \ldots\ldots$ (upto n terms) is
(a) 2^n (b) 2^{-n} (c) 0 (d) 1

44. If X is any matrix of order $n \times p$ (n and p are integers) and I is an identity matrix of order $n \times n$, then the matrix $M = I - X(X'X)^{-1}X'$ is
(i) idempotent matrix (ii) $MX = O$
Choose the correct answer.
(a) (i) is correct (b) (ii) is correct
(c) (i) is incorrect (d) (ii) is incorrect

45. If $g: R \to R$ is a mapping such that $g(x) = 9x + 4, \forall x \in R$, then $g^{-1}(7)$ is
(a) 3 (b) 1/3
(c) −3 (d) −1/3

46. The value of $4 + 2(1+2)\log 2 + \frac{2(1+2^2)}{2!}(\log 2)^2 + \frac{2(1+2^3)}{3!}(\log 2)^3 + \ldots$ is
(a) 10 (b) 12
(c) $\log(3^2 \cdot 4^2)$ (d) $\log(2^2 \cdot 3^2)$

47. The value of $\log(10 + 10x + 10x^2 + \ldots\ldots)$ is
(a) $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots\ldots$
(b) $1 - x + \frac{x^2}{2!} - \frac{x^3}{3!} + \ldots\ldots$
(c) $1 - x - \frac{x^2}{2} - \frac{x^3}{3} + \ldots\ldots$
(d) $1 + x + \frac{x^2}{2} + \frac{x^3}{3} + \ldots\ldots$

48. The value of $\frac{(\sqrt{\sqrt{3}+1}+\sqrt{\sqrt{3}-1})(\sqrt{3}-\sqrt{2})}{(\sqrt{\sqrt{3}+1}-\sqrt{\sqrt{3}-1})}$ is

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

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

49. If the sets A and B are as follows : $A = \{1, 2, 3, 4\}, B = \{3, 4, 5, 6\}$, then

(a) $A - B = \{1, 2\}$
(b) $B - A = \{5, 6\}$
(c) $[(A - B) - (B - A)] \cap A = \{1, 2\}$
(d) $[(A - B) - (B - A)] \cup A = \{3, 4\}$

50. If A and B are two equivalence relations defined on set C, then

(a) $A \cap B$ is an equivalence relation
(b) $A \cap B$ is not an equivalence relation
(c) $A \cup B$ is an equivalence relation
(d) $A \cup B$ is not an equivalence relation

Answers

Physics

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

Chemistry

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

Mathematics

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

Note '*' None of the given option is correct.