UPSEE - 2012

Physics

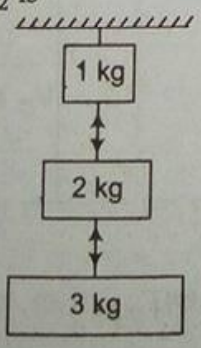
1. The dimensions of capacitance are
   (a) $[ML^{-2}Q^{-2}T^2]$ (b) $[M^{-1}L^2T^{-2}Q^{-2}]$
   (c) $[M^{-1}L^2T^{-2}Q^2]$ (d) $[M^{-1}L^{-2}T^2Q^2]$

2. A scooter going to the east at 10 m/s turns right through an angle of 90°. If the speed of the scooter remains unchanged in taking this turn, the change in the velocity of the scooter is
   (a) 20 m/s in south-west direction
   (b) zero
   (c) 10.0 m/s in south direction
   (d) 14.14 m/s in south-western direction

3. A man of height h walks in a straight path towards a lamp post of height H with uniform velocity u. Then, the velocity of the edge of the shadow on the ground will be
   (a) $\frac{hu}{(H-h)}$ (b) $\frac{(Hu)}{(H+h)}$
   (c) $\frac{(H-h)}{Hu}$ (d) $\frac{(H+h)}{Hu}$

4. A ball is projected upwards from the top of a tower with a velocity of 50 m/s making an angle of 30° with the horizontal. The height of the tower is 70 m. After how many seconds from the instant of throwing will the ball reach the ground ?
   (a) 2 s (b) 5 s (c) 7 s (d) 9 s

5. In the system shown in the adjoining figure, the tension T_2 is



   (a) g (b) $2g$
   (c) $5g$ (d) $6g$

6. A bullet when fired at a target with a velocity of 100 m/s penetrates one metre into it. If the bullet is fired at a similar target with a thickness 0.5 m. Then, it will emerge from it with a velocity of
   (a) $50\sqrt{2}$ m/s (b) $\frac{50}{\sqrt{2}}$ m/s
   (c) 50 m/s (d) 10 m/s

7. A 500 kg boat is 9 m long and is floating without motion on still water. A man of mass 100 kg is at one end and if he runs to the other end of the boat and stops, the displacement of the boat is
   (a) 1.5 m in the direction of displacement of the man
   (b) 0.75 m in the direction of displacement of the man
   (c) 1.5 m in the direction opposite to the displacement of the man
   (d) 0.75 m in the direction opposite to the displacement of the man

8. A man weighing 80 kg is standing on a trolley weighing 320 kg. The trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley along the rails at speed 1 m/s. Then after 4 s, his displacement relative to ground will be
   (a) 4.5 m (b) 5 m
   (c) 8 m (d) 3.2 m

9. The magnitudes of gravitational field at distances r_1 and r_2 from the centre of a uniform sphere of radius R and mass M and F_1 and F_2 respectively. Then,
   (a) $\frac{F_1}{F_2} = \frac{r_1}{r_2}$ if $r_1 < R$ and $r_2 < R$
   (b) $\frac{F_1}{F_2} = \frac{r_1^2}{r_2^2}$ if $r_1 > R$ and $r_2 > R$
   (c) Both (a) and (b)
   (d) None of the above

10. One end of a uniform bar of weight w_1 is suspended from the roof and a weight w_2 is suspended from the other end, the area of cross-section is A. What is the stress at the mid point of the rod?

(a) $\frac{w_1 + w_2}{A}$ (b) $\frac{w_1 - w_2}{A}$

(c) $\frac{(w_1/2) + w_2}{A}$ (d) $\frac{w_2/2 + w_1}{A}$

11. The potential energy of a molecules on the surface of a liquid compared to the one inside the liquid is

(a) zero (b) lesser

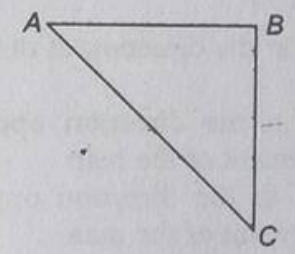
(c) equal (d) greater

12. The fraction of a floating object of volume V_o and density d_o above the surface of a liquid of density d will be

(a) $\frac{d_o}{d}$ (b) $\frac{dd_o}{d + d_o}$

(c) $\frac{d - d_o}{c}$ (d) $\frac{dd_o}{d \cdot d_o}$

13. In a metallic triangular sheet ABC, $AB = BC = l$. If M is mass of sheet, what is the moment of inertia about AC?



(a) $\frac{Ml^2}{4}$ (b) $\frac{Ml^2}{12}$

(c) $\frac{Ml^2}{6}$ (d) $\frac{Ml^2}{18}$

14. A small ball describes a horizontal circle on the smooth inner surface of a conical funnel. If the height of the plane of the circle above the vertex be 10 cm, what is the speed of the particle?

(a) 2 m/s (b) 4 m/s

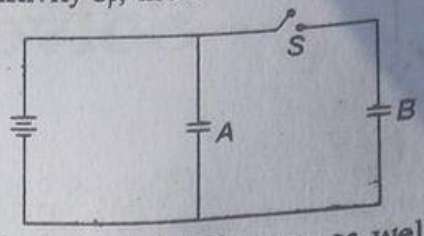
(c) 16 m/s (d) 1 m/s

15. A satellite of mass m is orbiting around the earth at a height equal to twice the radius of the earth (R). Its potential energy is given by

(a) $-2mgR$ (b) $-mg\frac{R}{2}$

(c) $-2mg\frac{R}{3}$ (d) $-mg\frac{R}{3}$

16. Two identical air filled parallel plate capacitors are charged to the same potential in the manner shown by closing the switch S. If now the switch S is opened and the space between the plates is filled with a dielectric of relative permittivity ε_r, then



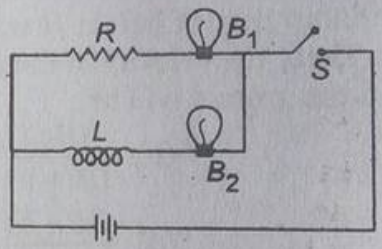
(a) the potential difference as well as charge on each capacitor goes up by a factor ε_r

(b) the potential difference as well as charge on each capacitor goes down by a factor ε_r

(c) the potential difference across A remains constant and the charge on B remains unchanged

(d) the potential difference across B remains constant while the charge on A remains unchanged

17. Figure represents two bulbs B_1 and B_2, resistor R and an inductor L. When the switch S is turned off



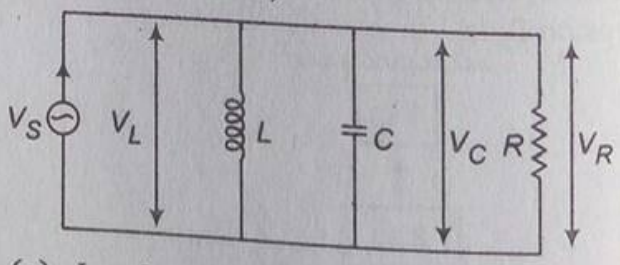
(a) both B_1 and B_2 die out promptly

(b) both B_1 and B_2 die out with some delay

(c) B_1 dies out promptly but B_2 with some delay

(d) B_2 dies out promptly but B_1 with some delay

18. An AC source is connected in parallel with an L-C-R circuit as shown. Let I_S, I_L, I_C and I_R denote the currents through and V_S, V_L, V_C and V_R the voltages across the corresponding components. Then,



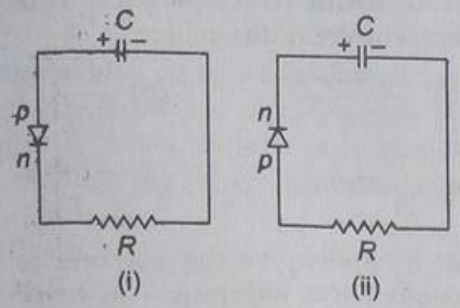
(a) $I_S = I_L + I_C + I_R$

(b) $V_S = V_L + V_C + V_R$

(c) $(I_L, I_C, I_R) < I_S$

(d) I_L, I_C may be greater than I_S

19. Two identical capacitors each of capacitance C are charged to the same potential V and are connected in two circuits (i) and (ii) at $t = 0$ as shown. The charged on the capacitor at $t = CR$ are



(a) $\frac{CV}{e}, \frac{CV}{e}$ (b) CV, CV

(c) $\frac{VC}{e}, VC$ (d) $VC, \frac{VC}{e}$

20. If a semiconductor has an intrinsic carrier concentration of $1.41 \times 10^{16}/m^3$, when doped with $10^{21}/m^3$ phosphorous atoms, then the concentration of holes/m^3 at room temperature will be

(a) 2×10^{21}

(b) 2×10^{11}

(c) 1.41×10^{10}

(d) 1.41×10^{16}

21. A parallel beam of light is incident normally on a plane surface absorbing 40% of the light and reflecting the rest. If the incident beam carries 60 W of power, the force exerted by it on the surface is

(a) 3.2×10^{-8} N

(b) 3.2×10^{-7} N

(c) 5.12×10^{-7} N

(d) 5.12×10^{-8} N

22. A fraction f_1 of a radioactive sample decays in one mean life and a fraction f_2 decay is one half-life

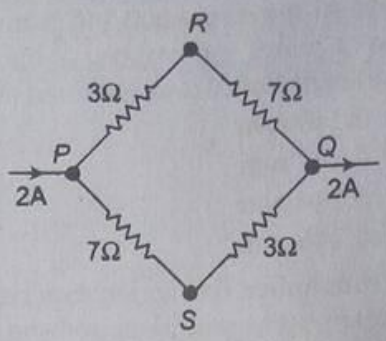
(a) $f_1 > f_2$

(b) $f_1 < f_2$

(c) $f_1 = f_2$

(d) may be (a), (b) or (c) depending on the values of the mean life and half-life

23. A current of 2 A flows in an electric circuit as shown in figure. The potential difference $(V_R - V_S)$, in volts (V_R and V_S are potentials at R and S respectively is



(a) −4 (b) +2

(c) +4 (d) −2

24. When a battery connected across a resistor of 16Ω, voltage across the resistor is 12V. When the same battery is connected across a resistor of 10 Ω, voltage across it is 11 V. The internal resistance of the battery (in ohm) is

(a) $\frac{10}{7}$ (b) $\frac{20}{7}$

(c) $\frac{25}{7}$ (d) $\frac{30}{7}$

25. One junction of a certain thermoelectric couple is at a fixed temperature T_r and the other junction is at temperature T. The thermo-electromotive force for this is expressed by $E = k(T - T_r)\left[T_0 - \frac{1}{2}(T + T_r)\right]$. At temperature $T = \frac{1}{2}T_0$, the thermoelectric power is

(a) $\frac{1}{2}kT_0$ (b) kT_0

(c) $\frac{1}{2}kT_0^2$ (d) $\frac{1}{2}k(T_0 - T_r)^2$

26. Two concentric coils of 10 turns each are placed in the same plane. Their radii are 20 cm and 40 cm and carry 0.2 A and 0.3 A. current respectively in opposite directions. The magnetic induction (in tesla) at the centre is

(a) $\frac{3}{4}\mu_0$ (b) $\frac{5}{4}\mu_0$

(c) $\frac{7}{4}\mu_0$ (d) $\frac{9}{4}\mu_0$

27. The number of turns in primary and secondary coils of a transformer is 50 and 200 respectively. If the current in the primary coil is 4 A, then the current in the secondary coil is

(a) 1 A (b) 2 A

(c) 4 A (d) 5 A

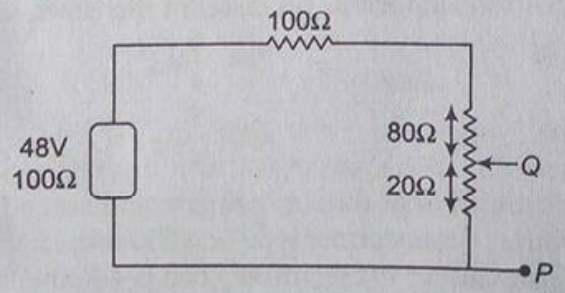
28. X-rays of wavelength 0.140 n-m are scattered from a block of carbon. What will be the wavelengths of X-rays scattered at 90°?
(a) 0.140 n-m
(b) 0.142 n-m
(c) 0.144 n-m
(d) 0.146 n-m

29. In Fraunhoffer diffraction experiment, L is the distance between screen and the obstacle, b is the size of obstacle and λ is wavelength of incident light. The general condition for the applicability of Fraunhoffer diffraction is
(a) $\frac{b^2}{L\lambda} >> 1$ (b) $\frac{b^2}{L\lambda} = 1$
(c) $\frac{b^2}{L\lambda} << 1$ (d) $\frac{b^2}{L\lambda} \neq 1$

30. With a standard rectangular bar magnet the time period of a vibration magnetometer is 4 s. The bar magnet is cut parallel to its length into four equal pieces. The time period of vibration magnetometer when one piece is used (in second) (bar magnet breadth is small) is
(a) 16 (b) 8
(c) 4 (d) 2

31. At a given place where acceleration due to gravity is g m/s^2, a sphere of lead of density d kg/m^3 is gently released in a column of liquid of density ρ kg/m^3. If $d > \rho$, the sphere will
(a) fall vertically with an acceleration g m/s^2
(b) fall vertically with no acceleration
(c) fall vertically with an acceleration $g\left(\frac{d-\rho}{d}\right)$
(d) fall vertically with an acceleration $g\left(\frac{\rho}{d}\right)$

32. In the circuit, the potential difference across PQ will be nearest to



(a) 9.6 V (b) 6.6 V
(c) 4.8 V (d) 3.2 V

33. A metal sphere of radius r and specific heat s is rotated about an axis passing through its centre at a speed of n rotations per second. It is suddenly stopped and 50% of its energy is used in increasing its temperature. Then the rise in temperature of the sphere is
(a) $\frac{2\pi^2 n^2 r^2}{5s}$ (b) $\frac{\pi^2 n^2}{10 r^2 s}$
(c) $\frac{7}{8}\pi^2 r^2 n^2 s$ (d) $\frac{5(\pi r n)^2}{14 s}$

34. Let n_p and n_e be the numbers of holes and conduction electrons in an extrinsic semiconductor, then
(a) $n_p > n_e$
(b) $n_p = n_e$
(c) $n_p < n_e$
(d) $n_p \neq n_e$

35. Two particles P and Q describe SHM of same amplitude a frequency v along the same straight line. The maximum distance between two particles is $\sqrt{2}a$. The initial phase difference between the particles is
(a) zero (b) $\pi/2$
(c) $\pi/6$ (d) $\pi/3$

36. A wire is stretched as to change its diameter by 0.25%. The percentage change in resistance is
(a) 4.0% (b) 2.0%
(c) 1.0% (d) 0.5%

37. A coil of inductance 8.4 mH and resistance 6 Ω is connected to 12 V battery. The current in the coil is 1 A at approximately the time
(a) 500 s (b) 20 s
(c) 35 ms (d) 1 ms

38. In a stationary wave,
(a) strain is maximum at antinodes
(b) strain is maximum at nodes
(c) strain is minimum at nodes
(d) amplitude is zero at all points

39. A string of density 7.5 g cm^{-3} and area of cross-section 0.2 mm^2 is stretched under a tension of 20 N. When it is plucked at the mid point, the speed of the transverse waves on the wire is
(a) 116 m/s (b) 40 m/s
(c) 200 m/s (d) 80 m/s

40. Amplitude of a wave is represented by

$$A = \frac{c}{a+b-c}$$

Then, resonance will occur when

(a) $b = -c/2$ (b) $b = 0$ and $a = c$

(c) $b = -a/2$ (d) None of these

41. Capacitance of a capacitor made by a thin metal foil is 2μF. If the foil is folded with paper of thickness 0.15 mm, dielectric constant of paper is 2.5 and width of paper is 400 mm, the length of the foil will be

(a) 0.34 m (b) 1.33 m

(c) 13.4 m (d) 33.9 m

42. A rod of a certain metal is 1.0 m long and 0.6 cm in diameter. Its resistance is 3.0×10^{-3} Ω. Another disc made of the same metal is 2.0 cm in diameter and 1.0 mm thick. What is the resistance between the round faces of the disc?

(a) 1.35×10^{-8} Ω (b) 2.70×10^{-7} Ω

(c) 4.05×10^{-6} Ω (d) 8.10×10^{-5} Ω

43. The cyclotron frequency of an electron grating in a magnetic field of 1 T is approximately

(a) 28 MHz (b) 280 MHz

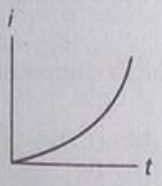
(c) 2.8 GHz (d) 28 GHz

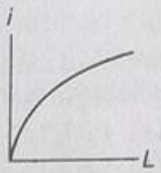
44. An electron is accelerated through potential difference of 45.5 volt. The velocity acquired by it is (in ms^{-1})

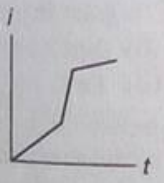
(a) 4×10^6 (b) 4×10^{-6}

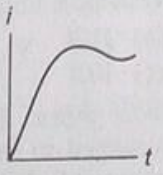
(c) 10^6 (d) zero

45. When a battery is connected across a series combination of self-inductance L and resistance R, the variation in the current i with time t is the best represented by

(a) 

(b) 

(c) 

(d) 

46. The magnetic moment produced in a substance of 1 g is 6×10^{-7} A-m^2. If its density is 5 g/km^2, then the intensity of magnetisation in A/m will be

(a) 8.3×10^6

(b) 3.0

(c) 1.2×10^{-7}

(d) 3×10^{-6}

47. A moving coil galvanometer has 48 turns and area of coil is 4×10^{-2} m^2. If the magnetic field is 0.2 T, then to increases the current sensitivity by 25% without changing area (A) and field (B) the number of turns should become

(a) 24

(b) 36

(c) 60

(d) 54

48. A coil carrying electric current is placed in uniform magnetic field, then

(a) torque is formed

(b) emf is induced

(c) Both (a) and (b) are correct

(d) None of the above

49. Two copper balls each weighing 10 g are kept in air 10 cm apart. If one electron from every 10^6 atoms is transferred from one ball to the other, the coulomb force between them is (atomic weight of copper is 63.5)

(a) 2.0×10^{10} N

(b) 2.0×10^4 N

(c) 2.0×10^8 N

(d) 2.0×10^6 N

50. A simple telescope consisting of an objective of focal length 60 cm and a single eye lens of focal length 5 cm is focused on a distant object is such a way that parallel rays come out from the eye lens. If the object subtends an angle 2° at the objective, the angular width of the image

(a) 10°

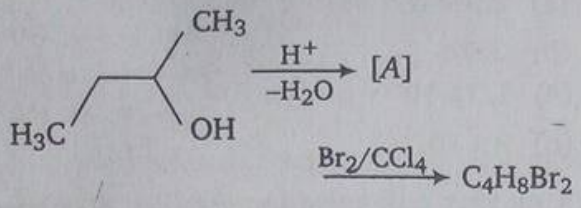
(b) 24°

(c) 50°

(d) 1/6°

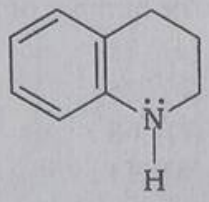
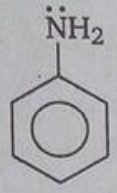
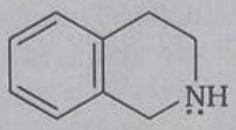
Chemistry

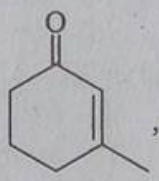
1. In the following reaction, number of possible structure is

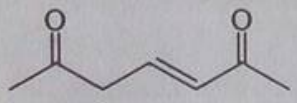
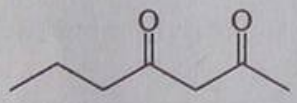
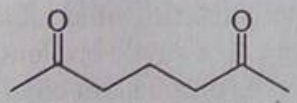
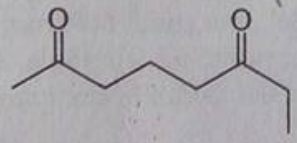


(a) 1 (b) 2
(c) 5 (d) 6

2. Which of the following is the most basic ?

(a) 
(b) 
(c) 
(d) 

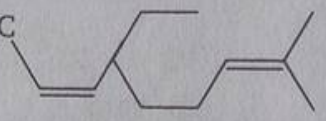
3. Which of the following will yield  , when reacted with base ?

(a) 
(b) 
(c) 
(d) 

4. Which of the following is formed on reduction of oxalic acid with magnesium mercury amalgum and H_2SO_4 ?
(a) Glyoxalic acid
(b) Formic acid
(c) Glycolic acid
(d) CO_2 and H_2O

5. On mixing urea with nitrous acid, the composition of the products is
(a) $NH_2—NH_2 + CO_2$
(b) $N_2 + C + H_2O$
(c) $NH_3 + CO_2 + H_2O$
(d) $N_2 + CO_2 + H_2O$

6. Mark out the correct decreasing order of ease of addition of halogen.
(a) $CH_2=CH_2 > CH_3—CH=CH—CH_3 > CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2 > (CH_3)_2C=C(CH_3)_2$
(b) $(CH_3)_2C=C(CH_3)_2 > CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2 > CH_3—CH=CH—CH_3 > CH_2=H_2$
(c) $(CH_3)_2C=C(CH_3)_2 > CH_3—CH=CHCH_3 > CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2 > CH_2=CH_2$
(d) $CH_2=CH_2 > CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2 > CH_3—CH=CH—CH_3 > (CH_3)_2C=C(CH_3)_2$

7. 

IUPAC name of the compound is
(a) 2-methyl-6-ethyloct- 1, 5-dienal
(b) 3-ethyl-7-methyloct-2, 6-dienal
(c) 7-methyl-3- ethyloct-2, 6-dienal
(d) None of the above

8. Which of the following nitro compounds are not soluble in NaOH?
(a) $(CH_3)_3C—NO_2$ (b) $(CH_3)_2CH—NO_2$
(c) $CH_3CH_2—NO_2$ (d) $Ph—CH_2—NO_2$

9. Transport number of Cl^- is least in
(a) HCl (b) NaCl
(c) KCl (d) CsCl

10. Iron pipes, lying in acidic soil, are often attached to the blocks of magnesium for their protection from rusting, because magnesium
(a) is lighter than iron
(b) is readily converted into positive ion

(c) forms a corrosion-resistant alloy with iron
(d) prevents air from reaching the surface of iron

11. Decomposition of H_2O_2 is a first order reaction. Initially, solution of H_2O_2 having half-life time 15 min is 16 volume. When solution becomes 1 volume
(a) 4 min (b) 15 min
(c) 30 min (d) 60 min

12. What is the name of the element with atomic number 105 ?
(a) Dubnium (b) Holmium
(c) Kurchatovium (d) Nobelium

13. Consider the ground state of Cr atom ($Z = 24$). The numbers of electrons with the azimuthal quantum numbers, $l = 1$ and 2 are respectively
(a) 12 and 4 (b) 12 and 5
(c) 16 and 4 (d) 16 and 5

14. Sodium bicarbonate on heating decomposes to form sodium carbonate, CO_2 and water. If 0.2 moles of sodium bicarbonate is completely decomposed, how many moles of sodium carbonate is formed?
(a) 0.1 (b) 0.2
(c) 0.05 (d) 0.025

15. Intermolecular hydrogen bonding is strongest in
(a) HCHO (b) CH_3OH
(c) C_6H_5OH (d) CH_3NH_2

16. What is the two third life of a first order reaction having $k = 5.48 \times 10^{-14}\ s^{-1}$?
(a) 1×10^{13} s (b) 2×10^{13} s
(c) 8×10^{13} s (d) 5×10^{14} s

17. In a cell that utilises the reaction
$Zn(s) + 2H^+(aq) \longrightarrow Zn^{2+}(aq) + H_2(g)$
addition of H_2SO_4 to cathode compartment will
(a) lower the E and shift equilibrium to the left
(b) lower the E and shift the equilibrium to the right
(c) increase the E and shift the equilibrium to the right
(d) increase the E and shift the equilibrium to the left

18. Which of the following solvents are aprotic ?
I. NH_3 II. SO_2
III. CH_3CN IV. CH_3CO_2H
(a) I, II, III (b) I, III, IV
(c) II, III (d) I, III

19. The most efficient agent for the absorption of SO_3 is
(a) 80% H_2SO_4 (b) 98% H_2SO_4
(c) 50% H_2SO_4 (d) 20% $H_2S_2O_7$

20. Which of the following reaction is used to make a fuel cell?
(a) $Cd(s) + 2Ni(OH)_3(s) \longrightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$
(b) $2Fe(s) + O_2(g) + 4H^+(aq) \longrightarrow 2Fe^{2+}(aq) + 2H_2O(l)$
(c) $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$
(d) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

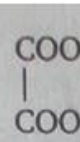
21. If 20 g of a solute was dissolve in 500 mL of water and osmotic pressure of the solution was found to be 600 mm of Hg at 15°C, then molecular weight of the solute is
(a) 1000 (b) 1200
(c) 1400 (d) 1800

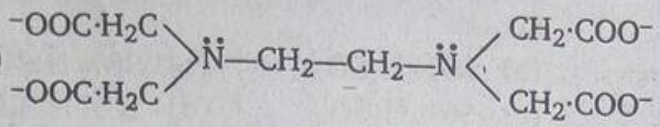
22. If standard enthalpies of formation of CaCl (s) (hypothetical) and that of $CaCl_2(s)$ are $-188\ J\ mol^{-1}$ and $-795\ kJ\ mol^{-1}$ respectively, calculate the value of standard heat of reaction for the following disproportionation reaction
$2CaCl(s) \longrightarrow CaCl_2(s) + Ca(s)$
(a) $-607\ kJ\ mol^{-1}$ (b) $+607\ kJ\ mol^{-1}$
(c) $-419\ kJ\ mol^{-1}$ (d) $+419\ kJ\ mol^{-1}$

23. Which of the following is not a polymer?
(a) Cholesterol (b) Oxytocin
(c) Amylose (d) RNA

24. Aluminium chloride exists as dimer, Al_2Cl_6, in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives
(a) $Al^{3+} + 3Cl^-$
(b) $[Al(H_2O_6]^{3+} + Cl^-$
(c) $[Al(HO)_6]^{3-} + 3HCl$
(d) $Al_2O_3 + 6HCl$

25. Which ligand is useful for removal of the toxic effect of lead metal in body in chelate therapy treatment?
(a) AsO_4^{3-}
(b) CH_3COO^+

(c) 

(d) 

26. The number of sodium atoms in 2 moles of sodium ferrocyanide is

(a) 12×10^{23} (b) 26×10^{23}

(c) 34×10^{23} (d) 48×10^{23}

27. The reaction,

$$R-\underset{\underset{O}{\|}}{C}-R \xrightarrow[H_2SO_4]{N_3H} RCONHR + N_2$$ is called

(a) Claisen-Schmidt reaction

(b) Kolbe-Schmidt reaction

(c) Schmidt reaction

(d) Kolbe's reaction

28. The ions N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+} are isoelectronic. Their ionic radii show

(a) an increase from N^{3-} to F^- and then decrease from Na^+ to Mg^{2+}

(b) a decrease from N^{3-} to F^- and then increase from Na^+ to Mg^{2+}

(c) a significant increase from N^{3-} to Mg^{2+}

(d) a significant decrease from N^{3-} to Mg^{2+}

29. Which of the following is not true?

(a) In a first order reaction, the half-life is independent to the initial concentration of reactant

(b) A given piece of charcoal shows increase in its surface area in its powdered form

(c) In valence bond of H_2, each electron spends its time around its own nucleus

(d) In valence bond of H_2, both the electrons spend their time around both the nucleus

30. When glucose reacts with acetone in acidic medium, the main product is

(a) laevulic acid

(b) glycosazone

(c) dioxopropylidene glucose

(d) None of the above

31. Which of the following is not true for antibiotics?

(a) Tetracycline is one of the broad spectrum antibiotics which are effective against a large number of harmful microorganisms

(b) Streptomycin is highly effective against microorganisms which cause tuberculois

(c) Penicillin has a narrow spectrum and certain persons are sensitive to it

(d) Penicillin may be administered without testing the patients for sensitivity to it

32. Match the Column I and Column II and choose the correct code given below.

S.No.	Column I		Column II
A.	Peroxyacetyl nitrile	(i)	Waste incineration
B.	Indigo	(ii)	Vat dye
C.	IR active molecules	(iii)	Global warming
D.	Dioxins	(iv)	Photochemical smog

Codes

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

33. 250 mL of a Na_2CO_3 solutioncontains 2.65 g of Na_2CO_3. 10 mL of this solution is added to x mL of water to obtain 0.001 M Na_2CO_3 solution.The value of x is (molecular weight of $Na_2CO_3 = 106$)

(a) 1000 mL (b) 990 mL

(c) 9990 mL (d) 90 mL

34. The densities of graphite and diamond at 298 K are 2.25 and 3.31 g cm^{-3} respectively. If the standard free energy difference is 1895 J mol^{-1}, the pressure at which graphite will be transformed into diamond is

(a) 9.92×10^8 Pa (b) 9.92×10^7 Pa

(c) 9.92×10^6 Pa (d) None of these

35. Which of the following statement is false ?

(a) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction

(b) The osmotic pressure (π) of a solution is given by the equation $\pi = MRT$, where M is the molarity of the solution

(c) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose

(d) Two sucrose solution of same molality prepared in different solvents will have the same freezing point depression

36. In the reduction of $KMnO_4$ by warm acidified oxalic acid, the oxidation number of Mn changes from
(a) + 4 to + 2 (b) + 6 to + 4
(c) + 7 to + 2 (d) + 7 to + 4

37. How much ethyl alcohol C_2H_5OH, must be added to 1.00 L of water so that the solution will not freeze at – 4°F?
(a) 211 g (b) 495 g
(c) 85 g (d) 46 g

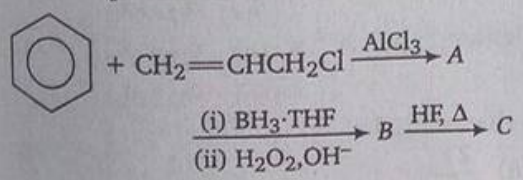
38. The reagent(s) used in the preparation of aspirin from salicylic acid
(a) $SOCl_2$, pyridine
(b) $(CH_3CO)_2O$, H^+
(c) CH_3CO_2H, HCl
(d) CH_3Cl, $AlCl_3$

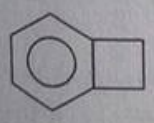
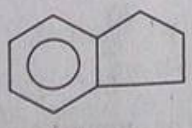
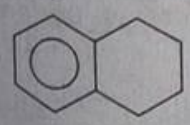
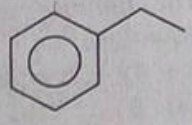
39. Chlorobenzene is *o*, *p*-directing in electrophilic substitution reaction. The directing influence is explained by
(a) + *M* of Ph (b) + *I* of Cl
(c) + *M* of Cl (d) – *I* of Ph

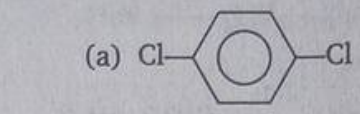
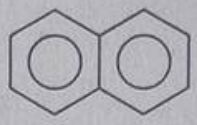
40. The correct order of decreasing dipole moment of (I) toluene, (II) *m*-dichlorobenzene (III) *o*-dichlorobenzene and (IV) *p*-dichlorobenzene is
(a) IV < II < I < III
(b) IV < I < II < III
(c) I < IV < II < III
(d) IV < I < III < II

41. Which of the following is the most stable compound ?
(a) $Ph_3\overset{+}{C}$ (b) $Ph_2\overset{+}{C}H$
(c) $Ph_2\overset{+}{C}H_2$ (d) $Ph\,\overset{+}{C}H_2$

42. The end product 'C' in the following reaction



(a)  (b) 
(c)  (d) 

43. Moth repellents are
(a)  (b) perchloroethane
(c)  (d) All of these

44. Alkaline earth's metals are denser than alkali metals, because metallic bonding in alkaline earth's metal is
(a) stronger (b) weaker
(c) volatile (d) not present

45. Transition metals have the electronic configuration $(n-1)\,d^{1-10}ns^{1-2}$. The *d*-orbitals are degenerate. Colour of transition metal ions is due to absorption of some wavelength. This results is
(a) *d-s* transition (b) *s-d* transition
(c) *s-s* transition (d) *d-d* transition

46. Which one of the following complexes is an outer orbital complex?
(Atomic number of Mn = 25, Fe = 26, Co = 27, Ni = 28)
(a) $[Fe(CN)_6]^{4-}$ (b) $[Mn(CN)_6]^{4-}$
(c) $[Co(NH_3)_6]^{3+}$ (d) $[Ni(NH_3)_6]^{2+}$

47. Which one of the following statements regarding helium is incorrect ?
(a) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable
(b) It is used as a cryogenic agent for carrying out experiments at low temperatures
(c) It is used to produce and sustain powerful superconducting magnets
(d) It is used in gas cooled nuclear reactors

48. Wolframite ore is separated from tin stone ore by the process of
(a) roasting (b) electromagnetic
(c) smelting (d) calcination

49. For a gas in equilibrium with a liquid, the ratio of the concentration of the gas in the solution phase to that in the gaseous phase is constant at constant temperature, only if molecules undergo
(a) ionisation (b) dissociation
(c) isolation (d) reaction with solvent

Mathematics

1. Out of 800 boys in a school, 224 played cricket, 240 played hockey and 336 played basketball. Of the total, 64 played both basketball and hockey; 80 played cricket and basketball and 40 played cricket and hockey; 24 played all the three games. The number of boys who did not play any game is

(a) 128 (b) 216
(c) 240 (d) 160

2. An integer m is said to be related to another integer n, if m is a multiple of n. Then, the relation is

(a) reflexive and symmetric
(b) reflexive and transitive
(c) symmetric and transitive
(d) an equivalence relation

3. The real part of $(1-i)^{-i}$ is

(a) $e^{-\pi/4}\cos\left(\frac{1}{2}\log 2\right)$

(b) $-e^{-\pi/4}\sin\left(\frac{1}{2}\log 2\right)$

(c) $e^{\pi/4}\cos\left(\frac{1}{2}\log 2\right)$

(d) $e^{-\pi/4}\sin\left(\frac{1}{2}\log 2\right)$

4. If $x_n = \cos\left(\frac{\pi}{4^n}\right) + i\sin\left(\frac{\pi}{4^n}\right)$, then $x_1 \cdot x_2 \cdot x_3 \ldots \infty$ is

(a) $\frac{1+i\sqrt{3}}{2}$ (b) $\frac{-1+i\sqrt{3}}{2}$
(c) $\frac{1-i\sqrt{3}}{2}$ (d) $\frac{-1-i\sqrt{3}}{2}$

5. The number of roots of the equation $|x|^2 - 7|x| + 12 = 0$ is

(a) 1 (b) 2
(c) 3 (d) 4

6. If the roots of the equation $ax^2 + bx + c = 0$ are real and of the form $\frac{\alpha}{\alpha-1}$ and $\frac{\alpha+1}{\alpha}$, then the value of $(a+b+c)^2$ is

(a) $b^2 - 4ac$ (b) $b^2 - 2ac$
(c) $2b^2 - ac$ (d) None of these

7. If $a^2 + b^2 + c^2 = -2$ and $f(x) = \begin{vmatrix} 1+a^2x & (1+b^2)x & (1+c^2)x \\ (1+a^2)x & 1+b^2x & (1+c^2)x \\ (1+a^2)x & (1+b^2)x & 1+c^2x \end{vmatrix}$, then $f(x)$ is a polynomial of degree

(a) 3 (b) 2
(c) 1 (d) 0

8. If $A = \begin{vmatrix} 1 & -1 & 1 \\ 0 & 2 & -3 \\ 2 & 1 & 0 \end{vmatrix}$ and $B = (\text{adj } A)$, and $C = 5A$, then $\frac{|\text{adj } B|}{|C|}$ is

(a) 5 (b) 25
(c) -1 (d) 1

9. If matrix $A = \begin{vmatrix} 1 & 0 & -1 \\ 3 & 4 & 5 \\ 0 & 6 & 7 \end{vmatrix}$ and its inverse is denoted by $A^{-1} = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$, then the value of a_{23} is

(a) $\frac{21}{20}$ (b) $\frac{1}{5}$
(c) $-\frac{2}{5}$ (d) $\frac{2}{5}$

10. The number of solutions of the system of equations $2x + y - z = 7$, $x - 3y + 2z = 1$ and $x + 4y - 3z = 5$ is

(a) 3 (b) 2 (c) 1 (d) 0

11. The number of triangles that can be formed by choosing the vertices from a set of 12 points, seven of which lie on the same straight line, is
(a) 185 (b) 175
(c) 115 (d) 105

12. In the expansion of $(1 + x + x^3 + x^4)^{10}$, the coefficient of x^4 is
(a) ${}^{40}C_4$ (b) ${}^{10}C_4$
(c) 210 (d) 310

13. Let $P(n)$ denote the statement that $n^2 + n$ is odd. It is seen that $P(n) \Rightarrow P(n+1)$, $P(n)$ is true for all
(a) $n > 1$ (b) n
(c) $n > 2$ (d) None of these

14. If the coefficient of $(2r+3)$th and $(r-3)$th terms in the expansion of $(1+x)^{18}$ are equal, then r is
(a) 12 (b) 10
(c) 8 (d) 6

15. $\binom{n}{0} + 2\binom{n}{1} + 2^2\binom{n}{2} + \ldots + 2^n\binom{n}{n}$ is equal to
(a) 2^n (b) 0
(c) 3^n (d) None of these

16. Let the sequence $a_1, a_2, a_3, \ldots, a_{2n}$ form an AP. Then, $a_1^2 - a_2^2 + a_3^2 - \ldots + a_{2n-1}^2 - a_{2n}^2$ is
(a) $\frac{n}{2n-1}(a_1^2 - a_{2n}^2)$
(b) $\frac{2n}{n-1}(a_{2n}^2 - a_1^2)$
(c) $\frac{n}{n+1}(a_1^2 + a_{2n}^2)$
(d) None of the above

17. The value of $\frac{1}{(1+a)(2+a)} + \frac{1}{(2+a)(3+a)} + \frac{1}{(3+a)(4+a)} + \ldots + \infty$ is, (where, a is a constant)
(a) $\frac{1}{1+a}$ (b) $\frac{2}{1+a}$
(c) ∞ (d) None of these

18. The harmonic mean of two numbers is 4 and the arithmetic and geometric mean satisfy the relation $2A + G^2 = 27$, the numbers are
(a) 6, 3 (b) 5, 4
(c) 5, – 2.5 (d) –3, 1

19. If f be the greater integer function and g be the modulus function, then
$(gof)\left(-\frac{5}{3}\right) - (fog)\left(-\frac{5}{3}\right)$ is
(a) 1 (b) –1
(c) 2 (d) 4

20. $\lim_{x \to 0} \frac{x}{|x| + x^2}$ is equal to
(a) 1 (b) –1
(c) 0 (d) Does not exist

21. If $a_1 = 1$ and $a_{n+1} = \frac{4 + 3a_n}{3 + 2a_n}$, $n \geq 1$ and if $\lim_{n \to \infty} a_n = n$, then the value of a is
(a) $\sqrt{2}$ (b) $-\sqrt{2}$
(c) 2 (d) None of these

22. $\lim_{x \to 0} \frac{\sin(\pi \cos^2 x)}{x^2}$ is equal to
(a) $-\pi$ (b) π
(c) $\frac{\pi}{2}$ (d) 1

23. If $f(x) = \begin{cases} \frac{1 - \cos 4x}{x^2}, & \text{when } x < 0 \\ a, & \text{when } x = 0 \\ \frac{\sqrt{x}}{\sqrt{(16 + \sqrt{x})} - 4}, & \text{when } x > 0 \end{cases}$ is continuous at $x = 0$, then the value of a will be
(a) 8 (b) –8
(c) 4 (d) None of these

24. If f is a real-valued differentiable function satisfying $|f(x) - f(y)| \leq (x-y)^2$, $x, y \in R$ and $f(0) = 0$, then $f(1)$ is equal to
(a) 2 (b) 1
(c) –1 (d) 0

25. $\int \frac{dx}{\sin x - \cos x + \sqrt{2}}$ is equal to
(a) $-\frac{1}{\sqrt{2}} \tan\left(\frac{x}{2} + \frac{\pi}{8}\right) + C$
(b) $\frac{1}{\sqrt{2}} \tan\left(\frac{x}{2} + \frac{\pi}{8}\right) + C$
(c) $\frac{1}{\sqrt{2}} \cot\left(\frac{x}{2} + \frac{\pi}{8}\right) + C$
(d) $-\frac{1}{\sqrt{2}} \cot\left(\frac{x}{2} + \frac{\pi}{8}\right) + C$

26. $\int e^{x/2} \sin\left(\frac{x}{2} + \frac{\pi}{4}\right) dx$ is equal to

(a) $e^{x/2} \cos\frac{x}{2} + C$

(b) $\sqrt{2}\, e^{x/2} \cos\frac{x}{2} + C$

(c) $e^{x/2} \sin\frac{x}{2} + C$

(d) $\sqrt{2}\, e^{x/2} \sin\frac{x}{2} + C$

27. The part of straight line $y = x + 1$ between $x = 2$ and $x = 3$ is revolved about x-axis, then the curved surface of the solid thus generated is

(a) $\frac{37\pi}{3}$ (b) $7\pi\sqrt{2}$

(c) 37π (d) $\frac{7\pi}{\sqrt{2}}$

28. The part of circle $x^2 + y^2 = 9$ in between $y = 0$ and $y = 2$ is revolved about y-axis. The volume of generating solid will be

(a) $\frac{46}{3}\pi$ (b) 12π

(c) 16π (d) 28π

29. If $\int_0^{t^2} x f(x)\, dx = \frac{2}{5}t^5, t > 0$, then $f\left(\frac{4}{25}\right)$ is

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

(c) $-\frac{2}{5}$ (d) None of these

30. The solution of the differential equation $xdy - ydx = (\sqrt{x^2 + y^2})\, dx$ is

(a) $y - \sqrt{x^2 + y^2} = Cx^2$

(b) $y + \sqrt{x^2 + y^2} = Cx^2$

(c) $y + \sqrt{x^2 + y^2} + Cx^2 = 0$

(d) None of the above

31. The solution of $\frac{dy}{dx} = \cos x\,(2 - y \operatorname{cosec} x)$, where $y = 2$, when $x = \frac{\pi}{2}$ is

(a) $y = \sin x + \operatorname{cosec} x$

(b) $y = \tan\frac{x}{2} + \cot\frac{x}{2}$

(c) $y = \frac{1}{\sqrt{2}} \sec\frac{x}{2} + \sqrt{2}\cos\frac{x}{2}$

(d) None of the above

32. The solution of the equation $\sin^{-1}\left(\frac{dy}{dx}\right) = x + y$ is

(a) $\tan(x + y) + \sec(x + y) = x + C$

(b) $\tan(x + y) - \sec(x + y) = x + C$

(c) $\tan(x + y) + \sec(x + y) + x + C = 0$

(d) None of the above

33. If the coordinates of the vertices of a triangle be $(1, a)$, $(2, b)$ and $(c^2, 3)$, then the centroid of the triangle

(a) lies at the origin

(b) cannot lie on x-axis

(c) cannot lie on y-axis

(d) None of the above

34. The area of a parallelogram formed by the lines $ax \pm by \pm c = 0$, is

(a) $\frac{c^2}{ab}$ (b) $\frac{2c^2}{ab}$

(c) $\frac{c^2}{2ab}$ (d) None of these

35. The equation of the circle with origin as centre passing the vertices of an equilateral triangle whose median is of length $3a$ is

(a) $x^2 + y^2 = 9a^2$

(b) $x^2 + y^2 = 16a^2$

(c) $x^2 + y^2 = a^2$

(d) None of the above

36. The axis of the parabola $9y^2 - 16x - 12y - 57 = 0$ is

(a) $3y = 2$

(b) $x + 3y = 3$

(c) $2x = 3$

(d) $y = 3$

37. The angle between the pair of tangents drawn to the ellipse $3x^2 + 2y^2 = 5$ from the point $(1, 2)$ is

(a) $\tan^{-1}\left(\frac{12}{5}\right)$ (b) $\tan^{-1}(6\sqrt{5})$

(c) $\tan^{-1}\left(\frac{12}{\sqrt{5}}\right)$ (d) $\tan^{-1} 12\sqrt{5}$

38. The angle between two diagonals of a cube will be

(a) $\sin^{-1}\left(\frac{1}{3}\right)$ (b) $\cos^{-1}\left(\frac{1}{3}\right)$

(c) variable (d) None of these

39. The lines $\frac{x-a+d}{\alpha-\delta}=\frac{y-a}{\alpha}=\frac{z-a-d}{\alpha+\delta}$ and $\frac{x-b+c}{\beta-r}=\frac{y-b}{\beta}=\frac{z-b-c}{\beta+r}$ are coplanar and then equation to the plane in which they lie, is
(a) $x+y+z=0$
(b) $x-y+z=0$
(c) $x-2y+z=0$
(d) $x+y-2z=0$

40. Three forces of magnitudes 1, 2 and 3 dynes meet in a point and act along diagonals of three adjacent faces of a cube. The resultant force is
(a) 114 dynes
(b) 6 dynes
(c) 5 dynes
(d) None of the above

41. The vectors $\mathbf{AB}=3\mathbf{i}+5\mathbf{j}+4\mathbf{k}$ and $\mathbf{AC}=5\mathbf{i}-5\mathbf{j}+2\mathbf{k}$ are side of a ΔABC. The length of the median through A is
(a) $\sqrt{13}$ units
(b) $2\sqrt{5}$ units
(c) 5 units
(d) 10 units

42. Let $\mathbf{a}=2\mathbf{i}+\mathbf{j}+\mathbf{k}$, $\mathbf{b}=\mathbf{i}+2\mathbf{j}-\mathbf{k}$, and a unit vector $\mathbf{c}$ be caplanar. If $\mathbf{c}$ is perpendicular to $\mathbf{a}$, then $\mathbf{c}$ is
(a) $\frac{1}{\sqrt{2}}(-\mathbf{j}+\mathbf{k})$
(b) $\frac{1}{\sqrt{3}}(-\mathbf{i}-\mathbf{j}-\mathbf{k})$
(c) $\frac{1}{\sqrt{5}}(\mathbf{i}-2\mathbf{j})$
(d) $\frac{1}{\sqrt{3}}(\mathbf{i}-\mathbf{j}-\mathbf{k})$

43. Odds 8 to 5 against a person who is 40 yr old living till he is 70 and 4 to 3 against another person now 50 till he will be living 80. Probability that one of them will be alive next 30 yr.
(a) $\frac{59}{91}$ (b) $\frac{44}{91}$
(c) $\frac{51}{91}$ (d) $\frac{32}{91}$

44. A purse contains 4 copper coins and 3 silver coins, the second purse contains 6 copper coins and 2 silver coins. If a coin is drawn out of any purse, then the probability that it is a copper coin is
(a) $\frac{4}{7}$ (b) $\frac{3}{4}$
(c) $\frac{37}{56}$ (d) None of these

45. The mean of the values $0, 1, 2, \ldots, n$ having corresponding weight ${}^nC_0, {}^nC_1, {}^nC_2, \ldots, {}^nC_n$ respectively, is
(a) $\frac{2^n}{(n+1)}$ (b) $\frac{2^{n+1}}{n(n+1)}$
(c) $\frac{n+1}{2}$ (d) $\frac{n}{2}$

46. Mean of 100 observations is 45. It was later found that two observations 19 and 31 were in correctly recorded as 91 and 13. The correct mean is
(a) 44.0 (b) 44.46
(c) 45.00 (d) 45.54

47. The value of $\sin\theta+\cos\theta$ will be greatest, when
(a) $\theta=30°$ (b) $\theta=45°$
(c) $\theta=60°$ (d) $\theta=90°$

48. A house subtends a right angle at the window of the opposite house and the angle of elevation of the window from the bottom of the first house is 60. If the distance between the two houses be 6 m, then the height of the first house is
(a) $6\sqrt{3}$ m (b) $8\sqrt{3}$ m
(c) $4\sqrt{3}$ m (d) None of these

49. $\tan\left[\frac{\pi}{4}+\frac{1}{2}\cos^{-1}\frac{a}{b}\right]+\tan\left[\frac{\pi}{4}-\frac{1}{2}\cos^{-1}\frac{a}{b}\right]$ is equal to
(a) $\frac{2a}{b}$ (b) $\frac{2b}{a}$
(c) $\frac{a}{b}$ (d) $\frac{b}{a}$

50. The proposition $(p\Rightarrow\sim p)\wedge(\sim p\Rightarrow p)$ is a
(a) tautology and contradiction
(b) neither tautology nor contradiction
(c) contradiction
(d) tautology

Answers

Physics

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

Chemistry

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

Mathematics

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