UPSEE- 2014

Physics

1. A solid cylinder of mass M and radius R rolls without slipping down on inclined plane of length L and height h. What is the speed of its centre of mass, when the cylinder reaches its bottom?
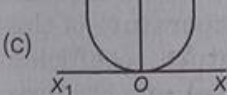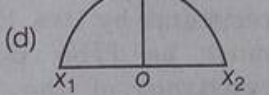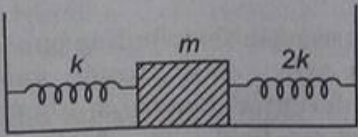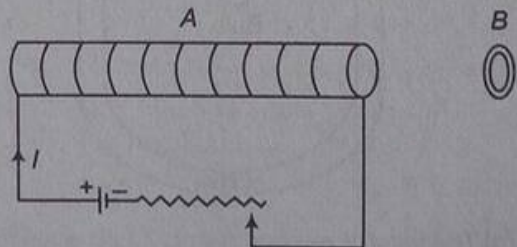
   (a) $\sqrt{\dfrac{4}{3}gh}$ (b) $\sqrt{4gh}$ (c) $\sqrt{2gh}$ (d) $\sqrt{\dfrac{3}{4}gh}$

2. A particle of mass m oscillates with simple harmonic motion between two points x_1 and x_2, the equilibrium position being O. Its potential energy is plotted on the graph. Which of the following curve reprssents the phenomenon?

   (a)   (b)

   (c)   (d)

3. A double slit experiment is performed with light of wavelength 500 nm. A thin film of thickness 2 μm and refractive index 1.5 is introduced in the path of the upper beam. The location of the central maximum will

   (a) remain unshifted
   (b) shift downward by nearly two fringes
   (c) shift upward by nearly two fringes
   (d) shift downward by its fringes

4. Two springs of force constant k and $2k$ are connected to a mass shown in figure. The frequency of oscillation of the mass is

   (a) $-\dfrac{1}{2\pi}\sqrt{\dfrac{m}{k}}$ (b) $\dfrac{1}{2\pi}\sqrt{\dfrac{2k}{m}}$ (c) $\dfrac{1}{2\pi}\sqrt{\dfrac{3k}{m}}$ (d) $\dfrac{1}{2\pi}\sqrt{\dfrac{m}{k}}$

5. A diatomic molecule is formed by two atoms which may be treated as mass points m_1 and m_2 joined by a massless rod of length r. Then, the moment of inertia of the molecule about an axis passing through the centre of mass and perpendicular to rod is

   (a) zero

   (b) $(m_1 + m_2)r^2$

   (c) $\dfrac{(m_1 + m_2)}{(m_1 m_2)}r^2$

   (d) $\left(\dfrac{m_1 m_2}{m_1 + m_2}\right)r^2$

6. A particle moves so that its acceleration a is given by $a = bn$, where x is displacement from equilibrium position and b is non-negative real constant. The time period of oscillation of the particle is

   (a) $2\pi\sqrt{b}$ (b) $\dfrac{2\pi}{b}$ (c) $\dfrac{2\pi}{\sqrt{b}}$ (d) $2\sqrt{\dfrac{\pi}{b}}$

7. An aluminium ring B faces an electromagnet A. The current I through A can be altered,

   (a) if i increase, A will repel B
   (b) if i increase, A will attract B
   (c) if i increase, A will repel B
   (d) whether i increase or decrease, B will not experience any force

8. In Thomson experiment of finding $\frac{e}{m}$ for electrons, beam of electrons is replaced by that of muons (particle with same charge as of electrons but mass 208 times that of electrons). No deflection condition in this case satisfied, if

(a) B is increased 208 times

(b) E is increased 208 times

(c) B is increased 14.4 times

(d) None of the above

9. If a lodder weighing 250 N is placed against a smooth vertical wall having coefficient of friction between it and floor is 0.3, then what is the maximum force of friction available at the point of contact between the lodder and the floor?

(a) 75 N   (b) 50 N

(c) 35 N   (d) 25 N

10. Which of the following statements is incorrect?

(a) All reversible cycles have same efficiency

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

(c) Carnot cycle is a reversible one

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

11. The following figure shows two air filled bulbs connected by a U-tube partly filled with alcohol. What happens to the levels of alcohol in the limbs X and Y when an electric bulb is placed midway between the bulb is lighted?
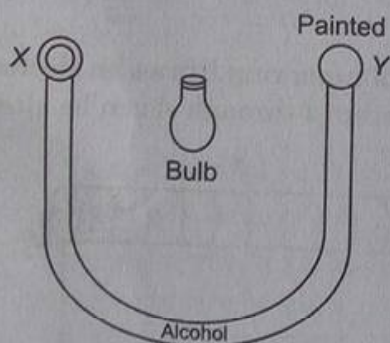
(a) The level of alcohol in limb X falls while that in limb Y rises

(b) The level of alcohol in limb X rises, while that the limb Y falls

(c) The level of alcohol falls in both limbs

(d) There is no change in the levels of alcohol in the two limbs

12. The bob of a pendulum of length l is pulled a side from its equilibrium position through an angle θ and then released. The bob will, then pass through its equilibrium position with a speed v, where v equals to

(a) $\sqrt{2gl(1-\sin\theta)}$ (b) $\sqrt{2gl(1+\cos\theta)}$

(c) $\sqrt{2gl(1-\cos\theta)}$ (d) $\sqrt{2gl(1+\sin\theta)}$

13. A particle moving along x-axis has acceleration f, at time t, given by $f = f_0\left(1 - \dfrac{1}{T}\right)$, where f_0 and T are constant. The particle at $t = 0$ has zero velocity. In the time interval between $t = 0$ and the instant when $f = 0$, the particle velocity v_x is

(a) f_0T (b) $\dfrac{1}{2}f_0T^2$ (c) f_0T (d) $\dfrac{1}{2}f_0T$

14. A spherical condenser has inner and outer spheres of radii a and b respectively. The space between the two is filled with air. The difference between the capacities of two condensers formed when outer sphere is earthed and when inner sphere is earthed will be

(a) zero

(b) $4\pi\varepsilon_0 a$

(c) $4\pi\varepsilon_0 b$

(d) $4\pi\varepsilon_0 a\left(\dfrac{b}{b-a}\right)$

15. The resistance of a wire at room temperature 30°C is found to be 10 Ω. Now to increase the resistance by 10%, the temperature of the wire must be [The temperature coefficient of resistance of the material of the wire is 0.002 per °C].

(a) 36°C   (b) 83°C   (c) 63°C   (d) 33°C

16. Pick out the wrong statement.

(a) In a simple battery circuit, the point of lowest potential is the negative terminal of the battery

(b) The resistance of an incandescent lamp is greatest when the lamp is switched off

(c) An ordinary 100 W lamp has less resistance than a 60 W lamp

(d) At constant voltage, the heat development in a uniform wire varies inversely as the length of the wire used

17. The current in the winding on a toroid is 2.0 A. There are 400 turns and the mean circumferential length is 40 cm. If the inside magnetic field is 1.0 T, the relative permeability is near to

(a) 1000   (b) 2000   (c) 2500   (d) 4000

18. The magnetic moment produced in a substance of 1 g is 6×10^{-7} A-m^2. If its density is 5 g/cm^3, 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}

19. The power factor of a yard choke is

(a) nearly zero   (b) exactly zero
(c) nearly one   (d) exactly one

20. When the momentum of a proton is changed by an amount p_0, then the corresponding change in the de-Broglie wavelength is found to be 0.25%. Then, the original momentum of the proton was

(a) p_0 (b) $100p_0$ (c) $400p_0$ (d) $4p_0$

21. A gamma ray photon creates an electron, positron pair. If the rest mass energy of an electron is 0.5 MeV and the total KE of the electron, positron pair is 0.78 MeV, then the energy of the gamma ray photon must be

(a) 0.78 MeV   (b) 1.78 MeV
(c) 1.28 MeV   (d) 0.28 MeV

22. The correct curve between voltage gain (A_V) and load resistance (R_L) is
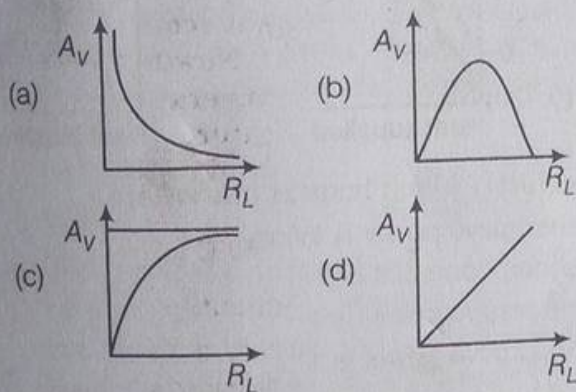
23. Red light of wavelength 625 nm is incident normally on an optical diffraction grating with 2×10^5 lines/m. Including central principal maxima, how many maxima may be observed on a screen which is far from the grating?
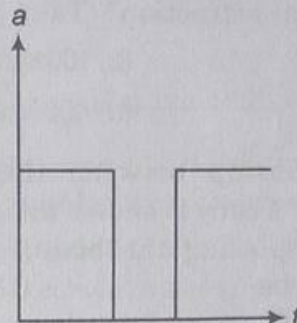
(a) 15   (b) 17   (c) 20   (d) 18

24. In a series resonant L-C-R circuit, the voltage across R is 100 V and $R = 1$ kΩ with $C = 2\,\mu$F. The resonant frequency ω is 200 rads^{-1}. At resonance the voltage across L is

(a) 2.5×10^{-2} V   (b) 4×10^{-8} V
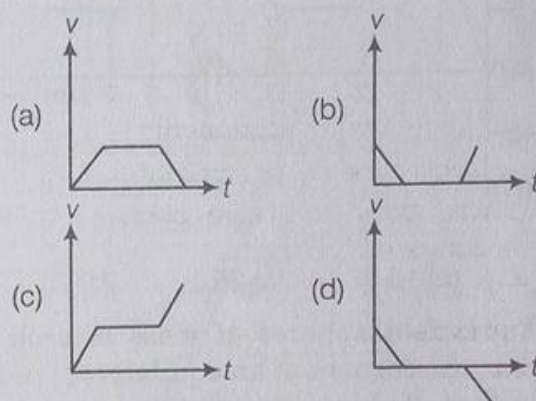(c) 250 V   (d) 4×10^{-3} V

25. The dimensions of self-inductance L are

(a) $[ML^2T^{-2}A^{-2}]$ (b) $[ML^2T^{-1}A^{-2}]$
(c) $[ML^2T^{-1}A^{-1}]$ (d) $[ML^{-2}T^{-2}A^{-2}]$

**26.** Acceleration-time graph of a body is shown below.

The corresponding velocity-time graph of the same body is

27. A can filled with water is revolved in a vertical circle of radius 4 m and the water does not fall down. The time period for a revolution is about

(a) 2 s   (b) 4s   (c) 8 s   (d) 10 s

28. A body of mass 8 kg is suspended through two light springs X and Y connected in series as shown in figure. The readings in X and Y respectively are
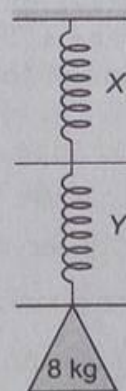
(a) zero, 8 kg   (b) 6 kg, 2 kg
(c) 2 kg, 6 kg   (d) 8 kg, 8 kg

29. A rocket of mass 1000 kg is to be projected vertically upwards. The gases are exhausted vertically downwards with velocity 100 ms^{-1} with respect to the rocket. What is the minimum rate of burning of fuel, so as to just lift the rocket upwards against, the gravitational attraction? (Take $g = 10 \text{ ms}^{-2}$)

(a) 50 kgs^{-1}
(b) 100 kgs^{-1}
(c) 200 kgs^{-1}
(d) 400 kgs^{-1}

30. The relationship between the force F and position x of a body is shown in figure. The work done in displacing the body from $x = 1$ m to $x = 5$ m will be
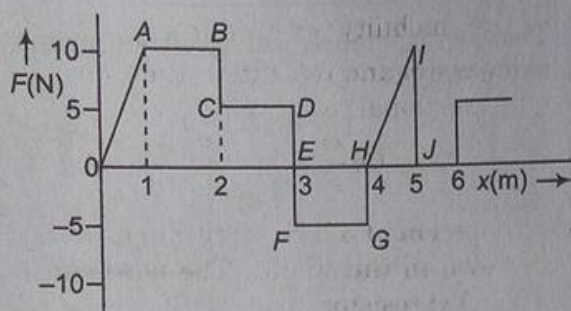
(a) 30 J
(b) 15 J
(c) 25 J
(d) 20 J

31. Three identical spheres of mass m each are placed at the corners of an equilateral triangle of side 2 m. Taking one of the corner as the origin, the position vector of the centre of mass is

(a) $\sqrt{3}(\hat{i} - \hat{j})$
(b) $\dfrac{\hat{i}}{\sqrt{3}} + \hat{j}$
(c) $\dfrac{\hat{i} + \hat{j}}{3}$
(d) $\hat{i} + \dfrac{\hat{j}}{\sqrt{3}}$

32. A particle of mass $m = 5$ unit is moving with a uniform speed $v = 3\sqrt{2}$ unit in the XOY plane along the line $y = x + 4$. The magnitude of the angular momentum of the particle about the origin is

(a) 60 unit
(b) $40\sqrt{2}$ unit
(c) zero
(d) 7.5 unit

33. The escape velocity for the earth is v_e. The escape velocity for a planet whose radius is $\dfrac{1}{4}$th, the radius of the earth and mass half that of the earth is

(a) $\dfrac{v_e}{\sqrt{2}}$
(b) $\sqrt{2}v_e$
(c) $2v_e$
(d) $\dfrac{v_e}{2}$

34. In case of steel wire or a metal wire, the elastic limit is reached when

(a) the wire just break
(b) the load is more than the weight of wire
(c) elongation is inversely proportional to the tension
(d) None of the above

35. A wire of length l metre, made of a material of specific gravity 8 is floating horizontally on the surface of water. If it is not wet by water, the maximum diameter of the wire (in millimetre) upto which it can continue to float is (surface tension of water is $T = 70 \times 10^{-3} \text{ Nm}^{-1}$)

(a) 1.5
(b) 1.1
(c) 0.75
(d) 0.55

36. A block of ice at temperature $-20°C$ is slowly heated and converted to steam at $100°C$. Which of the following diagram is most appropriate?
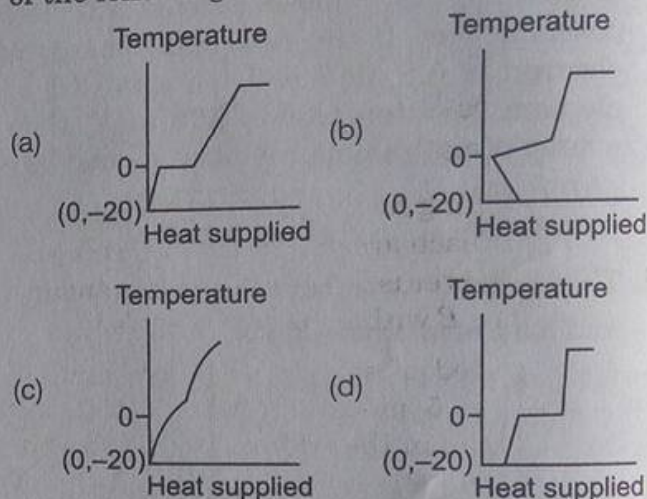
37. A perfectly black body is one where

(a) absorptive power is infinity
(b) absorption point is 0
(c) emmissive power is 1
(d) absorptive power is 1

38. A constant volume gas thermometer works on

(a) Archimedes' principle
(b) Pascal's law
(c) Boyle's law
(d) Charles' law

39. Two gases, carbon monoxide (CO) and nitrogen (N_2) at the same temperature, have kinetic energies E_1 and E_2 respectively. Then,

(a) $E_1 = E_2$
(b) $E_1 > E_2$
(c) $E_1 < E_2$
(d) E_1 and E_2 cannot be compared

40. A pendulum has time period T in air when it is made of oscillate in water, it acquired a time period $T' = \sqrt{2}T$. The density of the pendulum bob is equal to (density of water = 1)

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

(c) $2\sqrt{2}$ (d) None of these

41. When a stationary wave is formed, then its frequency is

(a) same as that of the individual waves

(b) twice that of the individual waves

(c) half that of the individual waves

(d) $\sqrt{2}$ that of the individual waves

42. The equation of a wave is $y = 5 \sin\left(\dfrac{t}{0.04} - \dfrac{x}{4}\right)$

where, x is in cm and t is in second. The maximum velocity of the wave will be

(a) 1 ms^{-1}

(b) 2 ms^{-1}

(c) 1.5 ms^{-1}

(d) 1.25 ms^{-1}

43. Two tuning forks A and B having frequency of 500 Hz each are placed with B to the right of A. An observer is between the forks and is moving towards B with a speed of 25 m/s.

The speed of sound is 345 m/s and the wind speed is 5 m/s from A to B. Calculate, the difference in the two frequencies heard by the observer.

(a) 72.5 Hz   (b) 55.6 Hz

(c) 76.2 Hz   (d) 80.9 Hz

44. The top of the atmosphere is about 400 kV with respect to the surface of the earth, corresponding to an electric field that decreases with altitude. Near the surface of the earth, the field is about 100 Vm^{-1}.

Still, we do not get an electric shock as we step out of our house into the open house, because (assume the house to be a steel cage so that there is no field inside)

(a) there is a potential difference between our body and the ground

(b) 100 Vm^{-1} is not a high electric field so that we do not feel the shock

(c) our body and the ground forms an equipotential surface

(d) the dry atmosphere is not a conductor

**45.** An insulator plate is passed between the plates of a capacitor. Then, current
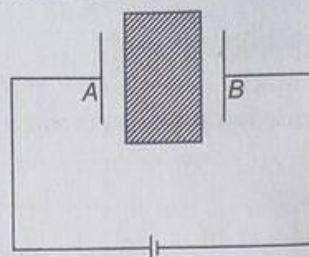
(a) first flows from A to B and then from B to A

(b) first flows from B to A and then from A to B

(c) always flows from B to A

(d) always flows from A to B

46. The mobility of free electrons (charge $= e$, mass $= m$ and relaxation time $= \tau$) in a metal is proportional to

(a) $\dfrac{e}{m}\tau$ (b) $\dfrac{m}{e}\tau$ (c) $\dfrac{e}{m\tau}$ (d) $\dfrac{m}{e\tau}$

47. A current of 3 A flows through the 2 Ω resistor shown in the circuit. The power dissipated in the 5 Ω resistor is
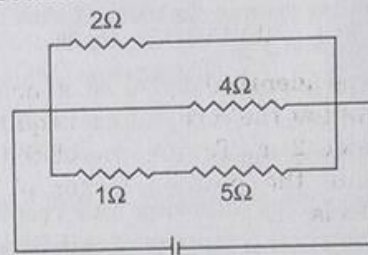
(a) 4 W   (b) 2 W   (c) 1W   (d) 5 W

48. A diverging meniscus lens of 1.5 refractive index has concave surface of radii 3 and 4 cm. The position of the image, if an object is placed 12 cm in front of the lens, is

(a) 7 cm   (b) – 8 cm   (c) 9 cm   (d) 10 cm

49. If the focal length of a lens of a camera is $5\,f$ and that of another is $2.5\,f$, what is the time of exposure for the second if for the first one is $\dfrac{1}{200}$ s? (where, f is focal length/unit aperture)
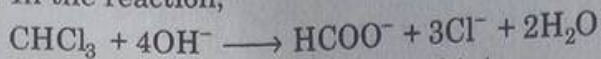
(a) $\dfrac{1}{200}$ (b) $\dfrac{1}{800}$ (c) $\dfrac{1}{6400}$ (d) $\dfrac{1}{3200}$

50. Critical angle for certain medium is $\sin^{-1}(0.6)$. The polarizing angle of that medium is

(a) $\tan^{-1}(1.5)$ (b) $\sin^{-1}(0.8)$

(c) $\tan^{-1}(1.6667)$ (d) $\tan^{-1}(0.667)$

Chemistry

1. In the reaction,

$$CHCl_3 + 4OH^- \longrightarrow HCOO^- + 3Cl^- + 2H_2O$$

the intermediate species formed is/are

(a) $: CCl_2$

(b) CCl_3^-

(c) Both (a) and (b)

(d) None of the above

2. Which of the following represents the correct order of the acidity in the given compound?

(a) $ClCH_2COOH < BrCH_2COOH < CH_3COOH$
$< FCH_2COOH$

(b) $CH_3COOH < BrCH_2COOH < ClCH_2COOH$
$< FCH_2COOH$

(c) $FCH_2COOH < ClCH_2COOH < BrCH_2COOH$
$< CH_3COOH$

(d) $CH_3COOH < FCH_2COOH < ClCH_2COOH$
$< BrCH_2COOH$

3. What will be the major product when 2-amino propane is treated with nitrous acid?

(a) Propane-2-ol

(b) Cyclopropene

(c) Propanol

(d) 2-nitropropane

4. Three of the following four reactions are due to one similar feature of carbonyl compounds, while the fourth one is different. Which one is fourth?

(a) Haloform reaction

(b) Aldol condensation

(c) Knoevenagel reaction

(d) Witting reaction

5. The two forms of D-glucopyranose obtained from the solution of D-glucose are called

(a) enantiomer

(b) epimer

(c) anomer

(d) isomer

6. Which type of polymer is the Buna-S-rubber?

(a) Addition polymer

(b) Condensation polymer

(c) Copolymer

(d) None of the above

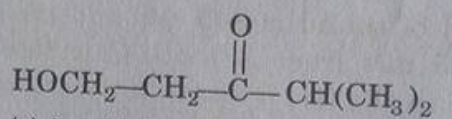**7.** What will be the final product of following reaction sequence?
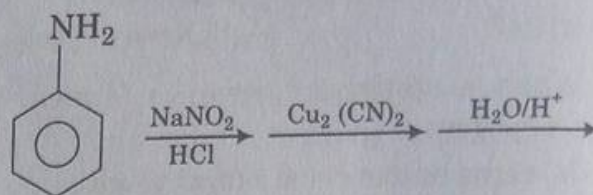
8. The number of possible alkynes with molecular formula C_5H_8 is

(a) 1   (b) 3   (c) 5   (d) 8

9. The IUPAC name of the following compound is

$$HOCH_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-CH(CH_3)_2$$

(a) 2-methyl-5-hydroxy-3-pentane

(b) 4-methyl-3-oxo-1-pentanol

(c) 1-hydroxy-4-methyl-3-pentanone

(d) 3-keto-hexan-1-ol

10. Which of the following orders is not correct regarding the $-I$ effect of the substituents?

(a) $-SR < -OR < -\overset{+}{O}R_2$

(b) $-\overset{+}{N}R_2 < - OR < -F$

(c) $-I < -Cl < -Br < -F$

(d) $-\overset{+}{N}R_3 < -\overset{+}{O}R_2 < -OR$

11. Which of the following types of reaction occurs when a substituent has got a double bond with evenly distributed π-electron cloud?

(a) Electrophilic addition

(b) Nucleophilic addition

(c) Electrophilic substitution

(d) Nucleophilic substitution

12. ~~How many~~ delocalised π-electrons are there in the following compound?
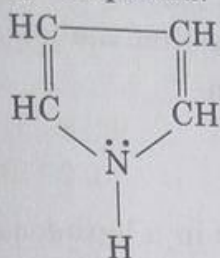

(a) 1   (b) 2   (c) 4   (d) 6

13. Which of the following is an anti-knocking compound?

(a) TEL   (b) LTC   (c) Freon   (d) Gasoline

14. Which one of the following will most readily be dehydrated in acidic medium?

(a) $CH_3-\overset{O}{\overset{||}{C}}-CH_2-\overset{OH}{\overset{|}{C}H}-CH_3$

(b) $CH_3-\overset{OH}{\overset{|}{C}}H-CH_2-CH_2-CH_3$

(c) $CH_3-\overset{O}{\overset{||}{C}}-\overset{OH}{\overset{|}{C}}H-CH_2-CH_3$

(d) $CH_3-\overset{O}{\overset{||}{C}}-CH_2-CH_2-\overset{OH}{\overset{|}{C}}H-CH_3$

15. Which one of the following is a Grignard reagent?

(a) CH_3OMgI (b) C_6H_5MgBr

(c) C_2H_5OMgBr (d) $(C_2H_5)_4Pb$

16. A compound contains two dissimilar asymmetric C-atoms. The number of optical isomers is

(a) 1   (b) 2   (c) 4   (d) 8

17. Which of the following is the strongest nucleophile?

(a) OH^- (b) CH_3O^- (c) CH_3S^- (d) $C_2H_5O^-$

18. In a Cannizzaro reaction, the intermediate that will be least hydride donor is
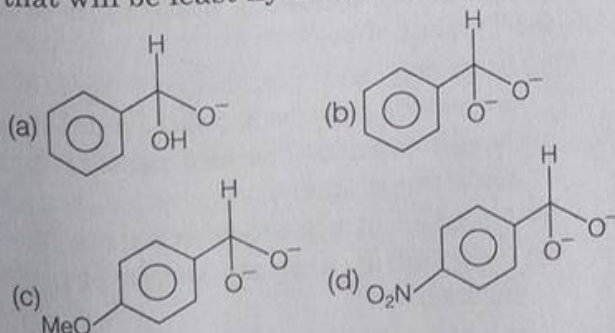
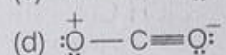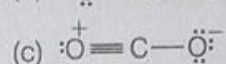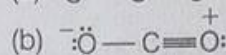**19.** Ni^{2+} ion ($Z = 28$) contains unpaired electrons

(a) 1   (b) 2   (c) 3   (d) 5

20. Which of the following will violate Pauli's exclusion principle?
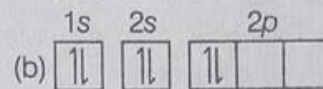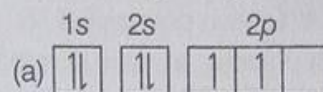
(c) Both (a) and (b)

(d) None of the above

21. Which of the following reasonating structures is not correct for CO_2?

(a) $\ddot{O}=C=\ddot{O}$

(b) $^-\ddot{O}-C\equiv\overset{+}{O}$

(c) $\overset{+}{O}\equiv C-\ddot{O}^-$

(d) $\overset{+}{O}-C\equiv O^-$
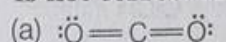
22. The pair of molecules forming strongest hydrogen bonds are

(a) HCOOH and CH_3COOH

(b) CH_3COCH_3 and $CHCl_3$

(c) H_2O and H_2

(d) SiF_6 and SiH_4
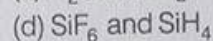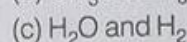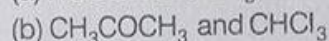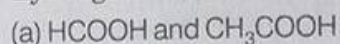
23. The bond order of H_2^- ion is $\frac{1}{2}$. If it has 2 bonding electrons, how many antibonding electrons it will have?

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

24.

Iodide	PI_3	AsI_3	SbI_3
Bond angle	102	100°2'	99°

The bond angle is maximum in PI_3, which is

(a) due to small size of P

(b) due to more bp-bp repulsion in PI_3

(c) due to less electronegativity of P

(d) None of the above

25. The radius of H-atom in its ground state is 0.53Å. The radius of $_3Li^{2+}$ in the similar state is

(a) 0.058 Å

(b) 0.177 Å

(c) 0.706 Å

(d) 1.06 Å

26. The incorrect statements among the following is

(a) the first ionisation potential of Al is less than the first ionisation potential of Mg

(b) the second ionisation potential of Mg is lower than the second ionisation potential of Na

(c) the first ionisation potential of Na is less than the first ionisation potential of Mg

(d) the third ionisation potential of Mg is greater than the third ionisation potential of Al

27. Which one of the following arrangements represents the correct order of electron gain enthalpy (with negative sign) of the given atomic species?

(a) $Cl < F < S < CO$

(b) $O < S < F < Cl$

(c) $S < O < Cl < F$

(d) $F < Cl < O < S$

28. Which pair of elements has same chemical properties?

(a) 13, 22

(b) 3, 11

(c) 4, 24

(d) 2, 4

29. Acidified solution of chromic acid on treatment with H_2O_2 yields

(a) $CrO_3 + H_2O + O_2$

(b) $Cr_2O_3 + H_2O + O_2$

(c) $CrO_5 + H_2O$

(d) $H_2Cr_2O_7 + H_2O + O_2$

30. Bleaching action of bleaching powder is due to

(a) Cl　　(b) O　　(c) Ca　　(d) Cl_2

31. Which of the following is an alum?

(a) $Na\,AlO_2$

(b) $Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$

(c) $KCl \cdot MgCl_2 \cdot 6H_2O$

(d) $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$

32. Sodium thiosulphate is used in photography

(a) as AgBr grain is reduced to non-metallic silver

(b) to convert metallic silver into silver salt

(c) to remove reduced silver

(d) to remove undecomposed AgBr in the form of $Na_3[Ag(S_2O_3)_2]$ (a complex salt)

33. When Lunar caustic reacts with acetylene gas, it yields

(a) Ag_2O

(b) AgCOOH

(c) Ag_2C_2

(d) Ag

34. Calculate the ionic radius of a Cs^+ ion, assuming that the cell edge length for CsCl is 0.4123 nm and that the ionic radius of a Cl^- ion is 0.181 nm.

(a) 0.176 nm

(b) 0.231 nm

(c) 0.357 nm

(d) 0.116 nm

35. Ice crystallises in a hexagonal lattice. At the low temperature, the lattice constants were $a = 4.53\,\text{Å}$ and $b = 7.41\,\text{Å}$. How many H_2O molecules are contained in a unit cell? $[d(\text{ice}) = 0.92\,\text{g}/\text{cm}^3]$
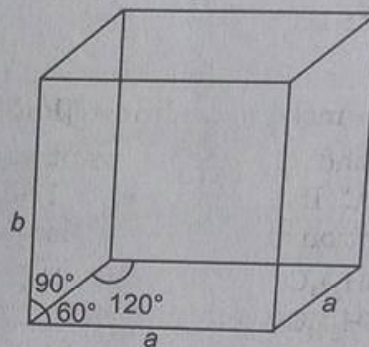
(a) 4

(b) 3

(c) 2

(d) 1

36. When 1 mole of a gas is heated at constant volume, temperature is raised from 298 K to 308 K. Heat supplied to the gas is 500J. Then, which statement is correct?

(a) $q = -W = 500\,J,\ \Delta E = 0$

(b) $q = W = 500\,J,\ \Delta E = 0$

(c) $q = \Delta E = 500\,J,\ W = 0$

(d) $\Delta E = 0,\ q = W = -500\,J$

37. Heat of formation of H_2O is -188 kJ/mol and H_2O_2 is 286 kJ/mol. The enthalpy change for the reaction; $2H_2O_2 \longrightarrow 2H_2O + O_2$ is

(a) 196 kJ

(b) −196 kJ

(c) 984 kJ

(d) −984 kJ

38. Which of the following statements is correct for Tyndall effect?

(a) Scattering and polarising of light by small suspended particles is called Tyndall effect

(b) Tyndall effect of colloidial particles is due to dispersion of light

(c) Tyndall effect is due to refraction of light

(d) Tyndall effect is zig-zag motion of suspended particles

39. If M is molecular weight of solvent, K_b is molal elevation constant, T_b is its boilling point, p^o is its vapour pressure at temperature T and p_s is vapour pressure of its solution having a non-volatile solute at T K, then

(a) $\dfrac{p^o - p_s}{p^o} = \dfrac{\Delta T_b}{K_b} \times M$

(b) $\dfrac{p^o - p_s}{p^o} = \dfrac{K_b}{\Delta T_b} \times M$

(c) $\dfrac{p^o - p_s}{p^o} = \dfrac{K_b}{\Delta T_b} \times \dfrac{M}{1000}$

(d) $\dfrac{p^o - p_s}{p^o} = \dfrac{\Delta T_b}{K_b} \times \dfrac{M}{1000}$

40. A 0.001 molal solution of $[Pt(NH_3)_4Cl_4]$ in water had a freezing point depression of 0.0054°C. If K_f for water is 1.80, the correct formulation of the above molecule is

(a) $[Pt(NH_3)_4Cl_3]Cl$
(b) $[Pt(NH_3)_4Cl_2]Cl_2$
(c) $[Pt(NH_3)_4Cl]Cl_2$
(d) $[Pt(NH_3)_4Cl_4]$

41. In Zeigler Natta polymerisation of ethylene, the active species is

(a) $AlCl_3$
(b) Et_3Al
(c) CH_2CH_2
(d) Ti^{3+}

42. Of the given anions, the strongest Bronsted base is

(a) ClO^-
(b) ClO_3^-
(c) ClO_2^-
(d) ClO_4^-

43. Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox titration. Some half cell reactions and their standard potentials are given below.

$MnO_4^-(aq) + 8H^+ (aq) + 5e^- \longrightarrow$
$\qquad Mn^{2+}(aq) + 4H_2O(l);\ E^o = 1.51$ V

$Cr_2O_7^{2-}(aq) + 14H^+ + 6e^- \longrightarrow 2Cr^{3+}(aq)$
$\qquad + 7H_2O(l);\ E^o = 1.38$ V

$Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq);\ E^o = 0.77$ V

$Cl_2(g) + 2e^- \longrightarrow 2Cl^-(aq);\ E^o = 1.40$ V
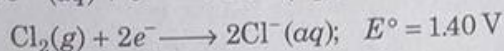
Identify the incorrect statement regarding the quantitative estimation of gaseous $Fe(NO_3)_2$.

(a) MnO_4^- can be used in aqueous HCl
(b) $Cr_2O_7^{2-}$ can be used in aqueous HCl
(c) MnO_4^- can be used in aqueous H_2SO_4
(d) $Cr_2O_7^{2-}$ can be used in aqueous H_2SO_4

44. When the sample of copper with the zinc impurity is to be purified by electrolysis, the appropriate electrodes are

	Anode	Cathode
(a)	pure zinc	pure copper
(b)	impure zinc	pure copper
(c)	impure zinc	impure sample
(d)	impure sample	pure copper

45. The compound that can work both as an oxidising as well as reducing agent is

(a) $KMnO_4$
(b) H_2O_2
(c) $Fe_2(SO_4)_3$
(d) $K_2Cr_2O_7$

46. The reaction,

$10FeSO_4 + 2KMnO_4 + 8H_2SO_4 \longrightarrow$
$\qquad 2MnSO_4 + 5Fe_2(SO_4)_3 + K_2SO_4 + 8H_2O$
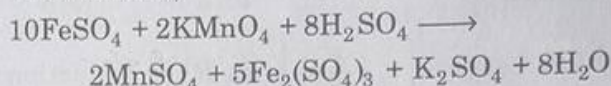
is an example of reaction of

(a) disproportionation
(b) intermolecular redox
(c) intramolecular redox
(d) None of these

47. For the following equilibrium,
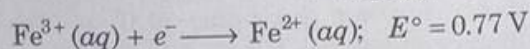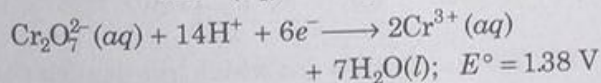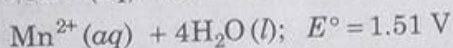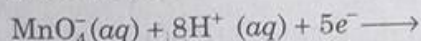
$N_2O_4 \rightleftharpoons 2NO_2$ in gaseous phase, NO_2 is 50% of the total volume when equilibrium is set up. Hence, per cent of dissociation of N_2O_4 is
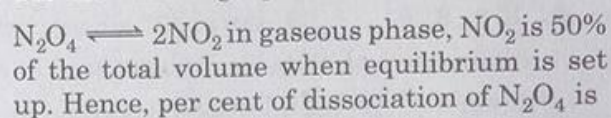
(a) 50%
(b) 25%
(c) 66.66%
(d) 33.33%

48. XY_2 dissociates as

$$XY_2(g) \rightleftharpoons XY(g) + Y(g)$$
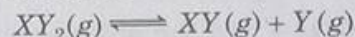
When the initial pressure of XY_2 is 600 mm Hg, the total equilibrium pressure is 800 mm Hg. Calculate K for the reaction assuming that the volume of the system remains unchanged.

(a) 50
(b) 100
(c) 166.6
(d) 400.0

49. Hydrogen ion concentration in mol/L in a solution of pH $= 5.4$ will be

(a) 3.98×10^8
(b) 3.88×10^6
(c) 3.68×10^{-6}
(d) 3.98×10^{-6}

50. The solubility of AgI in NaI solution is less than that in pure water because

(a) AgI forms complex with NaI
(b) of common ion effect
(c) solubility product of AgI is less
(d) the temperature of the solution decreases

Mathematics

1. Let F_1 be the set of parallelograms, F_2 be the set of rectangles, F_3 be the set of rhombuses, F_4 be the set of squares and F_5 be the set of trapeziums in a plane. Then, F_1 may be equal to

   (a) $F_2 \cap F_3$
   (b) $F_3 \cap F_4$
   (c) $F_2 \cup F_5$
   (d) $F_2 \cup F_3 \cup F_4 \cup F_1$

2. If $A = \{x : x$ is a multiple of $4\}$ and $B = \{x : x$ is a multiple of $6\}$, then $A \cap B$ consists of all multiples of

   (a) 16
   (b) 12
   (c) 8
   (d) 4

3. Let $f = \left\{ \left(x, \dfrac{x^2}{1 + x^2} \right) : x \in R \right\}$ be a function from R to R. Determine the range of f.

   (a) $[0, 1)$
   (b) $[0, 1]$
   (c) $[0, 2)$
   (d) None of these

4. If $\theta_1, \theta_2, \theta_3, \ldots\ldots, \theta_n$ are in AP, whose common difference is d, then $\sin d \, (\sec\theta_1 \sec\theta_2 + \sec\theta_2 \sin\theta_3 + \ldots\ldots + \sec\theta_{n-1} \sec\theta_n)$ is equal to

   (a) $\tan\theta_n - \tan\theta_2$
   (b) $\tan\theta_n + \tan\theta_1$
   (c) $\tan\theta_n - \tan\theta_1$
   (d) None of these

5. The probability that a man will live 10 more years, is $\dfrac{1}{4}$ and the probability that his wife will live 10 more years, is $\dfrac{1}{3}$. Then, what is the probability that neither will be alive in 10 yr?

   (a) $\dfrac{1}{2}$
   (b) $\dfrac{3}{7}$
   (c) $\dfrac{2}{3}$
   (d) $\dfrac{1}{4}$

6. The probability that in a year of the 22nd century chosen at random, there will be 53 Sunday, is

   (a) $\dfrac{3}{28}$
   (b) $\dfrac{2}{28}$
   (c) $\dfrac{7}{28}$
   (d) $\dfrac{5}{28}$

7. The values of x, y and z for the system of equations $x + 2y + 3z = 6$, $3x - 2y + z = 2$ and $4x + 2y + z = 7$ are respectively

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

8. The minimum force required to move a body of weight w placed on a rough horizontal plane surface is

   (a) $w \sin\lambda$
   (b) $w \cos\lambda$
   (c) $w \tan\lambda$
   (d) $w \cot\lambda$

9. The resultant of two like parallel forces P and Q passes through a point O. If the resultant also passes through O when Q and R replace P and Q respectively, then

   (a) P, Q, R are in GP
   (b) Q, P, R are in GP
   (c) R, P, Q are in GP
   (d) P, Q, R are in AP

10. If a particle A is moving along a straight line with velocity 3 m/s and another particle B has a velocity 5 m/s at an angle of $60°$ to the path of A, then the velocity B relative to A is

    (a) $\sqrt{39}$ m/s
    (b) $\sqrt{19}$ m/s
    (c) 19 m/s
    (d) None of these

11. A particle is projected down on inclined plane with a velocity of 21 m/s at an angle of $60°$ with the horizontal. Its range on the inclined plane, inclined at an angle of $30°$ with the horizontal is

    (a) 21 dm
    (b) 2.1 dm
    (c) 30 dm
    (d) 6 dm

12. If $3\sin^2\theta + 2\sin^2\phi = 1$ and $3\sin 2\theta = 2\sin 2\phi$, $0 < \theta < \dfrac{\pi}{2}$ and $0 < \phi < \dfrac{\pi}{2}$, then the value of $\theta + 2\phi$ is

    (a) $\dfrac{\pi}{4}$
    (b) $\dfrac{\pi}{2}$
    (c) π
    (d) None of these

13. The equation $e^{\sin x} - e^{-\sin x} - 4 = 0$ has

    (a) no solution
    (b) two solutions
    (c) three solutions
    (d) None of these

14. At a distance $2h$ m from the foot of a tower of height h m, the top of the tower and a pole at the top of the tower subtend equal angles. Height of the pole should be

    (a) $\dfrac{5h}{3}$ m
    (b) $\dfrac{4h}{3}$ m
    (c) $\dfrac{7h}{5}$ m
    (d) $\dfrac{3h}{2}$ m

15. The locus of a point which moves such that its distance from the point $(0, 0)$ is twice its distance from the Y-axis, is

    (a) $x^2 - y^2 = 0$
    (b) $x^2 - 3y^2 = 0$
    (c) $3x^2 - y^2 = 0$
    (d) None of these

16. Find the distance of the line $4x + 7y + 5 = 0$ from the point $(1, 2)$ along the line $2x - y = 0$.

    (a) $\dfrac{23}{7} \sqrt{5}$ sq units
    (b) $\dfrac{23}{18} \sqrt{5}$ sq units
    (c) $\dfrac{23}{8} \sqrt{5}$ sq units
    (d) None of these

7. The tangent at $(1, 7)$ to the curve $x^2 = y - 6$ touches the circle $x^2 + y^2 + 16x + 12y + c = 0$ at

(a) $(6, 7)$ (b) $(-6, 7)$

(c) $(6, -7)$ (d) $(-6, -7)$

18. 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) $\dfrac{2a \cos \theta}{\sin^2 \theta}$ (b) $\dfrac{4a \cos \theta}{\sin^2 \theta}$

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

19. The line $x = at^2$ meets the ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ in the real points, if

(a) $|t| < 2]$ (b) $|t| \le 1$

(c) $|t| > 1$ (d) None of these

20. The equation of tangents to the ellipse $3x^2 + 4y^2 = 5$, which are inclined at $30°$ to the X-axis, are

(a) $y = \sqrt{3}\,x \pm \dfrac{5}{2}$ (b) $y = \dfrac{1}{\sqrt{3}}\,x \pm \dfrac{5}{2}$

(c) $y = \dfrac{1}{\sqrt{3}}\,x \pm 1$ (d) None of these

21. Common roots of the equations $z^3 + 2z^2 + 2z + 1 = 0$ and $z^{1985} + z^{100} + 1 = 0$ are

(a) ω, ω^2 (b) ω, ω^3

(c) ω^2, ω^3 (d) None of these

22. The nth term of the series $1 + 2 + 5 + 12 + 25 + \ldots$ is

(a) $(n - 1)(n - 2)$ (b) $\dfrac{1}{3} n(n-1)(n-2) + n$

(c) n (d) None of these

23. $(100)^{50} + (99)^{50}$

(a) $< (101)^{50}$ (b) $< (101)$ (c) $> (101)^{50}$ (d) $> (101)$

24. If the determinant $\Delta = \begin{vmatrix} 3 & -2 & \sin 3\theta \\ -7 & 8 & \cos 2\theta \\ -11 & 14 & 2 \end{vmatrix} = 0$, then the value of $\sin \theta$ is

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

(c) 0 or $\dfrac{1}{2}$ (d) None of these

25. The relation R in R defined by $R = \{(a, b) : a \le b^3\}$, is

(a) reflexive   (b) symmetric

(c) transitive   (d) None of these

26. The value of $2 \tan^{-1}(\csc \tan^{-1} x - \tan \cot^{-1} x)$ is

(a) $\tan^{-1} x$ (b) $\tan x$

(c) $\cot x$ (d) $\csc^{-1} x$

27. Let $f(x + y) = f(x) + f(y)$ for all x and y. If the function $f(x)$ is continuous at $x = 0$, then $f(x)$ is continuous

(a) only at $x = 0$ (b) at $x \in R - \{0\}$

(c) for all x (d) None of these

28. Let $f(x) = \begin{cases} x^n \sin \dfrac{1}{x}, & x \ne 0 \\ 0, & x = 0 \end{cases}$.

Then, $f(x)$ is continuous but not differentiable at $x = 0$, if

(a) $n \in (0, 1)$ (b) $n \in [1, \infty)$

(c) $n \in (-\infty, 0)$ (d) $n = 0$

29. If $\sin^2 x + \cos^2 y = 1$, then $\dfrac{dy}{dx}$ is equal to

(a) $\dfrac{\sin 2x}{\sin 2y}$ (b) $\dfrac{\sin^2 y}{\sin 2x}$

(c) $\dfrac{\sin^2 x}{\sin^2 y}$ (d) $-\dfrac{\sin^2 y}{\sin^2 x}$

30. The altitude of the right circular cone of maximum volume that can be inscribed in a sphere of radius r is

(a) $\dfrac{r}{2}$ (b) $\dfrac{r}{3}$

(c) $\dfrac{3r}{4}$ (d) $\dfrac{4r}{3}$

31. $\displaystyle\int \dfrac{x + 2}{(x^2 + 3x + 3)\sqrt{x + 1}}\, dx$ is equal to

(a) $\dfrac{2}{\sqrt{3}} \tan^{-1}\left(\dfrac{x}{x + 1}\right) + C$

(b) $\dfrac{2}{\sqrt{3}} \tan^{-1}\left[\dfrac{x}{\sqrt{3}(x + 1)}\right] + C$

(c) $\dfrac{2}{\sqrt{3}} \tan^{-1}\left[\dfrac{x}{(x + 1)^2}\right] + C$

(d) None of the above

32. $\int \sin^{-1} \sqrt{\dfrac{x}{a+x}}\, dx$ is equal to

(a) $\left[\tan^{-1} \sqrt{\dfrac{x}{a}} + \sqrt{\dfrac{x}{a}} \right] + C$

(b) $a \left[\tan^{-1} \sqrt{\dfrac{x}{a}} - \sqrt{\dfrac{x}{a}} \right] + C$

(c) $a \left[\tan^{-1} \sqrt{\dfrac{x}{a} \cdot \dfrac{(a+x)}{a}} \right] + C$

(d) $a \left[\tan^{-1} \sqrt{\dfrac{x}{a} \cdot \dfrac{(a+x)}{a}} - \sqrt{\dfrac{x}{a}} \right] + C$

33. A girl walks 4 km towards West, then she walks 3 km in a direction 30° East of North and stops. Then, the girl's displacement from her initial point of departures is

(a) $-\dfrac{5}{2}\hat{i} + \dfrac{3\sqrt{3}}{2}\hat{j}$ (b) $\dfrac{1}{2}\hat{i} + \dfrac{\sqrt{3}}{2}\hat{i}$

(c) $-\dfrac{1}{2}\hat{i} + \dfrac{3\sqrt{3}}{2}\hat{j}$ (d) None of these

34. If $\mathbf{a} = \hat{i} + \hat{j} + \hat{k}, \mathbf{b} = 4\hat{i} + 3\hat{j} + 4\hat{k}$ and $\mathbf{c} = \hat{i} + \alpha\hat{j} + \beta\hat{k}$ are linearly dependent vectors and $|\mathbf{c}| = \sqrt{3}$, then the value of α and β are respectively

(a) $\pm 1, 1$ (b) $\pm 2, 1$

(c) $0, \pm 1$ (d) None of these

35. The projection of the vector $\mathbf{a} = \hat{i} - 2\hat{j} + \hat{k}$ on the vector $\mathbf{b} = 4\hat{i} - 4\hat{j} + 7\hat{k}$ is

(a) $\dfrac{9}{19}$ (b) $\dfrac{19}{9}$ (c) 9 (d) $\sqrt{19}$

36. Forces of magnitude 5 and 3 units acting in the directions $6\hat{i} + 2\hat{j} + 3\hat{k}$ and $3\hat{i} - 2\hat{j} + 6\hat{k}$ respectively act on a particle which is displaced from the point $(2, 2, -1)$ to $(4, 3, 1)$. The work done by the forces is

(a) 148 units (b) $\dfrac{148}{7}$ units

(c) $\dfrac{78}{7}$ units (d) None of these

37. The solution of differential equation $(x^2 + y^2) - 2xy\dfrac{dy}{dx} = 0$ is

(a) $x^2 + y^2 = xC$ (b) $x^2 - y^2 = xC$

(c) $x^2 + y^2 = C$ (d) $x^2 - y^2 = C$

38. The solution of the equation $\dfrac{dy}{dx} = \dfrac{x(2\log x + 1)}{\sin y + y\cos y}$ is

(a) $y\sin y = x^2 \log x + C$

(b) $y = x^2 + \log x + C$

(c) $y\sin y = x^2 + C$

(d) None of the above

39. The area of the portion of the circle $x^2 + y^2 = 64$ which is exterior to the parabola $y^2 = 12x$, is

(a) $(8\pi - \sqrt{3})$ sq units

(b) $\dfrac{16}{3}(8 - \sqrt{3})$ sq units

(c) $\dfrac{16}{3}(8\pi - \sqrt{3})$ sq units

(d) None of the above

40. $\displaystyle\lim_{n \to \infty} \dfrac{1}{n}\left(\dfrac{1}{n+1} + \dfrac{2}{n+2} + \dots + \dfrac{3n}{4n} \right)$ is equal to

(a) $\log 4$

(b) $-\log 4$

(c) $1 - \log 4$

(d) None of the above

41. The value of integral $\displaystyle\int_0^{\pi/2} \dfrac{\sin^2 x}{\sin x + \cos x}\, dx$ is equal to

(a) $\sqrt{2}\,(\log\sqrt{2})$

(b) $\sqrt{2}\,(\sqrt{2} + 1)$

(c) $\log(\sqrt{2} + 1)$

(d) None of the above

42. The product of the perpendiculars drawn from the foci upon any tangent to an ellipse

(a) depends upon foci

(b) is constant

(c) depends upon the tangent

(d) None of the above

43. The parametric equations of the circle $x^2 + y^2 + mx + my = 0$ are

(a) $x = -\dfrac{m}{2} + \dfrac{m}{\sqrt{2}}\cos\theta, y = \dfrac{m}{2} + \dfrac{m}{\sqrt{2}}\sin\theta$

(b) $x = -\dfrac{m}{2} + \dfrac{m}{\sqrt{2}}\cos\theta, y = -\dfrac{m}{2} + \dfrac{m}{\sqrt{2}}\sin\theta$

(c) $x = 0, y = 0$

(d) None of the above

44. If in a $\triangle ABC$, $\sin^3 A + \sin^3 B + \sin^3 C = 3\sin A \sin B \sin C$, then the value of determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ is equal to

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

45. $\sin \dfrac{\pi}{n} + \sin \dfrac{3\pi}{n} + \sin \dfrac{5\pi}{n} + \ldots$ upto n terms is equal to

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

46. The maximum and minimum value of $6 \sin x \cos x + 4 \cos 2x$ are respectively

(a) 5, 5
(b) – 5, 5
(c) 5, – 5
(d) None of these

47. Let $f(x) = x(x-1)^2$, the point at which $f(x)$ assumes maximum and minimum are respectively

(a) $\dfrac{1}{3}, 1$
(b) $1, \dfrac{1}{3}$
(c) 3, 1
(d) None of these

48. Rectangles are inscribed in a circle of radius r. The dimensions of the rectangle which has the maximum area, are

(a) r, r
(b) $2r, 2r$
(c) $\sqrt{2}r, \sqrt{2}r$
(d) None of the above

49. The equation $4^{(x^2 + 2)} - 9 \cdot 2^{(x^2 + 2)} + 8 = 0$ has the solution

(a) $x = 1$
(b) $x = 0$
(c) $x = \sqrt{2}$
(d) $x = -\sqrt{2}$

50. If a, b, c are in GP and $\log a - \log 2b$, $\log 2b - \log 3c$ and $\log 3c - \log a$ are in AP, then a, b, c are the lengths of the sides of a triangle which is

(a) acute angled
(b) obtuse angled
(c) right angled
(d) equilateral

Answers

Physics

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

Chemistry

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

Mathematics

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