

1. A boat takes 2 h to travel 8 km and back in still water, if the velocity of water is 4 km/h the time taken for going upstream 8 km and coming back is
- (a) 2 h
 (b) 2 h 40 min
 (c) 1 h 20 min
 (d) Cannot be estimated from the information given

2. The rms speed of a certain gas is v at 400 K. The temperature at which the rms speed becomes two times, will be
- (a) 800 K (b) 1600 K
 (c) 1200 K (d) None of these

3. The kinetic energy of an electron with de-Broglie wavelength of 0.3 nm is
- (a) 0.168 eV (b) 16.8 eV
 (c) 1.68 eV (d) 2.5 eV

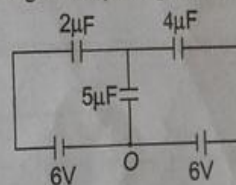
4. A body cools from 100°C to 90°C in 20 min, it will cool down from 110°C to 100°C in [Assume same surroundings]
- (a) 20 min
 (b) less than 20 min
 (c) more than 20 min
 (d) 30 min

5. Consider two observers moving with respect to each other at a speed v along a straight line. They observe a block of mass m moving a distance l on a rough surface. The following quantities will be same as observed by the two observers
- (a) kinetic energy of the block at time t
 (b) work done by friction
 (c) total work done on the block
 (d) acceleration of the block

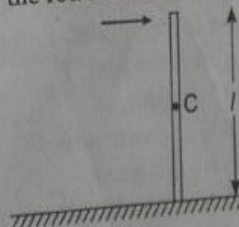
6. An astronaut has left the international space station to test a new space scooter. His partner measures the following velocity changes which take place in 10 s interval. Find the magnitude

and direction of average acceleration. At the beginning of 10 s interval the astronaut is moving towards positive x -axis at 10 m/s and at the end of 10 s he is moving towards negative x -axis at 5 m/s.

- (a) 15 m/s^2 , along positive x -axis
 (b) 15 m/s^2 , along negative x -axis
 (c) 1.5 m/s^2 , along negative x -axis
 (d) 1.5 m/s^2 , along positive x -axis
7. A particle of mass 10 kg starts from point A, with an initial velocity of 3 m/s towards negative x -axis, it has been acted by a force of 10 N towards positive x -axis. Find the distance travelled by particle in 4 s .
- (a) 4 m (b) 0.5 m
 (c) 4.5 m (d) 5 m
8. Find the charge on $5 \mu\text{F}$ capacitor.



- (a) $5.45 \mu\text{C}$ (b) $16.37 \mu\text{C}$
 (c) $10.9 \mu\text{C}$ (d) $18 \mu\text{C}$
9. A uniform slender rod 1m long is initially standing vertically on a smooth, horizontal surface. It is struck by a sharp horizontal blow at the top end, with the blow directed at right angles to the rod axis. As a result, the rod acquires an angular velocity of 3.00 rad/s . What is the translational velocity of the centre of mass of the rod after the blow ?

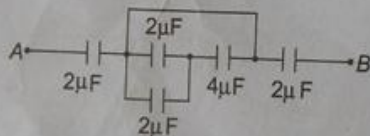


- (a) 0.25 m/s (b) 0.64 m/s
(c) 0.5 m/s (d) 1.2 m/s

10. Mark the incorrect option.

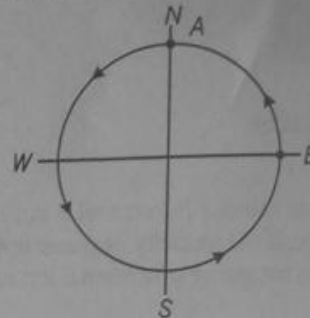
- (a) During the discharging of battery, the battery supplies electrical energy at the rate of $VI = EI - I^2r$. Here, EI represent the rate at which non-electrical energy is converted to electrical energy
(b) During the charging of battery, the battery consumes energy at the rate of $VI = EI + I^2r$. Here, EI represents the rate at which electrical energy is converted to non-electrical energy
(c) In both the above cases the term I^2r represents the rate of dissipation of energy in the internal resistance of battery
(d) None of the above
11. Why does a glass sometimes break, if we quickly pour boiling water into it ?
(a) Hot water expands, pushing the glass out
(b) The hot water cools when it touches the glass, shrinking and pulling the glass in
(c) The glass becomes hot and expands, causing the molecules to break
(d) The inside of the glass expands faster than the outside of the glass, causing the glass to break

12. Find the equivalent capacitance between A and B.



- (a) $\frac{2}{3} \mu\text{F}$ (b) $1 \mu\text{F}$
(c) $\frac{4}{3} \mu\text{F}$ (d) $6 \mu\text{F}$
13. A 0.5 kg ball is dropped from rest at a point 1.20 m above the floor. The ball rebounds straight upward to a height of 0.7 m. What is the magnitude and the direction of the impulse of the net force applied to the ball during the collision with the floor ?
(a) 4.28 N-s, upward
(b) 4.28 N-s, downward
(c) 8.56 N-s, upward
(d) 8.56 N-s, downward
14. A body is moving with uniform speed v in a horizontal circle in anticlockwise direction as

shown in figure. The motion starts from point A, find the change in velocity in second quarter of revolution.



- (a) $\sqrt{2}v$ N-W (b) $\sqrt{2}v$ N-E
(c) $\sqrt{2}v$ S-W (d) $\sqrt{2}v$ S-E

15. The statement "For a given body resistance is unique" is .

- (a) true
(b) false
(c) Cannot be predicted
(d) None of the above

16. The block which is moving with constant speed 4 m/s with respect to ground is observed from two reference frames A and B. The frame A is non-inertial while B is inertial, then

- (a) acceleration of block, with respect to A as well as with respect to B is zero
(b) acceleration of block, with respect to A is non-zero while with respect to B is zero
(c) acceleration of block with respect to A may be zero while with respect to B may be non-zero
(d) acceleration of block with respect to both reference frames A and B would be non-zero

17. N moles of an ideal diatomic gas are in a cylinder at temperature T . If we supply some heat to it, then $N/3$ moles of gas dissociates into atoms while temperature remains constant. Heat supplied to the gas is

- (a) $NRT/6$ (b) $5NRT/2$
(c) $5.6 NRT$ (d) $8NRT/3$

18. Electrons having KE 15 eV is collided with hydrogen atom and 80.6% of it is used to excite the electrons from its ground state. Find the number of emitted wavelengths.

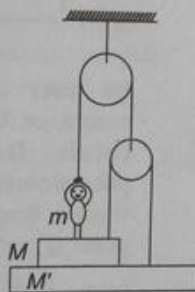
- (a) 1 (b) 2
(c) 3 (d) 4

Mock Test

19. A pistol fires a 3g bullet with a speed of 400 m/s. The pistol barrel is 13 cm long. How much energy is given to the bullet? Also, calculate the average force acted on the bullet while it was moving down the barrel.
- (a) 140 J, 1846 N (b) 240 J, 184.6 N
(c) 240 J, 1846 N (d) 240 J, 1746 N

20. If a charged conductor is not isolated and other conducting bodies are approaching towards it, then the
- (a) capacitance of conductor will change as potential of conductor changes due to induction phenomenon
(b) capacitance of conductor remains constant as it is depending on shape and size of conductor
(c) capacitance of conductor will change due to redistribution of charge on approaching bodies
(d) None of the above

21. A person of mass m is standing on a structure made up of pulley, strings and platform as shown in figure. Find the force exerted by the person on the rope, so that the system (person + structure) remains in equilibrium.



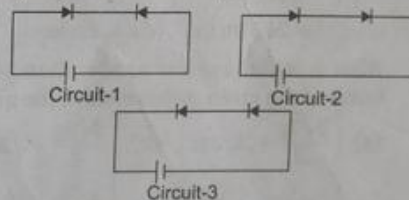
- (a) mg (b) $(m + M' + M)g$
(c) $\frac{(M + M' + m)g}{2}$ (d) None of these
22. Find the distance between the object and its doubly magnified real image by a concave mirror of focal length f .
- (a) $2f$ (b) $\frac{3f}{2}$ (c) $\frac{5f}{2}$ (d) $3f$
23. A point source of light is taken away from the experimental set up of photoelectric effect, then which is the most appropriate statement?
- (a) Saturation photo current remains same, while stopping potential increases.
(b) Saturation photocurrent and stopping potential both decrease.
(c) Saturation photocurrent decreases while stopping potential remains same.
(d) Saturation photocurrent decreases and stopping potential increases.
24. K_{β} X-ray of argon has wavelength 0.36 nm. The minimum energy needed to ionize an argon atom is 16 eV. Find the energy needed to knock

- out an electron from K shell of an argon atom.
- (a) 16 eV (b) 3.45 keV
(c) 3.47 keV (d) 3.43 keV

Directions : Question No. 25 and 26 are Assertion-Reason type. Each of these contains two statements : Statement I (Assertion), Statement II (Reason). Each of these questions also has four alternative choices, only one of which is correct. You have to select the correct choices from the codes (a), (b), (c) and (d) given below :

(a) Statement I is true; Statement II is true; Statement II is not a correct explanation for Statement I.
(b) Statement I is true; Statement II is false.
(c) Statement I is false; Statement II is true.
(d) Statement I is true; Statement II is true; Statement II is the correct explanation for Statement I.

25. **Statement I :** When speed of projection of a body is made n times, its time of flight becomes n times.
Statement II : At this speed the range of projectile becomes n times.
26. **Statement I :** No diffraction is produced in sound waves near a very small opening.
Statement II : For diffraction to take place the aperture of opening should be of the same order as wavelength of the waves.
27. Two identical p - n junctions may be connected in series with a battery in three ways as shown in figure. The potential differences across the two p - n junctions are equal in



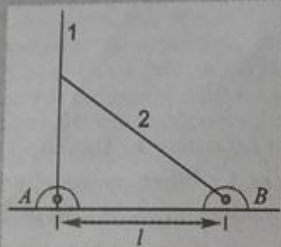
- (a) circuit 1 and circuit 2
(b) circuit 2 and circuit 3
(c) circuit 3 and circuit 1
(d) circuit 1 only
28. The electric field associated with a monochromatic beam becomes zero 2.4×10^{15} times per second. Find the maximum KE of the photoelectrons when this light falls on a metal surface whose work function is 2 eV.
- (a) 7.95 eV (b) 17.9 eV
(c) 2.96 eV (d) 4.96 eV
29. A radioactive sample whose half-life is 40 h has 18 times too much activity for safety, then after how many half-lives will the radioactive sample will be safe?

Mock Test

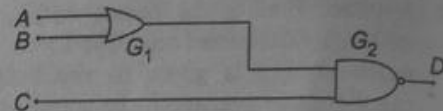
- (a) 4 (b) 5
(c) 40 (d) 1

Directions : Question No. 30 to 32 are based on the following paragraph.

Two rods 1 and 2 are released from rest as shown in figure. Given : $l_1 = 4l$, $m_1 = 2m$, $l_2 = 2l$ and $m_2 = m$. There is no friction between the two rods. If α be the angular acceleration of rod 1 just after the rods are released. Then

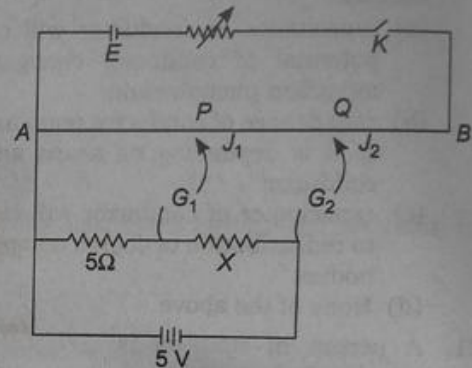


30. What is the normal reaction between the two rods at this instant ?
 (a) $16\sqrt{3} m\alpha$ (b) $\frac{4m\alpha}{\sqrt{3}}$
 (c) $\frac{32m\alpha}{3\sqrt{3}}$ (d) $12\sqrt{3} m\alpha$
31. What is the horizontal force on rod 1 by hinge A at this instant ?
 (a) $\left(\frac{32-12\sqrt{3}}{3\sqrt{3}}\right) m\alpha$ (b) $\left(\frac{16-2\sqrt{3}}{\sqrt{3}}\right) m\alpha$
 (c) $(14+2\sqrt{3})m\alpha$ (d) $\sqrt{3}m\alpha$
32. What is initial angular acceleration of rod 2 in terms of the given parameters in the question ?
 (a) $\left[\frac{2\sqrt{3}g}{2l} + 2\sqrt{3}\alpha\right]$ (b) $\left[\frac{3\sqrt{3}g}{l} - \sqrt{3}\alpha\right]$
 (c) $\left[\frac{6\sqrt{3}g}{8l} + 5\sqrt{3}\alpha\right]$ (d) $\left[\frac{3\sqrt{3}g}{8l} - \frac{8}{\sqrt{3}}\alpha\right]$
33. For the given combination of gates, if the logic states of inputs A, B, C are as follows $A=B=C=0$ and $A=B=1, C=0$, then the logic states of output D are



- (a) 0, 0 (b) 0, 1
(c) 1, 0 (d) 1, 1

34. A person tries to find the value of unknown resistance using potentiometer as shown in the diagram below.



He uses a resistance of 5Ω , unknown resistance X and a battery of $5V$ in secondary circuit. He touches the jockey J_1 on potentiometer wire to get the point P , so that there is no deflection in G_1 , then he locates the point Q , so that G_2 shows zero deflection. It is found that $AP = \frac{AQ}{3}$. Value of X is

- (a) 5Ω
 (b) 15Ω
 (c) 10Ω
 (d) This method won't work
35. A rain drop of radius 0.2 cm is falling through air with a terminal velocity of 8.7 m/s . The viscosity of air in SI units is [Take $\rho_{\text{water}} = 1000\text{ kg/m}^3$ and $\rho_{\text{air}} = 1\text{ kg/m}^3$]
 (a) 10^{-4} poise (b) 1×10^{-3} poise
 (c) 8.6×10^{-3} poise (d) 1.02×10^{-3} poise

Chemistry

36. The non existence of PbI_4 is due to
 (a) small size of Pb^{4+} ions and large size of I^- ions
 (b) high oxidising power of Pb^{4+} ions
 (c) high reducing power of I^- ions
 (d) Both (b) and (c)
37. An ore of tin containing FeCrO_4 is concentrated by
 (a) froth floatation process
 (b) magnetic separation method
 (c) electrostatic method
 (d) gravity separation method

38. For the reaction $A + B \rightleftharpoons C + D$, equilibrium concentration of $[C] = [D] = 0.5M$ if we start with 1 mole each of A and B. Percentage of A converted into C if we start with 2 moles of A and 1 mole of B, is

(a) 25% (b) 40%
(c) 66.66% (d) 33.33%

39. The molecule BF_3 and NF_3 both are covalent compounds, but BF_3 is non-polar and NF_3 is polar. The reason is that

(a) boron is a metal and nitrogen is a gas in uncombined state
(b) BF_3 bonds have no dipole moment whereas NF_3 bond have dipole moment
(c) atomic size of boron is smaller than that of nitrogen
(d) BF_3 is symmetrical molecule whereas NF_3 is unsymmetrical

40. The rate of effusion doesn't depend on

(a) the area of cross-section of hole
(b) number of molecules per unit volume
(c) the average molecular speed
(d) size of the molecule

41. The correct IUPAC name of complex $Fe(C_5H_5)_2$ is

(a) Cyclopentadienyliron (II)
(b) Bis(cyclopentadienyl)iron (II)
(c) Dicyclopentadienylferrate (II)
(d) Ferrocene

42. Which of the following is an example of chlorodising roasting ?

(a) $Ag_2S + 2NaCl \rightarrow 2AgCl + Na_2S$
(b) $PbS + 2O_2 \rightarrow PbSO_4$
(c) $2AgCl + 4Hg \rightarrow 2AgHg + Hg_2Cl_2$
(d) Both (a) and (c)

43. The raw materials required for the manufacture of Na_2CO_3 by Solvay process, are

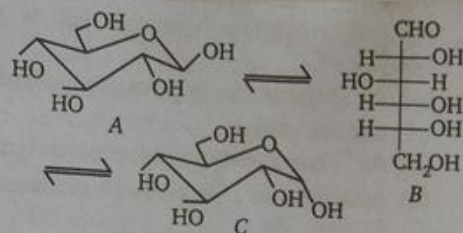
(a) $CaCl_2, (NH_4)_2CO_3, NH_3$
(b) $NH_4Cl, NaCl, Ca(OH)_2$
(c) $NaCl, (NH_4)_2CO_3, NH_3$
(d) $NaCl, NH_3, CaCO_3$

44. $X \xleftarrow[H_2SO_4, H_2O]{HgSO_4} \text{1-pentyne} \xrightarrow[OH^-, H_2O_2]{BH_3, THF} Y$

X and Y cannot be distinguished by

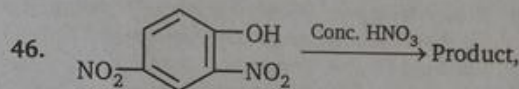
(a) silver-mirror test
(b) iodoform test
(c) NH_2OH
(d) $LiAlH_4$

45.

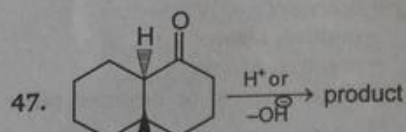
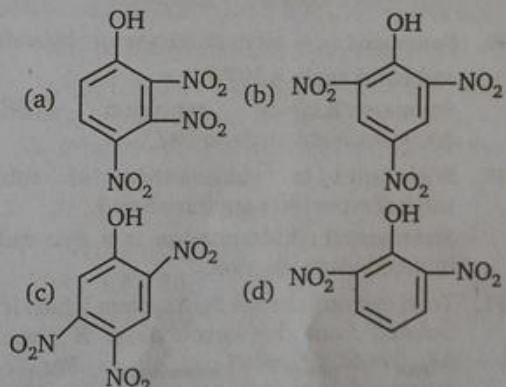


Which of the following is correct about A, B and C ?

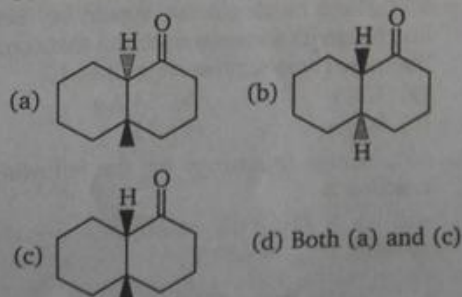
(a) A, B and C are anomers
(b) A, B and C are metamers
(c) Only A and C are anomers
(d) None of the above



Predominant product is



Product is



(d) Both (a) and (c)

Mock Test

48. AgCl is colourless whereas AgI is yellow because of
- Ag⁺ possess 18 electrons shell to screen the nuclear charge
 - Ag⁺ shows pseudo inert gas configuration
 - distortion of I⁻ is more pronounced than Cl⁻ ion
 - existence of d-d transition

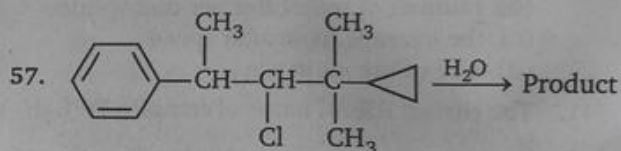
Directions : Question No. 49 to 50 are Assertion-Reason type. Each of these contains two statements Statement-I (Assertion), Statement-II (Reason). Each of these questions also has four alternative choices, only one of which is correct. You have to select the correct choices from the codes (a), (b), (c) and (d) given below :

- Statement I is true, Statement II is true; Statement II is not the correct explanation for Statement I
- Statement I is true, Statement II is false.
- Statement I is false, Statement II is true.
- Statement I is true, Statement II is true; Statement II is the correct explanation for Statement I.

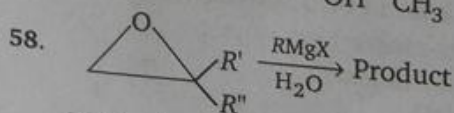
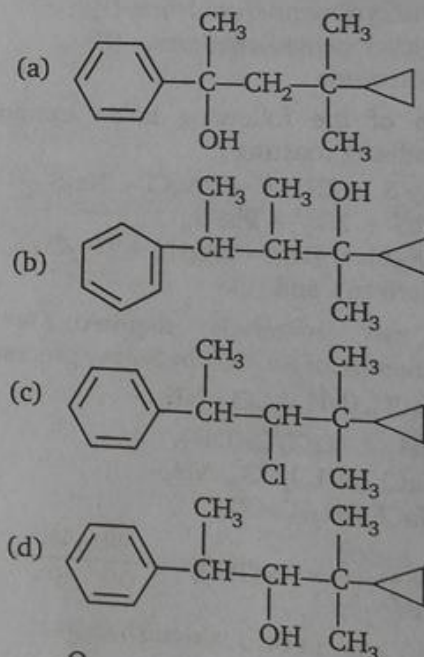
49. Statement I : N-atom in NH₃ is sp³-hybridised and bond angle is 107°. Statement II : lp-lp repulsion (VSEPR) decreases bond angle to 107°.
50. Statement I : In vulcanisation of rubber, sulphur cross links are introduced. Statement II : Vulcanisation is a free radical initiated chain reaction.
51. Total entropy change for a system which is not isolated from the surroundings is given by $\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surroundings}}$. For the spontaneous process
- $\Delta S_{\text{total}} = 0$, always
 - $\Delta S_{\text{total}} = \text{positive}$, always
 - $\Delta S_{\text{total}} = \text{negative}$, always
 - ΔS_{total} will be positive or negative other than zero
52. The osmotic pressure of blood is 7.65 atm at 37°C. How much glucose should be used per litre for an intravenous injection that is to have the same osmotic pressure as blood?
- 180 g
 - 54.2 g
 - 86 g
 - 111 g
53. ΔS° , change in entropy for the following cell reaction is
- $$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$$
- (Given : $E^\circ_{\text{cell}} = 1.23 \text{ V}$, $\Delta H_f^\circ(\text{H}_2\text{O}) = -285.8 \text{ kJ mol}^{-1}$, $\Delta G^\circ = -474.78 \text{ kJ}$)

- 126.7 JK⁻¹
- +126.7 JK⁻¹
- 324.9 JK⁻¹
- 324.9 JK⁻¹

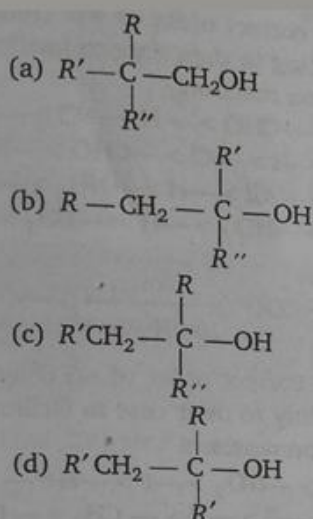
54. Molar conductance of a 1.5M solution of an electrolyte is found to be 138.9 S cm². The specific conductance of this solution is
- 0.208 S cm⁻¹
 - 0.102 S cm⁻¹
 - 0.320 S cm⁻¹
 - 0.152 S cm⁻¹
55. A metal X on heating in nitrogen gas gives Y. Y on treatment with H₂O gives a colourless gas which when passed through CuSO₄ solution gives a blue colour. Y is
- Mg(NO₃)₂
 - Mg₃N₂
 - NH₃
 - MgO
56. If one litre of air is passed repeatedly over heated copper and magnesium till no further reduction in volume takes place, the volume finally obtained would be approximately
- 800 mL
 - 200 mL
 - 10 mL
 - zero



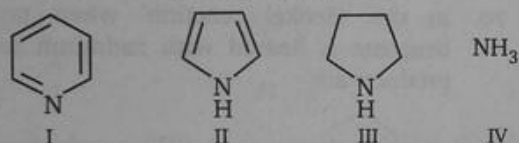
The predominant product is



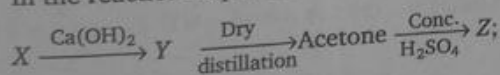
Predominant product is



59. Which of the following is correct order of basicity for these molecules ?



- (a) IV > II > I > III
 (b) III > IV > I > II
 (c) I > IV > III > II
 (d) III > I > II > IV
60. The compound 'X' was boiled under reflux for some time with a solution of sodium hydroxide. The solution was cooled, acidified with dilute nitric acid and then silver nitrate solution was added, a thick precipitate was formed, which one is incorrect as 'X' ?
- (a) CH_3COCl (b) $C_6H_5CH_2Cl$
 (c) $CH_2ClCOOH$ (d) C_6H_5Cl
61. In the reaction sequence



X, Y and Z are

- (a) CH_3CHO , aldol, phorone
 (b) $HCOOH$, $(HCOO)_2Ca$, mesityl oxide
 (c) CH_3COOH , $(CH_3COO)_2Ca$, mesityl oxide
 (d) CH_3COOH , $(CH_3COO)_2Ca$, pinacol
62. The ratio of kinetic energy and potential energy of an electron in Bohr orbit of a hydrogen like species is
- (a) 1/2 (b) -1/2
 (c) 1 (d) -1

63. To a 25 mL H_2O_2 solution, excess of acidified solution of potassium iodide was added. The iodine liberated required 20 mL of 0.3 N sodium thiosulphate solution. The volume strength of H_2O_2 solution is
- (a) 4.444 (b) 2.444
 (c) 3.344 (d) 1.344

64. Which of the following is not correctly matched?

Colloidal solution	Type
I Cheese	Gel
II Hair cream	Emulsion
III Mist	Aerosol
IV Whipped cream	Solid foam

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

65. In a certain polluted atmosphere containing O_3 at a steady state concentration of $2.0 \times 10^{-8} \text{ mol/L}$, the hourly production of O_3 by all sources was estimated as $7.2 \times 10^{-15} \text{ mol/L}$. If the only mechanism for destruction of O_3 is the second order reaction $2O_3 \rightarrow 3O_2$, what is the rate constant for the destruction reaction ?
- (a) $1.3 \times 10^{-3} \text{ L mol}^{-1} \text{ s}^{-1}$
 (b) $5 \times 10^{-3} \text{ L mol}^{-1} \text{ s}^{-1}$
 (c) $1.9 \times 10^{-3} \text{ L mol}^{-1} \text{ s}^{-1}$
 (d) $3.6 \times 10^{-15} \text{ L mol}^{-1} \text{ s}^{-1}$

66. The chemical reaction $2O_3 \rightarrow 3O_2$ proceeds as follows
- $O_3 \rightleftharpoons O_2 + O \dots$ (fast)
 $O + O_3 \rightarrow 2O_2 \dots$ (slow), the rate law expression should be
- (a) $r = k[O_3]^2$ (b) $r = k[O_3]^2 [O_2]^{-1}$
 (c) $r = k[O_3][O_2]$ (d) unpredictable

67. The salt of which one of the following weak acids will be the most hydrolysed ?
- (a) HA : $K_a = 1 \times 10^{-8}$
 (b) HB : $K_a = 2 \times 10^{-6}$
 (c) HC : $K_a = 3 \times 10^{-8}$
 (d) HD : $K_a = 4 \times 10^{-10}$

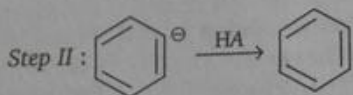
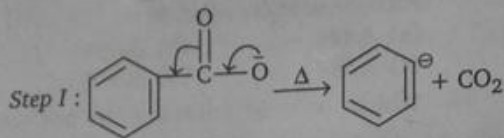
Directions : Question No. 68 to 70 are based on the following paragraph.
 The decarboxylation of aromatic acids is most often carried out by heating with Cu-quinoline

$$ArCOOH \xrightarrow{\text{Cu-quinoline}} ArH + CO_2$$

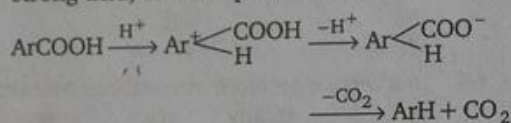
Mock Test

Cuprous salts of aromatic acids, actually undergoes decarboxylation. However, two other methods can be used with certain substrates.

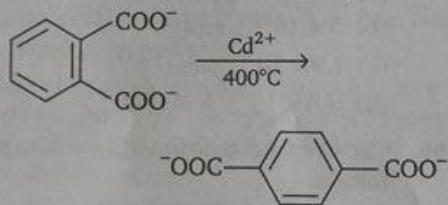
Method I : Salt of acid, ArCOO^- is heated (SE1)



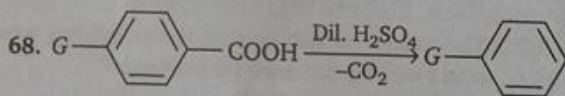
Method II : Carboxylic acid is heated with a strong acid, often sulphuric acid.



Decarboxylation takes place by the arenium ion mechanism, with H^+ electrophile. Evidently, the order of electrofugal ability is $\text{CO}_2 > \text{H}^+ > \text{COOH}^+$. Rearrangements are also known to take place. For example, when the phthalate ion is heated with catalytic amount of cadmium, the terephthalate ion is produced.

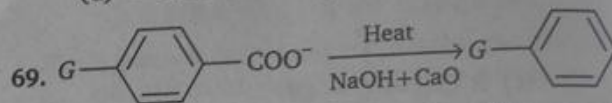


In a similar process, potassium benzoate heated with cadmium salts disproportionates. The rearrangement is named as 'Henkel rearrangement'.



Mark out the correct order of $-G$ (functional group) according to their ease to facilitate the decarboxylation reaction.

- (a) $-\text{NO}_2 > -\text{CHO} > -\text{H} > -\text{Cl} > -\text{CH}_3$
 (b) $-\text{CH}_3 > -\text{H} > -\text{Cl} > -\text{CHO} > -\text{NO}_2$
 (c) $-\text{CH}_3 > -\text{Cl} > -\text{H} > -\text{NO}_2 > -\text{CHO}$
 (d) $-\text{CHO} > -\text{NO}_2 > -\text{H} > -\text{CH}_3 > -\text{Cl}$



Mark out the correct order of $-G$ (functional group) according to their ease to facilitate the decarboxylation reaction.

- (a) $-\text{OCH}_3 > -\text{NO}_2 > -\text{F} > -\text{H} > -\text{CH}_3$
 (b) $-\text{NO}_2 > -\text{F} > -\text{H} > -\text{CH}_3 > -\text{OCH}_3$
 (c) $-\text{NO}_2 > -\text{F} > -\text{OCH}_3 > -\text{H} > -\text{CH}_3$
 (d) $-\text{OCH}_3 > -\text{CH}_3 > -\text{H} > -\text{F} > -\text{NO}_2$

70. In the 'Henkel reaction' when potassium benzoate is heated with cadmium salts, the products are

- (a)
- (b) and
- (c) and
- (d) and CO_2

Mathematics

1. If a , b and c are distinct positive numbers, then the expression $(b + c - a)(a + c - b)(a + b - c) - abc$ is
- (a) positive
 (b) negative
 (c) non-positive
 (d) non-negative

2. If x_1, x_2, x_3 as well as y_1, y_2, y_3 are in GP with the same common ratio, then the points $(x_1, y_1), (x_2, y_2)$ and (x_3, y_3)
- (a) lie on a straight line
 (b) lie on an ellipse
 (c) lie on a circle
 (d) are vertices of a triangle

3. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & -2 & 4 \end{bmatrix}$, $6A^{-1} = A^2 + cA + dI$, then

- (c, d) is
 (a) (-6, 11) (b) (-11, 6)
 (c) (11, 6) (d) (6, 11)

Directions : Question No. 4 and 5 are based on the following paragraph.

If $\cos \frac{\pi}{7}$, $\cos \frac{3\pi}{7}$, $\cos \frac{5\pi}{7}$ are the roots of the equation $8x^3 - 4x^2 - 4x + 1 = 0$.

4. Find the value of $\sec \frac{\pi}{7} + \sec \frac{3\pi}{7} + \sec \frac{5\pi}{7}$.
 (a) 2 (b) 4
 (c) 8 (d) None of these
5. Find the value of $\sin \frac{\pi}{14} \sin \frac{3\pi}{14} \sin \frac{5\pi}{14}$.
 (a) $\frac{1}{4}$ (b) $\frac{1}{8}$
 (c) $\frac{\sqrt{7}}{4}$ (d) $\frac{\sqrt{7}}{8}$
6. On the interval $[0, 1]$ the function $x^{25}(1-x)^{75}$ takes its maximum value at the point
 (a) 0 (b) $\frac{1}{4}$
 (c) $\frac{1}{2}$ (d) $\frac{1}{3}$
7. The area enclosed between the curves $y = ax^2$ and $x = ay^2$ ($a > 0$) is 1 sq unit. Then, the value of 'a' is
 (a) $\frac{1}{\sqrt{3}}$ (b) $\frac{1}{2}$
 (c) 1 (d) $\frac{1}{3}$
8. Let $\vec{a}, \vec{b}, \vec{c}$ be three vectors such that $\vec{a} \neq 0$ and $\vec{a} \times \vec{b} = 2\vec{a} \times \vec{c}$, $|\vec{a}| = |\vec{c}| = 1$, $|\vec{b}| = 4$ and $|\vec{b} \times \vec{c}| = \sqrt{15}$. If $\vec{b} - 2\vec{c} = \lambda \vec{a}$, then λ is equal to
 (a) -4 (b) -2
 (c) 1 (d) 3
9. Chords of an ellipse are drawn through the positive end of the minor axis. Then, their mid point lies on
 (a) a circle (b) a parabola
 (c) an ellipse (d) a hyperbola
10. Eight chairs are numbered 1 to 8. Two women and three men wish to occupy one chair each. First the women choose the chairs from amongst the chairs marked 1 to 4 and then the men select the chairs from amongst the

remaining. The number of possible arrangements is

- (a) ${}^6C_3 \times {}^3C_2$ (b) ${}^4P_2 \times {}^4P_3$
 (c) ${}^4C_2 + {}^4P_3$ (d) None of these
11. For any integer n the integral $\int_0^\pi e^{\cos^2 x} \cos^3 (2n+1)x dx$ has the value
 (a) π (b) 1
 (c) 0 (d) None of these
12. If $x=9$ is the chord of the hyperbola $x^2 - y^2 = 9$, then the equation of the corresponding pair of tangents is
 (a) $9x^2 - 8y^2 + 18x - 9 = 0$
 (b) $9x^2 - 8y^2 - 18x + 9 = 0$
 (c) $9x^2 - 8y^2 - 18x - 9 = 0$
 (d) $9x^2 - 8y^2 + 18x + 9 = 0$
13. The number of all possible triplets (a_1, a_2, a_3) such that $a_1 + a_2 \cos 2x + a_3 \sin^2 x = 0, \forall x$, is
 (a) 0 (b) 1
 (c) 3 (d) ∞
14. The number of real solutions of $\tan^{-1} \sqrt{x(x+1)} + \sin^{-1} \sqrt{x^2 + x + 1} = \frac{\pi}{2}$ is
 (a) 0 (b) 1
 (c) 2 (d) ∞
- Directions : Question No. 15 to 17 are Assertion-Reason type questions. Each of these questions contains two statements : Statement I (Assertion) and Statement II (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice in the codes (a), (b), (c) and (d) given below :
- (a) Statement I is true, Statement II is true; Statement II is not the correct explanation for Statement I.
 (b) Statement I is true, Statement II is false.
 (c) Statement I is false, Statement II is true.
 (d) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I.
15. Statement I : A coin is tossed 31 times. If the probability of getting number of heads more than the number of tails is equal to the probability of getting tails more than the number of heads, then the coin must be unbiased.
 Statement II : If $p = q$ and $p + q = 1$, then coin is unbiased.
16. Statement I : If $f(x)$ is odd function and $g(x)$ is even function, then $f(x) + g(x)$ is neither even nor odd.

Mock Test

Statement II : Odd function is symmetrical at in opposite quadrants and even function is symmetrical about the y -axis.

17. **Statement I :** If normal at the ends of double ordinate $x = 4$ of parabola $y^2 = 4x$ meet the curve again at P and P' respectively, then $PP' = 12$ unit.

Statement II : If normal at t_1 of $y^2 = 4ax$ meet the parabola again at t_2 , then $t_2 = -t_1 - \frac{2}{t_1}$.

18. The minimum value of $x^2 + \frac{1}{1+x^2}$ is at

(a) $x = 0$ (b) $x = 1$
(c) $x = 4$ (d) $x = 3$

19. 10 different toys are to be distributed among 10 children. Total number of ways of distributing these toys, so that exactly 2 children do not get any toy, is equal to

(a) $(10!)^2 \left(\frac{1}{3!2!7!} + \frac{1}{(2!)^5 6!} \right)$

(b) $(10!)^2 \left(\frac{1}{3!2!7!} + \frac{1}{(2!)^4 6!} \right)$

(c) $(10!)^2 \left(\frac{1}{3!7!} + \frac{1}{(2!)^5 6!} \right)$

(d) $(10!)^2 \left(\frac{1}{3!7!} + \frac{1}{(2!)^4 (6!)} \right)$

20. If $(1+x)^n = \sum_{r=0}^n {}^n C_r x^r$, then

$$\frac{{}^n C_0}{1 \cdot 2} 2^2 + \frac{{}^n C_1}{2 \cdot 3} 2^3 + \frac{{}^n C_2}{3 \cdot 4} 2^4 + \dots$$

$$+ \frac{{}^n C_n}{(n+1) \cdot (n+2)} 2^{n+2}$$

is equal to

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

(c) $\frac{3^{n+2} - 2n - 5}{(n+1)(n+2)}$ (d) None of these

21. The solution of the differential equation $x dy - y dx = \sqrt{x^2 + y^2} dx$ is

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

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

(c) $x - \sqrt{x^2 + y^2} = cx$

(d) $y + \sqrt{x^2 + y^2} = cx^2$

22. If the base of a triangle and the ratio of the lengths of the other two unequal sides are given, then the vertex lies on a/an

(a) straight line (b) circle
(c) ellipse (d) parabola

23. The tangent to the curve $x = a(\theta - \sin \theta)$, $y = a(1 + \cos \theta)$ at the points $\theta = (2k+1)\pi$, $k \in I$ are parallel to

(a) $y = x$ (b) $y = -x$
(c) $y = 0$ (d) $x = 0$

24. If the imaginary part of the expression $\frac{z-1}{e^{i\theta}} + \frac{e^{i\theta}}{z-1}$ be zero, then the locus of z is

(a) a straight line parallel to the x -axis
(b) a circle of radius 1 and centre (1, 0)
(c) a parabola
(d) None of the above

25. A parallelepiped is formed by planes drawn through the points (2, 3, 5) and (5, 9, 7), parallel to the coordinate planes. The length of a diagonal of the parallelepiped is

(a) 7 (b) $\sqrt{38}$
(c) $\sqrt{155}$ (d) None of these

26. If a vertex of a triangle is (1, 1) and the mid points of two sides through this vertex are (-1, 2) and (3, 2), then the centroid of the triangle is

(a) $\left(\frac{1}{3}, \frac{7}{3}\right)$ (b) $\left(1, \frac{7}{3}\right)$
(c) $\left(-\frac{1}{3}, \frac{7}{3}\right)$ (d) $\left(-1, \frac{7}{3}\right)$

27. The expression $\{x + (x^3 - 1)^{1/2}\}^5 + \{x - (x^3 - 1)^{1/2}\}^5$ is a polynomial of degree

(a) 5 (b) 6
(c) 7 (d) 8

28. If p , q , r are simple propositions, then $(p \wedge q) \wedge (q \wedge r)$ is true, then

(a) p , q , r are all false
(b) p , q , r are all true
(c) p , q are true and r is false
(d) p is true and q and r are false

29. $\lim_{x \rightarrow 1} \frac{\sqrt{1 - \cos 2(x-1)}}{x-1}$ is equal to

(a) exists and it equals $\sqrt{2}$
(b) exists and it equals $-\sqrt{2}$
(c) does not exist because $x-1 \rightarrow 0$
(d) does not exist because left hand limit is not equal to right hand limit

30. The value of $\int \frac{\sin^{-1}\sqrt{x} - \cos^{-1}\sqrt{x}}{\sin^{-1}\sqrt{x} + \cos^{-1}\sqrt{x}} dx$ is
- (a) $\frac{2}{\pi} \{\sqrt{x-x^2} - (1+2x)\sin^{-1}\sqrt{x}\} - x + c$
 (b) $\frac{2}{\pi} \{\sqrt{x-x^2} - (1-2x)\sin^{-1}\sqrt{x}\} - x + c$
 (c) $\frac{2}{\pi} \{\sqrt{x-x^2} - (1-2x)\sin^{-1}x\} - x + c$
 (d) None of the above
31. If $a > 2b > 0$, then positive value of m for which $y = mx - b\sqrt{1+m^2}$ is a common tangent to $x^2 + y^2 = b^2$ and $(x-a)^2 + y^2 = b^2$, is
- (a) $\frac{2b}{\sqrt{a^2-4b^2}}$ (b) $\frac{\sqrt{a^2-4b^2}}{2b}$
 (c) $\frac{2b}{a-2b}$ (d) $\frac{b}{a-2b}$
32. If $a_r > 0, r \in N$ and a_1, a_2, \dots, a_{2n} are in AP, then
- $$\frac{a_1 + a_{2n}}{\sqrt{a_1} + \sqrt{a_2}} + \frac{a_2 + a_{2n-1}}{\sqrt{a_2} + \sqrt{a_3}} + \frac{a_3 + a_{2n-2}}{\sqrt{a_3} + \sqrt{a_4}} + \dots + \frac{a_n + a_{n+1}}{\sqrt{a_n} + \sqrt{a_{n+1}}}$$
- is equal to
33. If the ratio of the roots of $\lambda x^2 + \mu x + \nu = 0$ is equal to the ratio of the roots of $x^2 + x + 1 = 0$ then λ, μ, ν are in
 (a) AP (b) GP
 (c) HP (d) None of these
34. PQ and RS are two perpendicular chords of the rectangular hyperbola $xy = c^2$. If C is the centre of the rectangular hyperbola, then the product of the slopes of CP, CQ, CR and CS is equal to
 (a) -1 (b) 1
 (c) 0 (d) None of these
35. If $\cos x - \frac{\cot \beta \sin x}{2} = \frac{\sqrt{3}}{2}$, then the value of $\tan \frac{x}{2}$ is
 (a) $\tan \frac{\beta}{2} \tan 15^\circ$ (b) $\tan \frac{\beta}{2}$
 (c) $\tan 15^\circ$ (d) None of these

Answers

PHYSICS AND CHEMISTRY

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (b) | 3. (b) | 4. (b) | 5. (d) | 6. (c) | 7. (d) | 8. (b) |
| 9. (c) | 10. (d) | 11. (d) | 12. (b) | 13. (a) | 14. (d) | 15. (b) | 16. (c) |
| 17. (a) | 18. (c) | 19. (c) | 20. (a) | 21. (c) | 22. (b) | 23. (c) | 24. (c) |
| 25. (b) | 26. (a) | 27. (b) | 28. (c) | 29. (b) | 30. (c) | 31. (a) | 32. (d) |
| 33. (d) | 34. (c) | 35. (b) | 36. (d) | 37. (b) | 38. (d) | 39. (d) | 40. (d) |
| 41. (b) | 42. (d) | 43. (d) | 44. (c) | 45. (c) | 46. (b) | 47. (d) | 48. (c) |
| 49. (d) | 50. (a) | 51. (b) | 52. (b) | 53. (c) | 54. (a) | 55. (b) | 56. (c) |
| 57. (b) | 58. (b) | 59. (b) | 60. (d) | 61. (c) | 62. (b) | 63. (d) | 64. (d) |
| 65. (b) | 66. (b) | 67. (d) | 68. (b) | 69. (c) | 70. (b) | | |

MATHEMATICS

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|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (a) | 3. (a) | 4. (b) | 5. (b) | 6. (b) | 7. (a) | 8. (a) |
| 9. (c) | 10. (d) | 11. (c) | 12. (b) | 13. (d) | 14. (c) | 15. (d) | 16. (a) |
| 17. (b) | 18. (a) | 19. (b) | 20. (c) | 21. (d) | 22. (b) | 23. (c) | 24. (b) |
| 25. (a) | 26. (b) | 27. (c) | 28. (b) | 29. (d) | 30. (b) | 31. (a) | 32. (b) |
| 33. (b) | 34. (b) | 35. (a) | | | | | |