Q1. A physical quantity y is represented by the formula $y = m^2 r^{-4}\, g^x l^{-\frac{3}{2}}$ If the percentage errors found in $y,\ m,\ r,\ l$ and g are $18,\ 1,\ 0.5,\ 4$ and p respectively, then find the value of x and p.

(1) 5 and ± 2
(2) 4 and ± 3
(3) $\frac{16}{3}$ and $\pm\frac{3}{2}$
(4) 8 and ± 2

Q2. Match List I with List II.

List-I		List-II	
a	Capacitance, C	i	$M^1\, L^1\, T^{-3}\, A^{-1}$
b	Permittivity of free space, ε_0	ii	$M^{-1}\, L^{-3}\, T^4\, A^2$
c	Permeability of free space, μ_0	iii	$M^{-1}\, L^{-2}\, T^4\, A^2$
d	Electric field, E	iv	$M^1 L^1 T^{-2} A^{-2}$

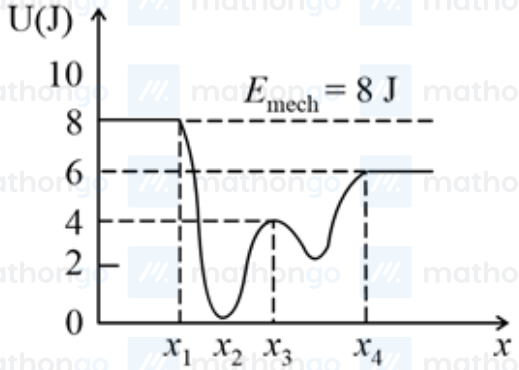
Choose the correct answer from the options given below

(1) $(a) \rightarrow$ (iii), $(b) \rightarrow$ (ii), $(c) \rightarrow$ (iv), $(d) \rightarrow$ (i)
(2) $(a) \rightarrow$ (iii), $(b) \rightarrow$ (iv), $(c) \rightarrow$ (ii), $(d) \rightarrow$ (i)
(3) $(a) \rightarrow$ (iv), $(b) \rightarrow$ (ii), $(c) \rightarrow$ (iii), $(d) \rightarrow$ (i)
(4) $(a) \rightarrow$ (iv), $(b) \rightarrow$ (iii), $(c) \rightarrow$ (ii), $(d) \rightarrow$ (i)

Q3. A particle of mass M originally at rest is subjected to a force whose direction is constant but magnitude varies with time according to the relation $F = F_0\left[1 - \left(\frac{t-T}{T}\right)^2\right]$ where F_0 and T are constants. The force acts only for the time interval $2\,T$. The velocity v of the particle after time $2\,T$ is:

(1) $\frac{2\,F_0\,T}{M}$
(2) $\frac{F_0\,T}{2M}$
(3) $\frac{4\,F_0\,T}{3M}$
(4) $\frac{F_0\,T}{3M}$

Q4. Given below is the plot of a potential energy function $U(x)$ for a system, in which a particle is in one dimensional motion, while a conservative force $F(x)$ acts on it. Suppose that $E_{mech} = 8$ J, the incorrect statement for this system is :



[where K.E. = kinetic energy]

(1) at $x > x_4$, K.E. is constant throughout the region.
(2) at $x < x_1$, K.E. is smallest and the particle is moving at the slowest speed.
(3) at $x = x_2$, K.E. is greatest and the particle is moving at the fastest speed.
(4) at $x = x_3$, K.E. $= 4$ J

Q5. An automobile of mass m accelerates starting from the origin and initially at rest, while the engine supplies constant power P. The position is given as a function of time by:

(1) $\left(\frac{9P}{8\,m}\right)^{\frac{1}{2}}t^{\frac{3}{2}}$ (2) $\left(\frac{8P}{9\,m}\right)^{\frac{1}{2}}t^{\frac{2}{3}}$

(3) $\left(\frac{9m}{8P}\right)^{\frac{1}{2}}t^{\frac{3}{2}}$ (4) $\left(\frac{8P}{9\,m}\right)^{\frac{1}{2}}t^{\frac{3}{2}}$

Q6. Two identical particles of mass $1\ \text{kg}$ each go round a circle of radius R, under the action of their mutual gravitational attraction. The angular speed of each particle is:

(1) $\sqrt{\frac{G}{2R^3}}$ (2) $\frac{1}{2}\sqrt{\frac{G}{R^3}}$

(3) $\frac{1}{2R}\sqrt{\frac{1}{G}}$ (4) $\sqrt{\frac{2G}{R^3}}$

Q7. The planet Mars has two moons, if one of them has a period 7 hours, 30 minutes and an orbital radius of $9.0\times10^3\ \text{km}$. Find the mass of Mars.

$\left\{\text{Given } \frac{4\pi^2}{G}=6\times10^{11}\ \text{N}^{-1}\,\text{m}^{-2}\,\text{kg}^2\right\}$

(1) $5.96\times10^{19}\ \text{kg}$ (2) $3.25\times10^{21}\ \text{kg}$

(3) $7.02\times10^{25}\ \text{kg}$ (4) $6.00\times10^{23}\ \text{kg}$

Q8. A raindrop with radius $\text{R}=0.2\ \text{mm}$ falls from a cloud at a height $\text{h}=2000\ \text{m}$ above the ground. Assume that the drop is spherical throughout its fall and the force of buoyance may be neglected, then the terminal speed attained by the raindrop is : [Density of water $f_{\text{w}}=1000\ \text{kg m}^{-3}$ and Density of air $f_{\text{a}}=1.2\ \text{kg m}^{-3}$, $\text{g}=10\ \text{m/s}^2$ Coefficient of viscosity of air $=1.8\times10^{-5}\text{N s m}^{-2}$]

(1) $250.6\ \text{m s}^{-1}$ (2) $43.56\ \text{m s}^{-1}$

(3) $4.94\ \text{m s}^{-1}$ (4) $14.4\ \text{m s}^{-1}$

Q9. One mole of an ideal gas is taken through an adiabatic process where the temperature rises from 27°C to 37°C. If the ideal gas is composed of polyatomic molecule that has 4 vibrational modes, which of the following is true? $\left[\text{R}=8.314\ \text{J mol}^{-1}\text{k}^{-1}\right]$

(1) work done by the gas is close to 332 J (2) work done on the gas is close to 582 J

(3) work done by the gas is close to 582 J (4) work done on the gas is close to 332 J

Q10. Two Carnot engines A and B operate in series such that engine A absorbs heat at T_1 and rejects heat to a sink at temperature T. Engine B absorbs half of the heat rejected by Engine A and rejects heat to the sink at T_3. When workdone in both the cases is equal, to value of T is :

(1) $\frac{2}{3}\ \text{T}_1+\frac{3}{2}\ \text{T}_3$ (2) $\frac{1}{3}\ \text{T}_1+\frac{2}{3}\ \text{T}_3$

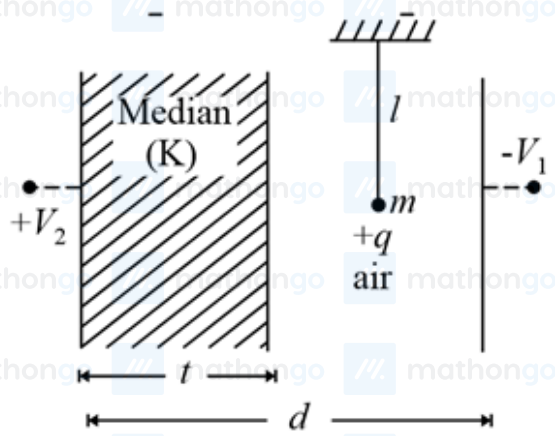
(3) $\frac{3}{2}\ \text{T}_1+\frac{1}{3}\ \text{T}_3$ (4) $\frac{2}{3}\ \text{T}_1+\frac{1}{3}\ \text{T}_3$

Q11. An object of mass $0.5\ \text{kg}$ is executing simple harmonic motion. It amplitude is $5\ \text{cm}$ and time period (T) is $0.2\ \text{s}$. What will be the potential energy of the object at an instant $\text{t}=\frac{\text{T}}{4}\ \text{s}$ starting from mean position. Assume that the initial phase of the oscillation is zero.

(1) $0.62\ \text{J}$ (2) $6.2\times10^{-3}\ \text{J}$

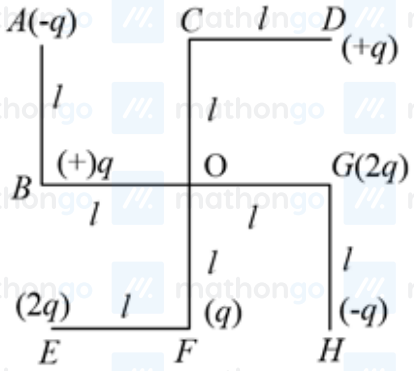
(3) $1.2\times10^{3}\ \text{J}$ (4) $6.2\times10^{3}\ \text{J}$

Q12. A simple pendulum of mass ' m ', length ' l ' and charge $'+q'$ suspended in the electric field produced by two conducting parallel plates as shown. The value of deflection of pendulum in equilibrium position will be



(1) $\tan^{-1}\left[\frac{q}{mg} \times \frac{C_1(V_2-V_1)}{(C_1+C_2)(d-t)}\right]$
(2) $\tan^{-1}\left[\frac{q}{mg} \times \frac{C_2(V_2-V_1)}{(C_1+C_2)(d-t)}\right]$
(3) $\tan^{-1}\left[\frac{q}{mg} \times \frac{C_2(V_1+V_2)}{(C_1+C_2)(d-t)}\right]$
(4) $\tan^{-1}\left[\frac{q}{mg} \times \frac{C_1(V_1+V_2)}{(C_1+C_2)(d-t)}\right]$

Q13. What will be the magnitude of the electric field at point O as shown in the figure? Each side of the figure is l and perpendicular to the other?

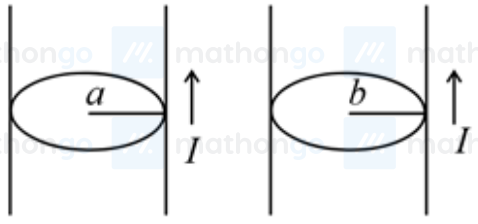


(1) $\frac{1}{4\pi\varepsilon_0}\frac{q}{l^2}$
(2) $\frac{1}{4\pi\varepsilon_0}\frac{q}{(2l^2)}\left(2\sqrt{2}-1\right)$
(3) $\frac{q}{4\pi\varepsilon_0(2l)^2}$
(4) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{2l^2}\left(\sqrt{2}\right)$

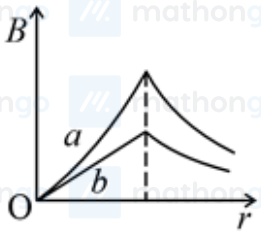
Q14. The resistance of a conductor at $15^\circ C$ is $16\ \Omega$ and at $100^\circ C$ is $20\ \Omega$. What will be the temperature coefficient of resistance of the conductor?

(1) $0.010^\circ C^{-1}$
(2) $0.033^\circ C^{-1}$
(3) $0.003^\circ C^{-1}$
(4) $0.042^\circ C^{-1}$

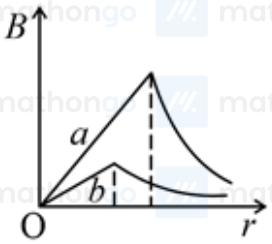
Q15. Figure A and B shown two long straight wires of circular cross-section (a and b with $a < b$), carrying current I which is uniformly distributed across the cross-section. The magnitude of magnetic field B varies with radius r and can be represented as:



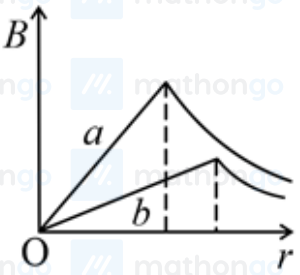
(1)



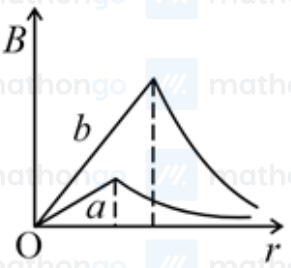
(2)



(3)



(4)



Q16. A 100Ω resistance, a 0.1μF capacitor and an inductor are connected in series across a 250 V supply at variable frequency. Calculate the value of inductance of inductor at which resonance will occur. Given that the resonant frequency is 60 Hz.

(1) 0.70H

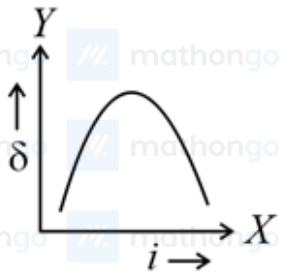
(2) 70.3 mH

(3) 7.03×10^{-5}H

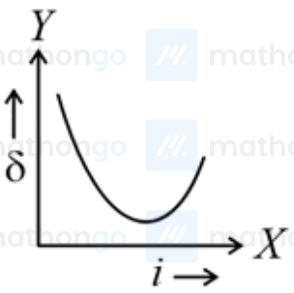
(4) 70.3 H

Q17. The expected graphical representation of the variation of angle of deviation ' δ ' with angle of incidence 'i' in a prism is :

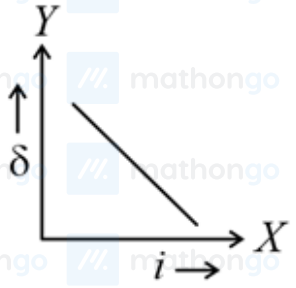
(1)



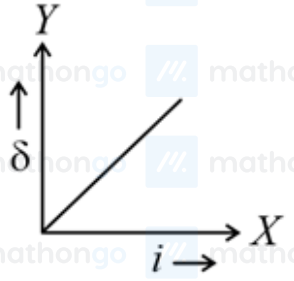
(2)



(3)



(4)



Q18. An electron and proton are separated by a large distance. The electron starts approaching the proton with energy 3 eV. The proton captures the electrons and forms a hydrogen atom in second excited state. The resulting photon is incident on a photosensitive metal of threshold wavelength $4000\mathring{A}$ What is the maximum kinetic energy of the emitted photoelectron?

(1) 7.61 eV (2) 1.41 eV
(3) 3.3 eV (4) No photoelectron would be emitted

Q19. Consider the following statements:

A. Atoms of each element emit characteristics spectrum.

B. According to Bohr's Postulate, an electron in a hydrogen atom revolves in a certain stationary orbit.

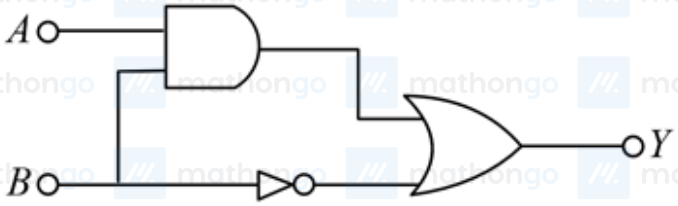
C. The density of nuclear matter depends on the size of the nucleus.

D. A free neutron is stable but a free proton decay is possible.

E. Radioactivity is an indication of the instability of nuclei. Choose the correct answer from the options given below.

(1) $A,\ B,\ C,\ D$ and E (2) $A,\ B$ and E only.
(3) B and D only (4) A, C and E only

Q20. Find the truth table for the function Y of A and B represented in the following figure.



(1)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	0

(2)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	1

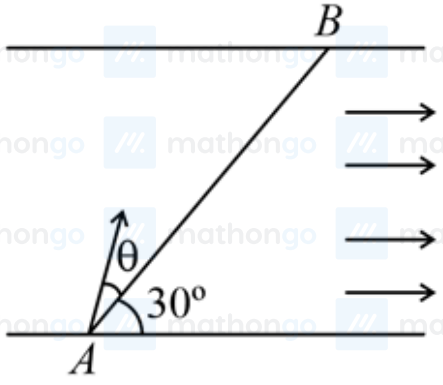
(3)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

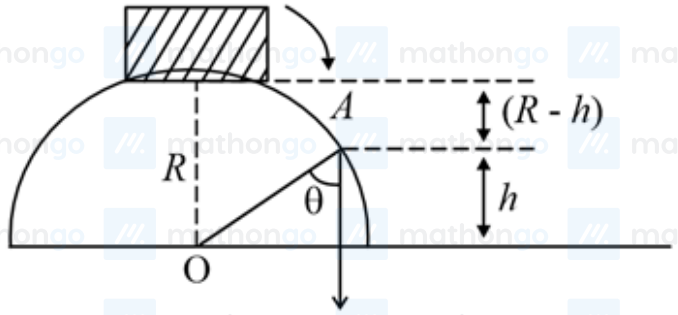
(4)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Q21. A swimmer wants to cross a river from point A to point B. Line AB makes an angle of 30° with the flow of the river. The magnitude of the velocity of the swimmer is the same as that of the river. The angle θ with the line AB should be _____$^\circ$, so that the swimmer reaches point B.

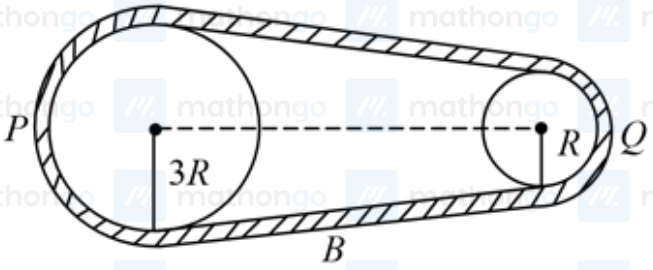


Q22. A small block slides down from the top of hemisphere of radius $R = 3$ m as shown in the figure. The height h at which the block will lose contact with the surface of the sphere is m. (Assume there is no friction between the block and the hemisphere)



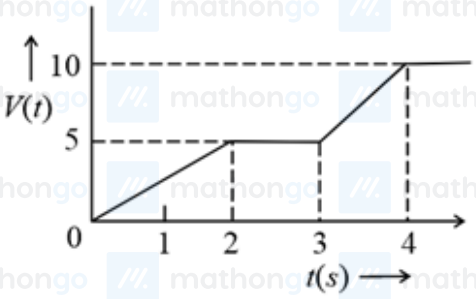
Q23. The water is filled up to a height of 12 m in a tank having vertical sidewalls. A hole is made in one of the walls at a depth h below the water level. The value of h for which the emerging stream of water strikes the ground at the maximum range is _____ m.

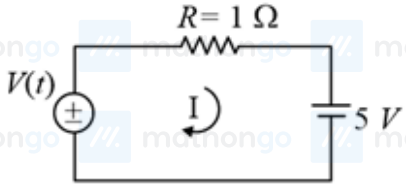
Q24. In the given figure, two wheels P and Q are connected by a belt B. The radius of P is three times that of Q. In the case of the same rotational kinetic energy, the ratio of rotational inertias $\left(\frac{I_1}{I_2}\right)$ will be $x : 1$. The value of x will be _____.



Q25. A particle executes simple harmonic motion represented by displacement function as $x(t) = A\sin(\omega t + \phi)$. If the position and velocity of the particle at $t = 0$ s are 2 cm and 2ω cm s^{-1} respectively, then its amplitude is $x\sqrt{2}$ cm where the value of x is

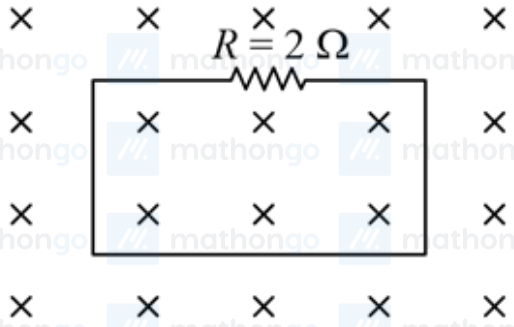
Q26. For the circuit shown, the value of current at time $t = 3.2$ s will be _____ A.





[Voltage distribution V(t) is shown by Fig. (1) and the circuit is shown in Fig. (2)]

Q27. In the given figure the magnetic flux through the loop increases according to the relation $\phi_B(t) = 10t^2 + 20t$, where ϕ_B is in milliwebers and t is in seconds. The magnitude of current through $R = 2\ \Omega$ resistor at $t = 5$ s is _____ mA.



Q28. The difference in the number of waves when yellow light propagates through air and vacuum columns of the same thickness is one. The thickness of the air column is _____ mm. [Refractive index of air $= 1.0003$, the wavelength of yellow light in vacuum $= 6000\ \mathring{A}$]

Q29. The K_α X-ray of molybdenum has wavelength 0.071 nm. If the energy of a molybdenum atom with a K electron knocked out is 27.5 keV, the energy of this atom when an L electron is knocked out will be keV. (Round off to the nearest integer) $[h = 4.14 \times 10^{-15}\ \text{eV s},\ c = 3 \times 10^8\ \text{m s}^{-1}]$

Q30. The maximum amplitude for an amplitude modulated wave is found to be 12 V while the minimum amplitude is found to be 3 V. The modulation index is $0.6x$ where x is _____.

Q31. If the Thomson model of the atom was correct, then the result of Rutherford's gold foil experiment would have been:

(1) All of the α-particles pass through the gold foil without decrease in speed.
(2) α-particles are deflected over a wide range of angles.
(3) All α-particles get bounced back by 180°.
(4) α-particles pass through the gold foil deflected by small angles and with reduced speed.

Q32. The CORRECT order of first ionisation enthalpy is:
(1) Mg < S < Al < P
(2) Mg < Al < S < P
(3) Al < Mg < S < P
(4) Mg < Al < P < S

Q33. The number of neutrons and electrons, respectively, present in the radioactive isotope of hydrogen is :-
(1) 1 and 1
(2) 3 and 1
(3) 2 and 1
(4) 2 and 2

Q34. Match List - I with List II :

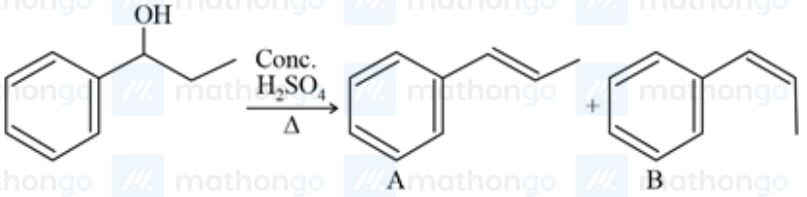
List-I		List-II
a Li	i	photoelectric cell
b Na	ii	absorbent of CO_2
c K	iii	coolant in fast breeder nuclear reactor
d Cs	iv	treatment of cancer
	v	bearings for motor engines

Choose the correct answer from the options given below:
(1) (a) -(v),(b)-(i),(c)-(ii),(d)-(iv)
(2) (a) -(v),(b)-(ii),(c)-(iv),(d)-(i)
(3) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)
(4) (a) - (v), (b) - (iii), (c) - (ii), (d) - (i)

Q35. Which one of the following set of elements can be detected using sodium fusion extract?
(1) Sulfur, Nitrogen, Phosphorus, Halogens
(2) Phosphorus, Oxygen, Nitrogen, Halogens
(3) Nitrogen, Phosphorus, Carbon, Sulfur
(4) Halogens, Nitrogen, Oxygen, Sulfur

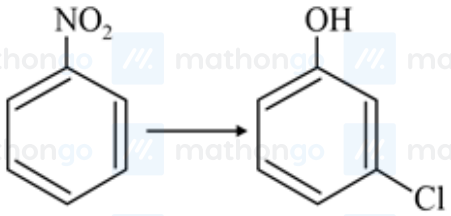
Q36. Given below are two statements :
Statement I : Hyperconjugation is a permanent effect.
Statement II : Hyperconjugation in ethyl cation $\left(CH_3-\overset{+}{C}H_2\right)$ involves the overlapping of $C_{sp^2}-H_{1s}$ bond with empty 2p orbital of other carbon.
Choose the correct option:
(1) Both statement I and statement II are false
(2) Statement I is incorrect but statement II is true
(3) Statement I is correct but statement II is false
(4) Both Statement I and statement II are true.

Q37.



consider the above reaction, and choose the correct statement:
(1) The reaction is not possible in acidic medium
(2) Both compounds A and B are formed equally
(3) Compound A will be the major product
(4) Compound B will be the major product

Q38. The correct sequence of correct reagents for the following transformation is :-



(1) (i) Fe, HCl
(ii) $Cl_2, HCl,$
(iii) $NaNO_2, HCl, 0^\circ C$
(iv) H_2O/H^+

(2) (i) Fe, HCl
(ii) $NaNO_2, HCl, 0^\circ C$
(iii) H_2O/H^+
(iv) $Cl_2, FeCl_3$

(3) (i) $Cl_2, FeCl_3$
(ii) Fe, HCl
(iii) $NaNO_2, HCl, 0^\circ C$
(iv) H_2O/H^+

(4) (i) $Cl_2, FeCl_3$
(ii) $NaNO_2, HCl, 0^\circ C$
(iii) Fe, HCl
(iv) H_2O/H^+

Q39. Match List - I with List - II :

List - I (compound)	List - II (effect/affected species)
a Carbon monoxide	i Carcinogenic
b Sulphur dioxide	ii Metabolized by pyrus plants
c Polychlorinated biphenyls	iii Haemoglobin
d Oxides of Nitrogen	iv Stiffness of flower buds

Choose the correct answer from the options given below:

(1) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii) (2) (a) – (iv), (b) – (i), (c) – (iii), (d) – (ii)

(3) (a) – (i), (b) – (ii), (c) – (iii), (d) – (iv) (4) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i)

Q40. Select the correct statements.

(A) Crystalline solids have long range order.

(B) Crystalline solids are isotropic.

(C) Amorphous solid are sometimes called pseudo solids.

(D) Amorphous solids soften over a range of temperatures.

(E) Amorphous solids have a definite heat of fusion. Choose the most appropriate answer from the options given below.

(1) (A), (B), (E) only (2) (B), (D) only

(3) (C), (D) only (4) (A), (C), (D) only

Q41. Given below are two statement : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : $SO_2(g)$ is adsorbed to a large extent than $H_2(g)$ on activated charcoal.

Reason R : $SO_2(g)$ has a higher critical temperature than $H_2(g)$

In the light of the above statements, choose the most appropriate answer from the options given below.

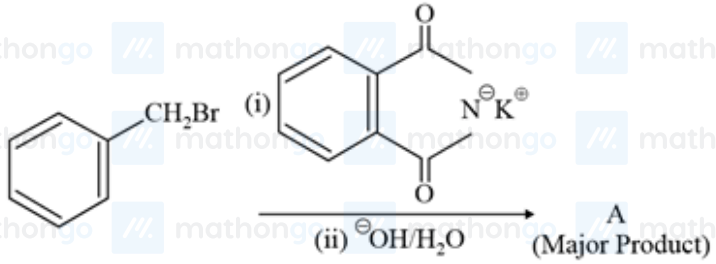
(1) Both A and R are correct but R is not the correct explanation fo A
(2) Both A and R are correct and R is the correct explanation of A.
(3) A is not correct but R is correct.
(4) A is correct but R is not correct.

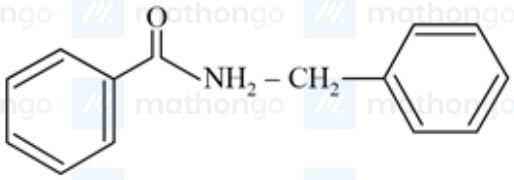
Q42. The addition of silica during the extraction of copper from its sulphide ore :-
(1) converts copper sulphide into copper silicate
(2) converts iron oxide into iron silicate
(3) reduces copper sulphide into metallic copper
(4) reduces the melting point of the reaction mixture

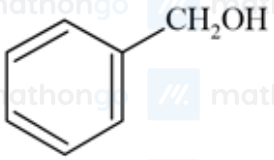
Q43. Number of Cl = O bonds in chlorous acid, chloric acid and perchloric acid respectively are:
(1) 3, 1 and 1
(2) 4, 1 and 0
(3) 1, 1 and 3
(4) 1, 2 and 3

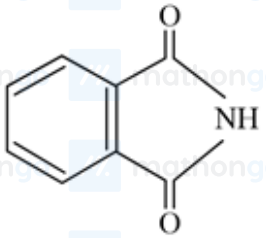
Q44. Given below are two statements :
Statement I: $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$ are d^2sp^3 hybridised.
Statement II : $[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$ are paramagnetic and have 4 and 5 unpaired electrons, respectively.
In the light of the above statements, choose the correct answer from the options given below:
(1) Statement I is correct but statement II is false
(2) Both statement I and statement II are false
(3) Statement I is incorrect but statement II is true
(4) Both statement I and statement II are are true

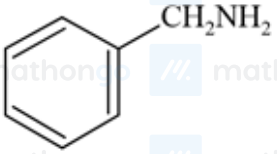
Q45. What is A in the following reaction?



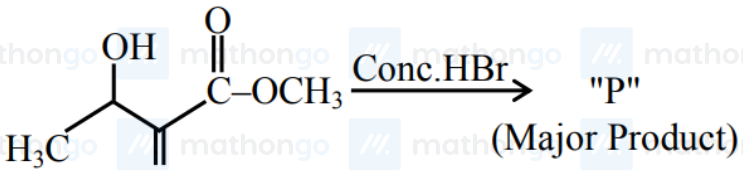
(1)


(2)


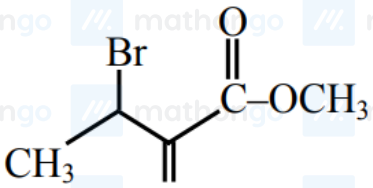
(3)


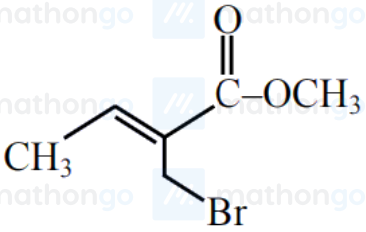
(4)


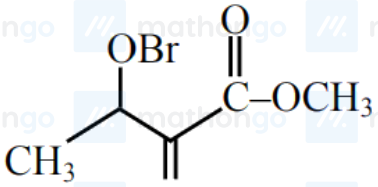
Q46.

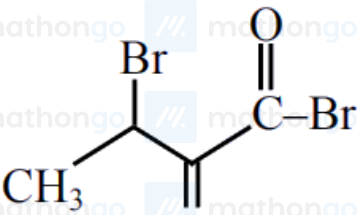


Consider the above reaction, the major product P formed is :-

(1) 

(2) 

(3) 

(4) 

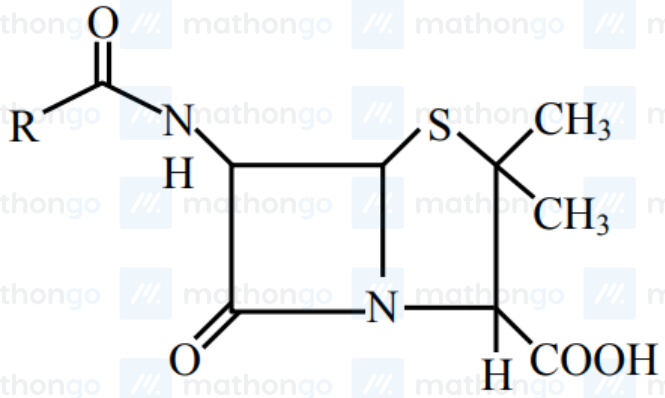
Q47. $R-CN \xrightarrow[(ii)H_2O]{(i)\ DIBAL-H} R-Y$ Consider the above reaction and identify "Y"

(1) $-CH_2NH_2$
(2) $-CONH_2$
(3) $-CHO$
(4) $-COOH$

Q48. Given below are two statements :

Statement I : Penicillin is a bacteriostatic type antibiotic.

Statement II : The general structure of Penicillin is:



Choose the correct option :

(1) Both statement I and statement II are false
(2) Statement I is incorrect but statement II is true
(3) Both statement I and statement II are true
(4) Statement I is correct but statement II is false

Q49. To an aqueous solution containing ions such as $Al^{3+}, Zn^{2+}, Ca^{2+}, Fe^{3+}, Ni^{2+}, Ba^{2+}$ and Cu^{2+} was added conc. HCl, followed by H_2S. The total number of cations precipitated during this reaction is/are :

(1) 1
(2) 3
(3) 4
(4) 2

Q50. Compound A gives D-Galactose and D-Glucose on hydrolysis. The compound A is :

(1) Amylose
(2) Sucrose
(3) Maltose
(4) Lactose

Q51. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

The above reaction is carried out in a vessel starting with partial pressure $P_{SO_2} = 250$ m bar, $P_{O_2} = 750$ m bar and $P_{SO_3} = 0$ bar. When the reaction is complete, the total pressure in the reaction vessel is _____ m bar.
(Round off of the nearest integer).

Q52. The total number of electrons in all bonding molecular orbitals of O_2^{2-} is ..... (Round off to the nearest integer)

Q53. When 400 mL of 0.2 M H_2SO_4 solution is mixed with 600 mL of 0.1 MNaOH solution, the increase in temperature of the final solution is — $\times 10^{-2}$ K. (Round off to the nearest integer).
[Use :$H^+(aq) + OH^-(aq) \rightarrow H_2O : \Delta_\gamma H = -57.1$ kJ mol^{-1}]
Specific heat of $H_2O = 4.18$ J K^{-1} g^{-1} , density of $H_2O = 1.0$ g cm^{-3}
Assume no change in volume of solution on mixing.

Q54. The equilibrium constant for the reaction $A(s) \rightleftharpoons M(s) + \frac{1}{2}O_2(g)$ is $K_p = 4$. At equilibrium, the partial pressure of O_2 is _____ atm. (Round off to the nearest integer)

Q55. 10.0 mL of 0.05 M $KMnO_4$ solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is ..... $\times 10^{-2}$ g/L. (Round off to the nearest integer)

Q56. The dihedral angle in staggered form of Newmann's projection of 1, 1, 1-Trichloro ethane is .....degree. (Round off to the nearest integer) (Round off to the nearest integer)

Q57. In a solvent 50% of an acid HA dimerizes and the rest dissociates. The van't Hoff factor of the acid is _____ $\times 10^{-2}$ (Round off to the nearest integer)

Q58. For the cell $Cu(s)\left|Cu^{2+}(aq)(0.1M)\right|\left|Ag^+(aq)(0.01M)\right|Ag(s)$ the cell potential $E_1 = 0.3095$ V. For the cell $Cu(s)\left|Cu^{2+}(aq)(0.01M)\right|\left|Ag^+(aq)(0.001M)\right|Ag(s)$ the cell potential $= x \times 10^{-2}$ V. Find value of x (Round off the Nearest Integer).
[Use : $\frac{2.303RT}{F} = 0.059$ J]

Q59. For the first order reaction $A \rightarrow 2B$, 1 mole of reactant A gives 0.2 moles of B after 100 minutes. The half life of the reaction is ..... min. (Round off to the nearest integer).
[Use : $\ln 2 = 0.69, \ln 10 = 2.3$
Properties of logarithms : $\ln x^y = y \ln x$
$\ln\left(\frac{x}{y}\right) = \ln x - \ln y$]
(Round off to the nearest integer)

Q60. 3 moles of metal complex with formula $Co(en)_2Cl_3$ gives 3 moles of silver chloride on treatment with excess of silver nitrate. The secondary valency of Co in the complex is (Round off to the nearest integer)

Q61. Let $\alpha = \max_{x \in R}\{8^{2\sin 3x} \cdot 4^{4\cos 3x}\}$ and $\beta = \min_{x \in R}\{8^{2\sin 3x} \cdot 4^{4\cos 3x}\}$. If $8x^2 + bx + c = 0$ is a quadratic equation whose roots are $\alpha^{1/5}$ and $\beta^{1/5}$, then the value of $c - b$ is equal to :

(1) 42 (2) 47
(3) 43 (4) 50

Q62. Let $\mathbb{C}$ be the set of all complex numbers. Let $S_1 = \{z \in \mathbb{C} : |z-2| \leq 1\}$ and $S_2 = \{z \in \mathbb{C} : z(1+i) + \overline{z}(1-i) \geq 4\}$. Then, the maximum value of $\left|z - \frac{5}{2}\right|^2$ for $z \in S_1 \cap S_2$ is equal to :

(1) $\frac{3+2\sqrt{2}}{4}$ (2) $\frac{5+2\sqrt{2}}{2}$

(3) $\frac{3+2\sqrt{2}}{2}$ (4) $\frac{5+2\sqrt{2}}{4}$

Q63. If $\tan\left(\frac{\pi}{9}\right), x, \tan\left(\frac{7\pi}{18}\right)$ are in arithmetic progression and $\tan\left(\frac{\pi}{9}\right), y, \tan\left(\frac{5\pi}{18}\right)$ are also in arithmetic progression, then $|x-2y|$ is equal to :

(1) 4 (2) 3

(3) 0 (4) 1

Q64. A possible value of x, for which the ninth term in the expansion of $\left\{3^{\log_3\sqrt{25^{x-1}+7}} + 3^{\left(-\frac{1}{8}\right)\log_3\left(5^{x-1}+1\right)}\right\}^{10}$ in the increasing powers of $3^{\left(-\frac{1}{8}\right)\log_3\left(5^{x-1}+1\right)}$ is equal to 180, is :

(1) 0 (2) -1

(3) 2 (4) 1

Q65. The point $P(a,b)$ undergoes the following three transformations successively:

(a) reflection about the line $y = x$.

(b) translation through 2 units along the positive direction of $x-$ axis.

(c) rotation through angle $\frac{\pi}{4}$ about the origin in the anti-clockwise direction.

If the co-ordinates of the final position of the point P are $\left(-\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$, then the value of $2a+b$ is equal to:

(1) 13 (2) 9

(3) 5 (4) 7

Q66. Two sides of a parallelogram are along the lines $4x+5y=0$ and $7x+2y=0$. If the equation of one of the diagonals of the parallelogram is $11x+7y=9$, then other diagonal passes through the point:

(1) $(1,2)$ (2) $(2,2)$

(3) $(2,1)$ (4) $(1,3)$

Q67. Consider a circle C which touches the $y-$ axis at $(0,6)$ and cuts off an intercept $6\sqrt{5}$ on the $x-$ axis. Then the radius of the circle C is equal to :

(1) $\sqrt{53}$ (2) 9

(3) 8 (4) $\sqrt{82}$

Q68. The value of $\lim\limits_{x\to 0}\left(\frac{x}{\sqrt[8]{1-\sin x}-\sqrt[8]{1+\sin x}}\right)$ is equal to :

(1) 0 (2) 4

(3) -4 (4) -1

Q69. Which of the following is the negation of the statement "for all $M>0$, there exists $x \in S$ such that $x \geq M$"?

(1) there exists $M>0$, such that $x<M$ for all $x \in S$ (2) there exists $M>0$, there exists $x \in S$ such that $x \geq M$

(3) there exists $M>0$, there exists $x \in S$ such that $x<M$ (4) there exists $M>0$ such that $x \geq M$ for all $x \in S$

Q70. Let the mean and variance of the frequency distribution

$x:$ $x_1=2$ $x_2=6$ $x_3=8$ $x_4=9$

$f:$ 4 4 α β

be 6 and 6. 8 respectively. If x_3 is changed from 8 to 7, then the mean for the new data will be:

(1) 4 (2) 5

(3) $\frac{17}{3}$ (4) $\frac{16}{3}$

Q71. Let N be the set of natural numbers and a relation R on N be defined by $R = \{(x, y) \in N \times N : x^3 - 3x^2y - xy^2 + 3y^3 = 0\}$. Then the relation R is

(1) symmetric but neither reflexive nor transitive (2) reflexive but neither symmetric nor transitive

(3) reflexive and symmetric, but not transitive (4) an equivalence relation

Q72. Let A and B be two 3×3 real matrices such that $\left(A^2 - B^2\right)$ is invertible matrix. If $A^5 = B^5$ and $A^3\,B^2 = A^2\,B^3$, then the value of the determinant of the matrix $A^3 + B^3$ is equal to :

(1) 2 (2) 4

(3) 1 (4) 0

Q73. Let $f : R \to R$ be defined as $f(x + y) + f(x - y) = 2f(x)f(y), f\left(\frac{1}{2}\right) = -1$. Then the value of $\sum_{k=1}^{20} \frac{1}{\sin(k)\sin(k+f(k))}$ is equal to :

(1) $\text{cosec}^2\,(21)\cos(20)\cos(2)$ (2) $\sec^2(1)\sec(21)\cos(20)$

(3) $\text{cosec}^2\,(1)\,\text{cosec}\,(21)\sin(20)$ (4) $\sec^2(21)\sin(20)\sin(2)$

Q74. Let $f : [0, \infty) \to [0, 3]$ be a function defined by $f(x) = \begin{cases} \max\{\sin t : 0 \le t \le \pi\}, & x \in [0, \pi] \\ 2 + \cos x, & x > \pi \end{cases}$. Then which of the following is true ?

(1) f is continuous everywhere but not differentiable exactly at one point in $(0, \infty)$ (2) f is differentiable everywhere in $(0, \infty)$

(3) f is not continuous exactly at two points in $(0, \infty)$ (4) f is continuous everywhere but not differentiable exactly at two points in $(0, \infty)$

Q75. Let $f : (a, b) \to R$ be twice differentiable function such that $f(x) = \int_a^x g(t)dt$ for a differentiable function $g(x)$. If $f(x) = 0$ has exactly five distinct roots in (a, b), then $g(x)g'(x) = 0$ has at least :

(1) twelve roots in (a, b) (2) five roots in (a, b)

(3) seven roots in (a, b) (4) three roots in (a, b)

Q76. The area of the region bounded by $y - x = 2$ and $x^2 = y$ is equal to :-

(1) $\frac{16}{3}$ (2) $\frac{2}{3}$

(3) $\frac{9}{2}$ (4) $\frac{4}{3}$

Q77. Let $y = y(x)$ be the solution of the differential equation $\left(x - x^3\right)dy = \left(y + yx^2 - 3x^4\right)dx, x > 2$ If $y(3) = 3$, then $y(4)$ is equal to:

(1) 4 (2) 12

(3) 8 (4) 16

Q78. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three vectors such that $\vec{a} = \vec{b} \times \left(\vec{b} \times \vec{c}\right)$. If magnitudes of the vectors $\vec{a}, \vec{b}$ and $\vec{c}$ are $\sqrt{2}, 1$ and 2 respectively and the angle between $\vec{b}$ and $\vec{c}$ is $\theta\left(0 < \theta < \frac{\pi}{2}\right)$, then the value of $1 + \tan\theta$ is equal to :

(1) $\sqrt{3} + 1$ (2) 2

(3) 1 (4) $\frac{\sqrt{3}+1}{\sqrt{3}}$

Q79. For real numbers α and $\beta \neq 0$, if the point of intersection of the straight lines $\frac{x-\alpha}{1} = \frac{y-1}{2} = \frac{z-1}{3}$ and $\frac{x-4}{\beta} = \frac{y-6}{3} = \frac{z-7}{3}$ lies on the plane $x + 2y - z = 8$, then $\alpha - \beta$ is equal to :

(1) 5 (2) 9

(3) 3 (4) 7

Q80. A student appeared in an examination consisting of 8 true-false type questions. The student guesses the answers with equal probability. The smallest value of n, so that the probability of guessing at least n correct answers is less than $\frac{1}{2}$, is :

(1) 5 (2) 6

(3) 3 (4) 4

Q81. The number of real roots of the equation $e^{4x} - e^{3x} - 4e^{2x} - e^{x} + 1 = 0$ is equal to

Q82. If the real part of the complex number $z = \frac{3+2i\cos\theta}{1-3i\cos\theta}, \theta \in \left(0, \frac{\pi}{2}\right)$ is zero, then the value of $\sin^2 3\theta + \cos^2\theta$ is equal to _____.

Q83. Let n be a non-negative integer. Then the number of divisors of the form $4n + 1$ of the number $(10)^{10} \cdot (11)^{11} \cdot (13)^{13}$ is equal to _____.

Q84. Let E be an ellipse whose axes are parallel to the co-ordinates axes, having its centre at $(3, -4)$, one focus at $(4, -4)$ and one vertex at $(5, -4)$. If $mx - y = 4, m > 0$ is a tangent to the ellipse E, then the value of $5m^2$ is equal to _____ .

Q85. Let $A = \{n \in N \mid n^2 \leq n + 10,000\}$, $B = \{3k + 1 \mid k \in N\}$ and $C = \{2k \mid k \in N\}$, then the sum of all the elements of the set $A \cap (B - C)$ is equal to _____.

Q86. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ and $M = A + A^2 + A^3 + \ldots + A^{20}$, then the sum of all the elements of the matrix M is equal to _____.

Q87. If $\int_0^{\pi} (\sin^3 x) e^{-\sin^2 x} dx = \alpha - \frac{\beta}{e} \int_0^1 \sqrt{t} e^t dt$, then $\alpha + \beta$ is equal to

Q88. Let $y = y(x)$ be the solution of the differential equation $dy = e^{\alpha x + y} dx; \alpha \in N$. If $y(\log_e 2) = \log_e 2$ and $y(0) = \log_e\left(\frac{1}{2}\right)$, then the value of α is equal to ___.

Q89. Let $\vec{a} = \hat{i} - \alpha\hat{j} + \beta\hat{k}, \vec{b} = 3\hat{i} + \beta\hat{j} - \alpha\hat{k}$ and $\vec{c} = -\alpha\hat{i} - 2\hat{j} + \hat{k}$, where α and β are integers. If $\vec{a} \cdot \vec{b} = -1$ and $\vec{b} \cdot \vec{c} = 10$, then $\left(\vec{a} \times \vec{b}\right) \cdot \vec{c}$ is equal to _____.

Q90. The distance of the point $P(3, 4, 4)$ from the point of intersection of the line joining the points $Q(3, -4, -5)$ and $R(2, -3, 1)$ and the plane $2x + y + z = 7$, is equal to _____.

ANSWER KEYS

1. (3)	**2.** (1)	**3.** (3)	**4.** (2)	**5.** (4)	**6.** (2)	**7.** (4)	**8.** (3)
9. (2)	**10.** (4)	**11.** (1)	**12.** (3)	**13.** (2)	**14.** (3)	**15.** (3)	**16.** (4)
17. (2)	**18.** (2)	**19.** (2)	**20.** (2)	**21.** (30)	**22.** (2)	**23.** (6)	**24.** (9)
25. (2)	**26.** (1)	**27.** (60)	**28.** (2)	**29.** (10)	**30.** (1)	**31.** (4)	**32.** (3)
33. (3)	**34.** (4)	**35.** (1)	**36.** (3)	**37.** (3)	**38.** (3)	**39.** (1)	**40.** (4)
41. (2)	**42.** (2)	**43.** (4)	**44.** (4)	**45.** (4)	**46.** (2)	**47.** (3)	**48.** (2)
49. (1)	**50.** (4)	**51.** (875)	**52.** (10)	**53.** (82)	**54.** (16)	**55.** (1575)	**56.** (60)
57. (125)	**58.** (28)	**59.** (655)	**60.** (6)	**61.** (1)	**62.** (4)	**63.** (3)	**64.** (4)
65. (2)	**66.** (2)	**67.** (2)	**68.** (3)	**69.** (1)	**70.** (3)	**71.** (2)	**72.** (4)
73. (3)	**74.** (2)	**75.** (3)	**76.** (3)	**77.** (2)	**78.** (2)	**79.** (4)	**80.** (1)
81. (2)	**82.** (1)	**83.** (924)	**84.** (3)	**85.** (832)	**86.** (2020)	**87.** (5)	**88.** (2)
89. (9)	**90.** (7)						