FIITJEE - JEE **(Mains)**

CPA C-LOT BATCH

PHYSICS, CHEMISTRY & MATHEMATICS

JEE - MAINS 2014

PHASE – I

SET - A

Time Allotted: 3 Hours **Maximum Marks: 360**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.*
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are ***three*** parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :______________________________

Enrolment Number :______________________________

Batch :____________________ **Date of Examination :** ____________________

Useful Data Chemistry:

Gas Constant	R	=	8.314 J K^{-1} mol^{-1}
		=	0.0821 Lit atm K^{-1} mol^{-1}
		=	1.987 $\approx$ 2 Cal K^{-1} mol^{-1}
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-27} erg.s
1 Faraday		=	96500 Coulomb
1 calorie		=	4.2 Joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No : H=1, D=1, Li=3, Na=11, K=19, Rb=37, Cs=55, F=9, Ca=20, He=2, O=8, Au=79.

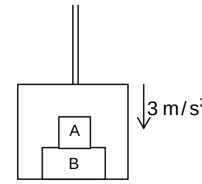
Atomic Masses: He=4, Mg=24, C=12, O=16, N=14, P=31, Br=80, Cu=63.5, Fe=56, Mn=55,
Pb=207,
Au=197, Ag=108, F=19, H=2, Cl=35.5, Sn=118.6

Useful Data Physics:

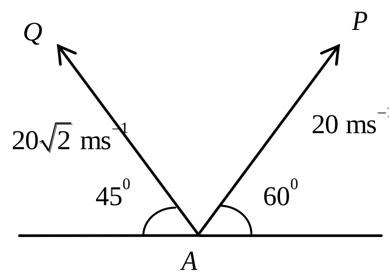
Acceleration due to gravity g = 10 m/s^2

Section – I (Physics)

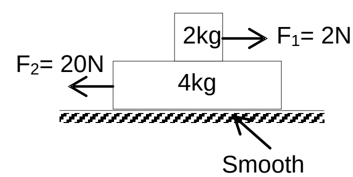
1. The elevator shown in figure is descending with an acceleration of 3 m/s ^{2}. The mass of the block A = 1 kg. The force exerted by the block B on A is
(A) 3 N (B) 4 N
(C) 6 N (D) 7 N



2. Two particles P and Q are projected simultaneously away from each other from a point A as shown in figure. The velocity of P relative to Q in ms^{-1} at the instant when the motion of P is horizontal is
(A) $10\sqrt{4-\sqrt{3}}$ (B) $20\sqrt{4-\sqrt{3}}$
(C) $10\sqrt{4+\sqrt{3}}$ (D) $20\sqrt{4+\sqrt{3}}$



3. In the arrangement shown in the figure, coefficient of friction between the two blocks is $\mu = \frac{1}{2}$. The force of friction acting between the two blocks is
(A) 8 N (B) 10 N
(C) 6 N (D) 4 N

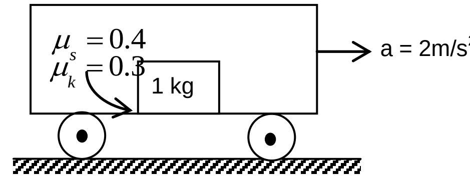


4. A particle is projected with speed u at angle α with horizontal to pass over a tower of height h. The product of the two possible times taken to pass over the tower is
(A) $\frac{2u}{g}$ (B) $\frac{2h}{g}$ (C) $\frac{u}{g}$ (D) $\frac{4h}{g}$

5. A particle of mass m is subjected to a force $\vec{F} = F_0[\cos(t)\hat{i} + \sin(t)\hat{j}]$. If initially (t=0) the particle was at rest, the kinetic energy of the particle as a function of time is given by:
(A) $\frac{F_0^2}{m}(1-\cos(2t))$ (B) $\frac{F_0^2}{m}(1-\cos t)$
(C) $\frac{F_0^2}{m}\sin(t)$ (D) $\frac{F_0^2}{m}t$

space for rough work

6. A block of mass 1 kg is placed on the rough horizontal surface of a car moving with a constant acceleration a = 2m/s^2 starting from rest as shown. The net work done by frictional force on the block relative to ground in first 4 sec is

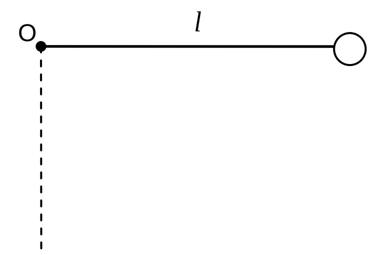


(A) 8 Joule (B) 16 Joule
(C) 32 Joule (D) 64 Joule

7. Velocity of a particle moving in a curvilinear path varies with time as $\vec{v} = \left(2t\hat{i} + t^2\hat{j}\right)$ m/s. Here, t is in second. At t = 1 s. The tangential acceleration of particle is

(A) $\frac{2}{\sqrt{5}}$ m/s^2 (B) $\frac{3}{\sqrt{5}}$ m/s^2 (C) $\frac{4}{\sqrt{5}}$ m/s^2 (D) $\frac{6}{\sqrt{5}}$ m/s^2

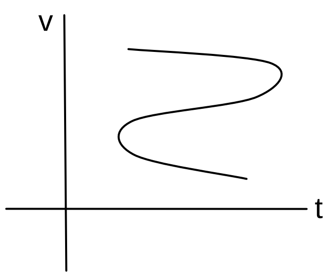
8. A particle is attached to one end of a string whose other end is fixed at point 'O' in the vertical plane. The particle is released from rest when the string is horizontal. Then, the angle made by the string with the vertical when the net acceleration of particle is horizontal

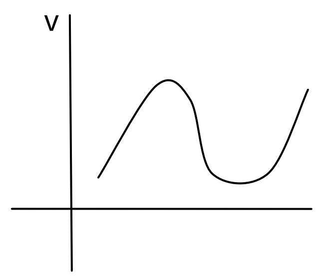


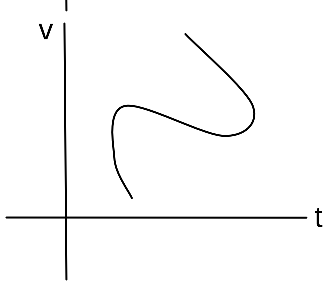
(A) $\tan^{-1}\left(\sqrt{2}\right)$ (B) $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$

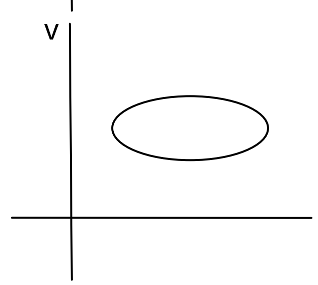
(C) $\tan^{-1}(2)$ (D) $\tan^{-1}\left(\frac{1}{2}\right)$

9. Which of the following velocity time graphs shows a realistic situation for a body in motion?

(A)


(B)


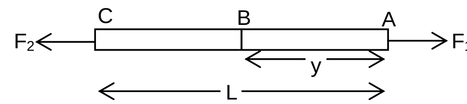
(C)


(D)


space for rough work

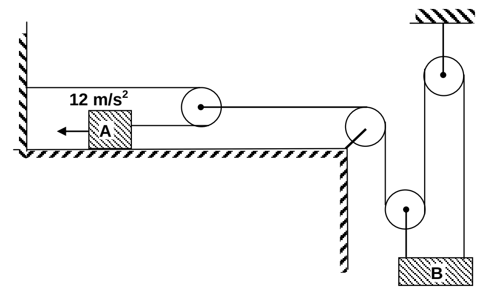
10. A grasshopper can jump maximum distance of 1.6 m. It spends negligible time on the ground. How far can it go in 10 seconds?
(A) $5\sqrt{2}$ m (B) $10\sqrt{2}$ m (C) $20\sqrt{2}$ m (D) $40\sqrt{2}m$

11. A uniform rod of length L and mass M is acted on by two unequal forces F_1 and F_2 $(F_2 < F_1)$ as shown in the figure. The tension in the rod at a distance y from the end A is given by

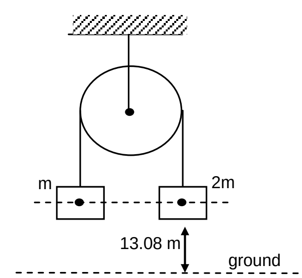


(A) $F_1\left(1-\frac{y}{L}\right)+F_2\left(\frac{y}{L}\right)$ (B) $F_2\left(1-\frac{y}{2}\right)+F_1\left(\frac{y}{L}\right)$
(C) $(F_1-F_2)\frac{y}{L}$ (D) $\frac{(F_2+F_1)y}{L}$

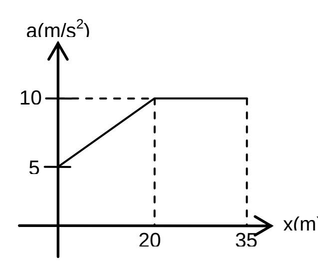
12. Assuming that the block B always remains horizontal, then acceleration of B is
(A) 6 m/s^2 (B) 2 m/s^2
(C) 4 m/s^2 (D) None of these



13. Two masses 'm' and '2m' are connected by a massless string which passes over a light frictionless pulley as shown in fig. The masses are initially held with equal lengths of the strings on either side of the pulley. (g = 9.81 m/s^2) Velocity of mass m after moving 6.54 m up is
(A) V = 6.54 m/s
(B) V = 5.54 m/s
(C) V = 7.54 m/s
(D) V = 8.54 m/s



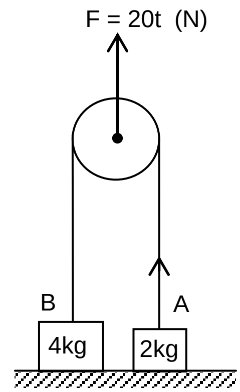
14. The a –x graph for a particle moving along x-axis is shown in the fig. If initial velocity of particle is 5 m/s at x = 0, then the velocity of particle at x = 35 m is
(A) 15 m/s (B) 25 m/s
(C) 35 m/s (D) 45 m/s



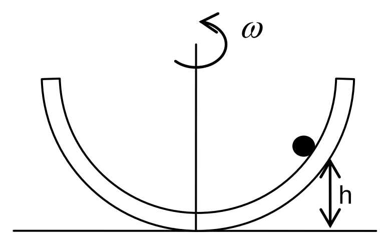
space for rough work

15. A particle moves in x – y plane according to the law $x = 4\sin t$ and $y = 4(1-\cos t)$. Then find the distance (in meter) covered by the particle in 2 seconds. (x and y are in meters)
(A) 8 (B) 4 (C) 10 (D) 16

16. In the arrangement shown string and pulley are massless and smooth and a vertical upward force $F = 20t$ (Newton) is applied to the pulley, then the velocity of the block A, when the block B will loose contact with the horizontal surface, is
(A) 5 m/s (B) 10 m/s
(C) 15 m/s (D) None of these

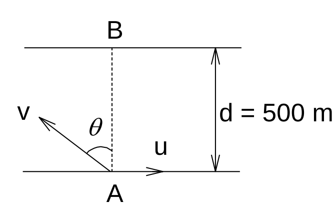


17. A small body of mass m can slide without friction along a trough bent which is in the form of a semi-circular arc of radius R. At what height h will the body be at rest with respect to the trough, if the trough rotates with uniform angular velocity ω about a vertical axis:
(A) R (B) $R - \frac{2g}{\omega^2}$
(C) $R + \frac{2g}{\omega^2}$ (D) $R - \frac{g}{\omega^2}$



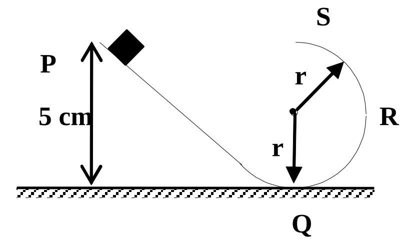
18. The position vector of a particle varies with time as $\vec{r} = \vec{r}_0(1-\alpha t)t$ where $\vec{r}_0$ is a constant vector and α is a positive constant then the distance covered during the time interval in which particle returns to its initial position is:
(A) r_0/α (B) $r_0/2\alpha$ (C) $\sqrt{r_0^2 + \frac{r_0}{\alpha}}$ (D) $\sqrt{r_0^2 + \frac{2r_0}{\alpha}}$

19. A swimmer wishes to cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angle θ with the perpendicular as shown in the figure. For u = 5km/hr and v = 3 km/hr, the swimmer:
(A) can reach to B in 7.5 min
(B) can reach to B in 6 min
(C) can reach to B in less than 6 min
(D) can never reach to B



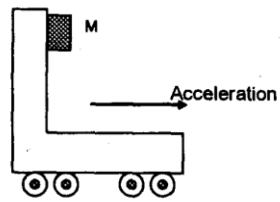
space for rough work

20. A frictionless track PQRS ends in a circular loop of radius r. A body slides down the track from point P which is at a height 5 cm. Find the maximum value of r for a body to complete the loop successfully.



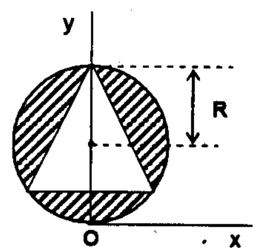
(A) 2 (B) 4
(C) 2.5 (D) 3

21. An accelerated system with a vertical wall has co-efficient of friction μ between block and walls as shown in the figure. A block M of mass 1 kg just remains in equilibrium with the vertical wall, when the system has an acceleration of 20 m/s^2 . The co-efficient of friction has a value



(A) 0.10 (B) 0.25 (C) 0.50 (D) 1

22. From a uniform disc of radius R an equilateral triangle of side $\sqrt{3}$ R is cut as shown. The new position of centre of mass is



(A) (0, 0) (B) (0, R) (C) (R, 0) (D) $\left(0, \frac{\sqrt{3}}{2R}\right)$

23. A block slides down an inclined plane of slope angle θ with constant velocity. If it is then projected up the same plane with an initial speed v_0, the distance in which it will come to rest is

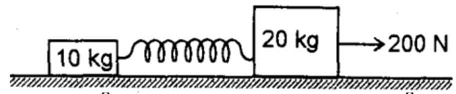
(A) $\frac{v_0^2}{g\tan\theta}$ (B) $\frac{v_0^2}{4g\sin\theta}$ (C) $\frac{v_0^2}{2g}$ (D) $\frac{v_0^2}{2g\sin\theta}$

24. A particle moving with uniform acceleration along a straight line covers distances a and b in successive intervals of p and q seconds. The acceleration of the particle is

(A) $\frac{pq(p+q)}{2(bp-aq)}$ (B) $\frac{2(aq-bp)}{pq(p+q)}$ (C) $\frac{2(bp-aq)}{pq(p-q)}$ (D) $\frac{2(bp-aq)}{pq(p+q)}$

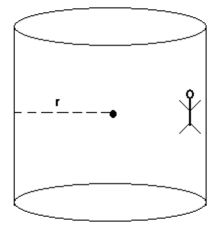
space for rough work

25. Two masses of 10 kg and 20 kg respectively are connected by a massless spring as shown in the figure. A force of 200 N acts upon the 20 kg mass. At the instant shown, the 10 kg mass has acceleration of 12 m/s^2 . The acceleration of 20kg mass is



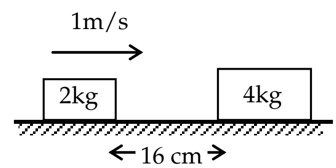
(A) 12 m/s^2 (B) 4 m/s^2 (C) 10 m/s^2 (D) Zero

26. A hollow cylinder of radius r rotates about its axis with a frequency f such that a person on the wall does not fall. The minimum value of coefficient of friction is



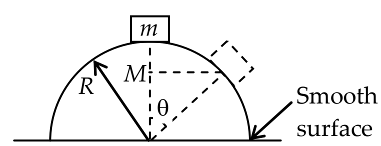
(A) $\frac{4\pi^2 f^2 r}{g}$ (B) $\frac{f^2 r}{g}$ (C) $\frac{\pi^2 f^2 r}{g}$ (D) $\frac{g}{4\pi^2 f^2 r}$

27. The friction coefficient between the horizontal surface and each of the blocks shown in figure is 0.2. The collision between the blocks is perfectly elastic. Find the separation between them when they come to rest.



(A) 2 cm (B) 5 cm (C) 8 cm (D) 11 cm

28. A block is released on the convex surface of a hemispherical wedge as shown in figure. Determine the displacement of wedge, when the block reaches the angular position q. so

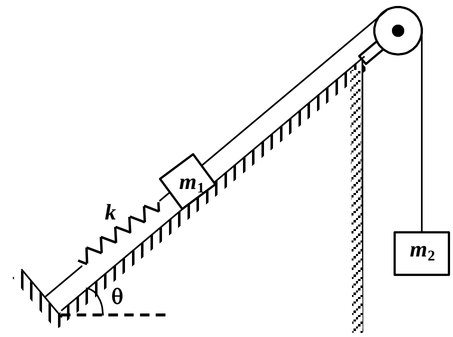


(A) $\frac{mR\cos\theta}{m+M}$ to left (B) $\frac{mg\cos\theta}{M+m}$ to right

(C) $\frac{mR\sin\theta}{m+M}$ to left (D) $x = \frac{mR\sin\theta}{m+M}$ to right

space for rough work

29. Two blocks with masses m_1 = 2 kg and m_2 = 3 kg hang on either side of a pulley as shown in figure. Block m_1 is on an incline ($\theta = 30^o$) and is attached to a spring whose stiffness constant is 40 N/m. The system is released from rest with the spring in its natural length. Find the maximum extension of the spring



(A) 0.98 m
(B) 1.96 m
(C) 0.49 m
(D) 2.94 m

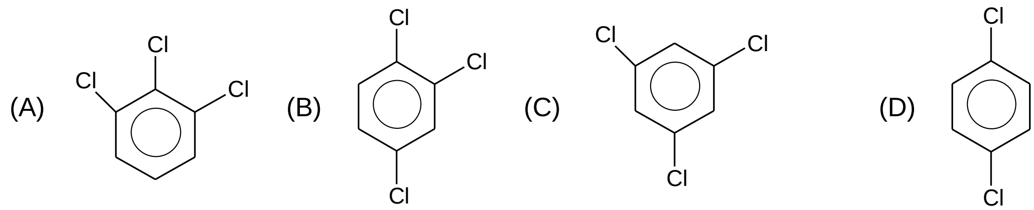
30. A particle is falling freely under gravity. In first t second it covers s_1 and the next t seconds it covers s_2, then t is given by

(A) $\sqrt{\frac{s_2 + s_1}{g}}$ (B) $\sqrt{\frac{s_2 - s_1}{g}}$ (C) $\sqrt{\frac{s_2 s_1}{g}}$ (D) $\sqrt{\frac{s_2^2 - s_1^2}{g}}$

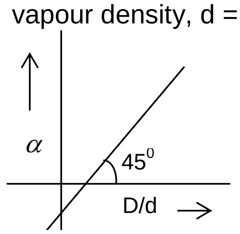
space for rough work

Section – II (Chemistry)

1. Which has maximum dipole moment?

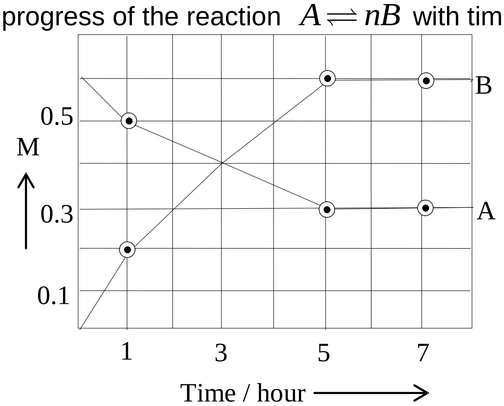


2. For an unknown decomposition chemical equilibrium in which 'A' decomposes to 'B', operating in gas phase a plot between $'\frac{D}{d}'$ and $'\alpha'$ gives a straight line, as shown in the figure. Find the ratio of the stoichiometric coefficient of the reactant to that of the product. Where D = initial vapour density, d = final vapour density at equilibrium.



(A) 1 : 2
(B) 1 : 1
(C) 2 : 1
(D) Data is inadequate to predict.

3. The progress of the reaction $A \rightleftharpoons nB$ with time is shown.



Stoichiometric coefficient of the product B is:
(A) 1
(B) 2
(C) 0
(D) 4

space for rough work

4. Among the following, the molecule that is linear is
(A) CO_2 (B) NO_2 (C) SO_2 (D) ClO_2

5. What is the % dissociation of H_2S if 1 mole of H_2S is introduced into a 1.1 litre vessel at 100K? K_c for the reaction,
$2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ is 10^{-6}
(A) 2.6% (B) 1.3% (C) 5% (D) 3%

6. $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$
Half – life period is independent of concentration of zinc at constant pH. For the constant concentration of Zn, rate becomes 100 times when pH is decreased from 3 to 2. Hence, the incorrect option is
(A) $\frac{dx}{dt} = k[Zn]^0[H^+]^2$
(B) $\left(\frac{dx}{dt}\right) = k[Zn][H^+]^2$
(C) rate is not affected if concentration of zinc is made four times and that of H^+ ion is halved.
(D) rate becomes four times if concentration of H^+ ion is doubled at constant Zn concentration.

7. Which of the following molecule is sea-saw shaped?
(A) XeF_4 (B) CF_4 (C) SF_4 (D) SiF_4

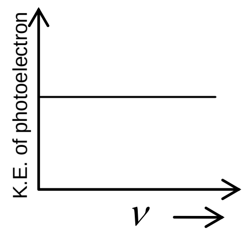
8. At a certain temperature 2 moles of carbon monoxide and 3 moles of chlorine were allowed to reach equilibrium according to the reaction CO(g) + Cl_2(g) $\rightleftharpoons$ $COCl_2$(g) in a 5 lit vessel. At equilibrium if one mole of CO is present, then equilibrium constant for the reaction is:
(A) 2 (B) 2.5 (C) 3.0 (D) 4

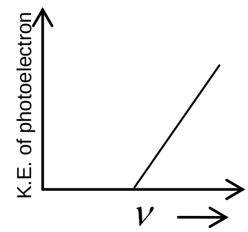
9. For a first order reaction, which is incorrect here?
(A) The time taken for the completion of 75% reaction is twice the $t_{1/2}$ of the reaction
(B) The degree of dissociation is equal to $1 - e^{-kt}$.
(C) A plot of reciprocal concentration of the reactant versus time gives a straight line
(D) The pre-exponential factor in the Arrhenius equation has the dimension of time, T^{-1}.

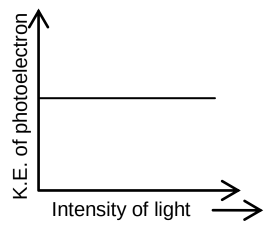
10. For a p-electron, the orbital angular momentum is
(A) $\sqrt{3}\frac{h}{2\pi}$ (B) $\frac{h}{2\pi}$ (C) $\sqrt{2}\frac{h}{2\pi}$ (D) $\frac{h}{\pi}$

space for rough work

11. Which is correct graph for photoelectric effect?

(A) 

(B) 

(C) 

(D) Both B & C are correct

12. Which of the following is the nodal plane of d_{xy} orbital?

(A) xy (B) yz
(C) zx (D) Both B & C are correct

13. Wave function of an electron is given by ψ_{321}. This electron belongs to

(A) 3p-subshell (B) 3s-subshell (C) 3d-subshell (D) 2p-subshell

14. Sodium carbonate on heating below 500^0C gives

(A) water vapours (B) carbon dioxide
(C) carbon dioxide + water vapours (D) none of the above

15. The precipitate of CaF_2 ($K_{sp} = 1.7 \times 10^{-10}$) is obtained when equal volumes of the following are mixed.

(A) 10^{-4} M [Ca^{++}] + 10^{-4} M [F^-] (B) 10^{-2} M [Ca^{++}] + 10^{-3} M [F^-]
(C) 10^{-5} M [Ca^{++}] + 10^{-3} M [F^-] (D) 10^{-3} M [Ca^{++}] + 10^{-5} M [F^-]

16. Aspirin is

(A) antipyretic (B) tranquiliser (C) narcotic (D) anaesthetic

space for rough work

17. Consider the following mechanism for this reaction: $2NO(g)+2H_2(g)\rightarrow N_2(g)+2H_2O(g)$

(1) $2NO(g) \rightleftharpoons N_2O_2(g)$ Fast

(2) $N_2O_2(g)+H_2(g)\rightarrow N_2O(g)+H_2O(g)$ Slow

(3) $N_2O(g)+H_2(g)\rightarrow N_2(g)+H_2O(g)$ Fast

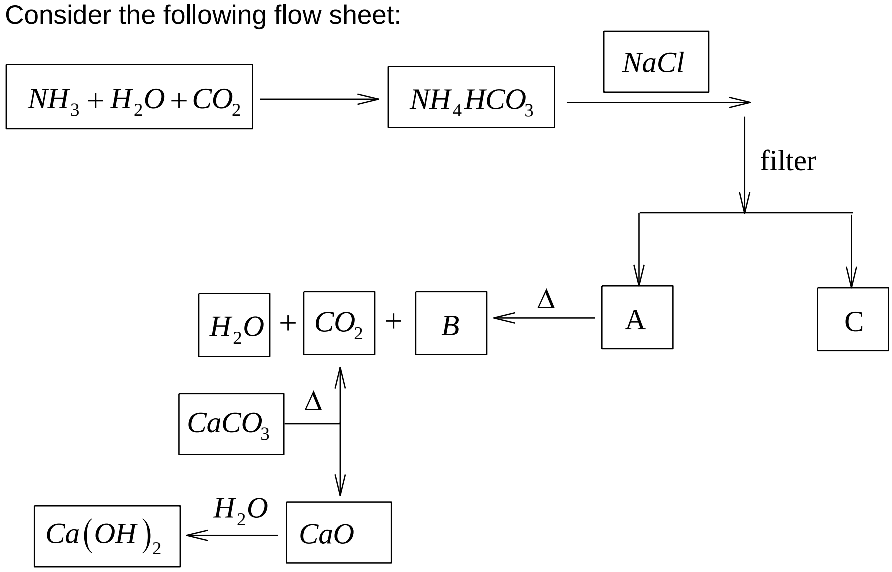
Which one of the following rate laws would be consistent with the mechanism proposed above?

(A) Rate = $k[NO]^2[H_2]^2$
(B) Rate = $k[NO][H_2]$
(C) Rate = $k[H_2]^2[N_2]$
(D) Rate = $k[NO]^2[H_2]$

18. Which is false statement?

(A) The heats of hydration of the dipositive alkaline earth metal ions decrease with an increase in their ionic size.
(B) Hydration of alkali metal ion is less than that of IIA.
(C) Alkaline earth metal ions, because of their much larger charge to size ratio exert a much stronger electrostatic attraction on the oxygen of water molecule surrounding them.
(D) None of the statements is correct

19. Consider the following flow sheet:



The above flow – sheet represents:

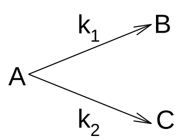
(A) Solvay process of NaOH
(B) Solvay process of Na_2CO_3
(C) Dow process of Na_2CO_3
(D) none of the above is correct

space for rough work

20. Incorrect order between following compounds is
(A) $O\left(CH_3\right)_2 < O\left(SiH_3\right)_2$; number of sp^3 hybrid atoms
(B) $O\left(CH_3\right)_2 < O\left(SiH_3\right)_2$; reactivity towards lewis acid
(C) Both (A) and (B) are incorrect Statements
(D) Both (A) and (B) are correct Statements

21. For the reaction, $N_2O_4 \rightleftharpoons 2NO_2,$ if degree of dissociation of N_2O_4 are 25 %, 50 %, 75 % and 100%, the gradation of observed vapour densities $\left(d_1, d_2, d_3, d_4 \text{ resp.}\right)$ is:
(A) $d_1 > d_2 > d_3 > d_4$
(B) $d_4 > d_3 > d_2 > d_1$
(C) $d_1 = d_2 = d_3 = d_4$
(D) none of these

22. A substance undergoes first order decomposition. The decomposition follows two parallel first order reaction as:



$k_1 = 1.26 \times 10^{-4} s^{-1}$ and $k_2 = 3.8 \times 10^{-5} s^{-1}$

The percentage distributions of B and C are:
(A) 80% B and 20% C
(B) 76.83% B and 23.17% C
(C) 90% B and 10% C
(D) 60% B and 40 % C

23. The equilibrium constant of a reaction of acetic acid with NaOH is 10^9. The dissociation constant of acetic acid is:
(A) 10^{-4}
(B) 10^{-5}
(C) 10^{-3}
(D) 10^{-6}

24. The decreasing order of the O – O bond order in O_2, $O_2\left[AsF_6\right]$, KO_2.
(A) $O_2\left[AsF_6\right] > O_2 > KO_2$
(B) $O_2 > KO_2 > O_2\left[AsF_6\right]$
(C) $O_2 > O_2\left[AsF_6\right] > KO_2$
(D) $O_2\left[AsF_6\right] > KO_2 > O_2$

25. The relationship between the dissociation energy of N_2 and N_2^+ is
(A) dissociation energy of N_2 = dissociation energy of N_2^+
(B) dissociation energy of N_2 can either be lower or higher than the dissociation energy of N_2^+
(C) Dissociation energy of N_2 > dissociation energy of N_2^+
(D) Dissociation energy of N_2^+ > dissociation energy of N_2

space for rough work

26. Which of the following solutions will have a pH of 4.74?
(A) 100 ml of 1M CH_3COOH (pK_a = 4.74) at the $\frac{3^{th}}{4}$ of the equivalence point using NaOH.
(B) 50 ml of 1M CH_3COONa + 25 ml of 1M HCl
(C) 50 ml of 1M CH_3COOH + 25 ml of 1M NaOH
(D) (B) and (C) both are correct.
(use log3 = 0.477)

27. Which of the following is incorrect about alkali metal solution in liquid ammonia?
(A) at low concentration the colour of solution is Blue.
(B) The solution conduct electricity
(C) The solution is not a reducing agent
(D) The dilute solution is paramagnetic

28. Photoelectric emission is observed from a surface when lights of frequency n_1 and n_2 are incident. If the ratio of maximum kinetic energy in two cases are K : 1 then (Assume $n_1 > n_2$) threshold frequency is
(A) $(K-1)\times(Kn_2-n_1)$
(B) $\frac{Kn_1-n_2}{1-K}$
(C) $\frac{K-1}{Kn_1-n_2}$
(D) $\frac{Kn_2-n_1}{K-1}$

29. Match list – I with list – II and select the correct answer using the codes given below:

	List – I		List – II
a.	CH_3COONa	1.	Strong electrolyte with pH > 7
b.	NH_4Cl	2.	Strong electrolyte with the pH < 7
c.	Bi_2S_3	3.	Weak electrolyte with $K_{sp} = S^2$
d.	CdS	4.	Weak electrolyte with $K_{sp} = 108S^5$

Codes

	a	b	c	d
(A)	2	3	1	4
(B)	1	2	4	3
(C)	1	3	2	4
(D)	1	3	4	2

30. The pH of aqueous solution of salt of weak base $\left(K_b = 10^{-5}\right)$ and weak acid $\left(K_a = 10^{-6}\right)$ at 25°C is
(A) 7 (B) 6.5 (C) 7.5 (D) 8

pace for rough work

Section – III (Mathematics)

1. Let ρ be the relation on the set R of all real numbers defined by $a\rho b$ iff $|a-b| \le \frac{1}{2}$. Then ρ is
(A) reflexive and symmetric but not transitive
(B) symmetric and transitive but not reflexive
(C) transitive but neither reflexive non symmetric
(D) reflexive and transitive but not symmetric

2. Total number of solution of equation $2^{\cos x} = |\sin x|$ in $[0, 2\pi]$ is equal to
(A) 2 (B) 4 (C) 6 (D) 8

3. Let $f_1(x) = \frac{x}{2} + 4\ \forall\ x \in R$ and define $f_n(x) = f_1(f_{n-1}(x))\ \forall\ n \ge 2$ then $\lim_{n\to\infty} f_n(x)$ is …
(A) 2 (B) 4 (C) 6 (D) 8

4. $\lim_{n\to\infty}\left\{\frac{1}{1.3} + \frac{1}{3.5} + ... + \frac{1}{(2n+1)(2n+3)}\right\}$ is equal to
(A) 0 (B) $\frac{1}{2}$ (C) $\frac{1}{9}$ (D) 2

5. The value of largest term in the sequence $a_n = \frac{n^2}{n^3+200}$ is given by
(A) $\frac{529}{49}$ (B) $\frac{8}{89}$ (C) $\frac{49}{543}$ (D) none of these

6. In which of the following function Lagrange's mean value theorem is not applicable in [0, 1]
(A) $f(x) = \begin{cases} x - \frac{1}{2}, x < \frac{1}{2} \\ \left(x-\frac{1}{2}\right)^2, x \ge \frac{1}{2} \end{cases}$ (B) $g(x) = \begin{cases} \frac{\sin x}{x}, x \ne 0 \\ 1, x = 0 \end{cases}$
(C) $h(x) = x|x|$ (D) $p(x) = |x|$

7. If $f(x) + f(x+1) + f(x+2) = 3x^2 + 2x + 1$, then $\int_0^3 f(x)\,dx =$
(A) 3 (B) 2 (C) 1 (D) 0

space for rough work

8. If $A=\left\{4^n-3n-1\right\}\left|n\in N\right\}$ and $B=\{9n-9:n\in N\}$, then $A\cap B$ is equal to
(A) B (B) A (C) N (D) None of these

9. Let α,β and γ be the roots of $f(x)=x^3+x^2-5x-1=0$. Then $[\alpha]+[\beta]+[\gamma]$, where [.] denotes the greatest integer function, is equal to
(A) 1 (B) -2 (C) -4 (D) -3

10. A function $g(x)$ is defined as $g(x)=\frac{1}{4}f\left(2x^2-1\right)+\frac{1}{2}f\left(1-x^2\right)$ and $f'(x)$ is an increasing function then $g(x)$ is increasing in the interval
(A) $\left(-\sqrt{\frac{2}{3}},\sqrt{\frac{2}{3}}\right)$ (B) $\left(-\sqrt{\frac{2}{3}},0\right)\cup\left(\sqrt{\frac{2}{3}},\infty\right)$ (C) $(-1,1)$ (D) none of these

11. Let $g(x)$ be the inverse of an invertible function $f(x)$ which is differentiable for all real x, then $g''(f(x))$ equals
(A) $-\frac{f''(x)}{\left(f'(x)\right)^3}$ (B) $\frac{f'(x)f''(x)-\left(f'(x)\right)^3}{f'(x)}$
(C) $\frac{f'(x)f''(x)-\left(f'(x)\right)^2}{\left(f'(x)\right)^2}$ (D) none of these

12. The complete set of values of x for which the function $f(x)=2\tan^{-1}x+\sin^{-1}\frac{2x}{1+x^2}$ behaves like a constant function with positive output is equal to
(A) $x\in[-1,1]$ (B) $[1,\infty)$ (C) $(-\infty,1]$ (D) $(-\infty,-1]\cup[1,\infty)$

13. Range of $f(x)=\sin^{-1}x+\sec^{-1}x+\tan^{-1}x$ is
(A) $\left\{\frac{3\pi}{4}\right\}$ (B) $(-\pi,2\pi)$ (C) $[-\pi,2\pi]$ (D) None of these

space for rough work

14. If $f(\sin 2x) = \sin x + \cos x$ then $f(0.44)$ is equal to

(A) $\frac{6}{5}$ (B) $\frac{5}{4}$ (C) $\frac{4}{3}$ (D) $\frac{3}{2}$

15. Total number of points of discontinuity in (0, 3) of the function $f(x) = [3x] + \{2x\}$ is/are (where [.] denotes G.I.F and {.} denotes fractional part)

(A) 9 (B) 12 (C) 15 (D) None of these

16. The number of roots of the equation $x^2 - x + 1 = \frac{1}{2} + \sqrt{x - \frac{3}{4}}$ is equal to

(A) 1 (B) 2 (C) 3 (D) 4

17. Let f be a one - one function with domain $\{1, 2, 3\}$ and range $\{x, y, z\}$. It is given that exactly one of the following statements is true and the remaining two are false.
$f(1) = x,\ f(2) \neq x,\ f(3) \neq y.$ Then $f^{-1}(x)$ is equal to

(A) 1 (B) 2 (C) 3 (D) Does not exist

18. Let $f(x)$ increasing function between $x \in [2, 3]$. If $f(x)$ is symmetric about line x = 2 and line x = 3, then fundamental period of $f(x)$ is

(A) $\frac{1}{2}$ (B) 1 (C) 2 (D) 4

19. The range of the function
$f(x) = \sin^{-1}\left[x^2 + \frac{1}{2}\right] + \cos^{-1}\left[x^2 - \frac{1}{2}\right]$, where $[.]$ is the greatest integer function, is

(A) $\left\{\frac{\pi}{2}, \pi\right\}$ (B) $\left\{0, -\frac{1}{2}\right\}$ (C) $\{\pi\}$ (D) $\left(0, \frac{\pi}{2}\right)$

space for rough work

20. $\int_3^4 \sqrt{x-3}\left(\sin^{-1}(\ln x)+\cos^{-1}(\ln x)\right)dx$ is equal to

(A) 1 (B) $\frac{\pi}{3}$ (C) cannot be determined (D) None of these

21. If $f:R\to R,\ g:R\to R$ be two functions than $h(x)=2\min\{f(x)-g(x),0\}$ equals

(A) $f(x)+g(x)-|g(x)-f(x)|$ (B) $f(x)+g(x)+|g(x)-f(x)|$

(C) $f(x)-g(x)+|g(x)-f(x)|$ (D) $f(x)-g(x)-|g(x)-f(x)|$

22. Let $f:R\to\left[0,\frac{\pi}{2}\right)$ defined by $f(x)=\tan^{-1}\left(x^2+x+a\right),$ then the set of vale of 'a' for which f is onto is

(A) $[0,\infty)$ (B) $[1,2]$ (C) $\left[\frac{1}{4},\infty\right)$ (D) None of these

23. If $\int\sqrt{1+\sin x}\,f(x)\,dx=\frac{2}{3}(1+\sin x)^{3/2}+c$ then

(A) $f(x)$ is period function (B) $f(x)$ is odd function

(C) $f(x)$ is constant function (D) None of these

24. Let $\int\frac{dx}{x^{2008}+x}=\frac{1}{p}\ln\left(\frac{x^q}{1+x^r}\right)+c$ where p, q, r $\in$N then

(A) q = 2r (B) q + r = p (C) $\frac{p}{q}=\frac{2q}{r}$ (D) $p+q+r=6021$

25. If $\int\frac{\cos x-\sin x}{e^x+\sin x}dx=\ln\left(f(x)\right)+g(x)+K$ then

(A) $g(x)$ is quadratic function (B) $f(x)+f''(x)=e^x$

(C) $f(x)-e^x$ is odd function (D) $g(x)$ is decreasing function

26. Let $f(x)=\max\{1+\sin x,1,1-\cos x\},\ x\in[0,2\pi]$ and $g(x)=\max\{1,|x-1|\}\ x\in R$ then

(A) $g(f(0))=1$ (B) $g(f(1))=0$ (C) $f(g(1))=1$ (D) $f(g(0))=\sin 1$

space for rough work

27. If $\int \frac{(2x+3)dx}{x(x+1)(x+2)(x+3)+1} = \frac{-1}{ax^2+bx+c} + k$, then 2a + b + c equal to

(A) 0 (B) 2 (C) 4 (D) 6

28. If $f(x) = \begin{cases} |x-1| + \lambda, & x \le 1 \\ 2x+3, & x > 1 \end{cases}$ has a local minima at $x = 1$, then maximum value of λ equals to

(A) 2 (B) 3 (C) 4 (D) 5

29. $\int_{-1}^{4} f(x)dx = 4$ and $\int_{2}^{4} (3 - f(x))dx = 7,$ then the value of $\int_{-1}^{2} f(x)dx$ is equal to

(A) 1 (B) 3 (C) 5 (D) 7

30. $\int_{0}^{2} |x^2 + 2x - 3| dx$ equal to

(A) 2 (B) 4 (C) 6 (D) 8

space for rough work

FIITJEE - JEE **(Mains)**

CPA C-LOT BATCH
PHYSICS, CHEMISTRY & MATHEMATICS
JEE - MAINS 2014
PHASE – I
SET - A
ANSWERS
PHYSICS

1.	D	2.	B	3.	A	4.	B
5.	B	6.	C	7.	D	8.	A
9.	B	10.	C	11.	A	12.	B
13.	A	14.	B	15.	A	16.	B
17.	D	18.	B	19.	D	20.	A
21.	C	22.	A	23.	B	24.	D
25.	B	26.	D	27.	B	28.	C
29.	A	30.	B				

CHEMISTRY

1.	A	2.	A	3.	B	4.	A
5.	B	6.	A	7.	C	8.	B
9.	C	10.	C	11.	D	12.	D
13.	C	14.	D	15.	B	16.	A
17.	D	18.	D	19.	B	20.	C
21.	A	22.	B	23.	B	24.	A
25.	C	26.	D	27.	C	28.	D
29.	B	30.	C				

MATHEMATICS

1.	A	2.	B	3.	D	4.	B
5.	C	6.	A	7.	A	8.	B
9.	D	10.	B	11.	A	12.	B
13.	D	14.	A	15.	A	16.	A
17.	B	18.	C	19.	C	20.	C
21.	D	22.	D	23.	A	24.	D
25.	C	26.	A	27.	D	28.	D
29.	C	30.	B				

HINTS & SOLUTIONS
Physics

1. D
Sol. For block A
$N = (mg - f_P)$
$f_P =$ Pseudo force

2. B
Sol. Initial velocity of P $\vec{u}_P = 10\hat{i} + 10\sqrt{3}\hat{j}$
Initial velocity of Q $\vec{u}_Q = -20\hat{i} + 20\hat{j}$
$\vec{a}_{PQ} = 0 \Rightarrow \vec{v}_{PQ} = \vec{u}_{PQ}$ always

3. A
Sol. Common acceleration a = $\frac{18}{6} = 3N$ left wards
For upper block $f - 2 = 6 \Rightarrow f = 8N < f_{s(\max)}$

4. B
Sol. $y = (4\sin\alpha)t - \frac{1}{2}gt^2$
This is a quadratic equation with two roots t_1 & t_2
$t_1 t_2 = \frac{h}{\frac{g}{2}} = \frac{2h}{g}$

5. B
Sol. $\vec{a} = \frac{\vec{F}}{m}$
$d\vec{v} = \vec{a}dt$
$\vec{v} = \int_0^t \vec{a}dt$
K.E. = $\frac{1}{2}m(\vec{v}.\vec{v})$

6. C
Sol. $f_s = ma = 2N$ in forward direction. ($f_{s/\max} = 4N$)
$W = \vec{f}_s.\vec{s} = 32J$, $s = \frac{1}{2}at^2$

7. D
Sol. Tangential acceleration is $a_t = \vec{a}.\hat{v}$

8. A
Sol. When net acceleration is horizontal, vertical components of $\vec{a}_r$ and $\vec{a}_t$ cancels.

9. B
Sol. Time can never come back

10. C
Sol. Range = 1.6 = $\frac{u^2}{g}\left(at\,\theta = 45^0\right)$
$u = 4m/\sec$ (taking g = 10m/sec^2)
Horizontal velocity $= u\cos\theta = 2\sqrt{2}m/\sec$

So distance travelled is 10 sec = $10\times 2\sqrt{2}=20\sqrt{2}m$

11. A

Sol. $a=\dfrac{F_2-F_1}{m}$

For BA section $T_B-F_1=\dfrac{m}{L}ya$

12. B

Sol. constraint relation $a_A=6a_B$

13. A

Sol. Use W.E. theorem for the two blocks

14. B

Sol. $a=v\dfrac{dv}{dx}$

$$\int_{x_1}^{x_2} adx=\int_{v_1}^{v_2} vdv$$

$\int_{x_1}^{x_2} adx=$ Area under the a – x graph.

15. A

Sol. $v_x=\dfrac{dx}{dt}=4\cos t$

$v_y=\dfrac{dy}{dt}=4\sin t$

$v=\sqrt{v_x^2+v_y^2}=4$

Distance = $vt=8$

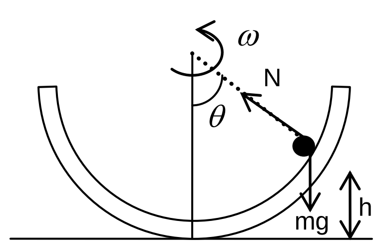
16. B

Sol. For pulley 2T = F

T = 10t

When blocks are lifted of Normal reaction because zero.

17. D

Sol.	$N\sin\theta=m\omega^2R\sin\theta$ $N\cos\theta=mg$ $\Rightarrow h=R-\dfrac{g}{\omega^2}$	

18. B

Sol. $\vec{v}=\dfrac{d\vec{r}}{dt}=\vec{r}_0\left(1-2\alpha t\right)$, particle moves on a straight line and turns back at $t=\dfrac{1}{2\alpha}$ at $\vec{r}=\dfrac{\vec{r}_0}{4\alpha}$

19. D

Sol. For zero drift $v_R<v_{sR}$

20. A

Sol. To complete the loop minimum speed at Q = $\sqrt{5gR}$

Use W.E theorem from P to Q

21. C

Sol. $N=Ma=20$

$f_{s(\max)} = Mg$
$\mu N = 10$

22. B

Sol. For remaining portion $x_{COM} = \dfrac{m_1 x_1 - m_2 x_2}{m_1 - m_2}$, Similarly for y_{COM}.

23. B

Sol. $f_k = mg\sin\theta$, use W.E theorem when body goes up.

24. D

Sol. use $s = ut + \dfrac{1}{2}at^2$ for given time intervals.

25. B

Sol. Force on 10 kg = 120 N = Spring force
For 20 kg $\Rightarrow 200 - 120 = 20a$

26. D

Sol. $N = m\omega^2 r$
$f_{s(\max)} = mg$

27. B

Sol. Velocity of first block before collision,
$v_1^2 = 1^2 - 2(2)\times 0.16$
= 1 - 0.64
v_1 = 0.6 m/s
By conservation of momentum, $2 \times 0.6 = 2\,v_1' + 4\,v_2'$
also $v_2' - v_1' = v_1$ for elastic collision
It gives v_2' = 0.4 m/s
v_1' = – 0.2 m/s
Now distance moved after collision
$s_1 = \dfrac{(0.4)^2}{2\times 2}$ & $s_2 = \dfrac{(0.2)^2}{2\times 2}$
$\therefore$ $s = s_1 + s_2$ = 0.05 m = 5 cm.

28. C

Sol. $\Delta x_{COM} = m_1\Delta x_1 + m_2 \Delta x_2 = 0$
No horizontal external force.

29. A

Sol. At the maximum extension x_{max}, the blocks come to rest, and thus ΔK = 0. Next, we must find the changes in U_g and U_S. When m_2 falls by x_{max}, the spring extends by x_{max} and m_1 rises by x_{max} sinq. Therefore,

$\Delta K + \Delta U_g + \Delta U_S = 0$

$0 + (-m_2 g x_{max} + m_1 g x_{max} \sin\theta) + \dfrac{1}{2}kx_{\max}^2 = 0$

Thus, $x_{max} = \dfrac{2g}{k}\left(m_2 - m_1 \sin\theta\right) = 0.98$ m

30. B

Sol. $s_1 = \dfrac{1}{2}gt^2$ …(1)
For next t sec
$s_2 = (gt)t + \dfrac{1}{2}gt^2$ …(2)
(2) – (1) we get

$$t=\sqrt{\frac{s_2-s_1}{g}}$$

Chemistry

1. A

Sol. In (C) and (D): the net dipole moment is zero. In (B) the bond moment of the two C – Cl bonds cancel each other. So, that net dipole moment corresponds to only one C – Cl bond.

2. A

$$A \rightleftharpoons mB$$

$$t=0 \quad n$$

$$t=eq^m \; n(1-\alpha) \quad mn\alpha$$

Initial vapour density = $D\propto\frac{1}{n}$

Final vapour density at equilibrium = $d\propto\frac{1}{n(1-\alpha)+mn\alpha}$

$$\frac{D}{d}=1-\alpha+m\alpha=1+\alpha(m-1)$$

$$\Rightarrow \alpha=\frac{1}{(m-1)}\left(\frac{D}{d}\right)-\frac{1}{(m-1)}$$

Since, we are given, slope = tan45^0 = 1

$$\Rightarrow m-1=1$$

$$\Rightarrow m=2$$

3. B

Sol. $A \rightleftharpoons nB$

a

a-x nx

a=0.6

At equilibrium, a-x=0.3

Therefore, x=0.3

nx=0.6

so,n=2

4. A

Sol. CO_2 is linear

$O=C=O$

5. B

Sol.

$$2H_2S_{(g)} \rightleftharpoons 2H_{2(g)}+S_{2(g)}$$

$$1 \quad 0 \quad 0$$

$$1-\alpha \quad \alpha \quad \alpha/2$$

$\because 1-\alpha=1$ since α is small because $K_c=10^{-6}$

$\because K_c=\frac{\alpha^3}{2(1)^2}$ or $\alpha=1.3\times10^{-2}$

$=1.3\%$

6. A

Sol. rate = $k[Zn]\left[H^+\right]^x=k'[Zn]$

$$k'=k\left[H^+\right]^x=\frac{0.693}{t_{1/2}}\Rightarrow\frac{10^{-3x}}{10^{-2x}}=\frac{1}{100}$$

$10^{-x} = 10^{-2} \Rightarrow x = 2$

7. C

Sol. SF_4 is sea –saw shaped as BP = 4 and LP = 1

8. B

Sol. $CO + Cl_2 \rightleftharpoons COCl_2$; $K = \dfrac{\frac{1}{5}}{\frac{1}{5}\times\frac{2}{5}} = \dfrac{5}{2} = 2.5$

2 –x 3 – x x

= 1

$\Rightarrow x = 1$

9. C

Sol. $t_{75\%} = 2t_{1/2}$

$[A]_t = [A]_0 e^{-kt}$

$\Rightarrow [A]_0 (1-\alpha) = [A]_0 e^{-kt}$

$\Rightarrow \alpha = 1 - e^{-kt}$

$k = Ae^{-Ea/RT}$

The unit of A is same as that of k.

10. C

Sol. For p – electron $\Rightarrow l = 1$

orbital angular momentum $= \sqrt{l(l+1)}\dfrac{h}{2\pi} = \sqrt{2}\dfrac{h}{2\pi}$

11. D

Sol. K.E of photoelectron is independent of intensity of light but depends upon its frequency (ν).

12. D

Sol. Lobes of d_{xy} orbital lie in xy plane.

13. C

Sol. $n = 3,\ l = 2,\ m = 1$

14. D

Sol. Sodium carbonate is a stable carbonate.

15. B

Sol. For precipitation IP > K_{sp} and IP = $\left[Ca^{+2}\right]\left[F^{-}\right]^2$

16. A

Sol. Aspirin is antipyretic

17. D

Sol. rate = $k'[N_2O_2][H_2]$

$$K = \frac{[N_2O_2]}{[NO]^2} \Rightarrow [N_2O_2] = K[NO]^2$$

$\Rightarrow$ rate = $k'K[NO]^2[H_2]$

Rate = $k[NO]^2[H_2]$

18. D

Sol. The heats of hydration of the dipositive alkaline earth metal ions decrease with an increase in their ionic size.

Hydration of alkali metal ion is less than that of IIA.

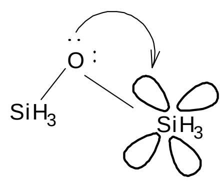
Alkaline earth metal ions, because of their much larger charge to size ratio exert a much stronger electrostatic attraction on the oxygen of water molecule surrounding them.

19. B

Sol. This flow – sheet represents Solvay process of Na_2CO_3

20. C

Sol. In OMe_2, 'O' and 'C' both are sp^3 hybrid but in $O\left(SiH_3\right)_2$ Only Si is sp^3 hybrid.



21. A

Sol. $N_2O_4 \rightleftharpoons 2NO_2,$

n

$n(1-\alpha)$ $\quad 2n\alpha$

$$M_{av} = \frac{M_{N_2O_4}}{1+\alpha}$$

$$\therefore VD_{av.} \propto \frac{1}{1+\alpha}$$

As, $'\alpha'$ increases, VD decreases

$\Rightarrow d_1 > d_2 > d_3 > d_4$

22. B

Sol. % of B = $\frac{k_1}{k_1+k_2}\times 100 = 76.83\%$

23. B

Sol. $CH_3COOH + OH^- \rightleftharpoons CH_3COO^- + H_2O$

$$K = \frac{1}{K_h} = \frac{K_a}{K_w} = 10^9$$

$K_a = 10^{-5}$

24. A

Sol. B.O. of O_2 = 2 ; B.O of $O_2^+ = 2.5$; B.O. of $O_2^{-1} = 1.5$

25. C

Sol. More is the B.O. Stronger is the bond and more is the bond dissociation energy.

$N_2 \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases}\pi 2p_y^2 \\ \pi 2p_z^2\end{cases} \sigma 2p_x^2$, B.O = 3

$N_2^+ \, \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \left[\begin{matrix}\pi 2p_y^2 \\ \pi 2p_z^2\end{matrix}\right. \sigma p_x^1$ B. O = 2.5

26. D

Sol. For A

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

m. mole 100

$100\left(\frac{1}{4}\right) \qquad \frac{3}{4}(100)$

$$pH = 4.74 + \log\left(\frac{3}{1}\right)$$

$= 4.74 + 0.477$

$= 5.217$

For B

$$CH_3COONa + HCl \rightarrow CH_3COOH + NaCl$$

m.mole 50 25

25 - 25 pH = pKa = 4.74

For C

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

m.mole 50 25

25 - 25 pH = pKa = 4.74

27. C

Sol. alkali metal solution in liquid ammonia is a strong reducing agent since it contains free ammoniated electrons.

28. D

Sol. $K.E. + hv' = hv$

$KE_1 = hn_1 - hn$

$KE_2 = hn_2 - hn$

$\frac{KE_1}{KE_2} = \frac{n_1 - n}{n_2 - n}$

$\frac{K}{1} = \frac{n_1 - n}{n_2 - n}$

$K(n_2 - n) = n_1 - n$

$Kn_2 - Kn = n_1 - n$

$Kn_2 - n_1 = -n + Kn$

$\frac{Kn_2 - n_1}{K - 1} = n$

29. B

Sol. $Bi_2S_3 \rightleftharpoons \underset{2s}{2Bi^{+3}} + \underset{3s}{3S^{-2}}$; $K_{sp} = (2s)^2(3s)^3$

$K_{sp} = 108s^5$

30. C

Sol. $pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b = 7 + 3 - \frac{5}{2} = 7.5$

Mathematics

1. A

Sol. Because $|a - a| = 0 \le \frac{1}{2}$ so ρ is reflexive

If $|a - b| \le \frac{1}{2}$ then $|b - a| \le \frac{1}{2}$ so ρ is symmetric

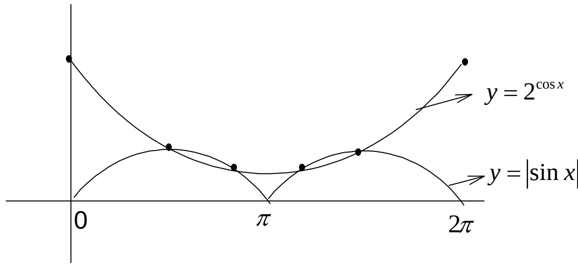
if $|a - b| \le \frac{1}{2}$ & $|b - c| \le \frac{1}{2}$ then it is not necessary that $|a - c| \le \frac{1}{2}$. So ρ is not transitive

e.g. $\left|0 - \frac{1}{3}\right| \le \frac{1}{2}$ & $\left|\frac{1}{3} - \frac{2}{3}\right| \le \frac{1}{2}$

But $\left|0 - \frac{2}{3}\right| \ge \frac{1}{2}$

2. B

Sol.



3. D

Sol. at n = ∞, f_n & f_{n-1} are same.

4. B

Sol. $\lim\limits_{n\to\infty}\frac{1}{2}\left[1-\frac{1}{3}+\frac{1}{3}-\frac{1}{5}+.....+\frac{1}{2n+1}-\frac{1}{2n+3}\right]$

$=\lim\limits_{n\to\infty}\frac{1}{2}\left[1-\frac{1}{2n+3}\right]=\frac{1}{2}.1=\frac{1}{2}$

5. C

Sol. largest term is at n = 7

6. A

Sol.

$f(x)$ is not differentiable at $x=\frac{1}{2}$

7. A

Sol. $\int_0^3 f(x)dx=\int_0^1 f(x)dx+\int_1^2 f(x)dx+\int_2^3 f(x)dx$

$=\int_0^1 f(x)dx+\int_0^1 f(x+1)dx+\int_0^1 f(x+2)dx$

$=\int_0^1 (3x^2+2x+1)dx=\left|x^3+x^2+x\right|_0^1=3$

8. B

Sol. $A\subset B\Rightarrow A\cap B=A$

9. D

Sol. $-3<\alpha<-2, -1<\beta<0, 1<\gamma<2$

10. B

Sol. $g'(x)=x\left(f'\left(2x^2-1\right)-f'\left(1-x^2\right)\right)$

If x > 0, $f'\left(2x^2-1\right)-f'\left(1-x^2\right)>0$ $\Rightarrow 2x^2-1>1-x^2$

So, $x\in\left(\sqrt{\frac{2}{3}},\infty\right)$ and If x < 0, $f'\left(1-x^2\right)>f'\left(2x^2-1\right)$ $\Rightarrow 1-x^2>2x^2-1$

So $x\in\left(-\sqrt{\frac{2}{3}},0\right)$

11. A

Sol. $g\left(f(x)\right)=x$

$\Rightarrow g'\left(f(x)\right)f'(x)=1$ $\Rightarrow g'\left(f(x)\right)=\frac{1}{f'(x)}$

$\Rightarrow g''(f(x))f'(x) = -\frac{1}{(f'(x))^2}.f''(x) \qquad \Rightarrow g''(f(x)) = -\frac{1}{(f'(x))^3}.f''(x)$

12. B

Sol. If $x \in (-\infty, -1]$ then $f(x) = -\pi$

If $x \in [-1,1]$ then $f(x) = 4\tan^{-1}x$

If $x \in [1,\infty)$ then $f(x) = \pi$

13. D

Sol. Domain = $\{-1,1\}$; Range = $\left\{\frac{\pi}{4}, \frac{3\pi}{4}\right\}$

14. A

Sol. $f(\sin 2x) = \sqrt{1+\sin 2x} \Rightarrow f(x) = \sqrt{1+x}\forall \in [-1,1] \Rightarrow f(0.44) = \sqrt{1.44} = 1.2$

15. A

Sol. Points of discontinuity are $\frac{1}{3}, \frac{1}{2}, \frac{2}{3}, \frac{4}{3}, \frac{3}{2}, \frac{5}{3}, \frac{7}{3}, \frac{5}{2}, \frac{8}{3}$

16. A

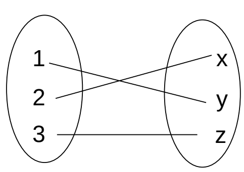
Sol. Because $y = x^2 - x + 1$ is inverse of $y = \frac{1}{2} + \sqrt{x - \frac{3}{4}}$, so both these curve intersect at line y = x.

$\Rightarrow$ Common points between $y = x^2 - x + 1$ and $y = x$ is $(1,1)$

$\Rightarrow$ Only one solution

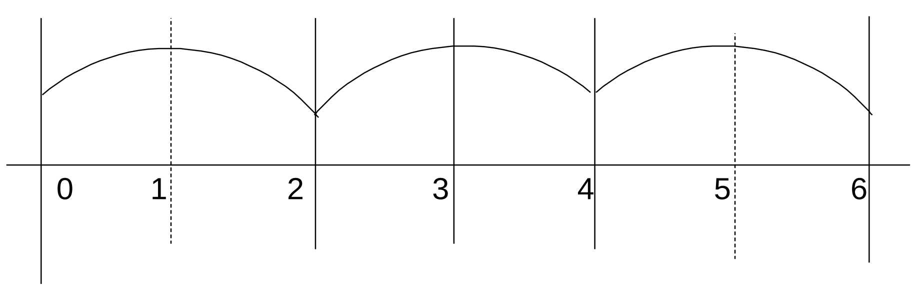
17. B

Sol.



18. C

Sol.



19. C

Sol. For $f(x)$ to be defined either $\left[x^2 - \frac{1}{x}\right] = -1$ and $\left[x^2 + \frac{1}{2}\right] = 0$

or $\left[x^2 - \frac{1}{2}\right] = 0$ & $\left[x^2 + \frac{1}{x}\right] = 1$

In first case value of

$f(x)$ is $\sin^{-1}(0) + \cos^{-1}(-1) = \pi$

In second case value of $f(x)$ is

$\sin^{-1}(1) + \cos^{-}(0) = \frac{\pi}{2} + \frac{\pi}{2} = \pi$

Hence range is $\{\pi\}$

20. D

Sol. Domain of $\sqrt{x-3}\left(\sin^{-1}\ln x+\cos^{-1}\ln x\right)$ is ϕ

21. D

Sol. If $f(x)>g(x)$ than $h(x)=0$

If $f(x)<g(x)$ than $h(x)=2\left(f(x)-g(x)\right)$

Which comes from option (D)

22. D

Sol. $x^2+x+a\geq 0$

$\Rightarrow (1)^2-4(a)\leq 0 \Rightarrow a\geq \frac{1}{4}$

But for $a>\frac{1}{4}$ range will not be entire $\left[0,\frac{\pi}{2}\right)$

23. A

Sol. $f(x)=\cos x$

24. D

Sol. $\int\frac{dx}{x^{2008}+x}=\frac{1}{2007}\ln\left(\frac{x^{2007}}{1+x^{2007}}\right)+c$

25. C

Sol. $f(x)=e^x+\sin x$ and $g(x)=-x$

26. A

Sol. $f(0)=1, f(1)=1+\sin 1, g(0)=1, g(1)=1$

Now $g\left(f(0)\right)=g(1)=1, g\left(f(1)\right)=g(1+\sin 1)=1$

$f\left(g(1)\right)=f(1)=1+\sin 1, f\left(g(0)\right)=f(1)=1+\sin 1$

27. D

Sol. $\int\frac{(2x+3)dx}{x(x+1)(x+2)(x+3)+1}=\frac{-1}{x^2+3x+1}+k$

28. D

Sol. because at x = 1, 2x + 3 = 5 $\Rightarrow \lambda\leq 5$

29. C

Sol. $\int\limits_{-1}^{4} f(x)dx=4, \int\limits_{2}^{4}\left(3-f(x)\right)dx=7$

$\Rightarrow 6-\int\limits_{2}^{4} f(x)dx=7.$

$\int\limits_{-1}^{2} f(x)dx=\int\limits_{-1}^{4} f(x)dx+\int\limits_{4}^{2} f(x)dx=4-(-1)=5$

Hence, $\int\limits_{-1}^{2} f(x)dx=5$

30. B

Sol. $I=\int\limits_{0}^{1}-\left(x^2+2x-3\right)dx+\int\limits_{1}^{2}\left(x^2+2x-3\right)dx$

$=-\left[\frac{x^3}{3}+x^2-3x\right]_0^1+\left[\frac{x^3}{3}+x^2-3x\right]_1^2$

$I = 4$

FIITJEE

BATCHES – 1 YR. CRP ADV. - C LOT

PHYSICS, CHEMISTRY & MATHEMATICS

CPT1 - 1 **CODE:0000.1** **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 210**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1.Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2.This question paper contains Three Parts.
3.**Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4.Each part is further divided into two sections: **Section-A & Section-C**
5.Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6.Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1.Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2.On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3.OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 10)** contains 10 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (11 – 15) contains 5 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

(ii) **Section-C (01 – 05)** contains 5 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer. There is no negative marking..

Name of the Candidate :____

Batch :_____________________ **Date of Examination :**____________________

Enrolment Number :____

USEFUL DATA

PHYSICS

Acceleration due to gravity : g = 10 m/s^2
Planck constant : h = 6.6 × $10^{-34}\ J-s$
Charge of electron : e = 1.6 × $10^{-19}\ C$
Mass of electron : $m_e = 9.1 \times 10^{-31}\ kg$
Permittivity of free space : $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N-m^2$
Density of water : $\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure : $Pa = 10^5\ N/m^2$
Gas constant : R = 8.314 J $K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant R = 8.314 J $K^{-1} mol^{-1}$
= 0.0821 Lit atm $K^{-1} mol^{-1}$
= 1.987 ≈ 2 Cal $K^{-1} mol^{-1}$
Avogadro's Number N_a = 6.023 × 10^{23}
Planck's constant h = 6.625 $\times 10^{-34}\ J.s$
= $6.625 \times 10^{-27}\ erg.s$
1 Faraday = 96500 coulomb
1 calorie = 4.2 joule
1 amu = 1.66 $\times 10^{-27}\ kg$
1 eV = $1.6 \times 10^{-19}\ J$

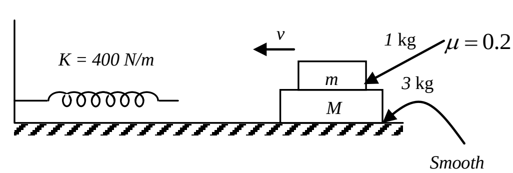
Atomic No: H = 1, He = 2, Li = 3, Be = 4, B = 5, C = 6, N = 7, O = 8, F = 9, Ne = 10, Na = 11, Mg = 12, Si = 14, Al = 13, P = 15, S = 16, Cl = 17, Ar = 18, K = 19, Ca = 20, Cr = 24, Mn = 25, Fe = 26, Co = 27, Ni = 28, Cu = 29, Zn = 30, As = 33, Br = 35, Ag = 47, Sn = 50, I = 53, Xe = 54, Ba = 56, Pb = 82, U = 92.

Atomic masses: H = 1, He = 4, Li = 7, Be = 9, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Si = 28, Al = 27, P = 31, S = 32, Cl = 35.5, K = 39, Ca = 40, Cr = 52, Mn = 55, Fe = 56, Co= 59, Ni = 58.7, Cu = 63.5, Zn = 65.4, As = 75, Br = 80, Ag = 108, Sn = 118.7, I = 127, Xe = 131, Ba = 137, Pb = 207, U = 238.

Physics
Section – I

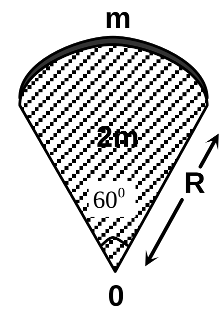
Part – A
Single Answer Questions

1. A block of mass M is kept on a smooth horizontal surface and another block of mass m is kept on it, as shown in the figure and there is friction present between the two blocks with friction coefficient $\mu = 0.2$. Both the blocks move together with initial speed *v* towards the spring, compress it and due to the force exerted by the spring, move in the reverse direction of the initial motion. The maximum possible value of *v* so that during the motion, there is no slipping between the blocks, is ($g = 10 m/s^2$)



(a) 0.2m/s (b) 0.4 m/s
(c) 0.6 m/s (d) 0.8 m/s

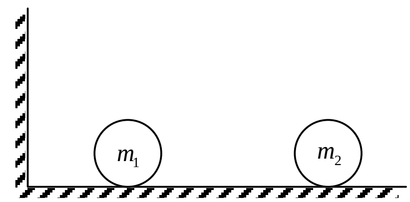
2. What is the distance of centre of mass of the combined system as shown in figure from 'O'. System consists of a uniform sector of mass 2m and radius R, fixed with a uniform arc of mass m and radius R along the edge of the sector. (System is making an angle $\theta = 60^0$ at their common centre)



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

(c) $\frac{7R}{3\pi}$ (d) none of these

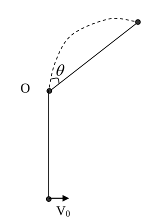
3. Mass m_1 strikes m_2 which is at rest. The limiting ratio of masses for which they will collide again (collision between ball and wall are elastic, coefficient of restitution between m_1 and m_2 is e and all the surfaces are smooth.)



(a) $\frac{e}{2+e}$ (b) $\frac{2e}{2+e}$

(c) $\frac{e}{2(2+e)}$ (d) none of the above

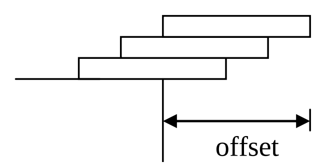
4. A heavy particle is suspended by a string of length ℓ from O. The particle is given a horizontal velocity v_o. The string becomes slack at some angle and the particle proceeds on a parabolic path. The value of θ if the particle passes through the point of suspension is



(a) $\sin^{-1}(\sqrt{2})$ (b) $\cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$

(c) $\tan^{-1}(\sqrt{2})$ (d) $\tan^{-1}(2)$

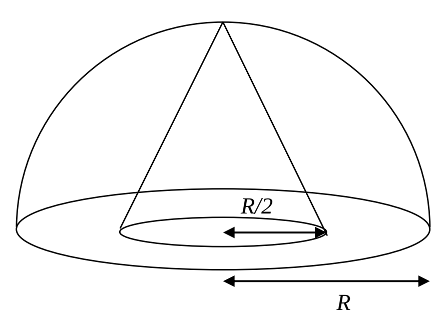
5. The maximum offset that one can obtained by piling up three identical bricks of length *l*



(a) $\frac{2l}{3}$ (b) $\frac{4l}{3}$

(c) $\frac{5l}{6}$ (d) $\frac{11l}{12}$

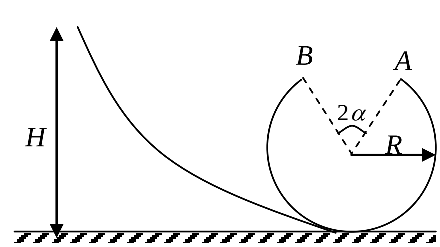
6. From a uniform solid hemisphere of radius R, a solid cone of base radius R/2 and height R is cut out as shown in figure. If R=5cm, then the height of the centre of mass of the remaining object is approximately (in cm)



(a) 2 (b) 3

(c) 3/8 (d) none of these

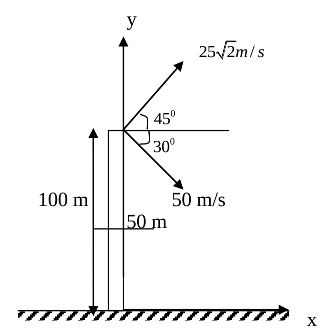
7. A small object slides without friction from a height of 50 cm as shown in the figure and then loops the vertical loop of radius 20 cm from which a symmetrical section of angle 2α has been removed. After losing contact at A and flying through the air, the object will reach point B. Then α is



(a) 60^0 (b) 30^0

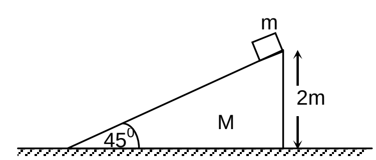
(c) 15^0 (d) 45^0

8. From the top of a tower of 100m, two particles are simultaneously thrown as shown in figure. In their subsequent motion, find the time gap between the two when they cross y = 50 m in their path. [take g = 10 m/s^2 and bottom of the tower is origin of coordinate system with upward the as +ve y- axis and horizontal as +ve x - axis]



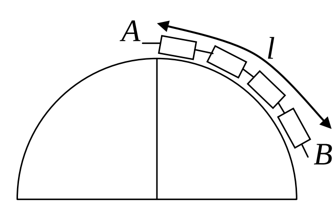
(a) 2 (b) 3
(c) 5 (d) 6

9. A wedge of mass M = 3kg and a cube of mass m = 1kg are shown in figure. the system is released, considering no frictional force between any two surface, the distance moved by the wedge, when cube just reaches on the ground is (in meters)



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

10. A uniform chain AB of mass m and length *l* is placed with one end *A* at the highest point of a hemisphere of radius *R.* Referring to the top of the hemisphere as the reference level, the potential energy of the chain is (given that $l < \frac{\pi R}{2}$).

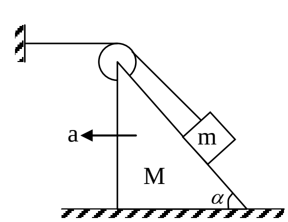


(a) $\frac{mR^2g}{l}\left(\frac{l}{R} - \sin\frac{l}{R}\right)$ (b) $\frac{mR^2g}{2l}\left(\frac{l}{R} - \sin\frac{l}{R}\right)$
(c) $\frac{mR^2g}{2l}\left(\sin\frac{l}{R} - \frac{l}{R}\right)$ (d) $\frac{mR^2g}{l}\left(\sin\frac{l}{R} - \frac{l}{R}\right)$

One or more than one answer questions

11. A particle moving along a straight line with uniform acceleration has velocities 7 m/s at P and 17 m/s at Q, R is the mid point of PQ. Then
(a) the average velocity between R and Q is 15 m/s
(b) the ratio of time to go from P to R and that from R to Q is 3 : 2
(c) the velocity at R is 10 m/s
(d) the average velocity between P and R is 10 m/s

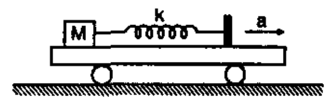
12. In the adjoining figure if acceleration of M with respect to ground is a, then (string s and pulleys are ideal and all surfaces are smooth)



(a) acceleration of m with respect M is a
(b) acceleration of m with respect ground is 2a sin $(\alpha/2)$

(c) acceleration of m with respect to ground is a
(d) acceleration of m with respect to ground is a tan α

13. A block of mass M is attached with a spring of spring constant k. The whole arrangement is placed on a vehicle as shown in the figure. If the vehicle starts moving towards right with an acceleration a (there is no friction anywhere), then:

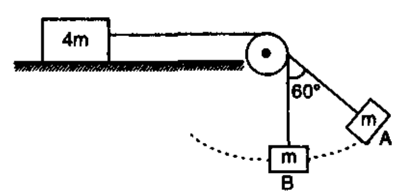


(a) maximum elongation in the spring is $\frac{Ma}{k}$
(b) maximum elongation in the spring is $\frac{2Ma}{k}$
(c) maximum compression in the spring sis $\frac{2Ma}{k}$
(d) maximum compression in the spring is zero

14. Two billiard balls of the same size and mass are in contact on a billiard table. A third ball of the same size and mass strikes them symmetrically and remains at rest after the impact. The coefficient of restitution between the balls is

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

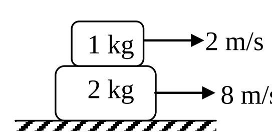
15. In the system shown in the figure the mass m moves in a circular arc of angular amplitude 60^0. Mass 4 m is stationary. Then (strings and pulley are ideal)



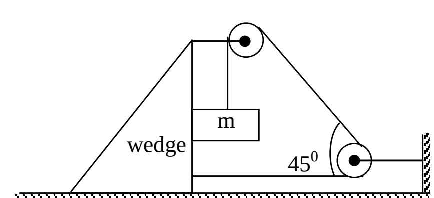
(a) the minimum value of coefficient of friction between the mass 4 m and the surface of the table is 0.50
(b) the work done by gravitational force on the block m is positive when it moves from A to B
(c) the power delivered by the tension when m moves from A to B is zero
(d) the kinetic energy of m in position B equals to the work done by gravitational force on the block when it moves from position A to B

Part – C
Numerical

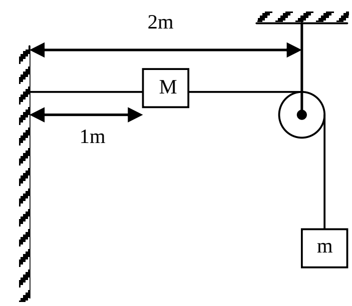
1. Coefficient of friction between two blocks shown in figure is $\mu = 0.4$. Floor is smooth. The blocks are given velocities of 2 m/s and 8 m/s in the directions shown in figure at t = 0. The time when relative motion between them will stop is (in sec.)



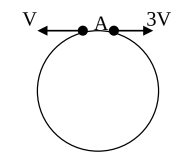
2. A wedge and block are connected by a mass less string passing over a frictionless pulley as shown in the figure. At the instant shown, the speed of the wedge is 1m/s. Assume all surfaces are smooth. The speed of the block of the instant shown is (approximately) (in m/s)



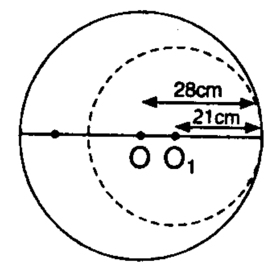
3. A string with one end fixed on a rigid wall passing over a fixed frictionless pulley at a distance of 2 m from the wall, has a point mass M = 2 kg attached to it at a distance of 1 m, from the wall. A mass m = 0.25 kg attached at the free end is held at rest so that the string is horizontal between the wall and the pulley, and vertical beyond the pulley. The speed with which the mass M will hit the wall when mass m is released, to the nearest integer (in m/s).



4. Two small particles of equal masses start moving in opposite directions from a point A in a horizontal circular orbit. Their tangential velocities are v and 3v respectively, as shown in the figure. Between collisions, the particles move with constant speeds. After making how many elastic collisions, other than that at A, these two particles will again reach the point A?



5. A circular plate of uniform thickness has a diameter of 56 cm. A circular portion of diameter 42 cm is removed from one edge as shown in the figure. The centre of mass of the remaining portion from the centre of the original plate will be(in cm)



Chemistry
Section – II

Part – A

Single Answer Questions

1. $SO_{3(g)}$ is heated in a closed vessel. An equilibrium: $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$ is established. The vapour density of the mixture, in which SO_3 is 50% dissociated, is:
   (a) 32 (b) 35 (c) 42 (d) 55

2. The equilibrium: $NH_4HS_{(S)} \rightleftharpoons NH_{3(g)} + H_2S_{(g)}$, is followed to set-up at 127^0C in a closed vessel. The total pressure at equilibrium was 20 atm. The K_c for the reaction is:
   (a) 0.092 (b) 0.085 (c) 3.045 (d) none of these

3. The K_{sp} of lead fluoride is 3.2×10^{-8} mol^3 L^{-3} at 298 K. The concentration of Pb^{2+} ions in a saturated solution of lead fluoride containing 0.1 M NaF is
   (a) 1.81×10^{-4} M (b) 1.44×10^{-3} M (c) 3.62×10^{-4} M (d) 3.2×10^{-6}M

4. 99% of a first order reaction was completed in 32 min. When will 99.9% of the reaction complete?
   (a) 24 min (b) 8 min (c) 4 min (d) 48 min

5. Which of the following expression is correct for first order reaction? “a” refers to initial concentration of reactant
   (a) $t_{1/2} \alpha a^2$ (b) $t_{1/2} \alpha a^{-1}$ (c) $t_{1/2} \alpha a^1$ (d) $t_{1/2} \alpha a^0$

6. AB_2 dissociates as $AB_2(g) \rightleftharpoons AB(g) + B(g)$
   When the initial pressure of AB_2 is 600 mm Hg, the total equilibrium pressure is 800 mm Hg. Calculate Kp (with respect to mm of Hg) for the reaction assuming that the volume of the system remains unchanged.
   (a) 50 (b) 100 (c) 166.6 (d) 400.0

7. $2B(OH)_3 + 2NaOH \rightleftharpoons NaBO_2 + Na\left[B(OH)_4\right] + 2H_2O$. How can this reaction is made to proceed in forward direction?
   (a) addition of cis-1,2-diol (b) addition of $borax_{(s)}$
   (c) addition of glycine (d) addition of $Na_2H\ PO_4$

8. The Exothermic formation of ClF_3 is represented by the equation $Cl_{2(g)} + 3F_{2(g)} \rightleftharpoons 2ClF_3(g)\ \Delta H = -329\ kJ$. Which of the following will increase the quantity of ClF_3 in the equilibrium mixture
   (a) increasing the temperature (b) removal of Cl_2
   (c) increasing the volume of the container (d) increasing the pressure

9. If 0.1 gm atom of radioactive isotope $(t_{1/2} = 5\,days)$ is taken, how many number of atoms will decay during the eleventh day (approximately) [$10^{0.66}$ = 4.57]?

(a) $2X10^{21}$ (b) $2X10^{25}$ (c) $2.5X10^{29}$ (d) none

10. With a certain radiation (exciting) of a particular frequency, to which hydrogen atoms are exposed, the maximum number of spectral lines obtainable in the emission is 15. The uppermost energy level to which the e^- is excited is n =
(a) 4 (b) 5 (c) 6 (d) 7

One or more than one correct option questions

11. Identify the correct statements
(a) The ionic product of water normally taken to be 1×10^{-14} is independent of temperature variation
(b) A solution of $NaHCO_3$ in water yields a pink colour with phenolphthalein.
(c) pK_w increases with temperature
(d) NaCl separates out from a saturated solution when HCl gas is passed through it.

12. Which of the following composition will constitute a buffer when HCOOH and NaOH respectively are mixed in the molar ratio?
(a) 1 : 2 (b) 2 : 1 (c) 1 : 1 (d) 3 : 2

13. Ratio between potential energy, kinetic energy and total energy of electron in hydrogen atom are
(a) $\frac{KE}{PE} = \frac{-1}{2}$ (b) $\frac{E}{PE} = \frac{1}{2}$ (c) $\frac{K.E}{E} = \frac{-1}{2}$ (d) $\frac{E}{PE + KE} = -1$

14. Which of the following statement about photo-electric effect is wrong?
(a) Photoelectric effect depends on intensity of light striking on the metal surface
(b) K.E. of electrons is dependent on the intensity of incident light.
(c) K.E. depends linearly on incident frequency.
(d) The ejection of photoelectron does not take place if frequency of radiation becomes greater or equal to the threshold frequency

15. Choose the correct relations on the basis of Bohr's theory
(a) Velocity of electron $\propto \frac{1}{n}$ (b) Frequency of revolution $\propto \frac{1}{n^3}$
(c) Radius of orbit $\propto n^2/Z$ (d) electrostatic force on electron $\propto n^4$

Part – C

Numerical

1. For the reaction, $2NO + H_2 \longrightarrow N_2O + H_2O$ the value of –dp/dt is found to be 1.50 Torr s^{-1} for a pressure of 359 Torr of NO and 0.25 Torr s^{-1} for a pressure of 152 Torr, the pressure of H_2 being constant. On the other hand, when the pressure of NO is kept constant, –dp/dt is 1.60 Torr s^{-1} for a hydrogen pressure of 289 Torr and 0.79 Torr s^{-1} for a pressure of 147 Torr. Determine the order of the reaction.
[log 359 = 2.5555, log 152 = 2.1818, log 289 = 2.4608, log 147 = 2.1673, log 1.60 = 0.2041, log 0.79 = -0.1023, log 1.5 = 0.1760, log 0.2 = - 0.6020]

2. What is the pH of the solution when 0.2 mol of hydrochloric acid is added to one litre of a solution containing 0.1M each of acetic acid and acetate ion? Assume that the total volume is one litre. K_a for acetic acid = 1.8×10^{-5}.

3. $M(OH)_x$ has $K_{sp} = 27 \times 10^{-12}$ and solubility in water is 10^{-3}M. Calculate the value of x

4. To a certain volume of a weak monobasic acid, when 20ml of NaOH solution is added, pH of the solution was found to be 3.7 whereas when 30ml of the same NaOH was added to the same volume of the acid from same stock pH was found to be 4.18. If the K_a of the acid is Y X 10^{-4}. ($10^{0.48}$=3) The value of Y is _________.

5. How many unpaired electron are present in O_2^-?

Mathematics Section – III

Part – A
Single Answer Questions

1. The two curves $x = y^2$, $xy = a^3$ cuts orthogonally at a point, then a^2 is equal to:

(a) $\frac{1}{3}$ (b) 3 (c) 2 (d) $\frac{1}{2}$

2. If $2f\left(x^2\right)+3f\left(\frac{1}{x^2}\right)=x^2-1\ \ \forall x\in R-\{0\}$ then $f\left(x^4\right)$ is

(a) $\frac{\left(1-x^4\right)\left(2x^4+3\right)}{5x^4}$ (b) $\frac{\left(1+x^4\right)\left(2x^4-3\right)}{5x^4}$ (c) $\frac{\left(1-x^4\right)\left(2x^4-3\right)}{5x^4}$ (d) $\left(1-x^4\right)\left(2x^4-3\right)$

3. $\int_{1/2}^{2}\frac{\tan^{-1}x}{x^2-x+1}dx$ is

(a) $\frac{\pi^2}{\sqrt{3}}$ (b) $\frac{\pi^2}{3\sqrt{3}}$ (c) $\frac{\pi^2}{12\sqrt{3}}$ (d) $\frac{\pi^2}{6\sqrt{3}}$

4. If $x + 4y = 14$ is a normal to the curve $y^2=\alpha x^3-\beta$ at (2, 3), then the value of $\alpha+\beta$ is

(a) 9 (b) –5 (c) 7 (d) –7

5. $\int\sqrt{\frac{\cos x-\cos^3 x}{1-\cos^3 x}}dx$ is equal to

(a) $\frac{2}{3}\sin^{-1}\left(\cos^{3/2}x\right)+C$ (b) $\frac{3}{2}\sin^{-1}\left(\cos^{3/2}x\right)+C$

(c) $\frac{2}{3}\cos^{-1}\left(\cos^{3/2}x\right)+C$ (d) none of these

6. If $f(x)$ is continuous function and satisfying $f(x)+f(1+x)=\left|2^x-1\right|+\left|x-1\right|$ in $0\le x\le 2$, then the value of $\int_0^2 f(x)dx$ is equal to

(a) $\frac{1}{\ln 2}-\frac{1}{2}$ (b) $\frac{1}{\ln 2}-1$ (c) $\frac{2}{\ln 2}-1$ (d) none of these

7. If $I_n = \int_0^1 x^n \tan^{-1}x \; dx$, then $(n + 1)I_n + (n - 1)I_{n-2}$ $(n \in N)$ is

(a) $\frac{\pi}{2}-\frac{1}{n}$ (b) $\frac{\pi}{2}-\frac{2}{n}$ (c) $\frac{\pi}{4}-\frac{2}{n}$ (d) none of these

8. Let $f:[1, 10] \to Q$ be a continuous function and f(1) = 10, then f(10) is equal to

(a) $\frac{1}{10}$ (b) 10 (c)1 (d) can't be obtained

9. If $\int_a^b |\sin x|\, dx = 8$ and $\int_0^{a+b} |\cos x|\, dx = 9$, then the value of $\int_a^b x\sin x\, dx$ is

(a) $\sqrt{2}\pi$ (b) $2\sqrt{2}\pi$ (c) $-2\sqrt{2}\pi$ (d) None of these

10. If f(x) = $[x^2] - [x]^2$, where [.] denotes the greatest integer function, and x $\in$ [0, n], n $\in$ N, then the number of elements in the range of f(x) is

(a) 2n + 1 (b) 4n – 3 (c) 3n – 3 (d) 2n – 1

(Multiple Correct Choice Type)

This section contains 5 **multiple choice questions.** Each question has four choices (a), (b), (c) and (d) out of which **ONE OR MORE** may be correct.

---

11. If f(x) is a polynomial of degree three with leading coefficient as unity such that f(1) = 1; f(3) = 9 & $f'(1)=2$ then

(a) $f'(x)=2x$ has at least one root between (1,3)

(b) $f''(x)=2$ has at least one root between (1, 7/3)

(c) $\frac{d}{dx}\left(\frac{f(x)-x^2}{(x-1)^2}\right)$ at x = 1 is equal to 1

(d) sum of roots of f(x) = 0 is 3

12. If $f(2-x)=f(2+x)$ and $f(4-x)=f(4+x)$ for all x and f(x) is a function for which $\int_0^2 f(x)dx=5$, then $\int_0^{50} f(x)\,dx$ is equal to

(a) 125 (b) $\int_{-4}^{46} f(x)dx$ (c) $\int_1^{51} f(x)dx$ (d) $\int_2^{52} f(x)dx$

13. Let f(x) = x^3+4x^2+6x+1 and $g(x)=\begin{cases}\{\max\ f(t), 0\le t\le x\} & \text{for } 0\le x\le 1\\ 13-x, & 1<x\le 3\end{cases}$ then

(a) g (x) is continuous at x = 1 (b) g (x) is differentiable at x = 1
(c) g (x) is not continuous at x = 1 (d) g (x) is not differentiable at x = 1

14. If $f(x)=[|x|]$, where [.] denotes the greatest integer function, then which of the following is **not true?**

(a) $f(x)$ is continuous $\forall x \in R$

(b) f (x) is continuous from right and discontinuous from left $\forall x \in N \cup \{0\}$

(c) f (x) is continuous from left and discontinuous from right $\forall x \in I$
(d) f (x) is continuous at x=0

15. Let f(x) = cosec^{-1} [1 + $\sin^2 x$], where [·] denotes the greatest integer function. Then
(a) The domain of f is R (b) The domain of f is [1, 2]

(c) The range of f is [1, 2]

(d) The range of f is $\left\{\frac{\pi}{2}, \operatorname{cosec}^{-1}2\right\}$

Part – C
Numerical

1. $f : R \to R$, f(x) = sinx + x, then the value of $\int_0^{\pi}\left(f^{-1}(x)\right)dx$ is equal to $\left(\frac{\pi^2}{A} - B\right)$, then A + B = ____

2. The value of $\int_0^{8}\left(x - [x]\right)dx$ is equal to (where [.] represents the greatest integer function) _____

3. The value of '*a*' for which $f(x) = \begin{cases} a + \sin^{-1}(x+b) & x \geq 1 \\ x & x < 1 \end{cases}$ is differentiable at *x* = 1 is _________

4. The number of integral values of a for which $x^3 - 3x + a = 0$ has three real and distinct roots is ________

5. If f (π) = 2 and $\int_0^{\pi}\left(f(x) + f''(x)\right)\sin x\,dx = 5$, then f (0) is

****

SET- 1

ANSWER KEYS

Physics

1.A	2.C	3.A	4.C	5.D
6.A	7.A	8.C	9.A	10.D
11.A,B,D	12.A,B	13.B,D	14.C	15.A,B,C,D
1.1	2.2	3.1	4.3	5.9

Chemistry

1. A	2. A	3. D	4. D	5. D
6. B	7. A	8. D	9. A	10. C
11. D	12. B,D	13. A,B	14. B,D	15. A,B,C
1. 3	2. 1	3. 3	4. 2	5. 1

Mathematics

1.D	2.A	3.D	4.A	5.C
6.A	7.A	8.B	9.C	10.D
11.A,B	12.A,B,D	13.A,D	14.A,B,C	15.A,D
1.4	2.4	3.1	4. 3	5.3

FIITJEE

BATCHES – 1 YR. CRP ADV. - C LOT

PHYSICS, CHEMISTRY & MATHEMATICS

CPT1 - 2 | **CODE:0000.1** | **PAPER - 2**

Time Allotted: 3 Hours **Maximum Marks: 198**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1.Attempt ALL the questions. Answers have to be marked on the OMR sheets.

2.This question paper contains Three Parts.

3.**Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.

4.Each part is further divided into one section: **Section-A**

5.Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.

6.Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1.Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.

2.On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.

3.OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 08)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 marks** for wrong answer.

Section-A (09 – 14) contains 3 paragraphs. Based upon paragraph, 2 multiple choice questions have to be answered. Each question has only one correct answer and carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (15 – 20) contains 6 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

Name of the Candidate :______________________________

Batch :________________ **Date of Examination :**________________

Enrolment Number :______________________________

USEFUL DATA

PHYSICS

Acceleration due to gravity : g = 10 m/s^2
Planck constant : h = 6.6 × $10^{-34}\ J-s$
Charge of electron : e = 1.6 × $10^{-19} C$
Mass of electron : $m_e = 9.1 \times 10^{-31} kg$
Permittivity of free space : $\varepsilon_0 = 8.85 \times 10^{-12} C^2 / N-m^2$
Density of water : $\rho_{water} = 10^3 kg/m^3$
Atmospheric pressure : $Pa = 10^5 N/m^2$
Gas constant : R = 8.314 J $K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant R = 8.314 J $K^{-1} mol^{-1}$
= 0.0821 Lit atm $K^{-1} mol^{-1}$
= 1.987 ≈ 2 Cal $K^{-1} mol^{-1}$
Avogadro's Number N_a = 6.023 × 10^{23}
Planck's constant h = 6.625 $\times 10^{-34} J.s$
= $6.625 \times 10^{-27} erg.s$
1 Faraday = 96500 coulomb
1 calorie = 4.2 joule
1 amu = 1.66 $\times 10^{-27} kg$
1 eV = $1.6 \times 10^{-19} J$

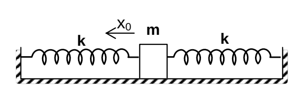
Atomic No: H = 1, He = 2, Li = 3, Be = 4, B = 5, C = 6, N = 7, O = 8, F = 9, Ne = 10, Na = 11, Mg = 12, Si = 14, Al = 13, P = 15, S = 16, Cl = 17, Ar = 18, K = 19, Ca = 20, Cr = 24, Mn = 25, Fe = 26, Co = 27, Ni = 28, Cu = 29, Zn = 30, As = 33, Br = 35, Ag = 47, Sn = 50, I = 53, Xe = 54, Ba = 56, Pb = 82, U = 92.

Atomic masses: H = 1, He = 4, Li = 7, Be = 9, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Si = 28, Al = 27, P = 31, S = 32, Cl = 35.5, K = 39, Ca = 40, Cr = 52, Mn = 55, Fe = 56, Co= 59, Ni = 58.7, Cu = 63.5, Zn = 65.4, As = 75, Br = 80, Ag = 108, Sn = 118.7, I = 127, Xe = 131, Ba = 137, Pb = 207, U = 238.

Physics
Section – I

Part – A
Single Answer Questions

1. In the spring mass system shown in the figure, the spring is compressed by $x_0 = mg/3k$ from its natural length and the block is released from rest. The speed of the block , when it passes through the point P at mean position, is (there is no friction)

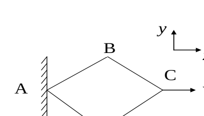


(a) $\frac{1}{3} g\sqrt{\frac{m}{k}}$ (b) $g\sqrt{\frac{2m}{9k}}$ (c) $g\sqrt{\frac{m}{3k}}$ (d) None of these

2. A swimmer crosses a flowing stream of width 'W' to and fro in time t_1. The time taken to cover the same distance up & down the stream is t_2. If t_3 is the time swimmer would take to swim a distance 2W in still water, then:

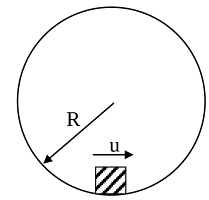
(a) $t_1^2 = t_2 t_3$ (b) $t_2^2 = t_1 t_3$ (c) $t_3^2 = t_1 t_2$ (d) $t_3 = t_1 + t_2$

3. Four rods each of length *l* have been hinged to form a rhombus. Vertex A is fixed to rigid support, vertex C is being moved along the x-axis with a constant velocity v as shown in the figure. The rate at which vertex B is approaching the x-axis at the moment the rhombus is in is in the form of a square is (figure is not to scale)



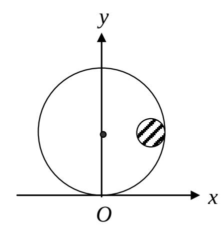
(a) $\frac{v}{4}$ (b) $\frac{v}{3}$ (c) $\frac{v}{2}$ (d) $\frac{v}{\sqrt{2}}$

4. A particle is given an initial speed u inside a fixed smooth spherical shell of radius R, so that it is just able to complete the circle. The magnitude of acceleration of the particle when its velocity becomes vertical is:



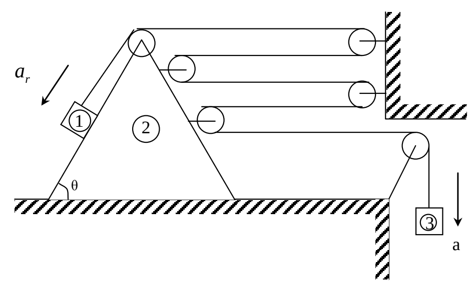
(a) $g\sqrt{10}$ (b) g
(c) $g\sqrt{2}$ (d) 3g

5. A small sphere of radius R held against the inner surface of a smooth spherical shell of radius 6R as shown in figure. The masses of the shell and small spheres are 4M and M respectively. This arrangement is placed on a smooth horizontal table. The small sphere is now released. The change in x-coordinate of the centre of the shell when the smaller sphere reaches the other extreme position is:



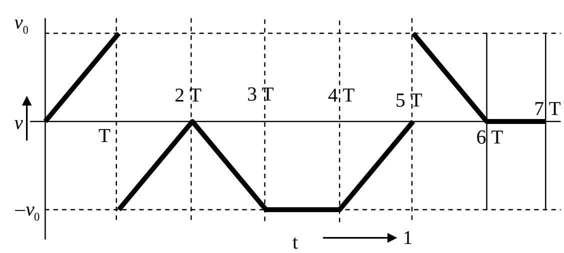
(a) R (b) 2R
(c) 3R (d) 4R

6. In the figure shown, all the three bodies 1, 2, 3 can move. If acceleration of body 1 w.r.t 2 is $a_r = 6 m/s^2$ and acceleration of 3 w.r.t ground is $a = 4 m/s^2$, then magnitude of acceleration wedge 2 w.r.t. ground is



(a) 2 m/s^2 (b) 0.8 m/s^2
(c) 0.4 m/s^2 (d) 1 m/s^2

7. Figure shows the velocity –time graph of a body in straight line motion then



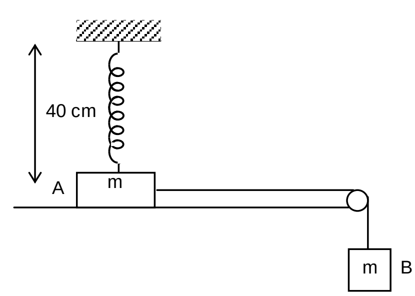
(a)Maximum acceleration is $2V_0 / T$

(b) Distance travelled by the body is $\left(\frac{7}{2}\right)V_0T$

(c) Displacement of the body is zero

(d) Distance travelled by the body is $\frac{3}{2}V_0T$

8. Figure shows two blocks A and B of same masses 0.32 kg connected by a light string passing over a massless smooth pulley. The block is attached to a spring of spring constant 40 N/m whose other end is fixed to a support 0.4 m above the horizontal surface. Initially the spring is unstretched and vertical when the system is released to move. The velocity of the block A at the instant it breaks of from the surface is (length of the spring in unstretched state = 40cm , g = 10m/s^2)



(a) 0.5 m/sec. (b) 1 m/sec.
(c) 1.5 m/sec. (d) 2 m/sec.

Comprehension - 1

When an airplane flies, its total velocity with respect to the ground is: $V_{total} = V_{plane} + V_{wind}$ where V_{plane} denotes the plane's velocity through motionless air, and V_{wind} denotes the wind's velocity. Crucially, all the quantities in this equation are vectors. The magnitude of a velocity vector is often called the "speed". Consider an airplane whose speed through motionless air is 100 m/s. To reach its destination, the plane must fly east.

The "heading" of a plane is the direction in which the nose of the plane points. So, it is the direction in which the engines propel the plane.

9. If the plane has an eastward heading, and a 20 m/s wind blows towards the southwest, then the plane's total speed is:
(a) 80 m/s (b) more than 80 m/s but less than 100 m/s
(c) 100 m/s (d) more than 100 m/s

10. The pilot maintains an eastward heading while a 20 m/s wind blows northward. The plane's total velocity makes an angle from east
(a) $\sin^{-1}(1/5)$ (b) $\cos^{-1}(1/5)$ (c) $\tan^{-1}(1/5)$ (d) none of these

Comprehension – 2

The potential energy of a particle that is bound to a certain point at a distance r from the centre of the force is given by U(r) = $\frac{A}{r^2} - \frac{B}{r}$: where A and B are positive constants. Answer the following questions:

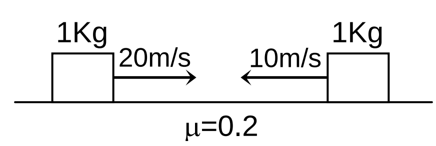
11. The equilibrium distance is given by:
(a) $\frac{A}{B}$ (b) $\frac{2A}{B}$ (c) $\frac{3A}{B}$ (d) $\frac{B}{2A}$

12. The equilibrium is:
(a) Stable (b) Unstable (c) Neutral (d) Cannot be predicted

Comprehension – 3

Read the following write up carefully and answer the following questions:

Two blocks are approaching towards each other from very far apart with the velocities shown.

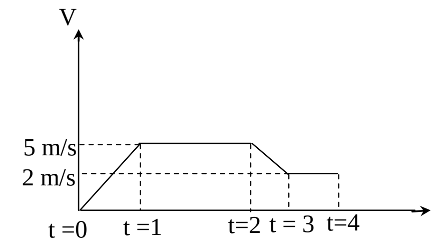


13. Linear momentum of the system is :
(A) conserved for all times (B) never conserved
(C) conserved upto 5 second (D) None of these.

14. How much distance will the centre of mass travel before coming permanently to rest.
(A) 25 m (B) 37.5 m (C) 42.5 m (D) 50 m

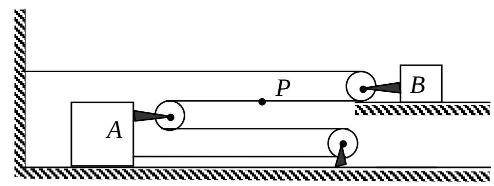
(Multiple Correct Choice Type)

15. The velocity time graph of a particle moving in a straight line is as shown. Then



(a) the acceleration of the particle from t = 0 to t = 1 sec is 5 m/s^2
(b)the acceleration of the particle from t = 1 to t = 2 sec is zero
(c) The displacement of the particle is 7.5m from t = 0 to t = 2 sec
(d) The displacement covered by the particle during its motion from t=0 to t=4 seconds is less than the distance covered.

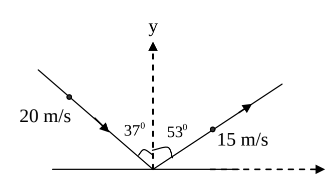
16. Block B shown in figure moves with a constant velocity of $30\,cm/s$ towards right , then



(a) The speed of block A is 20 cm/s.
(b) The speed of the point P of the string is 60 cm/s
(c) The speed of the point P of the string is 40 cm/s
(d) The speed of the block A is 10 cm/s.

17. A small spherical ball is suspended through a string of length *l*. The whole arrangement is placed in a vehicle which is moving with velocity v. Now suddenly the vehicle stops and ball starts moving along a circular path. If tension in the string at the highest point is twice the weight of the ball then :
(a) v = $\sqrt{5gl}$
(b) v = $\sqrt{7gl}$
(c) velocity of the ball at highest point is $\sqrt{gl}$
(d) velocity of the ball at the highest point is $\sqrt{3gl}$

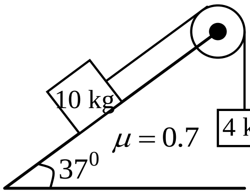
18. A ball of mass 2 kg strikes a floor as shown in figure. For this situation mark the correct statement(s)



(a) The impulse experienced by ball during the collision is acting along the +ve y – direction and is having a magnitude of 50 N – S .
(b) The coefficient of restitution between the floor and the ball is 3/4.
(c) Coefficient of restitution between floor and ball is 9/16
(d) The direction of impulse experienced by ball during the collision is along some where between the y axis and – ve x - axis

19. Velocity of a particle moving in a curvilinear path varies with time as $\vec{V} = \left(2t\hat{i} + t^2\hat{j}\right)m/s$. Then t is in sec. At t = 1 sec
(a)acceleration of particle is $8m/s^2$
(b)tangential acceleration of particle is $\frac{6}{\sqrt{5}}m/s^2$
(c)Radial acceleration of particle is $\frac{2}{\sqrt{5}}m/s^2$
(d) Radius of curvature to the paths is $\frac{5\sqrt{5}}{2}m$

20. In the arrangement shown in figure, which statement(s) is/are true $\left[\sin 37^0 = \frac{3}{5} \text{ and } \cos 37^0 = \frac{4}{5}\right]$



(a) direction of force of friction is up the plane
(b) the magnitude of force of friction is zero
(c) the tension in the string is 40 N
(d) magnitude of force of friction is 56 N

Chemistry
Section – II

Part – A
Single Answer Questions

1. For the reaction, 3A $\rightarrow$ products, rate constant at 25°C is 1.52×10^{-5} mol^{-1} dm^{3} s^{-1}. If the rate of the reaction at a given instant is 3.8×10^{-4} mol dm^{-3} s^{-1}, the concentration of (A) at that instant is
   (a) 125 M (b) 62.5 M (c) 25 M (d) 5 M

2. Phosphorous pentachloride vapour dissociates into $PCl_{3(g)}$ and $Cl_{2(g)}$ at 250°C. If its K_p is equal to 1.8 at this temperature, the density of the gas mixture (in g L^{-1}) at a total pressure of 2 atm is
   (a) 2.88 (b) 2.54 (c) 4.32 (d) 5.75

3. To an 100 ml of 0.1M solution of sodium dihydrogen phosphate, 75 ml of 0.1 M sodium phosphate is added. Calculate the pH when 25 ml of 0.1M HCl is added to the above solution.(stepwise acid dissociation constants for phosphoric acid are 10^{-3},10^{-6}, 10^{-13}).
   a)6 b) 4 c) 8.5 d) none of these

4. A gaseous substance $AB_{2(g)}$ converts to $AB_{(g)}$ in the presence of Solid $A_{(s)}$ as
   $$AB_{2(g)} + A_{(s)} \Leftrightarrow 2AB_{(g)}$$
   The initial pressure and equilibrium pressure are 0.7 and 0.95 bar. Now the equilibrium mixture is expanded reversibly and isothermally till the gas pressure falls to 0.4 bar. The volume percentage of $AB_{(g)}$ at the final equilibrium is
   a)67.5 b) 32.5 c) 45.3 d) 63.1

5. Which of the following carbides yield CH_4 gas on hydrolysis?
   (a) CaC_2 (b) Be_2C (c) Mg_2C_3 (d) Na_2C_2

6. For the reaction, $2NO_2^- + 4H^+ + 2I^- \longrightarrow I_2 + 2NO + 2H_2O$, rate = k$[NO_2][H^+]^2[I^-]$. Keeping all concentrations constant, the pH of solution was reduced by 1 unit. The rate will
   (a) Increase by two times (b) Decrease by two times
   (c) Increase by four times d) Increase by hundred times

7. 0.1 M acetic acid solution is titrated against 0.1M NaOH. What would be the difference in pH between 1/4 and 3/4 stages of neutralization of acid
   (a) $2\log 3/4$ (b) $2\log 1/4$ (c) $\log 1/3$ (d) $2\log 3$

8. The correct order of solubility of alkaline earth metal sulphates is
   (a) $BaSO_4 > SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$
   (b) $BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$
   (c) $MgSO_4 > BeSO_4 > CaSO_4 > SrSO_4 > BaSO_4$
   (d) $SrSO_4 > BaSO_4 > MgSO_4 > CaSO_4 > BeSO_4$

Comprehension 1

The equilibrium constant in terms of partial pressure (K_p) of the reaction,

$$A_{(g)} + 2B_{(g)} \rightleftharpoons X_{(g)} + 3Y_{(g)} \text{ — Reaction (1)}$$

increases three fold when the temperature is raised from 27°C to 37°C. The effect of temperature on K_p is given by the equation,

$$\log\frac{K_{p_2}}{K_{p_1}} = \frac{\Delta H^0}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right] \text{ — Equation (1).}$$

The equilibrium constant $\{K_c\}$ in terms of molar concentration also varies with temperature. $\Delta G°$ of reaction(1) at 298K is given as –11.4 kJ

9. If Kp increases by 10 fold for the reaction (1) when the temperature is increased from 27°C to 67°C, the standard enthalpy change in this temperature range is close to
(a) 6 kcal (b) 12 kcal (c) 24 kcal (d) 18 kcal

10. For the reaction , $\frac{X_{(g)}}{2}+\frac{3}{2}Y_{(g)} \rightleftharpoons \frac{1}{2}A_{(g)}+B_{(g)}$, Kp_1 for this reaction is written with respect to Kp for reaction (1) as
(a) $[1/Kp]^{1/2}$ (b) $[K_p]^{3/2}$ (c) $[K_p]^{1/2}$ (d) $[K_p]^{-1/2}$

Comprehension 2

If a sparingly soluble salt is placed in water, after sometime an equilibrium is established when the rate of dissolution of ions from the solid equals the rate of precipitation of ions from the saturated solution at a particular temperature. Then a dynamic undissolved solid species and the dissolved ionic species in a saturated solution. For eg.

$$AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)}+Cl^-_{(aq)}$$

$K_{sp} = [Ag^+] [Cl^-]$

When ionic product (Q) is equal to K_{sp} the solution is saturated
When Q < K_{sp} solution is unsaturated when Q > K_{sp} precipitation takes place.

11. pH of a saturated solution of $Ba(OH)_2$ is 12. Hence K_{sp} of $Ba(OH)_2$ is
(a) 5×10^{-7} (b) 5×10^{-14} (c) 1×10^{-6} (d) 4×10^{-6}

12. A solution is a mixture of 0.05M NaCl and 0.05M NaI. The concentration of iodide ion in the solution when AgCl just starts precipitating is equal to: (K_{sp} (AgCl) = 1×10^{-10}, K_{sp} (AgI) = 4×10^{-16})
(a) 4×10^{-6} (b) 2×10^{-8} (c) 2×10^{-7} (d) 8×10^{-15}

Comprehension 3

Isomerization of cyclobutene into 1,3 butadiene follow first order kinetics. The kinetic study was performed by taking same amounts of cyclobutene in three sealed flasks. First flask was broken 20minute and the reaction mixture was absorbed completely in bromine solution. 10ml of 1.0M bromine solution was required. The second flask was broken after a very long time and the reaction mixture required 12ml bromine solution of same strength. The third flask was broken after 30 minutes.

13. Millimoles of cyclobutene isomerized after 20 min is-----
(a) 6 (b) 4 (c)8 (d)5

14. Volume of bromine solution required after 30 min (solution in third flask) is----
(a)17.5ml (b) 25ml (c) 15ml (d) none

(Multiple Correct Choice Type)

15. Identify the correct statements for 2 M pyridinium acetate solution {$K_{a(acetic\ acid)}$ = 1.75×10^{-5}, $K_{b(pyridinium\ hydroxide)}$ = 1.5×10^{-9}, $K_w = 1 \times 10^{-14}$}
(a) Hydrolysis constant is 0.38 (b) Percentage of hydrolysis is close to 43
(c) pOH of the solution is 9.03 (d) The solution is neutral

16. O_2^{2-} will have:
(a) bond order lower than O_2 (b) bond order higher than O_2
(c) bond order equal to C_2 (d) bond order equal to H_2

17. Which of the following statements are correct?
(a) Lithium is the only alkali metal to form a stable nitride
(b) With Me_3N as donor, the stability order of donor-acceptor complexes of boron compounds is

$BBr_3 > BCl_3 > BF_3 > BMe_3$
(c) $NaBH_4$ is very much less rapidly hydrolysed by water than $NaAlH_4$
(d) Magnesium silicide reacts with ammonium bromide in liquid ammonia to form silane

18. Which statements concerning Bohr's model are true?
(a) Predicts that probability of electron near nucleus is more
(b) Angular momentum of electron in H-atom = $\frac{nh}{2\pi}$
(c) Introduces the idea of stationary states
(d) Explains line spectrum of hydrogen

19. Which of these compounds do not have H-bonds?
(a) Phenol (b) PH_3 (c) $NaHCO_3$ (d) HI

20. Which of the following have identical bond order
(a) CN^- (b) O_2^- (c) NO^+ (d) CN^+

Mathematics Section – III

Part – A
Single Answer Questions

1. Let f(x) = $\begin{cases} x^3-1, & x<2 \\ x^2+3, & x\geq 2 \end{cases}$. Then

(a) $f^{-1}(x) = \begin{cases} (x+1)^{1/3}, & x<2 \\ (x-3)^{1/2}, & x\geq 2 \end{cases}$
(b) $f^{-1}(x) = \begin{cases} (x+1)^{1/3}, & x<7 \\ (x-3)^{1/2}, & x\geq 7 \end{cases}$
(c) $f^{-1}(x) = \begin{cases} (x+1)^{1/3}, & x<1 \\ (x-3)^{1/2}, & x\geq 7 \end{cases}$
(d) $f^{-1}(x)$ does not exist

2. The value of $\int_{1/2}^{2} \frac{1}{x}\sin\left(x-\frac{1}{x}\right)dx$ is

(a) 0 (b) 1 (c)2 (d) none of these

3. The function x^x decreases in the interval

(a) (0, e) (b) (0, 1) (c) $\left(0,\frac{1}{e}\right)$ (d) None of these

4. The value of $\lim_{n\to\infty}\left[\tan\frac{\pi}{2n}.\tan\frac{2\pi}{2n}.....\tan\frac{n\pi}{2n}\right]^{1/n}$

(a) e (b) e^2 (c) 1 (d) e^3

5. $\int \frac{2\sin\theta+\sin 2\theta}{(\cos\theta-1)\sqrt{\cos\theta+\cos^2\theta+\cos^3\theta}}d\theta$ is

(a) $-\frac{2}{\sqrt{3}}\ln\left|\frac{\sqrt{(\cos\theta+\sec\theta-1)}-\sqrt{3}}{\sqrt{(\cos\theta+\sec\theta-1)}+\sqrt{3}}\right|+c$
(b) $\frac{2}{\sqrt{3}}\ln\left|\frac{\sqrt{(\cos\theta+\sec\theta+1)}-\sqrt{3}}{\sqrt{(\cos\theta+\sec\theta+1)}+\sqrt{3}}\right|+c$
(c) $-\frac{2}{\sqrt{3}}\ln\left|\frac{\sqrt{(\cos\theta+\sec\theta+1)}-\sqrt{3}}{\sqrt{(\cos\theta+\sec\theta+1)}+\sqrt{3}}\right|+c$
(d) None of these

6. $\int \frac{(x-\sin x)^{3/2}}{\sqrt{x}}.\left\{\frac{6x^2\sin^2\frac{x}{2}}{x-\sin x}+3x\right\}dx$ is

(a) $2\left(x^2+x\sin x\right)^{\frac{3}{2}}+c$ (b) $2\left(x^2-x\sin x\right)^{-\frac{3}{2}}+c$ (c) $2\left(x^2-x\sin x\right)^{\frac{3}{2}}+c$ (d) None of these

7. $\int_{-1}^{1}([x]+|x|)dx$ has the value (where [.] represents the greatest integer function) is

(a) 0 (b) 1/2 (c) 1 (d) ¼

8. If f(x) = $x^9 - 6x^8 - 2x^7 + 12x^6 + x^4 - 7x^3 + 6x^2 + x - 3$, then the value of f (6) is
(a) 3 (b) –3 (c) 0 (d) none of these

Comprehension -1

This section contains 3 **paragraphs.** Based upon the paragraphs **2 multiple choice questions each** have to be answered. Each of these questions has 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

f : R $\to$ R, $f(x)$ is a differentiable function such that all its successive derivatives exist. $f'(x)$ can be zero at discrete points only and $f(x)$ $f''(x) \le 0 \forall x \in R$.

Now answer the following questions based on the above comprehension:

9. If α and β are two consecutive roots of $f(x)$ = 0, then
(a) $f''(\gamma)=0 \quad \gamma\in(\alpha,\beta)$ (b) $f'''(\gamma)=0 \quad \gamma\in(\alpha,\beta)$
(c) $f''''(\gamma)=0 \quad \gamma\in(\alpha,\beta)$ (d) $f'''''(\gamma)=0 \quad \gamma\in(\alpha,\beta)$

10. If f(a) = 0, then which of the following is correct (where h$\to$0$^+$)
(a) $f(a+h)\,f''(a-h)<0$ (b) $f(a+h)\,f''(a-h)>0$
(c) $f'(a+h)\,f''(a-h)<0$ (d) $f'(a+h)\,f''(a-h)<0$

Comprehension -2

Read the following write up carefully and answer the following questions:

If $y=f(x)$ satisfies the relation $\int_2^x f(t)dt=\frac{x^2}{2}+\int_x^2 t^2 f(t)dt-2$

11. The value of $\int_{-2}^{2} f(x)dx$ is
(a) 0 (b) -2 (c) $2\log 2$ (d) none of these

12. The value of x for which $f(x)$ is increasing, is
(a) $(-\infty,1]$ (b) $[-1,\infty)$ (c) $[-1,1]$ (d) none of these

Comprehension -3

Consider the function $f(x)=\begin{cases} x+1 & x\le 1 \\ 2x+1 & 1<x\le 2\end{cases}$ and $g(x)=\begin{cases} x^2 & -1\le x<2 \\ x+2 & 2\le x\le 3\end{cases}$

13. The range of the function $f(g(x))$ is :
(a) [1, 5] (b) [2, 3] (c) $[1,2]\cup(3,5]$ (d) None of these

14. The number of roots of the equation $f(g(x))=2$ is :
(a) 1 (b) 2 (c) 4 (d) None of these

(Multiple Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (a), (b), (c) and (d) out of which **ONE OR MORE** may be correct.

15. If f(x) = $2^{\{x\}}$, where {x} denotes the fractional part of x. Then which of the following is true?

(a) f is periodic
(b) $\int_0^1 2^{\{x\}}dx = \frac{1}{\ln 2}$
(c) $\int_0^1 2^{\{x\}}dx = \log_2 e$
(d) $\int_0^{100} 2^{\{x\}}dx = 100\log_2 e$

16. $2f(x) + x f\left(\frac{1}{x}\right) - 2f\left(\left|\sqrt{2}\sin\left(\pi\left(x+\frac{1}{4}\right)\right)\right|\right) = 4\cos^2\left(\frac{\pi x}{2}\right) + x\cos\frac{\pi}{x}$ $\forall$ x $\in$ R, x $\neq$ 0, then

(a) $f(2) + f\left(\frac{1}{2}\right) = 1$
(b) $f(2) + f(1) = f\left(\frac{1}{2}\right)$
(c) f(2) + f(1) = 0
(d) f(1) = –1, but f(2) and f(1/2) can not be obtained

17. $\int \tan^7 x dx = A\sec^6 x + B\sec^4 x + C\sec^2 x + \log|\cos x| + k$, then

(a) $A = \frac{1}{6}$
(b) $B = \frac{3}{4}$
(c) $C = \frac{-3}{2}$
(d) $C = \frac{3}{2}$

18. If f(x) = $\log_{x^2} x$, (x$\in$ R^+ – (1), then

(a) f is one-one
(b) f is many one
(c) f′(2) = 1
(d) f is a constant function within its domain

19. The domain of the function f(x) = $\frac{x^{1/2}}{\sqrt{\sin(\ln x) - \cos(\ln x)}}$ is

(a) $\bigcup_{n\in I}\left(e^{2n\pi},\ e^{\left(3n+\frac{1}{2}\right)\pi}\right)$
(b) $\bigcup_{n\in I}\left(e^{\left(2n+\frac{1}{4}\right)\pi},\ e^{\left(2n+\frac{5}{4}\right)\pi}\right)$
(c) $\bigcup_{n\in I}\left(e^{\left(2n+\frac{1}{4}\right)\pi},\ e^{\left(3n-\frac{3}{4}\right)\pi}\right)$
(d) $\bigcup_{n\in I}\left(e^{\left(2n-\frac{3}{4}\right)\pi},\ e^{\left(3n+\frac{3}{4}\right)\pi}\right)$

20. If f(x) is defined by f(x) = $\begin{cases} \frac{|x^2-2x|}{x^2-2x}; & x \neq 0,2 \\ 1 & x = 0 \\ -1 & x = 2 \end{cases}$, then f is discontinuous at

(a) –1
(b) 0
(c) 1
(d) 2

****

SET- I

ANSWER KEYS

Physics

1.B	2.A	3.C	4.A	5.B
6.A	7.B	8.C	9.B	10.C
11.B	12.A	13.C	14.B	15.A,B,C
16.A,B	17.B,D	18.A,C	19.B,C,D	20.A,C

Chemistry

1. D	2. D	3. D	4. A	5. B
6. D	7. D	8. B	9. B	10. A
11. A	12. C	13. A	14. D	15. A,C
16. A,D	17. A,B,C,D	18. B,C,D	19. B,D	20. A,C

Mathematics

1.B	2.A	3.C	4.C	5.C
6.C	7.A	8.A	9. B	10.B
11.A	12.C	13.C	14.B	15.A,B,C,D
16.A,B,C	17.A,D	18.B,D	19.B	20.B,D

FIITJEE - JEE (Mains)

CPA –B LOT BATCH

PHYSICS, CHEMISTRY & MATHEMATICS

JEE - MAINS 2014

PHASE – II

SET - A

Time Allotted: 3 Hours **Maximum Marks: 360**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.*
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are ***three*** parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :_______________________________________

Enrolment Number :____

Batch :_________________________ **Date of Examination :** _________________________

Useful Data Chemistry:

Gas Constant	R	=	8.314 J K^{-1} mol^{-1}
		=	0.0821 Lit atm K^{-1} mol^{-1}
		=	1.987 ≈ 2 Cal K^{-1} mol^{-1}
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-27} erg.s
1 Faraday		=	96500 Coulomb
1 calorie		=	4.2 Joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No : H=1, D=1, Li=3, Na=11, K=19, Rb=37, Cs=55, F=9, Ca=20, He=2, O=8, Au=79.

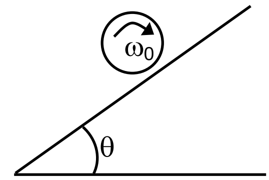
Atomic Masses: He=4, Mg=24, C=12, O=16, N=14, P=31, Br=80, Cu=63.5, Fe=56, Mn=55, Pb=207, Au=197, Ag=108, F=19, H=2, Cl=35.5, Sn=118.6

Useful Data Physics:

Acceleration due to gravity g = 10 m/s^2

Section – I (Physics)

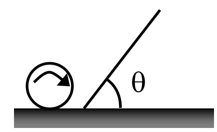
1. A cylinder of radius R is spinned and then placed on an incline having coefficient of friction $\mu = \tan\theta$ (θ is the angle of incline). The cylinder continues to spin without falling for time



(A) $\frac{R\omega_0}{3g\sin\theta}$ (B) $\frac{R\omega_0}{2g\sin\theta}$

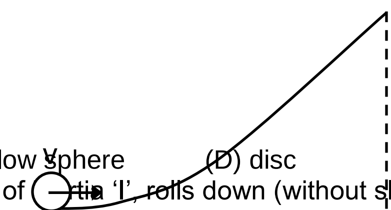
(C) $\frac{R\omega_0}{g\sin\theta}$ (D) $\frac{2R\omega_0}{g\sin\theta}$

2. A uniform solid cylinder rolling without slipping along a horizontal plane suddenly encounters a plane inclined at angle θ as shown in figure. The value of θ which could bring the cylinder immediately to rest after impact, is



(A) 90° (B) 60° (C) 120° (D) 30°

3. A small object of uniform density rolls up a curved surface with an initial velocity υ. It reaches up to a maximum height of $\frac{3\upsilon^2}{4g}$ with respect to the initial position. The object is



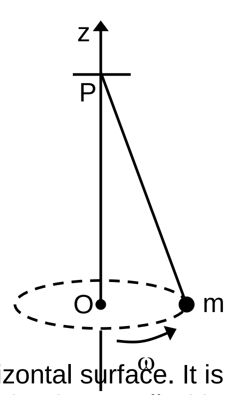
(A) ring (B) solid sphere (C) hollow sphere (D) disc

4. A round uniform body of radius R, mass M and moment of inertia 'I', rolls down (without slipping) an inclined plane making an angle θ with the horizontal. Then its acceleration is

(A) $\frac{g\sin\theta}{1-MR^2/I}$ (B) $\frac{g\sin\theta}{1+I/MR^2}$ (C) $\frac{g\sin\theta}{1+MR^2/I}$ (D) $\frac{g\sin\theta}{1-I/MR^2}$

space for rough work

5. A small mass m is attached to a massless string whose other end is fixed at P as shown in the figure. The mass is undergoing circular motion in the x – y plane with centre at O and constant angular speed ω. If the angular momentum of the system, calculated about O and P are denoted by $\vec{L}_O$ and $\vec{L}_P$ respectively, then



(A) $\vec{L}_O$ and $\vec{L}_P$ do not vary with time

(B) $\vec{L}_O$ varies with time while $\vec{L}_P$ remains constant

(C) $\vec{L}_O$ remains constant while $\vec{L}_P$ varies with time.

(D) $\vec{L}_O$ and $\vec{L}_P$ both vary with time.

6. A solid sphere of mass M and radius R is placed on a rough horizontal surface. It is pulled by a horizontal force F acting through its centre of mass as a result of which it begins to roll without slipping. Angular acceleration of the sphere can be expressed as:

(A) $\frac{3F}{4MR}$ (B) $\frac{5F}{7MR}$ (C) $\frac{7F}{11MR}$ (D) $\frac{5F}{2MR}$

7. A rectangular block has a square base measuring $a \times a$, and its height is h. It moves on a horizontal surface in a direction perpendicular to one of the edges of the base. The coefficient of friction is μ. It will topple if (choose the most appropriate option):

(A) $\mu > a/2h$ (B) $\mu > 2a/h$ (C) $\mu > a/h$ (D) $\mu > h/a$

8. Equal charges q are placed at the three corners B,C,D of a square ABCD of side a,

(i) The potential at A is

(A) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{a}$ (B) $\frac{3q}{4\pi\varepsilon_0 a}$

(C) $\frac{q}{4\pi\varepsilon_0 a}\left[2+\frac{1}{\sqrt{2}}\right]$ (D) $\frac{q}{4\pi\varepsilon_0 a}\left[1+\sqrt{2}\right]$

space for rough work

9. Three point charges +q, –2q and +q are placed at points (x = 0, y = a, z = 0), (x = 0, y =0, z =0) and (x = a, y = 0, z = 0) respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are

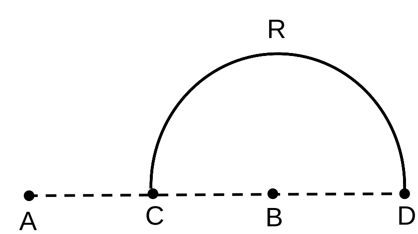
(A) $\sqrt{2}$ qa along + y-direction

(B) $\sqrt{2}$ qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(C) qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(D) $\sqrt{2}$ qa along +y –direction

10. Charges +q and –q are placed at points A and B respectively which are at a distance 2 L apart, C is the mid-point between A and B. The work done in moving a charge +Q along the semicircle CRD is



(A) $\frac{qQ}{4\pi\varepsilon_0 L}$ (B) $\frac{qQ}{2\pi\varepsilon_0 L}$

(C) $\frac{qQ}{6\pi\varepsilon_0 L}$ (D) $-\frac{qQ}{6\pi\varepsilon_0 L}$

11. Which of the following statement(s) is/are correct?

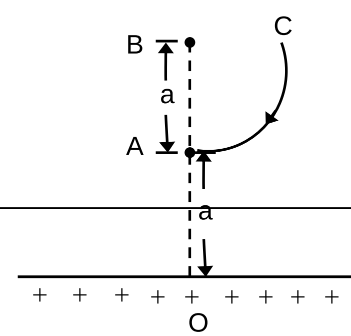
(A) If the electric field due to a point charge varies as $r^{-2.5}$ instead of r^{-2}, then the Gauss's law will still be valid

(B) The Gauss's law can be used to calculate the field distribution around an electric dipole

(C) If the electric field between two point charges is zero somewhere, then the sign of the two charges is the same

(D) The work done by the external force in moving a unit positive charge from point A at potential V_A to point B at potential V_B is $(V_A - V_B)$

12. For an infinite line of charge having charge density λ lying along x-axis, the work done in moving charge from C to A along arc CA is



space for rough work

(A) $\frac{q\lambda}{2\pi\varepsilon_0}\log_e 2$ (B) $\frac{q\lambda}{2\pi\varepsilon_0}\log_e \sqrt{2}$

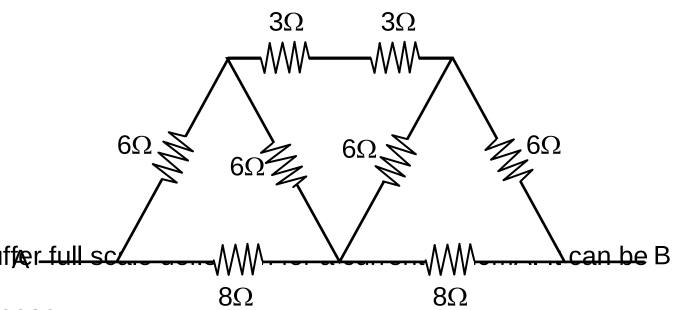
(C) $\frac{q\lambda}{4\pi\varepsilon_0}\log_e 2$ (D) $\frac{q\lambda}{2\pi\varepsilon_0}\log_e \frac{1}{2}$

13. There are two concentric metal shells of radii r_1 and r_2 (> r_1). If the outer shell has a charge q and the inner shell is grounded, the charge on the inner shell is

(A) zero (B) $-(r_1/r_2)q$ (C) $r_1 r_2 q$ (D) ∞

14. The equivalent resistance of the given network between the points A and B is

(A) 3Ω
(B) 12Ω
(C) 23Ω
(D) 8Ω

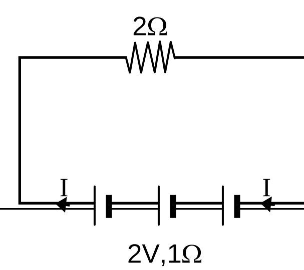


15. A galvanometer of resistance 20 ohm suffer full sc[illegible] can be converted into a voltmeter of range 200 V by

(A) Connecting in series a resistance of 9980Ω
(B) Connecting in series a resistance of 19980Ω
(C) Using a shunt of resistance 20 m Ω
(D) Using a shunt of resistance 9980Ω

16. In the electric circuit shown each cell has an emf of 2V and internal resistance of 1Ω. The external resistance is 2Ω. The value of the current I is(amperes):

(A) 2 (B) 1.25
(C) 0.4 (D) 1.2



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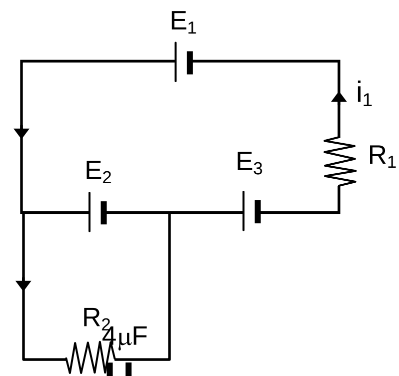
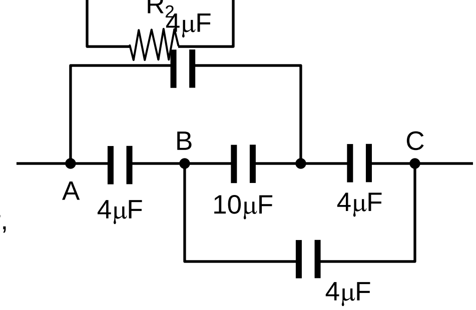
17. The current i_1 and i_2 through the resistors R_1 (= 10Ω) and R_2 (= 30Ω) in the circuit diagram with E_1 = 3 V, E_2 = 3 V and E_3 = 2 V are respectively



(A) 0.2 A, 0.1 A
(B) 0.4 A, 0.2 A
(C) 0.1 A, 0.2 A
(D) 0.2 A, 0.4 A

18. Equivalent capacitance of the given combination of five capacitances between A and C is



(A) 8μF
(B) 10μF
(C) 4μF
(D) 120μF

19. A capacitor connected across another charged capacitor,
(A) can be equal to the energy in the initial capacitor
(B) can be less in energy than that in the initial capacitor
(C) can be more in energy that in the initial capacitor
(D) can be more or less in energy than initial capacitor depending on the relative capacities of the two capacitors

20. Three capacitors of equal capacities are to be connected in different ways to give different capacities, the number of ways in which they can be connected are
(A) two
(B) three
(C) four
(D) any number

space for rough work

21. Let I be the moment of inertia of a uniform square plate about an axis AB that passes through its centre and is parallel to two of its sides. CD is a line in the plane of the plate and it passes through the centre of the plate, making an angle θ with AB. The moment of inertia of the plate about the axis CD is equal to

(A) I
(B) $I\sin^2\theta$
(C) $I\cos^2\theta$
(D) $I\cos^2\left(\frac{\theta}{2}\right)$

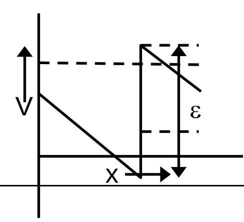
22. A flywheel rotates about an axis. Due to friction at the axis, it experiences an angular retardation proportional to its angular velocity. If its angular velocity falls to half while it makes n rotations, how many more rotations will it makes before coming to rest?

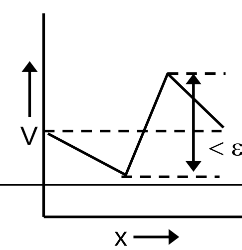
(A) 2n
(B) n
(C) $n/2$
(D) $n/3$

23. An external device, e.g., an electric motor, supplies constant power to a rotating system, e.g., a flywheel, through a torque τ. The angular velocity of the system is ω. Both τ and ω are variable.

(A) $\omega \propto \tau$
(B) $\omega \propto \frac{1}{\tau}$
(C) $\omega \propto \sqrt{\tau}$
(D) $\omega \propto \frac{1}{\sqrt{\tau}}$

24. The two ends of a uniform conductor are joined to a cell of emf ε and some internal resistance. Starting from the midpoint P of the conductor, we move in the direction of the current and return to P. The potential V at every point on the path is plotted against the distance covered (x). Which of the following best represents the resulting curve?

(A) 

(B) 

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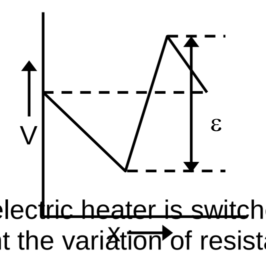
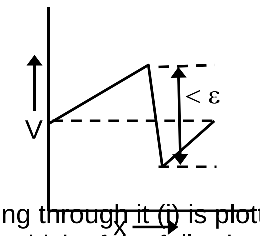
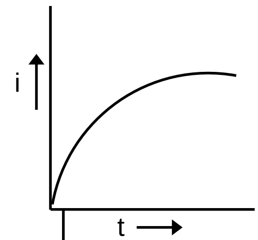
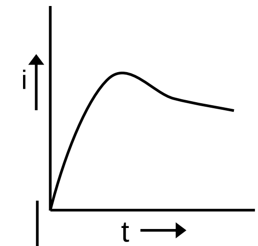
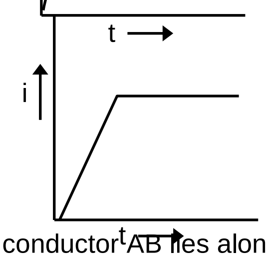
(C) 

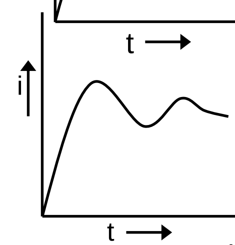
(D) 

25. When an electric heater is switched on, the current flowing through it (i) is plotted against time (t). Taking into account the variation of resistance with temperature, which of the following best represents the resulting curve?

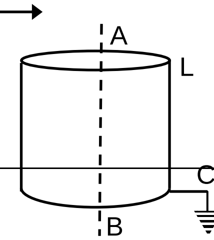
(A) 

(B) 

(C) 

(D) 

26. A straight conductor AB lies along the axis of a hollow metal cylinder L, which is connected to earth through a conductor C. A quantity of charge will flow through C



space for rough work

(A) if a current begins to flow through AB
(B) if the current through AB is reversed
(C) if AB is removed, and a beam of photons flows in its place
(D) if AB is removed, and a beam of protons flows in its place

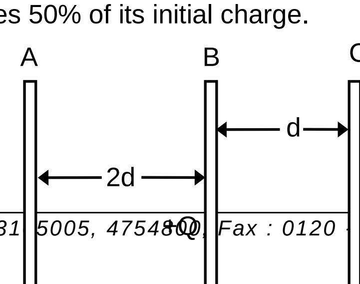
27. A parallel-plate capacitor, filled with a dielectric of dielectric constant k, is charged to a potential V_0. It is now disconnected from the cell and the slab is removed. If it now discharges, with time constant τ, through a resistance, the potential difference across it will be V_0 after time

(A) $k\tau$ (B) $\tau \ln k$ (C) $\tau \ln\left(1-\frac{1}{k}\right)$ (D) $\tau \ln(k-1)$

28. Capacitors $C_1 = 1\,\mu F$ and $C_2 = 2\,\mu F$ are separately charged from the same battery. They are then allowed to discharge separately through equal resistors. Which of the following is incorrect

(A) The currents in the two discharging circuits at t = 0 is zero
(B) The currents in the two discharging circuits at t = 0 are equal but not zero.
(C) The initial rate of heat generation in the two discharging circuits at t = 0 are equal.
(D) C_1 loses 50% of its initial charge sooner than C_2 loses 50% of its initial charge.

29. Three identical, parallel conducting plates A, B and C are placed as shown. Switches S_1 and S_2 are open, and can connect A and C to earth when closed. +Q charge is given to B



(A) If S_1 is closed with S_2 open, a charge of amount 2Q will pass through S_1.
(B) If S_2 is closed with S_1 open, a charge of amount $Q/2$ will pass through S_2
(C) If S_1 and S_2 are closed together, a charge of amount Q/3 will pass through S_1, and a charge of amount 2Q/3 will pass through S_2.
(D) All the above statements are incorrect.

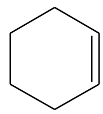
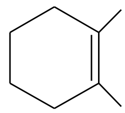
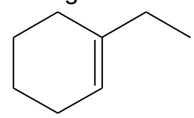
space for rough work

30. A conducting sphere of radius R, carrying charge Q, lies inside an uncharged conducting shell of radius 2R. If they are joined by a metal wire,
(A) Q/3 amount of charge will flow from the sphere to the shell
(B) 2Q/3 amount of charge will flow from the sphere to the shell
(C) $Q/2$ amount of charge will flow from the sphere to the shell
(D) $k\frac{Q^2}{4R}$ amount of heat will be produced

space for rough work

Section – II (Chemistry)

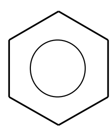
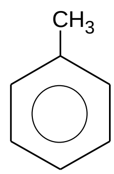
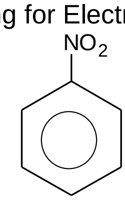
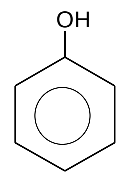
1. Arrange the following in increasing order of stability

(I) (II) (III)

(A) I < II < III (B) II < I < III
(C) I < III < II (D) II < III < I

2. Increasing order of the following for Electrophilic substitution reaction is

(I) (II) (III) (IV)

(A) IV < III < II < I (B) IV < III < I < II
(C) III < I < II < IV (D) III > I > II > IV

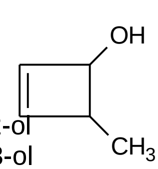
3. Normal butane converts into isobutene by
(A) $LiAlH_4$ (+little ether) (B) $AlCl_3$ (+little moisture)
(C) $NaBH_4$ (+little ethanol) (D) Zn/HCl(+little Hg)

4. What is the relative reactivity of 1° and 2° H in the propane for bromination?
(A) 3.52 & 96.47 (B) 97 & 3
(C) 1.5 & 485 (D) None of these

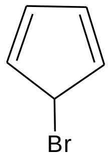
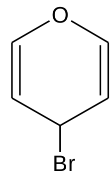
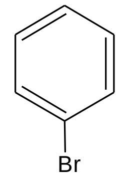
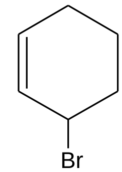
space for rough work

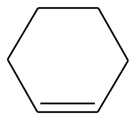
5. H_3BO_3 is
(A) Mono basic and weak Lewis acid (B) Mono basic and weak Bronsted acid
(C) Mono basic acid and strong Lewis acid (D) Tri basic acid and weak Bronsted acid

6. Phenol and ethanol are distinguished by the reaction with
(A) Red litmus (B) $NaHCO_3$
(C) $FeCl_3$ (D) NaOH

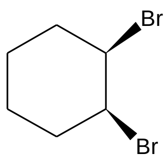
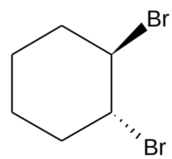
7. What is the IUPAC name of  ?
(A) 3-Methylcyclo-1-butene-2-ol (B) 4-Methylcyclo-2-butene-1-ol
(C) 4-Methylcyclo-1-butene-3-ol (D) 2-Methylcyclo-3-butene-1-ol

8. Ease of ionization to produce carbocation and Br^- will be maximum in which of the following compounds?

(A)  (B)  (C)  (D) 

9.  + $Br_2 \longrightarrow A$

A will have configuration

(A)  (B)  (C) Both true (D) None is true

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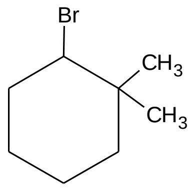
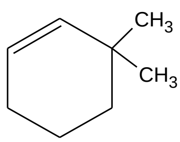
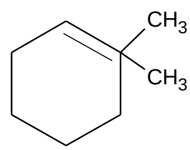
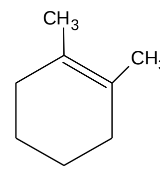
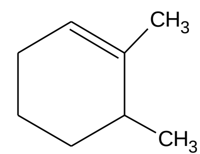
10.  $\xrightarrow{\text{alcKOH}}$ Product.

The product can be

(A)  (B)  (C)  (D) 

11. $CH_3CH = CH_2 \xrightarrow[H_2O_2/OH^-]{B_2D_6} \text{Product X. X is}$

(A) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_2D$

(B) $CH_3-\underset{\underset{D}{|}}{CH}-CH_2OH$

(C) $CH_3-\underset{\underset{OD}{|}}{CH}-CH_3$

(D) none is correct

12 The addition of Br_2 to trans-2-butene produces

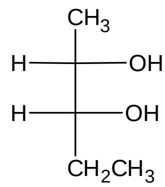
(A) (+) 2, 3-dibromobutane
(B) (–) 2, 3-dibromobutane
(C) rac–2, 3–dibromobutane
(D) meso–2, 3–dibromobutane

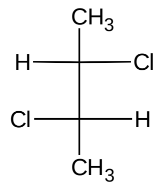
13. Name the type of structure of silicate in which one oxygen atom is shared between two $[SiO_4]^{4-}$ units

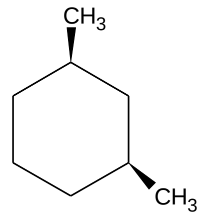
(A) Linear chain silicate
(B) Pyrosilicate
(C) Sheet silicate
(D) None of these

space for rough work

14. Which of the following compound are meso forms?

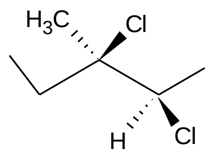

1

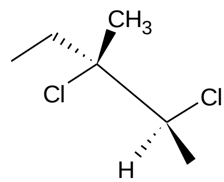

2


3

(A) 1 and 3 (B) 3 only (C) 1 and 2 (D) 2 and 3

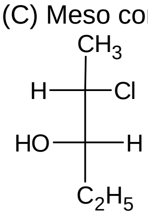
15. How are the following compounds related?





(A) Diastereomers (B) Enantiomers
(C) Meso compounds (D) Identical

16.

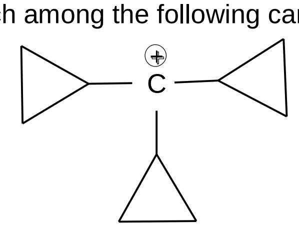


The compound with the above configuration is called
(A) (2S, 3S)-2-chloro-3-hydroxypentane (B) (2S, 3R)-2-chloro-3-hydroxypentane
(C) (2R, 3R)-2-chloro-3-hydroxypentane (D) (2R, 3S)-2-chloro-3-hydroxypentane

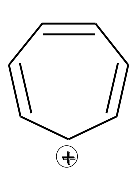
17. What product would be formed from the S_N2 reaction of (R)-2-bromobutane and hydroxide ion?
(A) 2-butanol (B) (S)-2-butanol
(C) (R)-3-hexanol (D) 3-pentanol

space for rough work

18. Which among the following carbocations is most stable?

(A) 

(B) $C_6H_5-\overset{\oplus}{C}H_2$

(C) 

(D) $CH_3-\overset{\oplus}{C}H-CH_3$

19. $R-\overset{\overset{\displaystyle O}{\|}}{C}-OH + C_2H_5\overset{18}{O}H \xrightarrow{H^+} X$

X would be

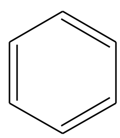
(A) $R-\overset{\overset{\displaystyle O}{\|}}{C}-OC_2H_5$

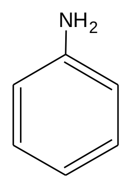
(B) $R-\overset{\overset{\displaystyle O^{18}}{\|}}{C}-O-C_2H_5$

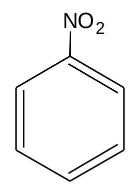
(C) $R-\overset{\overset{\displaystyle O}{\|}}{C}-\overset{18}{O}C_2H_5$

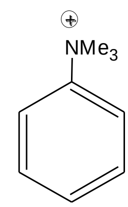
(D) none

20. Which of the following gives Friedel Craft's reaction?

(A) 

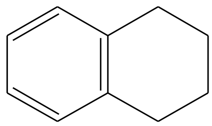
(B) 

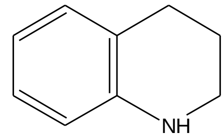
(C) 

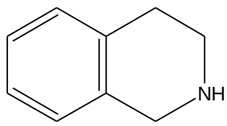
(D) 

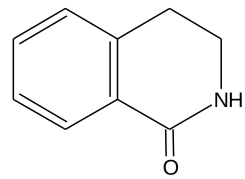
21. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate?

space for rough work

(A) 

(B) 

(C) 

(D) 

22 What product will be obtained when 2-methyl-2-phenyl propane is subjected to oxidation by MnO_4^-/H^+ followed by decarboxylation by $NaOH/CaO/Heat$?

(A) Benzene (B) Propane (C) Isobutane (D) Methane

23. Friedel-craft's alkylation proceeds through the intermediate formation of

(A) Alkyl anion (B) Alkyl free radical
(C) Alkyl cation (D) Alkene

24. An enantiomerically pure acid is treated with racemic mixture of an alcohol having one chiral carbon. The ester formed will be

(A) Optically active mixture (B) Pure enantiomer
(C) Meso compound (D) Racemic mixture

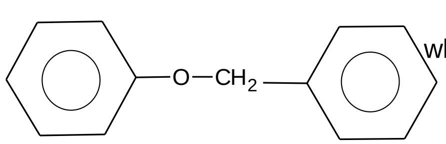
25. The optically active tartaric acid is named as D-(+)-tartaric acid because it has a positive

(A) Optical rotation and is derived from D-glucose
(B) pH in organic solvent
(C) Optical rotation and is derived from D-(+)-glyceraldehyde
(D) Optical rotation only when substituted by deuterium

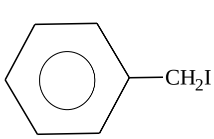
26. Which of the following compounds will exhibit geometrical isomerism?

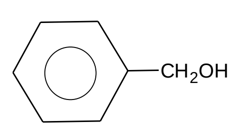
(A) 1-Phenyl-2-butene (B) 3-Phenyl-1-butene
(C) 2-Phenyl-1-butene (D) 1, 1-Diphenyl-1-propene

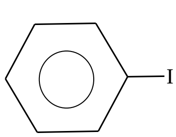
space for rough work

27. The ether 

when treated with HI produces

(A) 

(B) 

(C) 

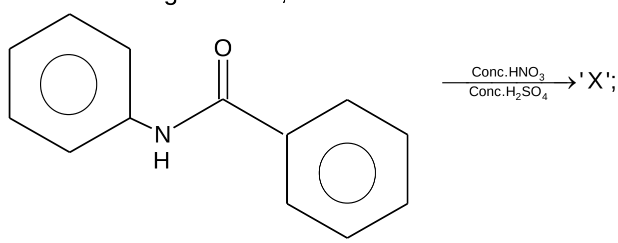
(D) All of these

28. Which of the following carboxylic acids undergoes decarboxylation easily?

(A) $C_6H_5—CO—CH_2—COOH$ (B) $C_6H_5—CO—COOH$

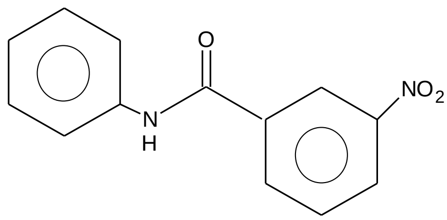
(C) $C_6H_5-\underset{\displaystyle OH}{\underset{|}{CH}}-COOH$ (D) $C_6H_5-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$

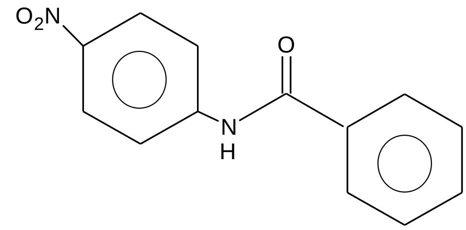
29. In the following reaction,

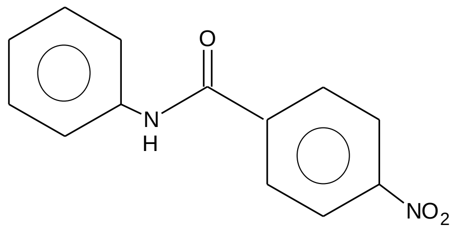


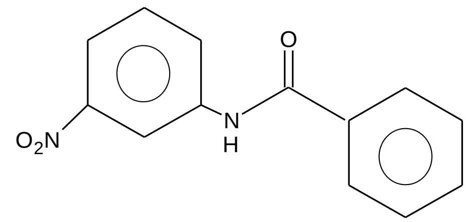
The structure of major product 'X' is

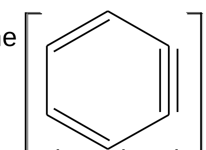
space for rough work

(A) 

(B) 

(C) 

(D) 

30. In benzyne  intermediate, the triple bond consists of:

(A) one sp-sp sigma bond and two p-p pi-bonds
(B) one sp^2-sp^2 sigma bond and two p-p pi-bonds
(C) two sp-sp sigma bonds and one p-p pi-bond
(D) one sp^2-sp^2 sigma bond, one sp^2-sp^2 pi-bond and one p-p pi-bond

space for rough work

Section – III (Mathematics)

1. Let $y = 3x - 8$ be the equation of tangent at the point. (7, 13) lying on a parabola, whose focus is at point. (–1, 1). If the latus rectum of the parabola is ℓ then the value of $\left[\ell^2\right]$, (where $[\cdot]$ denotes greatest integer function) is
   (A) 4 (B) 5 (C) 6 (D) None of these
2. A circle with radius 'a' and centre on y-axis slides along y-axis and a variable line through (a, 0) cuts the circle at points P and Q. Then the point of intersection of tangents to the circle at P and Q will lie in the region defined by
   (A) $y^2 \ge 4a(x-a)$ (B) $y^2 \le 4ax$
   (C) $x^2 + y^2 \le 4a^2$ (D) $x^2 - y^2 \ge a^2$
3. If $3x + 4y + k = 0$ represents the equation of the tangent at the vertex of the parabola $16x^2 - 24xy + 9y^2 + 14x + 2y + 7 = 0,$ then the value of k is
   (A) 1 (B) 2 (C) 3 (D) 4
4. Let AB be the chord of contact of the point (5, –5) w.r t the circle $x^2 + y^2 = 5,$ then the locus of the orthocentre of the $\Delta PAB,$ where P is any point moving on the circle is
   (A) $(x-1)^2 + (y+1)^2 = 5$ (B) $(x-1)^2 + (y+1)^2 = \frac{5}{2}$
   (C) $(x+1)^2 + (y-1)^2 = 5$ (D) $(x+1)^2 + (y-1)^2 = \frac{5}{2}$
5. If a tangent of slope 2 of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is a normal to the circle $x^2 + y^2 + 4x + 1 = 0$ then the maximum value of ab is
   (A) 4 (B) 2 (C) 1 (D) None of these

space for rough work

6. A variable line $ax+by+c=0$, where a, b, c are in A.P is normal to a circle $(x-\alpha)^2+(y-\beta)^2=\gamma$, which is orthogonal to circle $x^2+y^2-4x-4y-1=0$. The value of $\alpha+\beta+\gamma$ is

(A) 3 (B) 5 (C) 10 (D) 7

7. Equation of the circle passing through the intersection of ellipses $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and $\frac{x^2}{b^2}+\frac{y^2}{a^2}=1$ is

(A) $x^2+y^2=a^2$
(B) $x^2+y^2=b^2$
(C) $x^2+y^2=\frac{a^2b^2}{a^2+b^2}$
(D) $x^2+y^2=\frac{2a^2b^2}{a^2+b^2}$

8. If p, q, r, a, b, c are in G.P, then the points (p, a) (q, b), (r, c) line on

(A) a parabola
(B) an ellipse
(C) on a circle
(D) on a line

9. If a focal chord of the parabola $y^2=px$ is $2x-y-8=0$, then the equation of the directrix is

(A) $x+4=0$
(B) $x-4=0$
(C) $y-4=0$
(D) $y+4=0$

10. The equation of latus rectum of the rectangular hyperbola $xy=c^2$ is

(A) $x-y=\sqrt{2}c$
(B) $x+y=2\sqrt{2}c$
(C) $x+y=\sqrt{2}c$
(D) $x+y=0$

11. Consider the parabola $x^2+4x-2y+6=0$. If its chord AB $2mx-2y+(4m+3)=0$ intersect its axis at K and directrix at M, then AM, KM and BM are in

(A) A.P (B) G.P (C) H.P (D) None of these

12. If e_1 and e_2 are the roots of the equation $x^2-ax+2=0$, where e_1 and e_2 are the eccentricities of an ellipse and hyperbola respectively then the value 'a' belongs to

(A) $(3,\infty)$ (B) $(2,\infty)$ (C) $(1,\infty)$ (D) $(-\infty,1)\cup(1,2)$

space for rough work

13. At a point (1, 1) on ellipse equation of tangent is $y = x$. If one of the foci of ellipse is (0, –2) and the co-ordinates of centre of ellipse are (α, β), then the value of $\alpha + \beta$ is (given that length of major axis of ellipse is $4\sqrt{10}$ units)

(A) 4 (B) 5 (C) 6 (D) 7

14. The co-ordinates of focus of a parabola which touches $x = 0$, $y = 0$, $x + y = 1$ and $y = x - 2$ are

(A) $\left(\frac{3}{5}, \frac{9}{5}\right)$ (B) $\left(\frac{6}{5}, \frac{2}{5}\right)$ (C) $\left(\frac{1}{3}, 1\right)$ (D) None of these

15. A right angle triangle ABC right angled at A is inscribed in hyperbola $xy = c^2$ ($c > 0$) such that slope of BC is 2. If distance of point A from the centre of hyperbola $xy = c^2$ is $\sqrt{10}$ then value of 'c' is

(A) 3 (B) 1 (C) 4 (D) 2

16. If $2p^2 - 3q^2 + 4pq - p = 0$ and a variable line $px + qy = 1$ always touches a parabola whose axis is parallel to x-axis. Then the equation of the parabola is

(A) $(y-4)^2 = 24(x-2)$ (B) $(y-3)^2 = 12(x-1)$

(C) $(y-4)^2 = 12(x-2)$ (D) $(y-2)^2 = 24(x-4)^2$

17. An ellipse of major and minor axes of length $\sqrt{3}$ and 1 respectively, slides along the co-ordinate axes and always remains confined in the first quadrant. The locus of the centre of the ellipse will be arc of a circle. The length of the arc is

(A) π (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{6}$

18. AD, BE and CF are the medians of triangle ABC whose centroid is G. If the points A, F, G and E are concyclic then

(A) $2b^2 = a^2 + c^2$ (B) $2a^2 = b^2 + c^2$

(C) $2c^2 = a^2 + b^2$ (D) $2b^2 = 2a^2 + c^2$

space for rough work

19. From a point P on the circle $x^2 + y^2 - 100x - 200y + 12300 = 0$, pair of tangents PA and PB are drawn on the circle $x^2 + y^2 - 100x - 200y + 12400 = 0$, then the locus of centre of circumcircle of triangle PAB is

(A) straight line (B) parabola

(C) ellipse (D) circle

20. A circle of radius 'r' touches the parabola $y^2 + 4x = 0$ at the vertex of the parabola. The centre of the circle lies to the left of the vertex and this circle lies completely within the parabola, then exhaustive range of 'r' is

(A) $\left(1, \frac{5}{2}\right)$ (B) $(0, 2]$

(C) $\left(\frac{5}{2}, 3\right)$ (D) $[2, \infty)$

21. The area enclosed by $\left[\frac{|3x+4y|}{5}\right] + \left[\frac{|4x-3y|}{5}\right] = 3$ is (where $[\cdot]$ denotes the greatest integer function)

(A) 2 (B) 4 (C) 8 (D) 16

22. Let R be the region containing the point (x, y) on the X-Y plane, satisfying $2 \le |x+3y| + |x-y| \le 4$ then the area of region R is

(A) 2 square units (B) 4 square units
(C) 6 square units (D) 8 square units

23. If m_1, m_2 be the roots of the equation $x^2 + (\sqrt{3}+2)x + \sqrt{3} - 1 = 0$ and the area of the triangle formed by the lines $y = m_1x$, $y = m_2x$ and y = 2 is $\sqrt{33} + \lambda$ then $\lambda = ?$

(A) 0 (B) 11 (C) 121 (D) $\sqrt{11}$

space for rough work

24. The curve represented by the differential equation x dy – y dx = ydy, intersects the y-axis at A(0, 1) and the line $y = e$ at (a, b) then the value of $(a+b)$ is

(A) 1 (B) 0 (C) 2 (D) 3

25. Family of curves which makes an angle of $\frac{\pi}{4}$ with the family of hyperbola xy = a, is (a > 0 and a is parameters)

(A) $x^2 + 2xy + y^2 = A$ (B) $y^2 + 4xy - x^2 = A$
(C) $x^2 - 2xy - y^2 = A$ (D) $x^2 + 3xy - y^2 = A$

26. If a curve is such that line joining orgin to any point P(x, y) on the curve and line parallel to y-axis through P are equally inclined to tangent at P, then the differential equation of the curve is

(A) $x\left(\frac{dy}{dx}\right)^2 - 2y\frac{dy}{dx} = x$ (B) $\left(\frac{dy}{dx}\right)^2 + 2y\frac{dy}{dx} = x$
(C) $y\left(\frac{dy}{dx}\right)^2 + 2y\frac{dy}{dx} = x$ (D) $y\left(\frac{dy}{dx}\right)^2 - 2y\frac{dy}{dx} = y$

27. The degree and order of the differential equation of the family of all parabolas whose axis is the x-axis, are respectively

(A) 1, 2 (B) 3, 2 (C) 2, 3 (D) 2, 1

28. Area bounded between the curves $y = \sqrt{4 - x^2}$ and $y^2 = 3|x|$ is/are

(A) $\frac{\pi - 1}{\sqrt{3}}$ (B) $\frac{2\pi - 1}{3\sqrt{3}}$ (C) $\frac{2\pi - 1}{\sqrt{3}}$ (D) $\frac{2\pi - \sqrt{3}}{3\sqrt{3}}$

29. Consider function $f(x) = \sqrt{4 - x^2}$, $g(x) = |x - 2|$ and $h(x) = \sqrt{x - 2}$, for $x \in R$, area of $F(x) = \min\{f(x), g(x), h(x)\}$ between the coordinates axes for x < 0 is

(A) 2π sq. units (B) π sq. units
(C) 4π sq. units (D) 8π sq. units

space for rough work

30. A curve passing through (1, 2) has its slope at any point (x, y) equal to $\frac{2}{y-2}$. Find the area of the region bounded by the curve and the line $2x-y-4=0$

(A) 12 sq. units
(B) 21 sq. units
(C) 9 sq. units
(D) none of these

space for rough work

FIITJEE - JEE (Mains)

CPA B-LOT BATCH

PHYSICS, CHEMISTRY & MATHEMATICS

JEE - MAINS 2014

PHASE – I

SET - A

ANSWERS

PHYSICS

1.	B	2.	C	3.	D	4.	B
5.	C	6.	B	7.	C	8.	C
9.	B	10.	D	11.	C	12.	A
13.	B	14.	D	15.	A	16.	D
17.	A	18.	C	19.	B	20.	C
21.	A	22.	B	23.	B	24.	B
25.	B	26.	D	27.	B	28.	A
29.	C	30.	D				

CHEMISTRY

1.	C	2.	C	3.	B	4.	A
5.	A	6.	C	7.	B	8.	B
9.	B	10.	C	11.	B	12.	D
13.	B	14.	B	15.	A	16.	A
17.	B	18.	A	19.	C	20.	A
21.	B	22.	C	23.	C	24.	A
25.	C	26.	A	27.	A	28.	A
29.	B	30.	D				

MATHEMATICS

1.	C	2.	A	3.	C	4.	A
5.	A	6.	D	7.	D	8.	D
9.	A	10.	B	11.	C	12.	A
13.	C	14.	B	15.	D	16.	C
17.	D	18.	B	19.	D	20.	B
21.	D	22.	C	23.	D	24.	B
25.	C	26.	A	27.	A	28.	D
29.	B	30.	C				

HINTS & SOLUTIONS

Physics

Chemistry

Mathematics

1. C

Sol. Image of focus (–1, 1) upon the tangent $y = 3x - 8$ is the point (5, –3) and it will lie on directrix.

Slope of directrix = $-\left(\frac{7-5}{13+3}\right) = -\frac{1}{8}$. Its equation is $y + 3 = \frac{-1}{8}(x - 5)$

$\Rightarrow x + 8y + 19 = 0$ now $\ell = 2 \times \frac{|-1-8+19|}{\sqrt{65}} = \frac{20}{\sqrt{65}}$

$= \ell^2 = \frac{400}{65} \Rightarrow \left[\ell^2\right] = 6.$

2. A

Sol. Let the circle be $x^2 + (y-\alpha)^2 = a^2$. Let the point of intersection of tangents at P and Q be (h, k).

Then equation of PQ is $hx + (k-\alpha)(y-\alpha) - a^2 = 0$. As it passes through $(a, 0)$ so $ha - \alpha(k-\alpha) - a^2 = 0$

$\Rightarrow \alpha^2 - k\alpha + a(h-a) = 0,\ D \ge 0\ k^2 - 4a(h-a) \ge 0$

i.e $y^2 \ge 4a(x-a)$.

3. C

Sol. The tangent at vertex be $3x + 4y + k = 0$. Let the axis be $4x - 3y + \lambda = 0$

Now comparing the given equation of parabola with the equation $(4x-3y+\lambda)^2=\mu(3x+4y+k)$, we get $8\lambda-3\mu=14$, $-6\lambda-4\mu=2$, $\lambda^2-k\mu=7$

Solving we get $\lambda=1, \mu=-2$ and k = 3.

4. A

Sol. The equation of AB is x–y = 1. Let the orthocenter be (h, k). Its image w.r.t AB is (k +1, h–1), which will lie on the circle $(k+1)^2+(h-1)^2=5$.

5. A

Sol. Equation of tangent is $y=2x\pm\sqrt{4a^2+b^2}$. It passes through (–2, 0)

$\Rightarrow 4a^2+b^2=16$

$\frac{4a^2+b^2}{2}\ge\sqrt{4a^2b^2}\Rightarrow ab\le 4$

6. D

Sol. $ax+by+c=0$, it always passes through (1,-2).

$\Rightarrow$ (1,-2) is centre of circle $\Rightarrow \alpha=1, \beta=-2$

$\Rightarrow (x-1)^2+(y+2)^2=\gamma \quad \Rightarrow \gamma=8 \quad \Rightarrow \alpha+\beta+\gamma=7$.

7. D

Sol. $s+\lambda s'=0 \quad \lambda=1$

8. D

Sol. The given points lie on the straight line $x=y\,k^3$, where k is the common ratio of the given G.P.

9. A

Sol. Put $\left(\frac{P}{4},0\right)$ i.e focus in the line $2x-y-8=0$

10. B

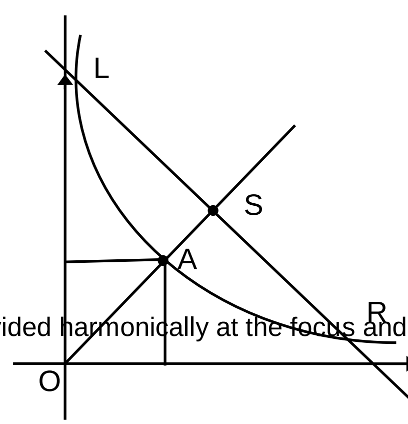
Sol. OA = c $\Rightarrow A\equiv(c,c)$

AS = e (OA)

$\Rightarrow$ AS $\sqrt{2}c$ $\therefore S=\left(\sqrt{2}c,\sqrt{2}c\right)$

$\therefore$ Equation of LR is

$\left(y-\sqrt{2}c\right)=-1\left(x-\sqrt{2}c\right)\Rightarrow x+y=2\sqrt{2}c$



11. C

Sol. K is focus of the given parabola and a focal chord is divided harmonically at the focus and the point where it meets directrix.

12. A

Sol. We must have $e_1<1<e_2$

$\Rightarrow f(1)<0 \Rightarrow a>3$.

13. C

Sol. Let $S(0,-2)$ and S' be the foci of the ellipse. The slope of $AS'=\frac{1}{3}$ and $AS'=3\sqrt{10}$, so the co-ordinates of S' will be (10, 4) and centre is midpoint of S and S'

14. B

Sol. Circle through point of intersection of 3 tangents to a parabola pass through focus. So focus is point of intersection $x(x-1)+y(y-1)=0$ and $x(x-2)+y(y+2)=0$

i.e $\left(\frac{6}{5},\frac{2}{5}\right)$

15. D

Sol. Let $A\left(ct,\frac{c}{t}\right)$. Slope of normal at A will be t^2 and normal is parallel to BC, so t^2 = 2 $\Rightarrow c=\pm 2$ but c > 0 $\Rightarrow$ c = 2.

16. C

Sol. Let the parabola be $(y-a)^2 = 4b(x-c)$

Equation of tangent is $y-a = -\frac{p}{q}(x-c) - \frac{bq}{p}$

Comparing it with $px+qy=1$, we get $cp^2 - bq^2 + apq - p = 0$

$\therefore \frac{c}{2} = \frac{b}{3} = \frac{a}{4} = 1$

$\Rightarrow$ The equation is $(y-4)^2 = 12(x-2)$

17. D

Sol. Locus of the centre is $x^2+y^2=1$. If C_1 and C_2 be the centre of ellipse in extreme positions, then $\angle C_1OC_2 = \frac{\pi}{6}$. Now $\ell = r\theta = 1.\frac{\pi}{6} = \frac{\pi}{6}$

18. B

Sol: BG. BE = BF. BA

$\Rightarrow \frac{2}{3}(BE)^2 = \frac{1}{2}c^2$

$\Rightarrow \frac{2}{3}\times\frac{1}{4}(2a^2+2c^2-b^2) = \frac{1}{2}c^2$

$\Rightarrow 2a^2 = b^2+c^2$

19. D

Sol: $\angle APB = \frac{\pi}{2}$ so circumcentre is midpoint of AB say Q. Let Q(h,k) and let C be the centre of both circle.

Now $\angle CQA = 90°$, $\angle ACQ = 45°$

Now $\frac{CQ}{CA} = \cos 45° = \frac{1}{\sqrt{2}}$

$\Rightarrow \sqrt{(h-50)^2+(k-100)^2} = \frac{10}{\sqrt{2}} \Rightarrow (h-50)^2+(k-100)^2 = 50$

$\Rightarrow (x-50)^2+(y-100)^2 = 50$, which is a circle

20. B

Sol. Equation of circle is $(x+r)^2+y^2=r^2$

solving it with $y^2+4x=0$, we get $x=0$ and $x=4-2r$, as the circle lies completely inside the parabola

$\therefore 4-2r \ge 0 \Rightarrow r \le 2$

21. D

Sol: Let $|X| = \frac{|4x-3y|}{5}$ and $|Y| = \frac{|3x+4y|}{5}$

$\Rightarrow$ Given equation is $[|X|]+[|Y|]=3$

symmetric about x-axis and y-axis.

For x, y ≥ 0 area = 4 square units

$\Rightarrow$ Total area = $4\times4=16$ sq. units

22. C

Sol: The region is enclosed between two parallelograms of areas 4×2 and 2×1. So area = 8 – 2 = 6 square units.

23. D

Sol: Vertices of the triangle are $(0,0),\left(\frac{2}{m_1}, 2\right)\left(\frac{2}{m_2}, 2\right)$.

Area = $2\left|\frac{m_1-m_2}{m_1m_2}\right| \Rightarrow \lambda = \sqrt{11}$

24. B

25. C

Sol: Slope of tangent of hyperbola $xy = a$ at point (x, y) is $\frac{dy}{dx} = -\frac{y}{x}$. Let the slope of tangents of curves which makes an angle of $\frac{\pi}{4}$ be $\frac{dy}{dx}$, now $\frac{\frac{dy}{dx}+\frac{y}{x}}{1-\frac{y}{x}\frac{dy}{dx}} = \pm 1 \Rightarrow \frac{dy}{dx} = \frac{1-\frac{y}{x}}{1+\frac{y}{x}}$ or $\frac{dy}{dx} = \frac{-1-\frac{y}{x}}{1-\frac{y}{x}}$

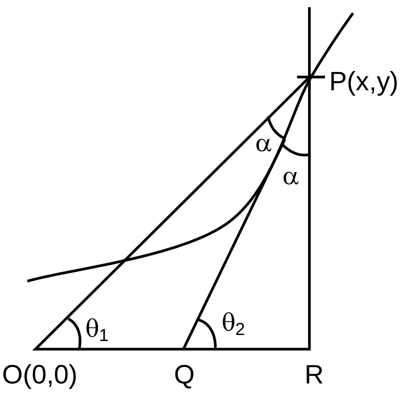
26. A

Sol. $\theta_1 + \alpha = \theta_2,\ \theta_1 + 2\alpha = \frac{\pi}{2}$

$\theta_1 + 2\left(\theta_2 - \theta_1\right) = \frac{\pi}{2} \Rightarrow 2\theta_2 - \theta_1 = \frac{\pi}{2}$

$\frac{2\tan\left(\theta_2\right)}{1-\left(\tan\left(\theta_2\right)\right)^2} = -\frac{1}{\tan\theta_1}$

$\Rightarrow\ 2y\frac{dy}{dx} = x\left(\frac{dy}{dx}\right)^2 - x$



27. A

Sol: The equation of the family is $y^2 = 4a\left(x-b\right)$, where a, b are arbitrary constants

$\therefore 2y\frac{dy}{dx} = 4a$ or $\left(\frac{dy}{dx}\right)^2 + y\frac{d^2y}{dx^2} = 0$

So degree is one order is two

28. D

Sol: Required area = $2\int_0^1\left(\sqrt{4-x^2} - \sqrt{3}x\right)dx$

$= 2\left(\frac{x}{2}\sqrt{4-x^2} + \frac{4}{2}\sin^{-1}\left(\frac{x}{2}\right) - \frac{\sqrt{3}.2x^{1/2}}{3}\right)_0^1$

$= \frac{2\pi - \sqrt{3}}{3\sqrt{3}}$.

29 B

Sol: Area = $\frac{\pi r^2}{4} = \pi$

30. C Sol: $\frac{dy}{dx} = \frac{y}{y-2}\ \Rightarrow y^2 = 4\left(x+y\right) - 8$

$\therefore$ Required area is 21 – 12 = 9 sq. units

FIITJEE

PHYSICS, CHEMISTRY & MATHEMATICS

CPT2 - 1 **CODE: SET-A** **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 240**

C01

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into two sections: **Section-A & Section-C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 07)** contains 7 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (08 – 11) contains 4 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

Section-A (12 – 16) contains 2 paragraphs. Based upon paragraph, 2 and 3 multiple choice questions have to be answered. Each question has only one correct answer and carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

(ii) **Section-C (01 – 07)** contains 7 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer. There is no negative marking.

Name of the Candidate :____

Batch :____________________ **Date of Examination :**___________________

Enrolment Number :____

PART – I : PHYSICS

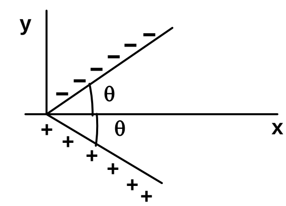
SECTION – A

(Single Correct Choice Type)

This section contains **7 multiple choice questions.** Each question has four choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. A constant voltage is applied between the two ends of a uniform metallic wire. Some heat is produced in it. The heat developed is doubled if:
(A) Both the length and radius of the wire are halved.
(B) Both the length and radius of the wire are doubled.
(C) The radius of the wire is doubled.
(D) The length of the wire is doubled and the radius of the wire is halved.

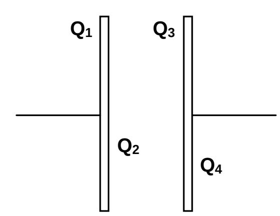
2. The given diagram shows two infinite line of charges having equal (in magnitude) linear charge density but with opposite sign. The electric field at any point on x axis for (x > 0) is along the unit vector



(A) $\cos\theta\hat{i} + \sin\theta\hat{j}$ (B) $\hat{j}$
(C) $\hat{j}$ (D) $-\sin\theta\hat{i} + \sin\theta\hat{j}$

3. Three identical particles of charges Q and mass m are placed such that they form an equilateral triangle of side ℓ. If they are released simultaneously. Their maximum speed attained by any one of the particles will be
(A) $Q\sqrt{\frac{1}{2\pi\varepsilon_0 m\ell}}$ (B) $Q\sqrt{\frac{1}{6\pi\varepsilon_0 m\ell}}$ (C) Zero (D) none of these

4. In an isolated parallel – plate capacitor of capacitance C, the four surfaces carry net charge Q_1, Q_2, Q_3 and Q_4, as shown. The potential difference between the plates is



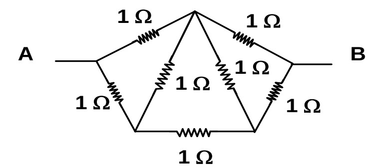
(A) $\frac{Q_1 + Q_2 - Q_3 - Q_4}{2C}$ (B) $\frac{Q_2 + Q_3}{2C}$
(C) $\frac{Q_2 - Q_3}{2C}$ (D) $\frac{Q_1 + Q_3}{2C}$

5. A wire of length ℓ and resistance R is bend in form of ring the resistance between two points which is separated by angle θ
(A) $\frac{R}{4\pi^2}(2\pi - \theta)\theta$ (B) $\frac{R\ell}{4\pi^2}(2\pi - \theta)\theta$ (C) $R(2\pi - \theta)$ (D) $R\,\theta$

Space For Rough Work

6. A point charge q = 50 μC is located in the x-y plane at the point $\vec{r}_0 = (2\hat{i} + 3\hat{j})$ m. What is the electric field at the point of position vector $\vec{r} = (8\hat{i} - 5\hat{j})$m
(A) 1200 v/ m (B) 4×10^{-2} v/m (C) 900 v/m (D) 4500 v/m

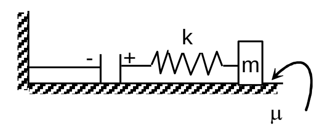
7. Find effective resistance between A and B.



(A) 2 Ω (B) 1 Ω
(C) $\frac{8}{7}\Omega$ (D) $\frac{6}{5}\Omega$

(Multiple Correct Answers Type)
This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D), out of which **ONE or MORE** may be correct

8. A spring of spring constant k connects a capacitor of the plate area A and surface charge density σ and a block of mass m. There is no friction force between the capacitor plate and surface. The coefficient of friction between the block and surface is μ. Initially, the separation between the plates is $\frac{\sigma^2 A}{k\varepsilon_0}$ and spring is unstretched. m and μ are such that very large amount of force is required to displace m. Which of following are true? Consider the final separation as separation on equilibrium.



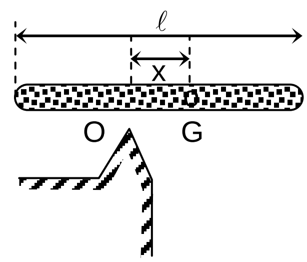
(A) The final capacitance is $\frac{2k\varepsilon_0^2}{\sigma^2}$
(B) The final separation between the plates of capacitor = $\frac{\sigma^2 A}{2k\varepsilon_0}$
(C) The final capacitance is $\frac{k\varepsilon_0^2}{\sigma}$
(D) The frictional force on the block $\le \mu$mg.

9. Two conducting spheres of radii r and 2r are placed at very large separation. Each sphere possesses charge Q. These spheres are connected with a conducting wire of resistance R. Then, which of the following is true?
(A) Initial current is $\frac{Q}{8\pi\varepsilon_0 rR}$
(B) Initial current is $\frac{Q}{4\pi\varepsilon_0 rR}$
(C) Current reduces to half the initial current after time $8\pi\varepsilon_0 rR\ln2$
(D) Current reduces to half the initial current after time $\frac{8\pi\varepsilon_0 rR\ln 2}{3}$

Space For Rough Work

10. In a region of space, the electric field $\vec{E} = E_0 x\hat{i} + E_0\hat{j}$. Consider an imaginary cubical volume of edge 'a' with its edges parallel to the axes of coordinates. Now,
(A) The total electric flux through the face 1 and 3 is E_0a^3
(B) The charge inside the cubical volume is $2\varepsilon_0E_0a^3$
(C) The total electric flux through the faces 2 and 4 is $2E_0a^3$
(D) The charge inside the cubical volume is $\varepsilon_0E_0a^3$

11. In the adjacent figure a uniform rod of length ℓ and mass is kept at rest in horizontal position on an elevated edge. The value of x (consider the figure) is such that the rod will have maximum angular acceleration α, as soon as it is set free.



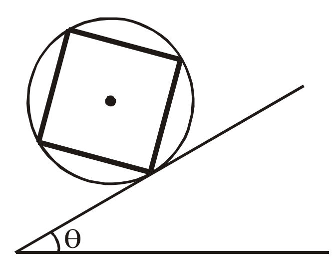
(A) x is equal to $\frac{\ell}{2\sqrt{3}}$ (B) α is equal to $\frac{g\sqrt{3}}{2\ell}$
(C) α is equal to $\frac{g\sqrt{3}}{\ell}$ (D) x is equal to $\frac{\ell}{\sqrt{3}}$

Comprehension Type

This section contains **2 paragraphs.** Based upon one of the paragraphs **2 multiple choice questions** and based on the other paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), B), C) and (D) out of WHICH **ONLY ONE** is correct.

$P_{12\text{-}13}$ ***Paragraph for question 12 to 13***

Four identical rods of mass M = 6 kg each are welded at their ends to form a square and then welded to a massive ring having mass m = 4 kg having radius R = 1m. If the system is allowed to roll down the incline of inclination $\theta = 30^o$.



12. The moment of inertia of the system about an axis perpendicular to the ring and passing through the centre of ring will be
(A) 20 kg m^2 (B) 40 kg m^2 (C) 10 kg m^2 (D) 60 kg m^2

13. The minimum value of friction coefficient to prevent slipping is
(A) $\frac{5}{7}$ (B) $\frac{5}{12\sqrt{3}}$ (C) $\frac{5\sqrt{3}}{7}$ (D) $\frac{7}{5\sqrt{3}}$

Space For Rough Work

$P_{14\text{-}16}$ *Paragraph for question 14 to 16*

COMBINATION OF CELLS :
IF N CELL ARE IN SERIES THEN CURRENT

$$I = \frac{nE}{nr + R}.$$

IF THE EXTERNAL RESISTANCE R IS VERY SMALL AS COMPARED TO THE TOTAL INTERNAL RESISTANCE NR, THEN

$I = \frac{nE}{nr} = \frac{E}{r}$. **ON THE OTHER HAND, IF THE INTERNAL RESISTANCE NR IS VERY SMALL AS COMPARED TO THE EXTERNAL RESISTANCE R, THEN**

$$I = \frac{nE}{R} = n \times \frac{E}{r}$$

SO THE CURRENT IN THE CIRCUIT IS N TIMES THE CURRENT DUE TO A SINGLE CELL.
IF N CELLS ARE IN PARALLEL THEN CURRENT

$$I = \frac{E}{R + \frac{r}{n}} \text{ or } I = \frac{nE}{nR + r}$$

IF R>>$\frac{r}{n}$**, THEN** $\frac{r}{n}$ **CAN BE NEGLECTED IN COMPARISON TO IN THIS CASE,**

$$I = \frac{E}{R}$$

ON THE OTHER HAND, IF R << R/N, THEN $I = \frac{nE}{R} = n \times \frac{E}{r}$. **IN THIS CASE, THE TOTAL CURRENT IS N TIMES THE CURRENT PRODUCED BY A SINGLE CELL.**
IF N CELLS ARE CONNECTED IN SERIES AND THERE ARE M ROWS OF SUCH COMBINATION. THEN

$$I = \frac{nE}{R + \frac{nr}{m}} \text{ or } I = \frac{mnE}{mR + nr}$$

CLEARLY, FOR MAXIMUM VALUE OF I, MR + NR SHOULD BE MINIMUM I.E., MR SHOULD BE EQUAL TO NR.

$$\therefore \quad R = \frac{nr}{m}$$

NOTE 1.

PUTTING $R = \frac{nr}{m}$ **IN THE EQUATION** $I = \frac{nE}{R + \frac{nr}{m}}$**, WE GET MAXIMUM VALUE OF CURRENT.**

$$I = \frac{mE}{2r}$$

NOTE 2.

$$I = \frac{nE}{R + \frac{nr}{m}} = \frac{nE}{R + R} = \frac{nE}{2R}$$ **(MAXIMUM VALUE OF CURRENT)**

NOTE 3.

$$\frac{m}{n} = \frac{r}{R}$$

IN WORDS $\dfrac{\text{Number of rows}}{\text{Number of cells in each row}} = \dfrac{\text{Inernal resistance of one cell}}{\text{External resistance}}$

14. A cell supplies a current of 0.9 A through a 2Ω resistor and a current of 0.3 A through a 7Ω resistor. The internal resistance of the cell is
(A) 2.0 Ω (B) 1.2 Ω (C) 1.0 Ω (D) 0.5 Ω

15. Six 1.1 V cells with internal resistance 3.0 Ω each are connected in three parallel branches of two cells each. If the resistance of external circuit is 2.0 Ω, then the current is
(A) 0.33 A (B) 0.44 A (C) 0.55 A (D) 0.66 A

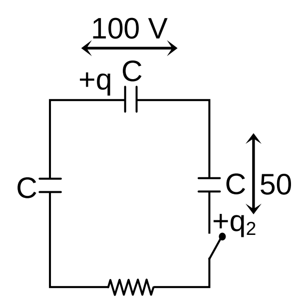
16. A cell of emf E and internal resistance r is connected in series with an external resistance nr. The ratio of the terminal potential difference to emf is
(A) $\frac{1}{n}$ (B) $\frac{1}{n+1}$ (C) $\frac{n}{n+1}$ (D) $\frac{n+1}{n}$

SECTION – C
(Integer Answer Type)

This Section contains **7 questions.** The answer to each question is a **single-digit integer,** ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

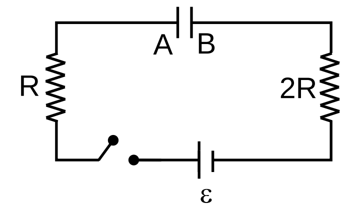
1. When two identical batteries of internal resistance 1Ω each are connected in series across a resistor R, the rate of heat produced in R is J_1. When the same batteries are connected in parallel across R, the rate is J_2. If $J_1 = 2.25\ J_2$ then the value of R in Ω is

2. Two capacitor each of capacitance C = 1 μF each charged to potential 100 V and 50 V respectively and connected across a uncharged capacitor 'C' = 1μF as shown in the figure if switch 'S' is closed then charge in the uncharged capacitor at equilibrium is $\frac{50}{K}\mu C$, then find the value of K.



Space For Rough Work

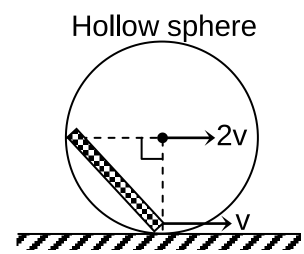
3. The figure shows a RC circuit with a parallel plate capacitor. Before switching on the circuit, plate A of the capacitor was given a charge – $C\varepsilon$ and while plate B has charge $C\varepsilon$. Now, at t=0, the circuit is switched on. How much heat (in μJ) is dissipated through resistance R till steady state is reached. If ε=1 V and C=12μF



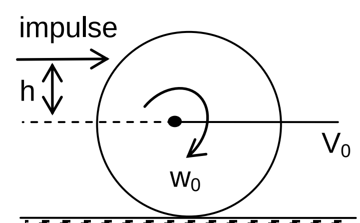
4. A milliammeter of range 10 mA has a coil of resistance 1Ω. To use it as an ammeter of range 0.1 A, the required shunt must have a resistance S. Then $\frac{1}{S} =$

5. The electric field strength depends only on the x and y coordinates according to the law $E = \frac{5(x\hat{i}+y\hat{j})}{x^2+y^2}$, where a is a constant. $\hat{i}$ and $\hat{j}$ are unit vectors of the x and y axis. Find the potential difference between x = 1 to x = 4, when moving on x-axis rounded off to the nearest integer in volts?

6. A uniform rod AB of mass M and length $\sqrt{2}R$ is moving in a vertical plane inside a hollow sphere of radius R. The sphere is rolling on a fixed horizontal surface without slipping with velocity of its centre of mass 2v. When the end B is at the lowest position, its speed is found to be v as shown in the figure. If the kinetic energy of the rod at this instant is $\frac{4}{K}Mv^2$. Find K.



7. A sphere is given a sharp impulse as a consequence, it starts moving with linear velocity V_0 and angular velocity $\frac{3V_0}{2R}$. The velocity of C.M. of the sphere which it starts pure rolling is given by $\left(\frac{n+1}{n}\right)V_0$. Find n.



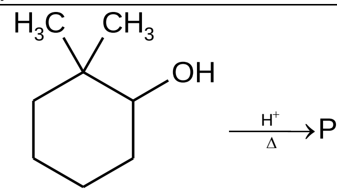
Space For Rough Work

PART–II: CHEMISTRY

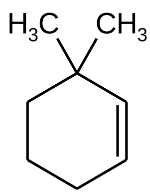
SECTION–A

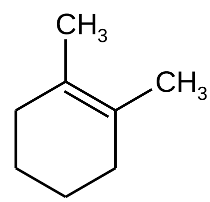
Single Correct Choice Type

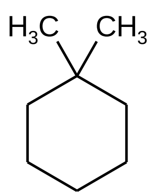
This section contains 7 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is

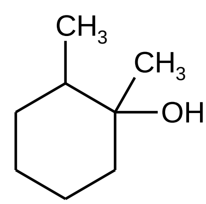
1. 

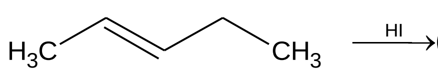
The product P is

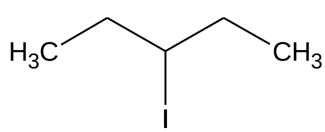
(A) 

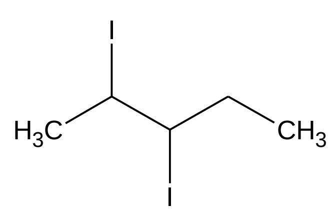
(B) 

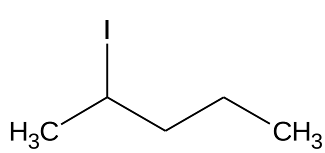
(C) 

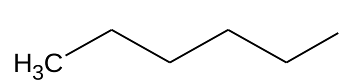
(D) 

2. (A). (A) is

(A) 

(B) 

(C) 

(D) 

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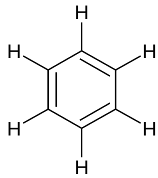
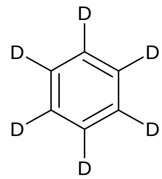
3. Which is true about the rate of nitration of the following compounds?

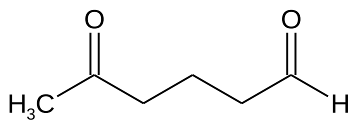


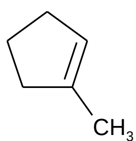
(I)

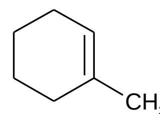


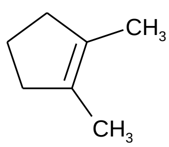
(II)

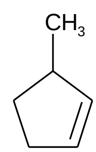
(A) I is faster than II
(B) II is faster than I
(C) They follow the same rate
(D) cannot be determined

4. (A) $\xrightarrow[H_2O]{O_3 / Zn}$  . (A) is

(A) 

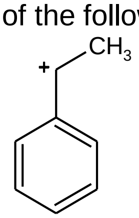
(B) 

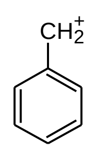
(C) 

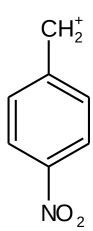
(D) 

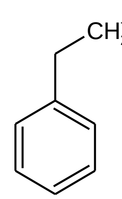
5. $B(OH)_3 + NaOH \rightleftharpoons Na[B(OH)_4]$
How can this reaction be made to proceed in forward direction?
(A) addition of cis ethane-1, 2-diol
(B)addition of borax
(C) addition of Trans ethane –1, 2-diol
(D) addition of Na_2HPO_4

6. Which of the following carbocation is most stable?

(A) 

(B) 

(C) 

(D) 

Space for rough work

7. In the reaction sequence

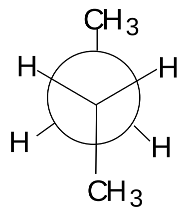
$$CH_3-\underset{\substack{|\\CH_3}}{CH}=CH_2 \xrightarrow[\text{(ii) } CH_3COOH]{\text{(i) } BH_3} [x] \text{ will be}$$

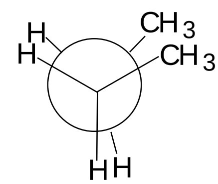
(A) 2-methl propane (B) 2- methyl propanone
(C) 2- methyl -2- propanol (D) 2- methyl propanal

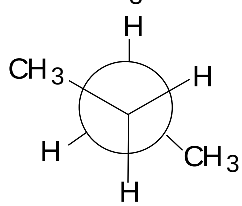
Multiple Correct Answers Type

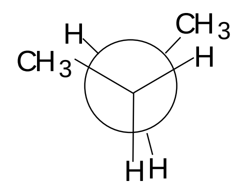
This section contains 4 multiple correct answer(s) type questions. Each question has 4 choices (A), (B), (C) and (D),

8. Which of the following(s) not represent staggered conformations of n–butane?

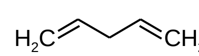
(A) 

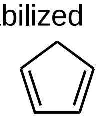
(B) 

(C) 

(D) 

9. Which of the following is(are) activating groups in EAS
(A) –OH (B) $-NH_2$ (C) –OR (D) $-CH_3$

10. In which of the following hydrocarbons, conjugate base is resonance stabilized
(A) $H_2C=CH_2$ (B) $HC\equiv CH$ (C) 

(D) 

11. When an inorganic compound (X) having 3C–2e as well as 2C–2e bonds reacts with ammonia gas at certain temperature, gives a compound Y, isostructural with benzene. Compound (X) with ammonia at a high temperature produces a substance (Z).
(A) X is B_2H_6 (B) (Z) is known as inorganic Graphite
(C) (Y) is $B_3N_3H_6$ (D) (Y) is called inorganic benzene

Space for rough work

Comprehension Type

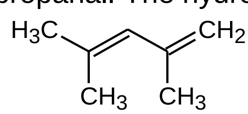
This section contains 2 paragraphs. Based upon each paragraph 2 & 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

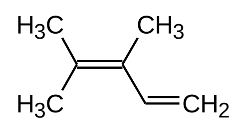
Paragraph for Question 12 to 13

Read the paragraph carefully and answer the following questions:

Alkenes can be oxidized in presence of different reagents to give different products, which also can be synthesized by using per acids. Alkenes on reductive ozonolysis give carbonyl compounds in presence of zinc and acid. On reaction with acidic $KMnO_4$, it also produces corresponding carbonyl compound. Alkynes can also be oxidized in presence of such reagents but the products are different.

12. An open chain hydrocarbon (C_7H_{12}), on ozonolysis produces propanone, methanal and 2-oxopropanal. The hydrocarbon could be

(A) 

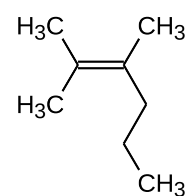
(B) 

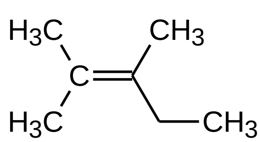
(C) Either of A & B

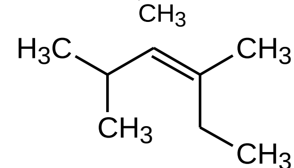
(D) None of the above

13. A hydrocarbon (C_8H_{16}), on oxidation with a hot acidified solution of $KMnO_4$ forms 2-butanone and isobutyric acid. The hydrocarbon is

(A) $(CH_3)_2C{=}C(CH_2CH_3)_2$

(B) 

(C) 

(D) 

Space for rough work

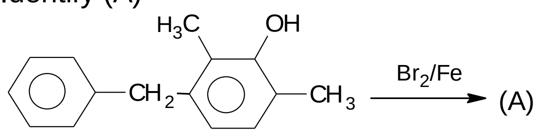
Paragraph for Question 14 to 16

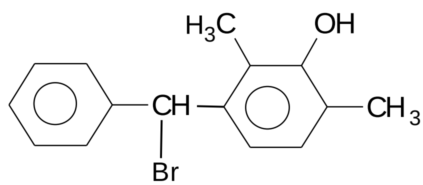
Read the paragraph carefully and answer the following questions:

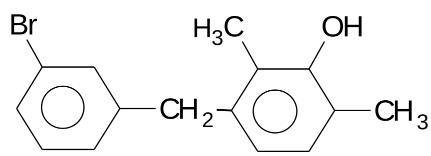
When a monosubstituted benzene undergoes an electrophilic substitutions the position taken up by the incoming group and rate of the reaction are determined by the substituent already present on the benzene ring. On this basis various substituents can be divided into three categories.

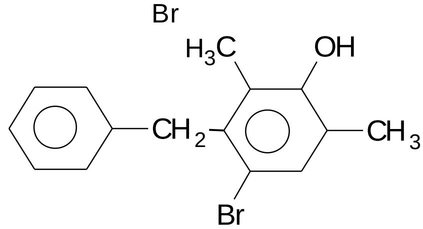
(1) O, P directing and activating
(2) m-directing and deactivating
(3) O, P-directing and deactivating

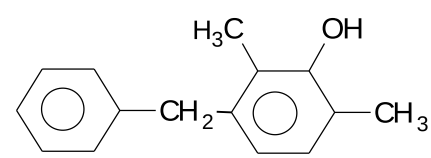
14. Identify (A)

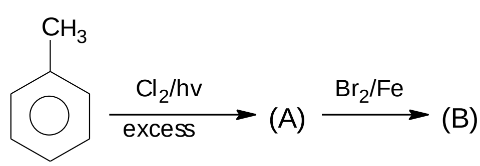


(A) 

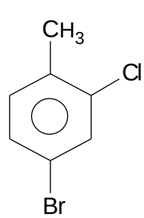
(B) 

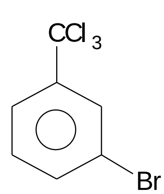
(C) 

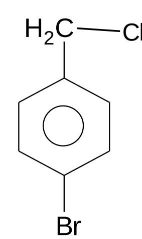
(D) 

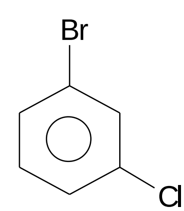
15. 

Identify (B)

(A) 

(B) 

(C) 

(D) 

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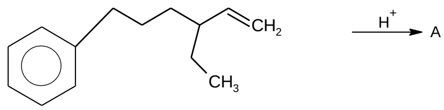
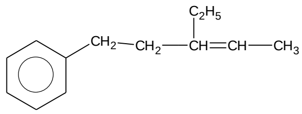
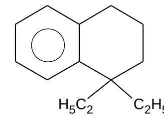
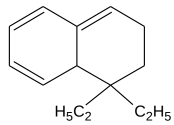
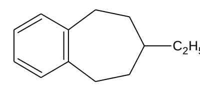
16.  A is

(A) 

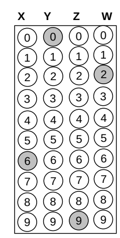
(B) 

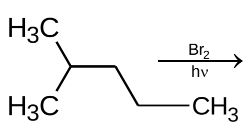
(C) 

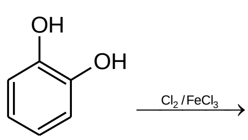
(D) 

SECTION–C
Integer Answer Type

This section contains 7 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to darkened. For example, if the correct answers to question numbers X, Y and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following:



1.  The number of structural monochloroderivatives formed is / are.................

2. 

How many monochloro product/s is / are formed?

Space for rough work

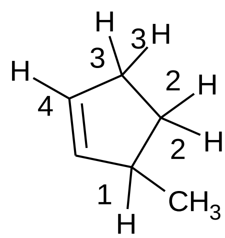
3. How many optically active stereo–isomers are possible for butane-2, 3-diol?

4. The treatment of CH_3MgX with $CH_3C{\equiv}C{-}H$ produces gas, find the number of carbon atom/s in gas/es

5. $A \xrightarrow[Zn, H_3O^+]{O_3} (CH_3)_2CO + CH_3CHO + \begin{array}{c} CHO \\ | \\ CHO \end{array}$ the number of sp^3 hybridized carbon atoms in A

6. The sum of hybridised orbitals of single Boron atom in the strucutre of B_2H_6(Borane) is

7. Which of the following C–H bond can give homolytic fission most easily



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PART – III : MATHEMATICS

SECTION–A

(Single Correct Choice Type)

This section contains **7 multiple choice questions.** Each question has four choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. If in triangle ABC, A ≡ (1, 10), circumcentre ≡ (– 1/3, 2/3) and orthocenter ≡ (11/3, 4/3), then the coordinates of midpoint of side opposite to A is
(A) (1, – 11/3) (B) (1, 5) (C) (1, – 3) (D) (1, 6)

2. A variable chord of circle $x^2 + y^2 = 4$ is drawn from the point P(3, 5) meeting the circle at the points A and B. A point Q is taken on this chord such that 2PQ = PA + PB. Locus of 'Q' is
(A) $x^2+y^2+3x+4y=0$ (B) $x^2+y^2=36$
(C) $x^2+y^2=16$ (D) $x^2+y^2-3x-5y=0$

3. An equilateral triangle SAB is inscribed in the parabola $y^2 = 4ax$ having it's focus at 'S'. If chord AB lies towards the left of S, then side length of this triangle is:
(A) $2a\left(2-\sqrt{3}\right)$ (B) $4a\left(2-\sqrt{3}\right)$ (C) $a\left(2-\sqrt{3}\right)$ (D) $8a\left(2-\sqrt{3}\right)$

4. The eccentricity of locus of point (3h + 2, k) where (h, k) lies on the circle $x^2 + y^2 = 1$ is
(A) $\frac{1}{3}$ (B) $\frac{\sqrt{2}}{3}$ (C) $\frac{2\sqrt{2}}{3}$ (D) $\frac{1}{\sqrt{3}}$

5. If foci of hyperbola lie on y = x and one of the asymptote is y = 2x, then equation of the hyperbola, given that it passes through (3, 4) is
(A) $x^2-y^2-\frac{5}{2}xy+5=0$ (B) $2x^2-2y^2+5xy+10=0$
(C) $2x^2+2y^2-5xy+10=0$ (D) None of these

6. The area bounded by the curve $y^2 = 1 – x$ and the lines $y=\frac{|x|}{x}$, $x=-1$ and $x=\frac{1}{2}$ is
(A) $\frac{3}{\sqrt{2}}-\frac{11}{6}$ sq. units (B) $3\sqrt{2}-\frac{11}{4}$ sq. units
(C) $\frac{6}{\sqrt{2}}-\frac{11}{5}$ sq. units (D) None of these

Space for rough work

7. The solution of the differential equation $y\left(2x^4+y\right)\frac{dy}{dx}=\left(1-4xy^2\right)x^2$ is given by

(A) $3\left(x^2y\right)^2+y^3-x^3=c$ (B) $xy^2+\frac{y^3}{3}-\frac{x^3}{3}+c=0$

(C) $\frac{2}{5}yx^5+\frac{y^3}{3}=\frac{x^3}{3}-\frac{4xy^3}{3}+c$ (D) None of these

(Multiple Correct Answers Type)

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D), out of which **ONE or MORE** may be correct

8. The lines x + y – 1 = 0, (m – 1)x + (m^2 – 7) y – 5 = 0 and (m – 2)x + (2m – 5)y = 0 are
(A) concurrent for three values of m (B) concurrent for one value of m
(C) concurrent for no value of m (D) are parallel for m = 3

9. Point M moved on the circle $(x-4)^2+(y-8)^2=20$. Then it broke away from it and moving along a tangent to the circle, cuts the x-axis at the point (– 2, 0). The co-ordinates of a point on the circle at which the moving point broke away is

(A) $\left(\frac{42}{5},\frac{36}{5}\right)$ (B) $\left(-\frac{2}{5},\frac{44}{5}\right)$ (C) (6, 4) (D) (2, 4)

10. The locus of the mid-point of the focal distance of a variable point moving on the parabola, $y^2=4ax$ is a parabola whose
(A) Latus rectum is half the latus rectum of the original parabola.
(B) vertex is $\left(\frac{a}{2},0\right)$.
(C) directrix is y-axis.
(D) focus has the co-ordinates (a, 0).

11. If the tangent at the point P(θ) to the ellipse $16x^2+11y^2=256$ is also a tangent to the circle $x^2+y^2-2x=15$, then θ =

(A) $\frac{2\pi}{3}$ (B) $\frac{4\pi}{3}$ (C) $\frac{5\pi}{3}$ (D) $\frac{\pi}{3}$

Space for rough work

Comprehension Type

This section contains **2 paragraphs.** Based upon one of the paragraphs **2 multiple choice questions** and based on the other paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), B), C) and (D) out of WHICH **ONLY ONE** is correct.

$P_{12\text{-}13}$ *Paragraph for question 12 to 13*

Consider function $f(x)=\sqrt{4-x^2}, g(x)=|x-2|,\ h(x)=\sqrt{x-2}$, now a function is defined as F(x)=max or min{f(x), g(x), h(x)}

12. Area of F(x)=min{f(x),g(x),h(x)} between the co-ordinate axes for x<0 is
(A) 2π sq. units (B) π sq.units (C) 4π sq.units (D) None of these

13. Are enclosed by F(x)=min{f(x),g(x),h(x)} and F(x) =max{f(x),g(x),h(x)} for $x\in[0,2]$ is
(A) π sq.units (B) (π+2)sq.units (C) (π–2)sq.units (D) (π–1)sq.units

$P_{14\text{-}16}$ *Paragraph for question 14 to 16*

For certain curves y = f(x) satisfying $\frac{d^2y}{dx^2}=6x-4$, f(x) has local minimum value 5 when x = 1.

14. Number of critical point for y = f(x) for $x \in [0, 2]$
(A) 0 (B) 1 (C) 2 (D) 3

15. Global minimum value of y = f(x) for $x \in [0, 2]$ is
(A) 5 (B) 7 (C) 8 (D) 9

16. Global maximum value of y = f(x) for $x \in [0, 2]$ is
(A) 5 (B) 7 (C) 8 (D) 9

Space for rough work

SECTION – C
(Integer Answer Type)

This Section contains **7 questions.** The answer to each question is a **single-digit integer,** ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

1. Consider f(x) = $x^2 - 3x + 2$. The area bounded by $|y| = |f(|x|)|, x \geq 1$ is A, then find the value of 3A + 2.

2. The degree of the differential equation satisfied by the curve $\sqrt{1+x} - a\sqrt{1+y} = 1$, is ....

3. The line x = C cuts the triangle with vertices (0, 0), (1, 1) and (9, 1) into two regions. For the area of the two regions to be the same, C must be equal to

4. The number of points P(x, y) lying inside or on the circle $x^2 + y^2 = 9$ and satisfying the equation $\tan^4 x + \cot^4 x + 2 = 4 \sin^2 y$, is

5. If circle $(x - 6)^2 + y^2 = r^2$ and parabola $y^2 = 4x$ have maximum number of common chord then least integral value of r is

6. Rectangle ABCD has area 200. An ellipse with area 200 π passes through A and C and has foci at B and D. If the perimeter of the rectangle is P, then the value of P/20 is

7. If the eccentricity of the hyperbola $x^2 - y^2 \sec^2 \theta = 5$ is $\sqrt{3}$ times the eccentricity of the ellipse $x^2 \sec^2 \theta + y^2 = 25$, then smallest positive value of θ is $\frac{\pi}{p}$, value of 'p' is

Space for rough work

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER-1)
ANSWER KEY

Paper Code
SET-A

PART – I (PHYSICS)		PART – II (CHEMISTRY)		PART – III (MATHS)	
SECTION-A		**SECTION-A**		**SECTION-A**	
1.	B	1.	B	1.	A
2.	C	2.	C	2.	D
3.	A	3.	C	3.	B
4.	A	4.	A	4.	C
5.	A	5.	A	5.	C
6.	D	6.	A	6.	A
7.	C	7	A	7.	A
8.	A, B, D	8.	B,D	8.	C, D
9.	A, D	9.	A,B,C,D	9.	B, C
10.	A, B	10.	C, D	10.	A, B, C, D
11.	A, C	11.	A,B,C,D	11.	C, D
12.	A	12.	C	12.	B
13.	B	13.	D	13.	C
14.	D	14.	C	14.	C
15.	C	15.	B	15.	A
16.	C	16.	B	16.	B
SECTION-C		**SECTION–C**		**SECTION–C**	
1.	4	1.	5	1.	3
2.	3	2.	2	2.	1
3.	8	3.	2	3.	3
4.	9	4.	1	4.	8
5.	7	5.	3	5.	5
6.	3	6.	4	6.	4
7.	7	7.	1	7.	4

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER-1)
ANSWER KEY

Paper Code
SET-B

PART – I (PHYSICS)	PART – II (CHEMISTRY)	PART – III (MATHS)
SECTION-A	**SECTION-A**	**SECTION-A**
1. C	1. A	1. A
2. D	2. A	2. A
3. A	3. A	3. C
4. A	4. A	4. C
5. A	5. C	5. B
6. C	6. C	6. D
7. B	7. B	7. A
8. A, C	8. A,B,C,D	8. C, D
9. A, B	9. C, D	9. A, B, C, D
10. A, D	10. A,B,C,D	10. B, C
11. A, B, D	11. B,D	11. C, D
12. D	12. C	12. C
13. C	13. B	13. A
14. C	14. B	14. B
15. A	15. C	15. B
16. B	16. D	16. C
SECTION-C	**SECTION–C**	**SECTION–C**
1. 7	1. 1	1. 4
2. 3	2. 4	2. 4
3. 7	3. 3	3. 5
4. 9	4. 1	4. 8
5. 8	5. 2	5. 3
6. 3	6. 2	6. 1
7. 4	7. 5	7. 3

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER-1)
ANSWER KEY

Paper Code
SET-C

PART – I (PHYSICS)		PART – II (CHEMISTRY)		PART – III (MATHS)	
SECTION-A		**SECTION–A**		**SECTION–A**	
1.	A	1.	A	1.	C
2.	D	2.	A	2.	A
3.	C	3.	A	3.	A
4.	B	4.	B	4.	A
5.	C	5.	C	5.	D
6.	A	6.	C	6.	B
7.	A	7.	A	7.	C
8.	A, B	8.	C, D	8.	A, B, C, D
9.	A, C	9.	A,B,C,D	9.	C, D
10.	A, B, D	10.	B,D	10.	C, D
11.	A, D	11.	A,B,C,D	11.	B, C
12.	A	12.	C	12.	B
13.	B	13.	D	13.	C
14.	D	14.	C	14.	C
15.	C	15.	B	15.	A
16.	C	16.	B	16.	B
SECTION-C		**SECTION–C**		**SECTION–C**	
1.	7	1.	3	1.	5
2.	3	2.	4	2.	4
3.	7	3.	1	3.	4
4.	4	4.	5	4.	3
5.	3	5.	2	5.	1
6.	8	6.	2	6.	3
7.	9	7.	1	7.	8

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER-1)
ANSWER KEY

Paper Code
SET-D

PART – I (PHYSICS)		PART – II (CHEMISTRY)		PART – III (MATHS)	
SECTION-A		**SECTION–A**		**SECTION–A**	
1.	A	1.	A	1.	C
2.	A	2.	C	2.	B
3.	C	3.	C	3.	D
4.	B	4.	B	4.	A
5.	C	5	A	5.	A
6.	D	6.	A	6.	A
7.	A	7.	A	7.	C
8.	A, D	8.	A,B,C,D	8.	B, C
9.	A, B, D	9.	B,D	9.	C, D
10.	A, C	10.	A,B,C,D	10.	C, D
11.	A, B	11.	C, D	11.	A, B, C, D
12.	D	12.	C	12.	C
13.	C	13.	B	13.	A
14.	C	14.	B	14.	B
15.	A	15.	C	15.	B
16.	B	16.	D	16.	C
SECTION-C		**SECTION–C**		**SECTION–C**	
1.	9	1.	1	1.	8
2.	8	2.	2	2.	3
3.	3	3.	2	3.	1
4.	4	4.	5	4.	3
5.	7	5.	1	5.	4
6.	3	6.	4	6.	4
7.	7	7.	3	7.	5

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C LOT
PHASE TEST – II (PAPER-1)
HINT & SOLUTIONS-PHYSICS

SECTION-A

1. B

$$H = \frac{V^2}{R}t$$

2. C

X components will cancel each other.

3. A

$$\frac{3Q^2}{4\pi\varepsilon_0\ell} = 3\frac{1}{2}mv^2$$

4. A

$$V = \frac{Q_{net} \text{ on plate } 1 - Q_{net} \text{ on plate } 2}{2C}.$$

5. A

$$R = \frac{R_1R_2}{R_1+R_2}$$

6. D

$$E = \frac{KQ}{r^2}$$

7. C

Apply vertical symmetry.

8. A, B, D

$$\frac{\sigma^2}{2\varepsilon_0}A = kx$$

$$x = \frac{\sigma^2 A}{2k\varepsilon_0}$$

New plate separation = initial separation – x.

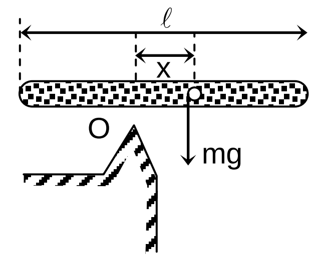
9. A, D

Both spheres behaves like capacitor
Apply R-C circuit concept.

10. A, B

$$\phi = \phi_{out} - \phi_{in} = \frac{Q_{en}}{\varepsilon_0}$$

11. A, C



Apply $\tau = \ell\alpha$ about O

$$mgx = \left(\frac{mL^2}{12} + mx^2\right)\alpha$$

for α to be maximum $d\alpha/dx = 0$

12. A

$$I = mR^2 + 4\left[\frac{M\ell^2}{12} + Mh^2\right]$$

ℓ = length of Rod = $\sqrt{2}$ meter

h = $\frac{1}{\sqrt{2}}$ meter.

13. B

$$mg\sin\theta - f = ma$$

$$f.R = I.\left(\frac{a}{R}\right)$$

14. D

E = I (R + r) ; E = constant ; I(R + r) = constant

0.9[2 + r] = 0.3[7 + r]

$\Rightarrow$ r = 0.5

15. C

Total emf = 2.2 volt, Total internal rest = $\frac{6}{3}\Omega = 2\Omega$

Total resistance = 4Ω

$$I = \frac{2.2}{4} = \frac{11}{20} = 0.55A$$

16. C

$$I = \frac{E}{nr + r}, V = E - IR \ ; \ V = E - \frac{E}{nr+r}r = E\left[1 - \frac{1}{n+1}\right] \ ; \ \frac{V}{E} = \frac{n}{n+1}$$

SECTION-C

1. 4

$$J_1 = i^2R = \frac{(2\varepsilon)^2}{(R+2)^2}R$$

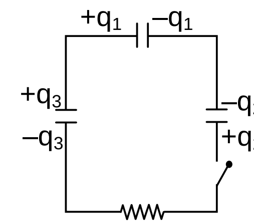
$$J_2 = \frac{\varepsilon^2}{\left(R + \frac{1}{2}\right)^2}R$$

2. 3

$q_1 + q_3 = 100$ .... (i)

$q_2 - q_3 = 50$ .... (ii)

$-q_2 + q_1 - q_3 = 0$ .... (iii)



3. 8

Energy dissipated in both resistors = $2C\varepsilon^2$

Energy dissipated in R is = $2\frac{C\varepsilon^2}{3}$ =$8\mu J$

4. 9

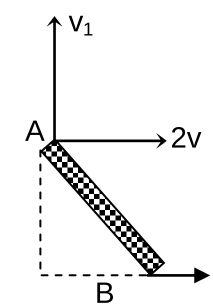
$I_g G = (I - I_g)s$

5. 7

$v = \int_{r_1}^{r_2} \vec{E}.d\vec{r}$

$= -\int_{r_1}^{r_2} \frac{5(x\hat{i} + y\hat{i})}{(x^2 + y^2)}(dx\hat{i} + dy\hat{j})$ Take y = 0, dy = 0

6. 3



In the frame of B

Let the velocity of the point A have components 2V along horizontal, v_1 along the vertical.

Since the rod AB is rigid, taking the velocities along the rod AB,

2v cos 45° – v_1 cos 45° = v cos 45°

or v_1 = v

The angular velocity of the rod AB equals (in the frame in which end B is at rest)

$\omega = \frac{\sqrt{2}v}{\sqrt{2}R} = \frac{v}{R}$

The velocity of the C.M. of AB

Where $\hat{i}, \hat{j}$ are the unit vectors along the horizontal and vertical (upward) direction respectively. The K.E. of the rod AB

$= \frac{1}{2}Mv_{CM}^2 + \frac{1}{2}I_{CM}\omega^2 = \frac{1}{2}M\left(\frac{9v^2}{4} + \frac{v^2}{4}\right) + \frac{1}{2}\frac{1}{12}M\left(\sqrt{2}R\right)^2\left(\frac{v}{R}\right)^2 = \frac{4}{3}Mv^2$

7. 7

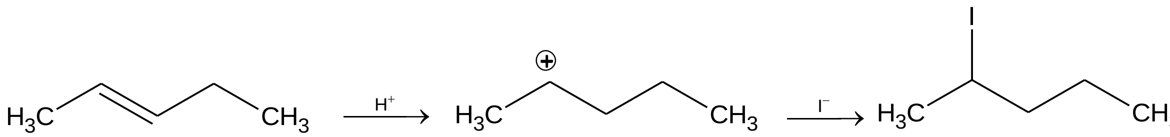
Applying conservation of angular momentum

V = $\frac{8}{7}V_0$

PART–II: CHEMISTRY

1. B C121203
Formation of carbocation followed by methyl shifting and then elimination

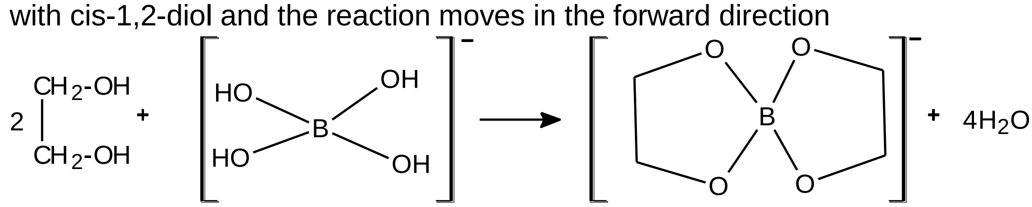
2. C C111707



3. C C111804
Rate determining step involves formation of carbocation which is same in both compound

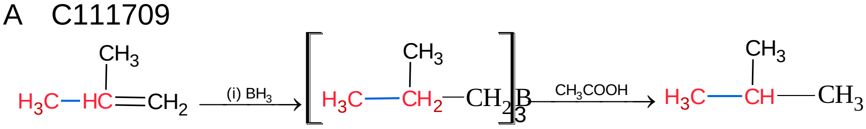
4. A C111709
Alkene is converted into carbonyl compounds by reductive ozonolysis.

5. A C111505
$Na[B(OH)_4]$ is removed from the equilibrium due to the formation of chelate compound with cis-1,2-diol and the reaction moves in the forward direction



6. A C111303
Product (A) is stabilized by resonance as well as hyperconjugation

7 A C111709

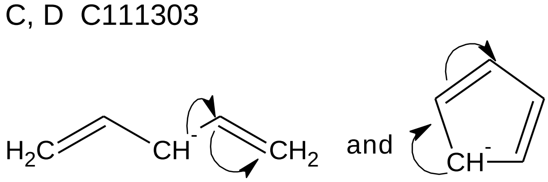


(B) (A)

8. B,D C111405
Option (B) and (D) are eclipsed form

9. A,B,C,D C111804
All of these groups increases electron density on aromatic ring

10. C, D C111303

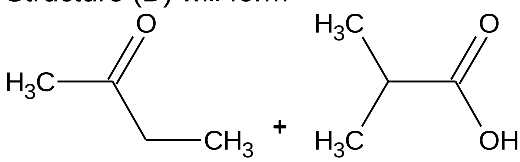


11. A,B,C,D C111507
Diborane, B_2H_6, is a compound consisting 2C–2e and 3c–2e bonds
$B_2H_6 + 2NH_3$ (X) $\xrightarrow{\text{Low temp}} B_2H_6.2NH_3 \xrightarrow{200°C} B_3N_3H_6$(Y)
Y has structure similar to benzene. If is called inorganic benzene
$B_2H_6 + NH_3 \xrightarrow{\text{High temprature}} \underset{(Z)}{(BN)_n}$

Z is hard substance

12. C C111709
Both the structures (A) and (B) will give same products on ozonolysis

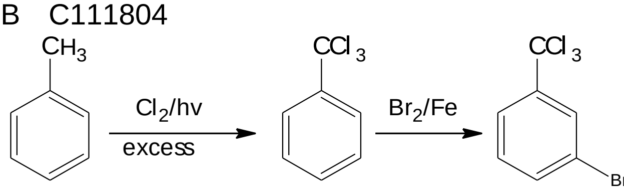
13. D C111709
Structure (D) will form



butan-2-one Isobutyric acid

14. C C111804
Since OH group is ortho and para directing

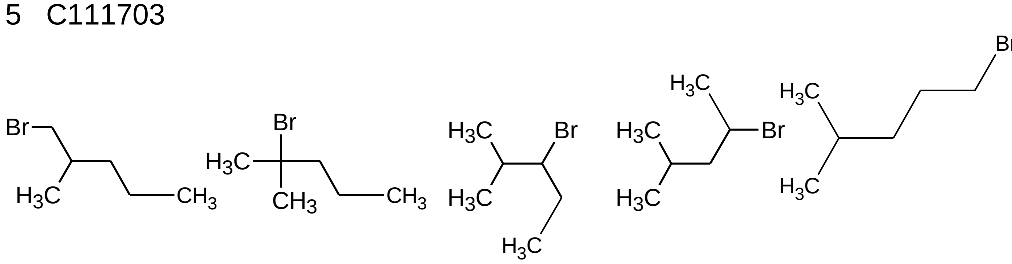
15. B C111804



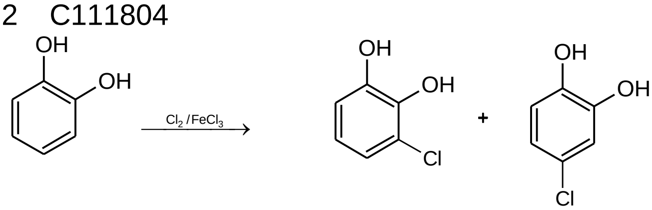
16. B C111804
Formation of 3° carbocation by hydride shifting and then electrophillic substitution

SECTION–C

1. 5 C111703



2. 2 C111804



3. 2 C111404
Two optical isomers and 1 meso compound (optical inactive) is possible

4. 1 C111701
$CH_3MgX + CH_3C\equiv C{-}H \longrightarrow CH_4 + CH_3{-}C\equiv CMgX$

5. 3 C111709
Reactant A is $CH_3\overset{\overset{CH_3}{|}}{C}=\overset{\overset{H}{|}}{C}-\overset{\overset{H}{|}}{C}=CH-CH_3$

6. 4 C111509

7. 1 C111303
Stability of free radicals
Vinylic < 2° < allylic < substituted allylic

MATHEMATICS-ANSWERS

1. A
2. D
3. B
4. C
5. C
6. A
7. A
8. C, D
9. B, C
10. A, B, C, D
11. C, D
12. B
13. C
14. C
15. A
16. B

1. 3
2. 1
3. 3
4. 8
5. 5
6. 4
7. 4

FIITJEE

4C01

PHYSICS, CHEMISTRY & MATHEMATICS

CPT2 - 2 **CODE: SET-A** **PAPER - 2**

Time Allotted: 3 Hours **Maximum Marks: 240**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

C. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into three sections: **Section-A, Section-B & Section-C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

D. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 08)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (09 – 12) contains 4 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

(ii) **Section-B (01 – 02)** contains 2 Matrix Match Type questions containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+8 marks** for all correct answer. For each correct row **+2 marks** will be awarded. There may be one or more than one correct choice. No marks will be given for any wrong match in any question. There is no negative marking.

(iii) **Section-C (01 – 06)** contains 6 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer. There is no negative marking

Name of the Candidate :____

Batch :____________________ **Date of Examination :**____________________

Enrolment Number :____

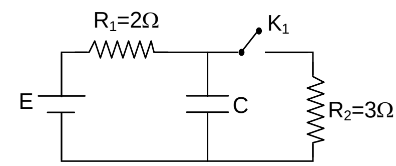
PART – I : PHYSICS
SECTION–A
Single Correct Answer Type

This section contains **8 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. A point charge Q is located at the centre of a hollow spherical conductor having inner radius as R_1 and outer radius R_2. The conductor being uncharged initially. The potential at the inner surface will be

(A) $KQ\left[\frac{1}{R_1}+\frac{1}{R_2}\right]$ (B) $KQ\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$ (C) $KQ\left[\frac{1}{R_2}-\frac{1}{R_1}\right]$ (D) None of these

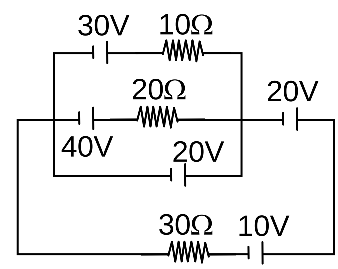
2. In the circuit shown in the figure k_1 is open. The charge on capacitor C in steady state is q_1. Now key is closed and at steady state charge on C is q_2. The ratio of charges q_1/q_2 is



(A) $\frac{5}{3}$ (B) $\frac{3}{5}$

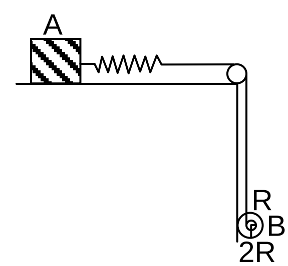
(C) 1 (D) $\frac{2}{3}$

3. Find the current through 30Ω resistor which is connected in the network as shown



(A) 3A
(B) 2A
(C) 1A
(D) None of these

4. A spool B of mass M and internal and external radii R and 2R is hanging from spring-string arrangement over a smooth pulley. The block A of mass m placed over a rough surface is attached to the spring. The system is in equilibrium. The spring constant is K. Find the elongation of the spring. The moment of inertia of spool about axis of rotation is I:

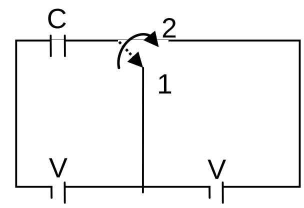


(A) $\frac{2(M+I/R^2)g}{K}$ (B) $\frac{2(M+m+I/R^2)g}{K}$

(C) $\frac{(2M+m+I/R^2)g}{K}$ (D) $2Mg/K$

Space For Rough Work

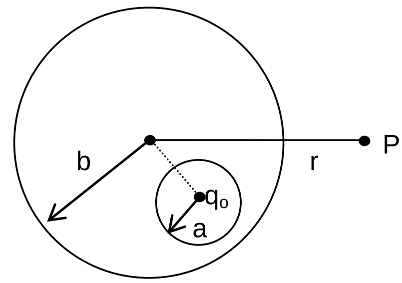
5. For the situation shown in figure. Switch is shifted from 1 to 2 at t = 0. The heat loss is



(A) CV^2 (B) $2CV^2$

(C) $\frac{1}{2}CV^2$ (D) None of these

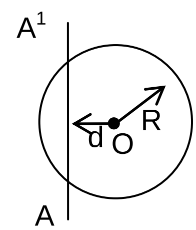
6. Spherical portion has been removed from spherical conducting sphere shown in figure. The electric field at point P is



(A) $\frac{1}{4\pi\in_0}\frac{q_0}{(a+r)^2}$ (B) $\frac{1}{2\pi\in_0}\frac{q_0}{r^2}$

(C) $\frac{1}{4\pi\in_0}\frac{q_0}{(a+b)^2}$ (D) $\frac{1}{4\pi\in_0}\frac{q_0}{r^2}$

7. Moment of inertia of a uniform circular disc of radius R about axis AA^1 is I_A . So, the mass of the disk is



(A) $\frac{2I_A}{R^2+2d^2}$ (B) $\frac{4I_A}{R^2+4d^2}$

(C) $\frac{2I_A}{R^2+4d^2}$ (D) $\frac{4I_A}{R^2+2d^2}$

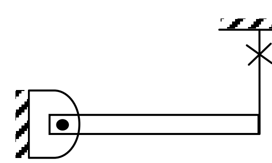
8. Two bulbs, one of 200V, 60W and other of 200V, 100W are connected in series to a 200V supply. The power consumed will be

(A) 37.5 W (B) 160W (C) 62.5W (D) 110W

Multiple Correct Answers Type

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** may be correct.

9. A uniform rod of length ℓ, mass m is hinged at one end as shown in figure. When the string is cut.



(A) Angular acceleration of the rod immediately after the event is $\frac{3g}{2\ell}$.

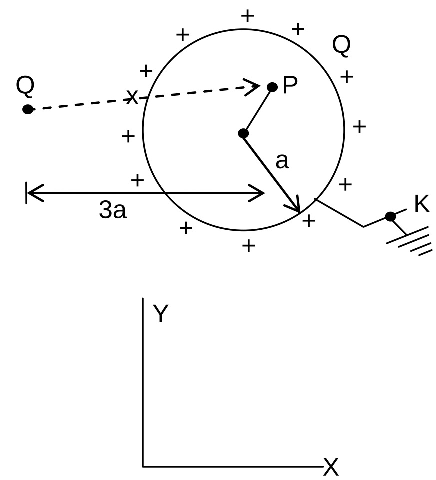
(B) Angular acceleration of the rod when it turns through an angle 90^0 is zero.

(C) Angular velocity of the rod when it turns by 90^0 is $\sqrt{\frac{3g}{\ell}}$.

(D) Reaction at hinge when rod turns by 90^0 is zero.

Space For Rough Work

10. A point charge Q is placed in front of a charged spherical conductor having radius a and charge Q at a distance 3a from centre.



(A) Potential of spherical conductor is $\frac{Q}{3\pi\varepsilon_0 a}$.

(B) Electric field at the centre of the spherical conductor due to induced charge on it is $\frac{Q}{36\pi\varepsilon_0 a^2}\left(-\hat{i}\right)$.

(C) Potential at point 'P' due to induced charge on it is $\frac{1}{4\pi\varepsilon_0}\left(\frac{Q}{3a}-\frac{Q}{x}\right)$

(D) Charge on the spherical conductor when it is earthed is $-\frac{Q}{3}$.

11. A uniform rod kept vertically on the ground falls from rest. Its foot does not slip on the ground.
(A) No part of the rod can have acceleration greater than g in any position.
(B) At any one position of the rod, different points on it have different accelerations
(C) Any one particular point on the rod has different acceleration at different positions of the rod.
(D) The maximum acceleration of any point on the rod, at any position, is 1.5 g.

12. Two free point charges +4Q and +Q are placed at a distance r. A third charge q is to be placed such that all the three are in equilibrium.

(A) q is placed at a distance $\frac{r}{3}$ from 4Q **(B) q is placed at a distance $\frac{r}{3}$ from Q**

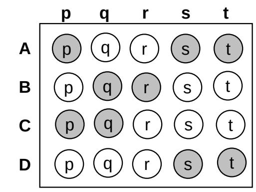
(C) $q=\frac{4Q}{9}$ (D) $q=-\frac{4Q}{9}$

Space For Rough Work

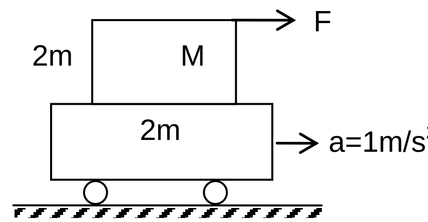
SECTION–B

Matrix–Match Type

This Section contains **2 questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.



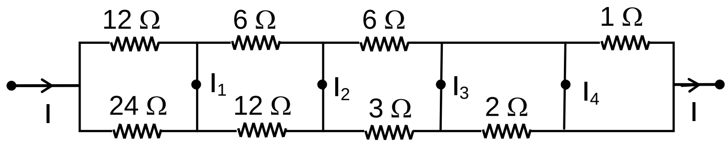
1. A cubical block having square cross-section of side 2m and of mass M=10kg is resting over a platform moving at constant acceleration $a=1 m/s^2$.
Coefficient of friction between black and plate form is $\mu=0.1$. A force F acts at the top of the cube as shown in figure. now match column I with Column II.



	Column I		Column II
(A)	F = 0 N	(p)	Block neither topples nor slips over the plate form.
(B)	F = 45 N	(q)	Block topples but does not slip over the plate form.
(C)	F = 15 N	(r)	Block slips but does not topple over the plate form.
(D)	F = 25 N	(s)	Block slips as well as topples on the plate form.

Space For Rough Work

2. Match the following and write the correct pairs.

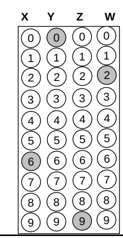


	Column – I		Column – II
(A)	I_1	(p)	0
(B)	I_2	(q)	2I/3
(C)	I_3	(r)	I/3
(D)	I_4	(s)	I
		(t)	None of these

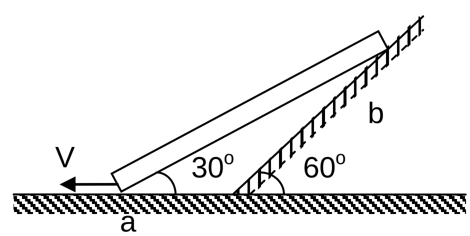
SECTION–C

Integer Answer Type

This Section contains **6 questions.** The answer to each question is a **single-digit integer,** ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

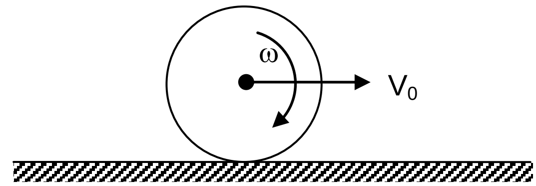


1. A uniform rod of length l slips in vertical plane in the arrangement shown. At any instant velocity of the end a is V and rod makes 30^0 with horizontal. Find angular velocity of the rod. (V = 12m/s, l = 6,)



Space For Rough Work

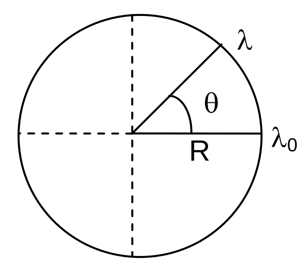
2. **A sphere of mass M and radius r slips on a rough horizontal plane. At some instant it has translational velocity V_0 and rotational velocity about to centre $\frac{V_0}{2r}$. The translational velocity when the sphere start pure rolling is $\left(\frac{n}{n+1}\right)V_0$. Find n**



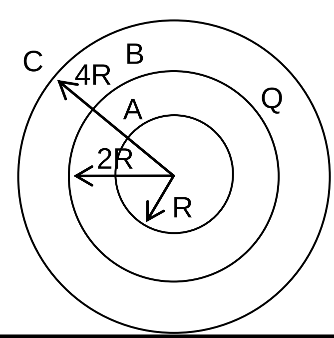
3. **When two resistances X and Y are put in the left and right hand gaps in a meter bridge, the null point is at 60 cm. If X is shunted by a resistance equal to half of itself then the shift in the null point is $\frac{40\ell}{3}$; then find the value of ℓ.**

4. **A solid conducting sphere of radius R and total charge q rotates about its diametric axis with constant angular velocity w. the magnetic moment of the sphere is given by $\frac{K}{5}qwR^2$. Find K.**

5. A thin non-conducting ring of radius R has a linear charge density $\lambda=\lambda_0\text{Cos}\theta$, where λ_0 is a constant. The net dipole moment for this charge distribution is given by $\frac{3\pi R^2\lambda_0}{K}$. Find K



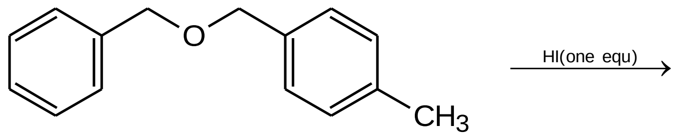
6. Three concentric spherical conductors A, B and C are of radii R, 2R and 4R respectively. A and C are shorted and B is uniformly charged (+Q). Find the ratio of charge on outer to inner surface of the sphere B.



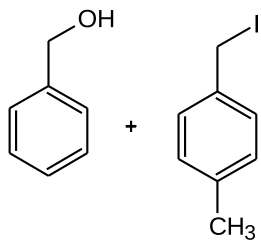
Space For Rough Work

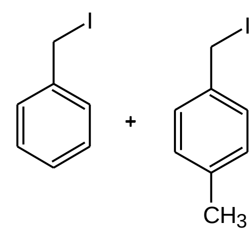
PART – II: CHEMISTRY
(SECTION–A)
Single Correct Choice Type

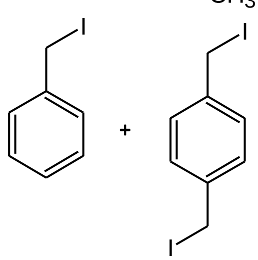
This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is

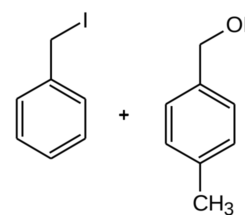
1. 

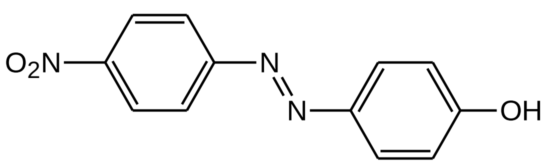
major product

(A) 

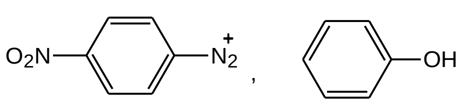
(B) 

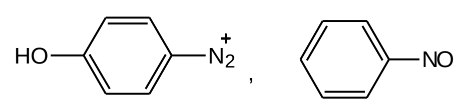
(C) 

(D) 

2. 

best yield is obtained by

(A) 

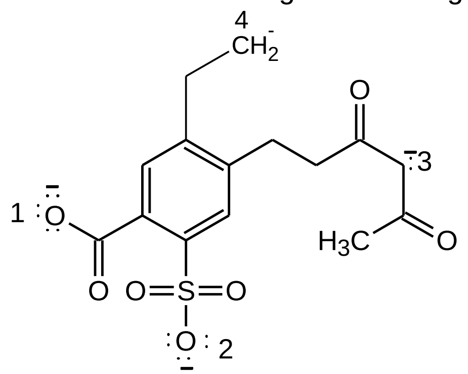
(B) 

(C) Both of the above

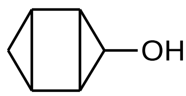
(D) None of the above

Space for rough work

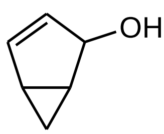
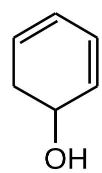
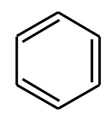
3. Which of the following is the strongest nucleophilic site in the following species?

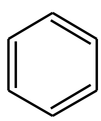


(A) 1 (B) 2 (C) 3 (D) 4

4.  $\xrightarrow[\Delta]{\text{strong acid}}$ X

The major product X is

(A)  (B)  (C)  (D) All are possible

5.  + $CH_3CH_2CH_2Cl \xrightarrow{AlCl_3} A \xrightarrow{O_2} B \xrightarrow{H^+} \text{Acetone} + C,$

What is C

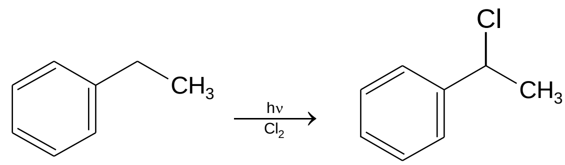
(A) Benzoic acid (B) Benzaldehyde (C) Phenol (D) Quinol

Space for rough work

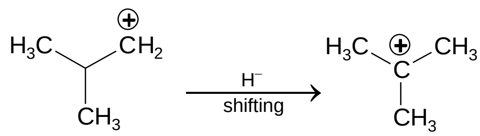
6. Which of the following reaction is not favourable?

(A) $CH_3CH_2CHO \xrightarrow{OH^-} CH_3-\overset{\ominus}{C}H-CHO$

(B)

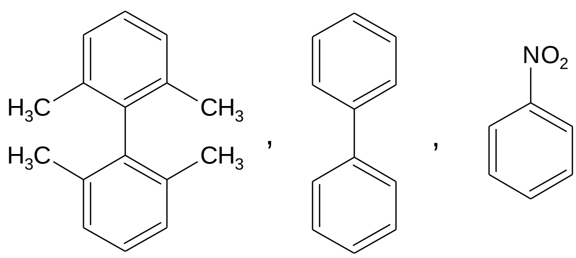


(C)



(D) None of these

7. The order of reactivity of following compounds towards electrophile is



(i) (ii) (iii)

(A) (i) > (ii) > (iii) (B) (ii) > (i) > (iii) (C) (iii) > (i) > (ii) (D) (i) = (ii) > (iii)

8. General formula of cyclic or Ring silicate is:

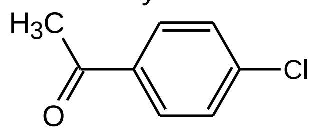
(A) $(Si_2O_5)_n^{2n-}$ (B) $(Si_2O_{11})_n^{2n-}$ (C) $(Si_2O_9^{2-})_n$ (D) $(SiO_3)_n^{2n-}$

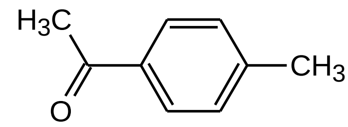
Space for rough work

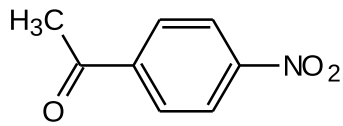
Multiple Correct Answers Type

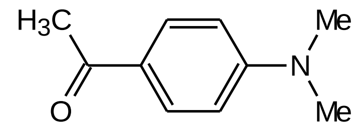
This section contains 4 multiple correct answer(s) type questions. Each question has 4 choices (A), (B), (C) and (D),

9. Friedel–Crafts acylation can be used to obtain:

(A) 

(B) 

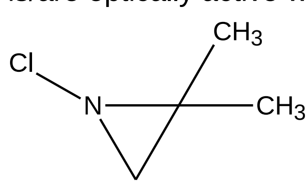
(C) 

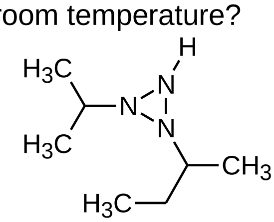
(D) 

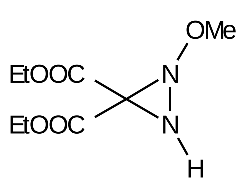
10. Select correct statement:
(A) Simple hydrides of B and Si are volatile and catch fire on exposure to air
(B) Oxides of B and Si(B_2O_3 and SiO_2) are acidic in nature
(C) Silicates have tetrahedral SiO_4^{-4} structural units
(D) Carbon has pronounced ability to form $p\pi$–$p\pi$ multiple bonds to itself and to other elements like O and N

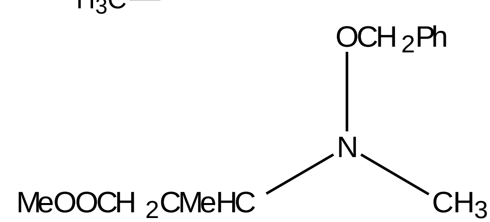
11. Me_2SiCl_2 on hydrolysis will produce:
(A) $Me_2Si(OH)_2$
(B) $Me_2Si=0$
(C) $-[O-(Me)_2Si]_n-$
(D) MeSiClOH

12. Which is/are optically active when all are kept at room temperature?

(A) 

(B) 

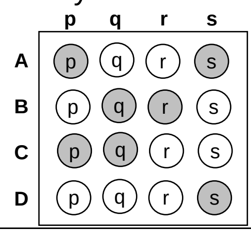
(C) 

(D) 

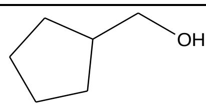
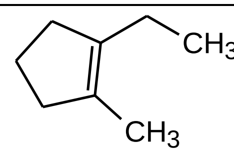
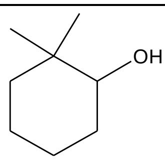
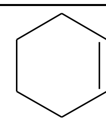
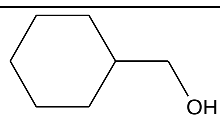
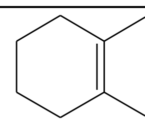
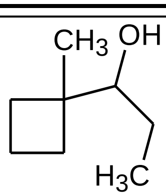
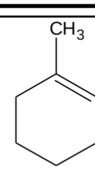
Space for rough work

Matrix–Match Type

This section contains 2 questions. Each questions contains statements given in two columns which have to be matched. Statements in Column-I are labeled as A,B,C and D whereas statements in Column-II labeled as p, q, r and s. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct match are A-p, A-s, B-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4×4 matrix should be as follows.



1. Match the following

	Column – I (Alcohol)		Column – II (Dehydration Product, acidic conditions, H^+)
A)		p)	
B)		q)	
C)		r)	
D)		s)	
		t)	Carbocation involved

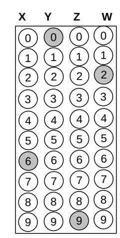
Space for rough work

2. Match the following

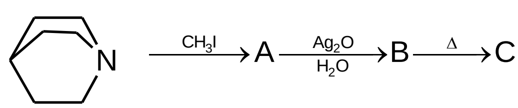
	Column – I		Column – II
A)	Negative charge on the anion is equal to the number of terminal oxygen atoms	p)	$Si_4O_{13}^{10-}$
B)	Three shared corners and ten on shared corners	q)	SiO_4^{4-}
C)	Silicon atom(s) is/are present at the centre of geometry and every oxygen atom is present at each corner of the geometry	r)	$Si_4O_{12}^{8-}$
D)	Non planar geometry	s)	$Si_2O_7^{6-}$
		t)	$Si_4O_6^{8-}$

SECTION–C
Integer Answer Type

This section contains 6 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to darkened. For example, if the correct answers to question numbers X, Y and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following:

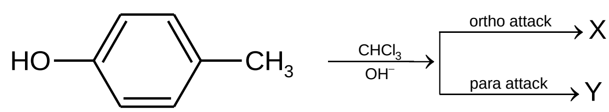


1. Number of B – O – B bridges in one molecule of borax is __________.

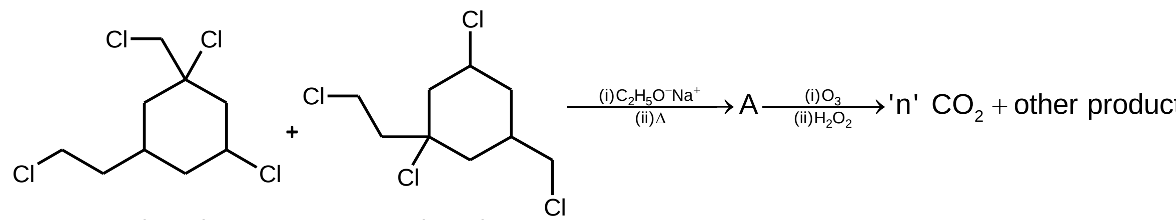
2. 

the no of CH_2 groups in the product C

Space for rough work

3. 

Total number of aromatic ring(s) 'X' + 'Y' is

4. 

(1 eq) (1 eq)

Find the value of 'n'

5. $$\begin{array}{l} H_2C-OH \\ \quad | \\ HC-OH \\ \quad | \\ H_2C-SH \end{array} + \underset{\text{(Excess)}}{CH_3MgBr} \longrightarrow xCH_4$$

What is the value of 'x' in the above reaction?

6. Ozonolysis products of an olefin are $\begin{array}{l} CHO \\ | \\ CHO \end{array}$ and $\begin{array}{l} CH_2CHO \\ | \\ CH_2CHO \end{array}$ then the degree of unsaturation of olefin is

Space for rough work

PART – III: MATHEMATICS
SECTION–A
Straight Objective Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. A line L passing through the focus of the parabola $y^2 = 4(x - 1)$ intersects the parabola in two distinct points. If m be the slope of the line L then
(A) $-1 < m < 1$ (B) $m < -1$ or $m > 1$ (C) $m \in R$ (D) none of these

2. The area bounded by $y \le 3 - |3 - x|$ and $y \ge |x-3|$ is
(A) $\frac{5}{2}$ (B) $\frac{9}{2}$ (C) $\frac{7}{2}$ (D) none of these

3. If $4a^2 + 9b^2 - c^2 + 12ab = 0$, the family of straight lines $ax + by + c = 0$ is concurrent at
(A) $(-1, -2)$ (B) $(-3, -2)$ (C) $(-2, -3)$ (D) none of these

4. The equation of a circle is $x^2+y^2=4$. The centre of the smallest circle touching this circle and the line $x + y = 5\sqrt{2}$ has the co-ordinates.
(A) $\left(-\frac{7}{2\sqrt{2}}, \frac{-7}{2\sqrt{2}}\right)$ (B) $\left(\frac{3}{2}, \frac{3}{2}\right)$ (C) $\left(\frac{7}{2\sqrt{2}}, \frac{7}{2\sqrt{2}}\right)$ (D) none of these

5. If normal at the point $(am^2, -2am)$ of the parabola $y^2 = 4ax$, subtends a right angle at the vertex then
(A) $m = 1$ (B) $m = \sqrt{2}$ (C) $m = -\sqrt{3}$ (D) $m = -\frac{1}{\sqrt{2}}$

6. If $x = 9$ is the chord of contact of the hyperbola $x^2 - y^2 = 9$, then the equation of the corresponding pair of tangent 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) $9x^2 - 8y^2 + 18x + 9 = 0$

Space for rough work

7. The slope of the chord of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, passing through centre of ellipse, whose length is the GM of the major and minor axes, is

(A) $\sqrt{\frac{a}{b}}$ (B) $\sqrt{ab}$ (C) $\sqrt{\frac{b}{a}}$ (D) $\frac{a}{b}$

8 The differential equation of the family of curves $cy^2 = 2x + c$, where c is an arbitrary constant is

(A) $y\frac{dy}{dx}=1$ (B) $\left(\frac{dy}{dx}\right)^2 + y\frac{d^2y}{dx^2}=0$ (C) $y^2 = 2xy\frac{dy}{dx}+1$ (D) none of these

Multiple Correct Answers Type

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** may be correct.

9. If three normals can be drawn from the point (h, 0) to the parabola $y^2 = -4x$, then h can be

(A) any real number in the interval $(-\infty,-3)$ (B) any real number in the interval $(-4,-3)$

(C) any real number in the interval $(-\infty,-4)$ (D) any real number

10. Let $y^2=4ax$ be a parabola and $x^2+y^2+2bx=0$ be a circle. If parabola and circle touch each other externally then

(A) a>0, b>0 (B) a>0, b<0 (C) a<0, b>0 (D) a<0, b<0

11. For the hyperbola $9x^2-16y^2-18x + 32y -151 = 0$

(A) one of the directrix is $x=\frac{21}{5}$ (B) Length of latus rectum = $\frac{9}{2}$

(C) Focii are (5, 1) and (–4,1) (D) eccentricity is $\frac{5}{4}$

Space for rough work

2. If the eccentric angles of extremities of a focal chord of an ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ are α,β, then

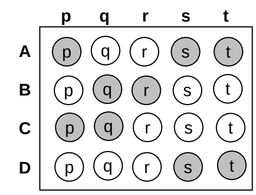
(A) $e=\frac{\cos\alpha+\cos\beta}{\cos(\alpha+\beta)}$ (B) $e=\frac{\sin\alpha+\sin\beta}{\sin(\alpha+\beta)}$

(C) $\cos\left(\frac{\alpha-\beta}{2}\right)=e\cos\left(\frac{\alpha+\beta}{2}\right)$ (D) $\tan\frac{\alpha}{2}\tan\frac{\beta}{2}=\frac{e-1}{e+1}$

SECTION–B

Matrix–Match Type

This Section contains **2 questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.



1. Match the following and write the correct pairs.

	Column – I		Column – II
A.	The eccentricity of a hyperbola can never be equal to	(p)	1
B.	If $\frac{2+\sin x}{y+1}\frac{dy}{dx}=-\cos x$ and y = 1 at x = 0, then the value of y at $x=\frac{\pi}{2}$ is	(q)	8
C.	If $\frac{x\frac{dy}{dx}-y}{\sqrt{x^2-y^2}}=mx^2$ and y = 0 at x = 1. if y = 1 at x = 2, then $m=\frac{\pi}{k}$. Then k is	(r)	$2\sqrt{\frac{1}{9}}$
D.	The sum of the abscissa and ordinates of the centre of ellipse $25x^2+9y^2-250x-54y+481 = 0$ is	(s)	1/3
		(t)	9

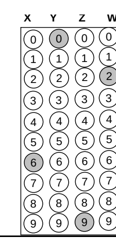
Space for rough work

2. Match the following and write the correct pairs.

	Column – I		Column – II
(A)	The value of K for which $x^2+y^2=4$ and $x^2+y^2-2x+2ky=k$ cut orthogonally is	(p)	–35
(B)	The value of k for which the lines $2x-ky+3=0$, $4x+y+5=0$ cut axes in concyclic points is	(q)	5
(C)	The value of k so that length of tangent from origin to the circle $x^2+y^2-2x-4y-k=0$ is 2 units is	(r)	–4
(D)	The value of k so that length of chord made by line $3x+4y+k=0$, to the circle $x^2+y^2-10x=0$ is of length 6 is	(s)	–8
		(t)	0

SECTION-C
Integer Answer Type

This part contains 6 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to darkened. For example, if the correct answers to question numbers X, Y, and W(say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following:



1. The shortest distance between the parabolas $y^2 = x - 1$ and $x^2 = y - 1$ is $\frac{3\sqrt{2}}{k}$, then the value of k must be

2. The area of the region enclosed by the curves $y = x \log x$ and $y = 2x - 2x^2$ is $\frac{a}{b}$ sq. units, then value of $b - a$ is

Space for rough work

3. If $a \neq 0$ and the line $2bx + 3cy + 4d = 0$ passes through the points of intersection of the parabolas $y^2 = 4ax$ and $x^2 = 4ay$, then $d^2 + (2b + 3c)^2 = \lambda^2$, then the value of λ is

4. For the primitive integral equation $ydx + y^2 dy = x\,dy$; $x \in R$, $y > 0$, $y = y(x)$, $y(1) = 1$, then $y(-3)$ is

5. The order of differential equation whose general solution is given by $y = (c_1 + c_2)\cos(x + c_3) - c_4 e^{x+c_5}$ where c_1, c_2, c_3, c_4, c_5 are arbitrary constants, is

6. The area bonded by the curves $y = \sqrt{x}, 2y + 3 = x$, and x-axis in the first quadrant is

Space for rough work

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER-2)
ANSWER KEY

Paper Code
SET-A

PART – I (PHYSICS)	PART – II (CHEMISTRY)	PART – III (MATHS)
SECTION–A	**SECTION–A**	**SECTION–A**
1. D	1. A	1. C
2. A	2. A	2. B
3. C	3. D	3. C
4. D	4. C	4. C
5. C	5. C	5. B
6. D	6. D	6. B
7. B	7. B	7. C
8. A	8. D	8. C
9. A, B, C	9. A,B	9. A, B, C
10. A, B, C, D	10. A,B,C,D	10. A, D
11. B, C	11. A,C	11. A,B,D
12. B, D	12. A,B,C,D	12. B, C, D
SECTION–B	**SECTION–B**	**SECTION–B**
1. (A)→p;(B)→r;(C)→p;(D)→r	1. A–q,,t' B – r,t; C–s,t D–p,t	1. A→ p, r, s; B→ s; C→ t; D→ q
2. (A)→p;(B)→r;(C)→q;(D)→s	2. A–s, B–r, C–q, D–p	2. A- r, B - s, C - r, D - p, q
SECTION–C	**SECTION–C**	**SECTION–C**
1. 2	1. 5	1. 4
2. 6	2. 5	2. 5
3. 2	3. 1	3. 0
4. 1	4. 3	4. 3
5. 3	5. 3	5. 3
6. 2	6. 3	6. 9

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER-2)
ANSWER KEY

Paper Code
SET-B

PART – I (PHYSICS)	PART – II (CHEMISTRY)	PART – III (MATHS)
SECTION–A	**SECTION–A**	**SECTION–A**
1. A	1. D	1. C
2. B	2. B	2. C
3. D	3. D	3. B
4. C	4. C	4. B
5. D	5. C	5. C
6. C	6. D	6. C
7. A	7. A	7. B
8. D	8. A	8. C
9. B, D	9. A,B,C,D	9. B, C, D
10. B, C	10. A,C	10. A,B,D
11. A, B, C, D	11. A,B,C,D	11. A, D
12. A, B, C	12. A,B	12. A, B, C
SECTION–B	**SECTION–B**	**SECTION–B**
1. (A)$\rightarrow$p;(B)$\rightarrow$r;(C)$\rightarrow$q;(D)$\rightarrow$s	1. A–s, B–r, C–q, D–p	1. A- r, B - s, C - r, D - p, q
2. (A)$\rightarrow$p;(B)$\rightarrow$r;(C)$\rightarrow$p;(D)$\rightarrow$r	2. A–q,t' B – r,t; C–s,t D–p,t	2. A$\rightarrow$ p, r, s; B$\rightarrow$ s; C$\rightarrow$ t; D$\rightarrow$ q
SECTION–C	**SECTION–C**	**SECTION–C**
1. 2	1. 3	1. 9
2. 3	2. 3	2. 3
3. 1	3. 3	3. 3
4. 2	4. 1	4. 0
5. 6	5. 5	5. 5
6. 2	6. 5	6. 4

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER-2)
ANSWER KEY

Paper Code
SET-C

PART – I (PHYSICS)	PART – II (CHEMISTRY)	PART – III (MATHS)
SECTION–A	**SECTION–A**	**SECTION–A**
1. C	1. C	1. B
2. D	2. D	2. B
3. B	3. B	3. C
4. A	4. D	4. C
5. D	5. A	5. C
6. A	6. A	6. B
7. C	7. D	7. C
8. D	8. C	8. C
9. B, C	9. A,C	9. A,B,D
10. B, D	10. A,B,C,D	10. B, C, D
11. A, B, C	11. A,B	11. A, B, C
12. A, B, C, D	12. A,B,C,D	12. A, D
SECTION–B	**SECTION–B**	**SECTION–B**
1. (A)$\rightarrow$p;(B)$\rightarrow$r;(C)$\rightarrow$p;(D)$\rightarrow$r	1. A–q,,t' B – r,t; C–s,t D–p,t	1. A$\rightarrow$ p, r, s; B$\rightarrow$ s; C$\rightarrow$ t; D$\rightarrow$ q
2. (A)$\rightarrow$p;(B)$\rightarrow$r;(C)$\rightarrow$q;(D)$\rightarrow$s	2. A–s, B–r, C–q, D–p	2. A- r, B - s, C - r, D - p, q
SECTION–B	**SECTION–C**	**SECTION–C**
1. 1	1. 3	1. 3
2. 3	2. 3	2. 3
3. 2	3. 3	3. 9
4. 2	4. 5	4. 4
5. 6	5. 5	5. 5
6. 2	6. 1	6. 0

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C-LOT
PHASE TEST-II (PAPER–2)
ANSWER KEY

Paper Code
SET-D

PART – I (PHYSICS)

SECTION–A

1. D
2. C
3. A
4. D
5. A
6. B
7. D
8. C
9. A, B, C, D
10. A, B, C
11. B, D
12. B, C

SECTION–B

1. (A)$\rightarrow$p;(B)$\rightarrow$r;(C)$\rightarrow$q;(D)$\rightarrow$s
2. (A)$\rightarrow$p;(B)$\rightarrow$r;(C)$\rightarrow$p;(D)$\rightarrow$r

SECTION–C

1. 2
2. 6
3. 2
4. 2
5. 3
6. 1

PART – II (CHEMISTRY)

SECTION–A

1. C
2. D
3. A
4. A
5. D
6. B
7. D
8. C
9. A,B,C,D
10. A,B
11. A,B,C,D
12. A,C

SECTION–B

1. A–s, B–r, C–q, D–p
2. A–q,,t' B – r,t; C–s,t D–p,t

SECTION–C

1. 1
2. 5
3. 5
4. 3
5. 3
6. 3

PART – III (MATHS)

SECTION–A

1. C
2. C
3. B
4. C
5. C
6. C
7. B
8. B
9. A, D
10. A, B, C
11. B, C, D
12. A,B,D

SECTION–B

1. A- r, B - s, C - r, D - p, q
2. A$\rightarrow$ p, r, s; B$\rightarrow$ s; C$\rightarrow$ t; D$\rightarrow$ q

SECTION–C

1\. 0
2\. 5
1\. 4
4\. 9
5\. 3
6\. 3

FIITJEE COMMON TEST

BATCHES: ONE YEAR CPA (1213) C LOT
PHASE TEST – II (PAPER-2)
HINT & SOLUTIONS-PHYSICS

SECTION-A

1. D

$$V = \frac{KQ_1}{R_1} - \frac{KQ}{R_1} + \frac{KQ}{R_2}$$

2. A

$Q_1 = CE$

$Q_2 = \frac{3CE}{5}$

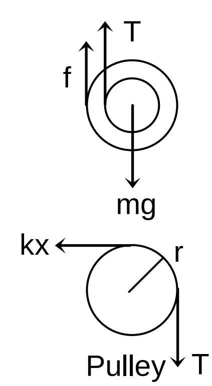
$\frac{Q_1}{Q_2} = \frac{5}{3}$

3. C

Applying KVL = 20 + 20 – 10 – I $\times$ 30 = 0

I = 1A.

4. D



Torque about point of contact of the spool will be zero.

TR = Mg.2R

Or T = 2Mg

Since system is in equilibrium

Tr – (Kx)r = $I\alpha$ = 0

(Since α = 0)

Or T = Kx

So, Kx = 2 Mg

Or x = 2Mg/K.

5. C

$W_{battery} = \Delta H + \Delta V$

$2(CV).\ V = \Delta H + \left[\frac{(2CV)^2}{2C} - \frac{CV^2}{2}\right]$

$$\Delta H = \frac{1}{2}CV^2$$

6. D

Electric field at P will be due to charge on the surface of spherical conductor only.

7. B

$$IA = \frac{mR^2}{4} + md^2$$

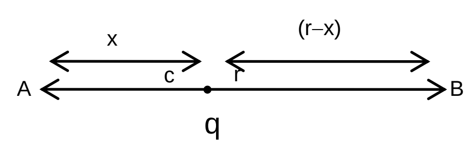
8. A
Power consumed can be found by I^2R.

9. A, B, C
$mg\frac{l}{2} = \frac{1}{3}ml^2\alpha$ (At the instant string is cut)
$$\alpha = \frac{3g}{2l}$$
$\alpha = 0$ ($\tau_{net} = 0$, when rod is vertical)

10. A, B, C, D
$V = V_Q + V_Q + V_{ind}$ (V_C = potential of the centre of the conductor)
$$= \frac{KQ}{3a} + \frac{KQ}{a} + O$$
$$V = \frac{4KQ}{3a}$$

11. B, C

12. B, D



$$F_{A,\,net} = \frac{4Qq}{x^2} + \frac{4Q^2}{r^2} = 0$$
$$= \frac{q}{x^2} + \frac{Q}{r^2} = 0 \text{ ----------- (I)}$$
$$F_{B,\,net} = \frac{4q^2}{r^2} + \frac{Qq}{(r-x)^2} = 0$$
$$= \frac{4Q}{r^2} + \frac{q}{(r-x)^2} = 0 \text{ -------- (II)}$$
From (I) and (II),
So, $x = \frac{2}{3}r$
Distance between q and Q
$= r - x = r - \frac{2}{3}r$
$= \frac{r}{3}$
Also from (I),
$$\frac{q}{\left(\frac{2}{3}r\right)^2} + \frac{Q}{r^2} = 0$$
$$\frac{9}{4}\frac{q}{r^2} + \frac{Q}{r^2} = 0$$
$$\frac{9}{4}q + Q = 0$$

$\frac{9}{4}q = Q$

$\therefore q = \frac{-9}{4}Q = 12$

SECTION-B

1. (A)→p ; (B)→r ; (C)→p ; (D)→r

(A) $\sum F_x = 0$ --------- (I)

Restoring torque > Toppling torque
So, Block neither topples nor slips.

(B) $\sum F_x = 45 - 10 - 10 = 25N$

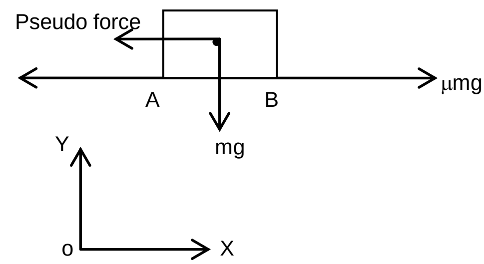
Restoring torque > Toppling torque
So, block slips but does not topple.

(C) $\sum F_x = 15 - 10 - 5 = 0N$

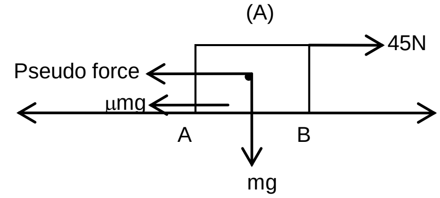
Restoring torque > Toppling torque
So, block slips but does not topple.

(D) $\sum F_x = 25 - 10 - 10 = 5N$

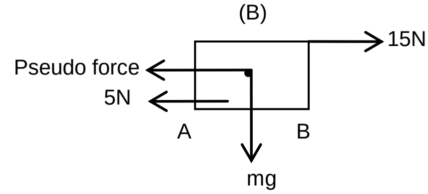
Toppling torque < Restoring torque
So, block slips but does not topple.



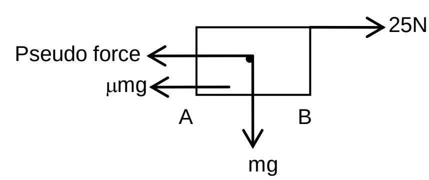
(A)



(B)



(C)



(D)

2. (A)→p ; (B)→r ; (C)→q ; (D)→s

SECTION-C

1. 2

$\omega = \frac{V_1}{\ell} = \frac{V}{\ell} = \frac{12}{6} = 2$

2. 6

By applying conservation of angular momentum
n = 6

3. 2

In 1st case $\frac{X}{Y} = \frac{60}{40}$ ----------- (I)

In 2nd case $\frac{\frac{X}{3}}{Y} = \frac{60 - 40\frac{l}{3}}{100 - \left(60 - 40\frac{l}{3}\right)}$ ----------- (II)

Hence I = 2.

4. 1

$\frac{M}{L} = \frac{q}{2m}$

$M = \frac{1}{5}qwR^2$

5. 3

$P = \int_0^{2\pi} \lambda_o \cos\theta \left[R\cos\theta.\hat{j} + R\sin\theta\,\hat{j}Q \right] Rd\theta$

6. 2

Let charge on outer surface of A = q
Charge on inner surface of B = –q
Charge on outer surface of B = q + Q
Charge on inner surface of C = –(q + Q)
Charge on outer surface of C = q + Q

Now, $V_A = \frac{Q}{2R} + \frac{q}{R}$ ---------- (I)

$V_C = \frac{Q+q}{4R}$ ---------- (II)

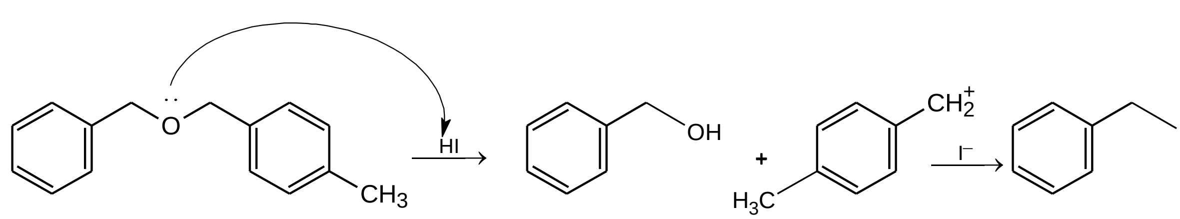
$\because$ $V_A = V_C$ (as A & B are shorted)

$\therefore q = \frac{-Q}{3}$

$\therefore \frac{Q_{o,B}}{Q_{i,B}} = \frac{\frac{2Q}{3}}{\frac{Q}{3}} = 2$

PART–II : CHEMISTRY
(SECTION–A)

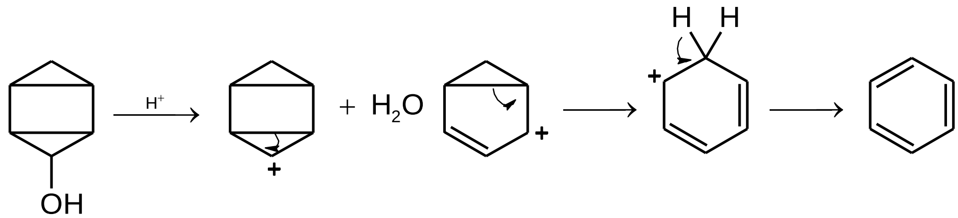
1. A C121204



2. A C121203
Nitro group is deactivating group and OH group is ortho and para activating group

3. D C111303
Position 4 is not invovled in any resonance hence more availability of electrons

4. C C111802



5. C C121205
Prepration of phenol from cumene (Product A)

6. D C111303
All steps are favourable

7. B C111804
In first and second proudct there is steric inhibition of resonance whereas in third product NO_2 is highly deactivating

8. D C111608
D is the cyclic silicates

9. A,B C121202
Group (–Cl) and (CH_3–) are ortho and para directing

10. A,B,C,D C111509
All statements are correct

11. A,C C111606
$Me_2SiCl_2 \xrightarrow{\text{hydrolysis}} Me_2Si(OH)_2 \xrightarrow{\text{polymerization}} -\!\!\left[O - (Me)_2 Si \right]\!\!-_n$

12. A,B,C,D C111404
At lower temperature the recimisation of compound get stop. Since all have chiral 'N' so, all are optically active

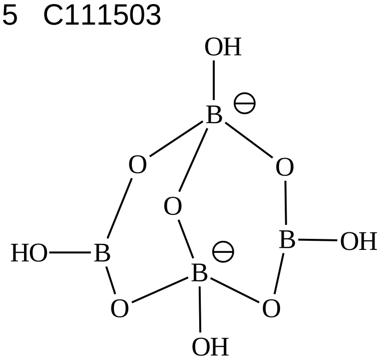
SECTION–B

1. A–q,,t' B – r,t; C–s,t D–p,t C121203
Formation of stable carbocation & ring expansion

2. A–s, B–r, C–q, D–p C111607
Refer to structure of silicates

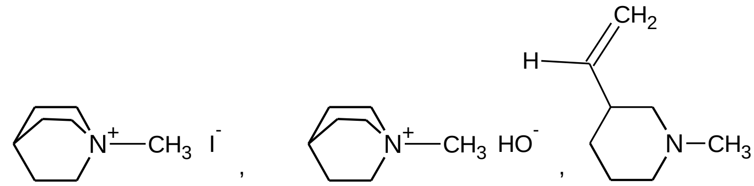
SECTION–C

1. 5 C111503



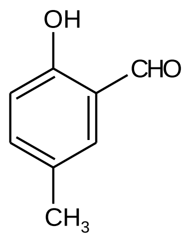
$2Na^+(8H_2O)$

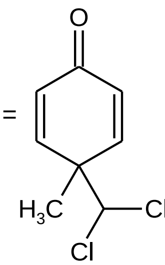
2. 5 C111706



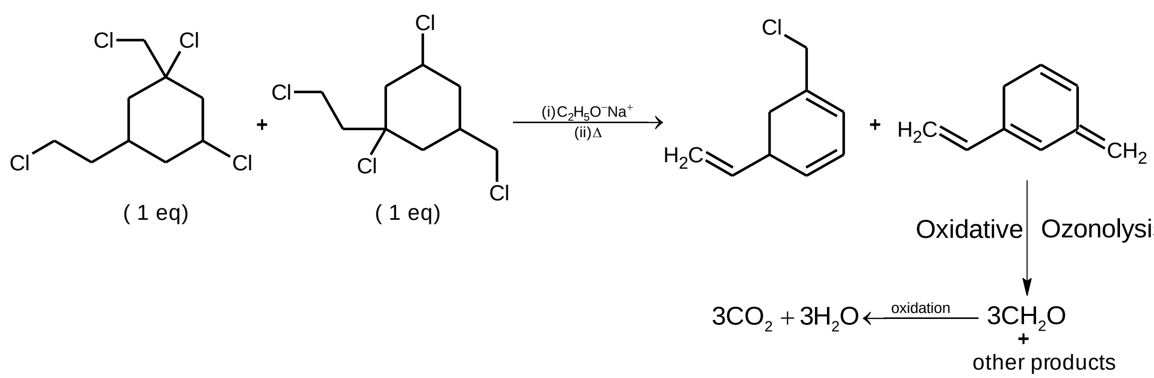
(A) , (B) , (C)

3. 1 C121203

X = 

Y = 

4. 3 C121201

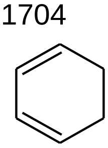


CH_2 group give CH_2O by ozonolysis which convert in CO_2

5. 3 C121203

As there are three acidic hydrogen, so three moles of CH_4 will produce

6. 3 C111704

Olefin is 

PART – III: MATHEMATICS
SECTION–A
Straight Objective Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. C

   D > 0

2. B
3. C
4. C
5. B

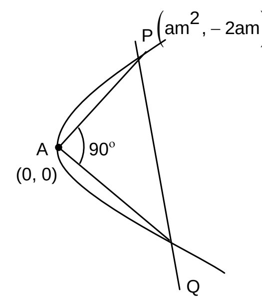
   Hint : Product of slopes for triangle lines = -1.

   Solution : $P=\left(am^2,-2am\right)=t_1$

   $Q=t_2 \;\therefore\; t_1=-m \qquad t_2=-t_1-\dfrac{2}{t_1}=m+\dfrac{2}{m}$.

   Slope of AP. Slope of AQ = -

   $\dfrac{2}{t_1}\cdot\dfrac{2}{t_2}=-1 \qquad t_1t_2=-4 \quad -m\left(m+\dfrac{2}{m}\right)=-4 \quad m=\pm\sqrt{2}$



6. B.

   Equation of chord of contact

   xh – yk – 9 = 0 ….(1)

   x – 9 = 0 …..(2)

   h = 1 and k = 0

   pair of tangent

   $SS'=T^2$

   $\left(x^2-y^2-9\right)(-8)=(x-9)^2 \quad 9x^2-8y^2-18x+9=0$

7. C

   The length of the diameter = $\sqrt{2a.2b}=2\sqrt{ab}$

   Let $P(a\cos\phi, b\sin\phi)$ be one end of the diameter.

   Then $2\{(a\cos\phi-0)^2+(b\sin\phi-0)^2\}=2ab$

   Or $a^2\cos^2\phi+b^2\sin^2\phi=ab$. The slope of he diameter $=\dfrac{b\sin\phi-0}{a\cos\phi-0}=\dfrac{b}{a}\tan\phi$

   Now, $a^2+b^2\tan^2\phi=ab\sec^2\phi = ab(1+\tan^2\phi)$

   $\therefore \tan^2\phi=\dfrac{ab-a^2}{b^2-ab}=\dfrac{a(b-a)}{b(b-a)}=\dfrac{a}{b}\Rightarrow\dfrac{b^2}{a^2}\tan^2\phi=\dfrac{b}{a} \qquad \therefore\ (\text{slope})^2=\dfrac{b}{a}$.

8. C

   Solution: Differentiating the given differential equation $cy^2=2x+c$ ….(1)

   $c\cdot 2y\cdot\dfrac{dy}{dx}=2$

   $\Rightarrow\ c=\dfrac{dx}{ydy}$

   Putting this value of c in equation (1) we get

   $\dfrac{dx}{ydy}\cdot y^2=2x+\dfrac{1}{y}\cdot\dfrac{dx}{dy}$

   $\Rightarrow\ y^2=2xy\cdot\dfrac{dy}{dx}+1$

9. A, B, C

(h, 0) satisfy the equation of the normal $y = mx - 2am - am^3$

10. A, D
11. A,B,D
12. B, C, D

SECTION–B

1. $A \to$ p, r, s; $B \to$ s; $C \to$ t; $D \to$ q
2. A- r, B - s, C - r, D - p, q

SECTION-C

1. 4

Since both curves are symm. about line y = x

$$\therefore 2\left(\frac{t^2+1-t}{\sqrt{2}}\right) = \sqrt{2}\left(t^2-t+1\right)$$

Min. value of $t^2 - t + 1 = \frac{3\sqrt{2}}{4}$ $\quad\therefore$ Min. distance $= \frac{3\sqrt{2}}{4}$

2. 5
3. 0
4. 3

$$\frac{ydx - xdy}{y^2} = -dy$$

$$\frac{x}{y} = -y + c$$

y(1) = 1 $\Rightarrow$ c = 2

$y^2 - 2y + x = 0$

y(-3):

$y^2 - 2y - 3 = 0$ $\Rightarrow$ (y – 3)(y + 1) = 0

y = 3, -1

5. 3

We can write equation as $y = a\cos(x+b) + ce^x$ where $a = c_1 + c_2, b = c_3, c = -c_4e^{c_5}$ and there- fore it has three independent constants.

6. 9

FIITJEE - JEE **(Mains)**

CPA A-LOT BATCH

PHYSICS, CHEMISTRY & MATHEMATICS

JEE - MAINS 2014

PHASE – 3

SET - A

Time Allotted: 3 Hours **Maximum Marks: 360**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.*

2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.

3. The test is of **3 hours** duration.

4. The Test Booklet consists of **90** questions. The maximum marks are **360**.

5. There are ***three*** parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.

6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*

7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.

8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***

9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.

10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***

11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :____________________

Enrolment Number :____________________

Batch :____________ **Date of Examination :** ____________

Useful Data Chemistry:

Gas Constant	R	=	8.314 J K^{-1} mol^{-1}
		=	0.0821 Lit atm K^{-1} mol^{-1}
		=	1.987 $\approx$ 2 Cal K^{-1} mol^{-1}
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-27} erg.s
1 Faraday		=	96500 Coulomb
1 calorie		=	4.2 Joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No : H=1, D=1, Li=3, Na=11, K=19, Rb=37, Cs=55, F=9, Ca=20, He=2, O=8, Au=79.

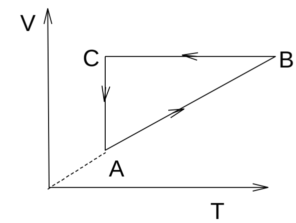
Atomic Masses: He=4, Mg=24, C=12, O=16, N=14, P=31, Br=80, Cu=63.5, Fe=56, Mn=55,
Pb=207,
Au=197, Ag=108, F=19, H=2, Cl=35.5, Sn=118.6

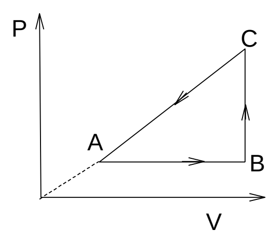
Useful Data Physics:

Acceleration due to gravity g = 10 m/s^2

Section – I (Physics)

1. A cyclic process ABCA is shown in the V-T diagram. Process on the P-V diagram is



(A)


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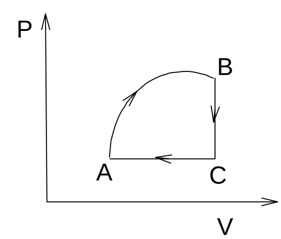

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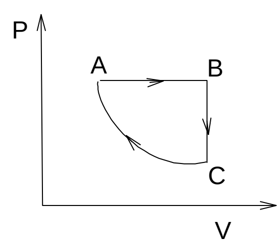

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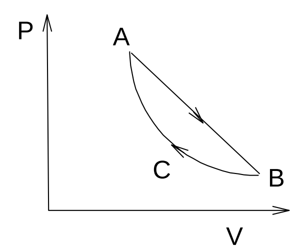
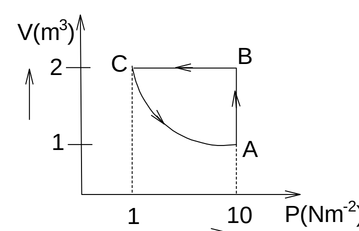


2. An ideal gas is taken through A → B → C→ A as shown in figure. If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process C → A is



(A) $-5J$ (B) $-10J$
(C) $-15J$ (D) $-20J$

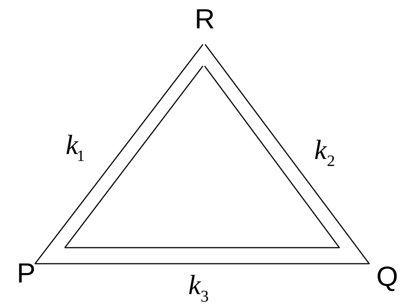
3. A tunnel is dug in the earth across one of its diameter. Two masses m and 2 m are dropped from the two ends of the tunnel. The masses collide and stick to each other. They perform SHM, of amplitude (Radius of earth = R)
(A) R (B) R/2 (C) R/3 (D) 2R/3

space for rough work

4. A spaceship is launched into a circular orbit close to the earth's surface. What additional velocity should be imparted to the spaceship in the orbit to overcome the gravitational pull (R = Radius of earth, g = acceleration due to gravity on surface of earth)

(A) $\sqrt{gR}$ (B) $\sqrt{3gR}$ (C) $\sqrt{2gR}$ (D) $\left(\sqrt{2}-1\right)\sqrt{gR}$

5. Three rods of same dimensions are arranged as shown in fig. They have thermal conductivities k_1, k_2 and k_3. The points P and Q are maintained at different temperatures for the heat to flow at the same rate along PRQ and PQ. Which of the following options is correct?



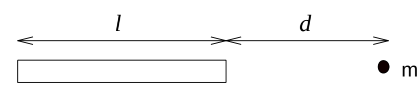
(A) $k_3 = \frac{1}{2}\left(k_1 + k_2\right)$ (B) $k_3 = k_1 + k_2$

(C) $k_3 = \frac{k_1 k_2}{k_1 + k_2}$ (D) $k_3 = 2\left(k_1 + k_2\right)$

6. One mole of oxygen gas is made to undergo a process in which its molar heat capacity C depends on its absolute temperature T as $C = \alpha T$. Work done by it when heated from an initial temperature, T_0 to a final temperature $2T_0$ will be

(A) $4\alpha T_0^2$ (B) $\left(\alpha T_0 - R\right)\frac{3T_0}{2}$ (C) $\left(3\alpha T_0 - 5R\right)\frac{T_0}{2}$ (D) $\frac{3\alpha T_0^2}{2}$

7. Find the gravitational force of a uniform a rod of length l and mass per unit length λ, on a particle of mass m located at a distance d form one end of the rod.



(A) $\frac{Gm\lambda d}{l\left(l+d\right)}$ (B) $\frac{Gm\lambda l}{\left(d+\frac{l}{2}\right)^2}$

(C) $\frac{Gm\lambda l}{d\left(l+d\right)}$ (D) $\frac{Gm\lambda l}{d^2}$

8. A body cools in a surrounding of constant temperature 30^0C. Its heat capacity is 2J/^{0}C. Initial temperature of the body is 40^0C. The body cools to 38^0 C in 10 min. In further 10 min it will cool from 38^0C to

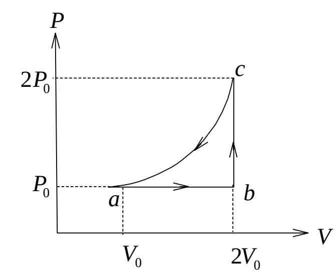
(A) 36^0C (B) 36.4 ^{0}C (C) 37^0C (D) 37.5^0C

space for rough work

9. The gravitational field in a region is given by $\vec{E} = \left(5\hat{i} + 12\hat{j}\right) N\,kg^{-1}$. Find the potential at the points (12m, 0) and (0, 5) if the potential at the origin is taken to be zero.
(A) -30 J kg^{-1}, - 30 J kg^{-1}
(B) -40 J kg^{-1}, -30 J kg^{-1}
(C) -60 J kg^{-1}, -60 J kg_{-1}
(D) -40 J kg^{-1}, - 50 J kg^{-1}

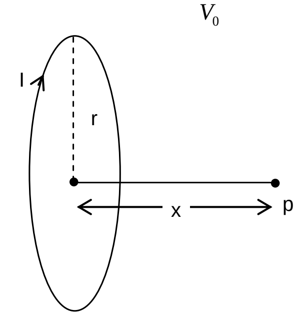
10. A vessel is partly filled with liquid. When the vessel is cooled to a lower temperature, the space in the vessel unoccupied by the liquid remains constant. Then the volume of the liquid (V_L), volume of the vessel $\left(V_V\right)$, the coefficient of cubical expansion of the material of the vessel $\left(\gamma_V\right)$ and of the solid $\left(\gamma_L\right)$ are related as
(A) $\gamma_L = \gamma_V$
(B) $\gamma_L < \gamma_V$
(C) $\frac{\gamma_V}{\gamma_L} = \frac{V_V}{V_L}$
(D) $\frac{\gamma_V}{\gamma_L} = \frac{V_L}{V_V}$

11. One mole of an ideal monoatomic gas has initial temperature T_0, is made to go through the cycle abca shown in fig. If U denotes the internal energy, then choose the incorrect alternative



(A) $U_c > U_b > U_a$
(B) $U_c - U_b = 3RT_0$
(C) $U_c - U_a = \frac{9RT_0}{2}$
(D) $U_b - U_a = \frac{5RT_0}{2}$

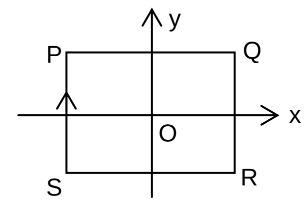
12. P is any point along the axial line of a ring of radius r, carrying current I. A small ring of radius 'a' is placed at P. The magnetic flux through the small ring is



(A) $\frac{\mu_0 I r^2 a^2}{4\pi\left(r^2 + x^2\right)^{3/2}}$
(B) $\frac{\mu_0 I r^2 \pi a^2}{2\left(r^2 + x^2\right)^{3/2}}$
(C) $\frac{\mu_0 I r^2 a^2}{2\left(r^2 + x^2\right)^{3/2}}$
(D) $\frac{\mu_0 I r^2 \pi a^2}{4\pi\left(r^2 + x^2\right)^{3/2}}$

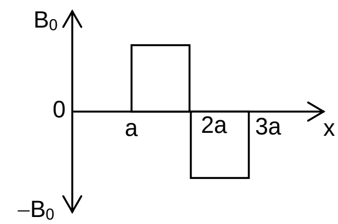
space for rough work

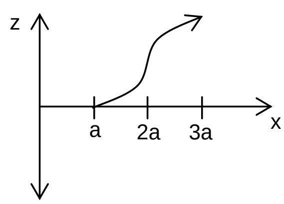
13. Figure shows a square loop PQRS in X-Y plane with its centre at the origin and carrying a current is the direction shown. There is a uniform magnetic field $\vec{B} = B_o(i - j)$. If the coil is released from rest, it will rotate about an axis along

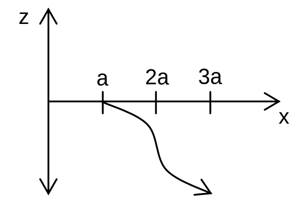


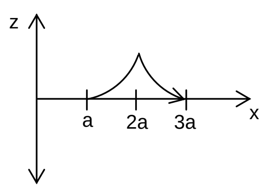
(A) z-axis
(B) QS
(C) PR
(D) x-axis

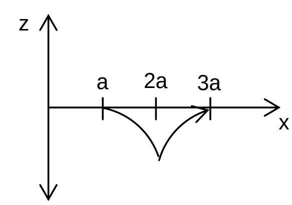
14. A magnetic field $\vec{B} = B_o\hat{j}$ exists in the region $a < x < 2a$ and $\vec{B} = -B_o\hat{j}$, in the region $2a < x < 3a$, where B_o is a positive constant. A positive point charge moving with a velocity $\vec{v} = v_o\hat{i}$, where v_o is a positive constant, enters the magnetic field at x = a. The trajectory of the charge in this region can be like,



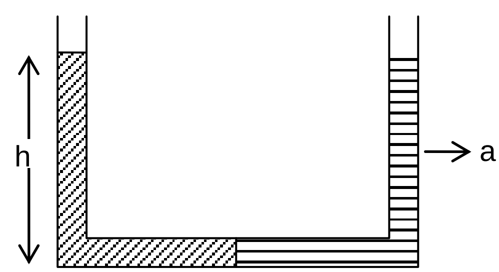
(A)


(B)


(C)


(D)


15. A U – tube of base length 'L' filled with same volume of two liquids of densities ρ and 2ρ is moving with an acceleration 'a' on the horizontal plane. If the height difference between two surfaces becomes zero, then the height h is given by



(A) $\frac{al}{2g}$
(B) $\frac{3al}{2g}$
(C) $\frac{al}{g}$
(D) $\frac{2al}{3g}$

space for rough work

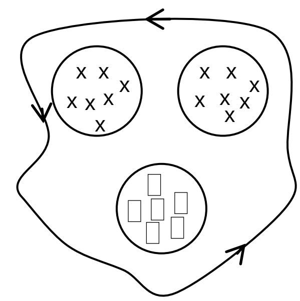
16. The coefficient of viscosity η of a liquid is defined as the tangential force on a layer in that liquid per unit area per unit velocity gradient across it. Then a sphere of radius 'a' moving through it under a constant force F attains a constant v given by (where k is numerical constant)

(A) $kFa\eta$ (B) $\frac{kF}{a}\eta$ (C) $\frac{kF}{a\eta}$ (D) $k\eta\frac{a}{F}$

17. Water is filled in an empty tank of area 10A through a tap of cross sectional area A. The speed of water flowing out of tap is given by $v = 10\left(1-\sin\frac{\pi}{30}t\right)$ where 't' is in seconds. The height of water level from the bottom of the tank at t = 15 sec will be

(A) 10 m (B) $15+\frac{30}{\pi}m$ (C) $\frac{5}{4}m$ (D) $15-\frac{30}{\pi}m$

18. Figure shows three regions of magnetic field each of area A and in each region magnitude of magnetic field decreases at a constant rate α. If $\vec{E}$ is induced electric field then value of line integral $\oint \vec{E}.d\vec{r}$ along the given loop is equal to

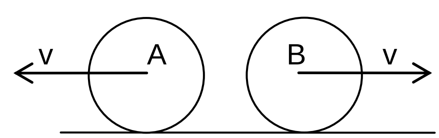


(A) αA (B) $-\alpha A$
(C) $3\alpha A$ (D) $-3\alpha A$

19. A rod of length l having uniformly distributed charge Q is rotated about one end with constant frequency 'f'. Its magnetic moment is

(A) πfQl^2 (B) $\frac{\pi fQl^2}{3}$ (C) $\frac{2\pi fQl^2}{3}$ (D) $2\pi fQl^2$

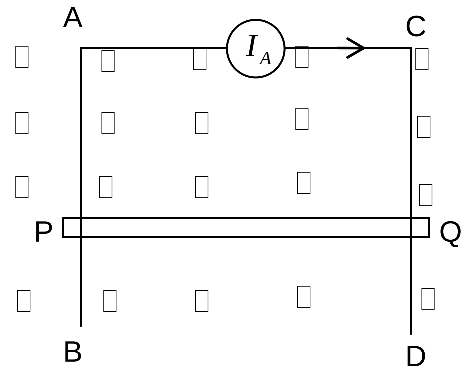
20. Two identical conducting rings A and B of radius R are in pure rolling over a horizontal conducting plane with same speed v but in opposite direction. A constant magnetic field B is present pointing inside the plane of paper. Then the potential difference between the highest points of the two rings is



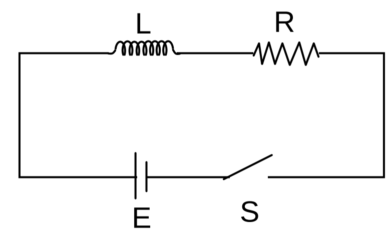
(A) zero (B) $2BvR$
(C) BvR (D) $4BvR$

space for rough work

21. AB and CD are fixed conducting smooth rails placed in a vertical plane and joined by a constant current source at its upper end. PQ is a conducting rod which is free to slide on the rails. A horizontal uniform magnetic field exists in space as shown. If the rod PQ is released from rest then, which of the following option is correct?
(A) The rod PQ will move downward with constant acceleration.
(B) The rod PQ will move upward with constant acceleration
(C) The rod will move downward with decreasing acceleration and finally acquire a constant velocity.
(D) Either A or B.

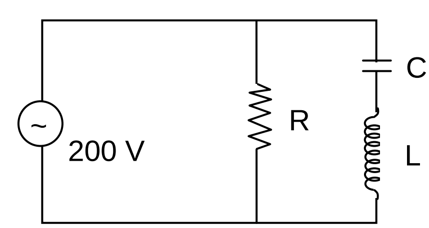


22. In the given circuit having an ideal inductor of inductance L, resistor of resistance R and an ideal cell of emf E, the work done by the battery in one time constant after the switch is closed is



(A) $\frac{E^2}{R}$
(B) $\frac{E^2 Le}{R^2}$
(C) $\frac{E^2 L}{R^2}$
(D) $\frac{E^2 L}{eR^2}$

23. In the circuit diagram shown $x_C = 100\Omega$, $x_L = 200\Omega$ and $R = 100\Omega$. The effective current through the source is



(A) 2 A
(B) $2\sqrt{2}A$
(C) 0.5 A
(D) $\sqrt{0.4}A$

24. 10 A bulb is rated at 100 V, 100W it can be treated as a resistor. Find the inductance of an inductor that should be connected in series with the bulb to operate the bulb at its rated power with the help of ac source of 200, 50Hz
(A) $\frac{\pi}{\sqrt{3}}H$
(B) 100 H
(C) $\frac{\sqrt{2}}{\pi}H$
(D) $\frac{\sqrt{3}}{\pi}H$

space for rough work

25. A rod of length l and cross section area A has a variable thermal conductivity given by $K = \alpha T$ where α is a positive constant and T temperature in Kelvin. Two ends of the rod are maintained at temperatures T_1 and T_2 ($T_1 > T_2$). Heat current flowing through the rod will be

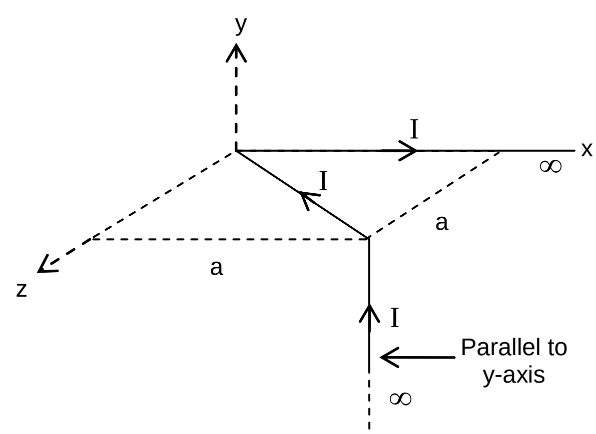
(A) $\frac{A\alpha\left(T_1^2 - T_2^2\right)}{l}$ (B) $\frac{A\alpha\left(T_1^2 + T_2^2\right)}{l}$ (C) $\frac{A\alpha\left(T_1^2 + T_2^2\right)}{3l}$ (D) $\frac{A\alpha\left(T_1^2 - T_2^2\right)}{2l}$

26. A black body emits radiation at the rate P when its temperature is T. At this temperature the wavelength at which the radiation has maximum intensity is λ_0. If at another temperature T' the power radiated is P' and wavelength at maximum intensity is $\frac{\lambda_0}{2}$ then

(A) $P'T' = 32PT$ (B) $P'T' = 16PT$ (C) $P'T' = 8PT$ (D) $P'T' = 4PT$

27. An ideal monoatomic gas undergoes a process described as $PV^2 =$ constant, then
(i) If volume increases temperature will decrease
(ii) For expansion heat will have to be supplied to the gas
(iii) If temperature increases workdone by gas is negative
(A) only (i) is correct (B) only (iii) is correct (C) (i), (ii) are correct (D) (i), (iii) are correct

28. The magnetic field at the origin due to the current flowing in the wire as shown in figure below is



(A) $-\frac{\mu_0 I}{8\pi a}\left(\hat{i} + \hat{k}\right)$

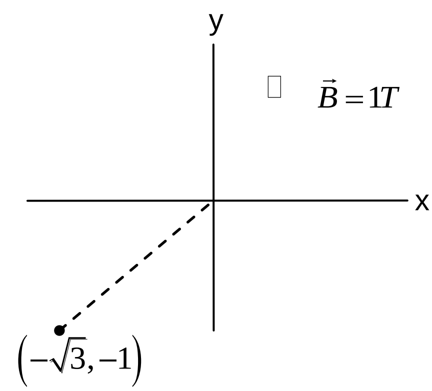
(B) $\frac{\mu_0 I}{2\pi a}\left(\hat{i} + \hat{k}\right)$

(C) $\frac{\mu_0 I}{8\pi a}\left(-\hat{i} + \hat{k}\right)$

(D) $\frac{\mu_0 I}{4\pi a\sqrt{2}}\left(\hat{i} - \hat{k}\right)$

space for rough work

29. A uniform magnetic field of magnitude 1T exists in region $y \geq 0$ is along x direction as shown. A particle of charge 1C is projected from a point $\left(-\sqrt{3}, -1\right)$ towards origin with speed 1 m/sec. If mass of particle is 1 kg then co-ordinates of centre of circle in which particle moves are



(A) $\left(1, \sqrt{3}\right)$ (B) $\left(1, -\sqrt{3}\right)$

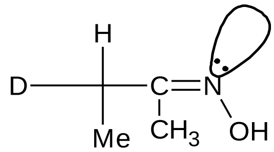
(C) $\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$ (D) $\left(\frac{\sqrt{3}}{2}, -\frac{1}{2}\right)$

30. A small area is removed from a uniform spherical shell of mass M and radius R, then the gravitational field intensity near the hollow portion is

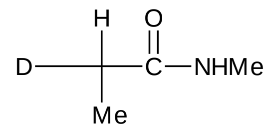
(A) $\frac{GM}{R^2}$ (B) $\frac{GM}{2R^2}$ (C) $\frac{3GM}{2R^2}$ (D) Zero

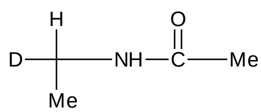
space for rough work

Section – II (Chemistry)

1. When  is reacted with an acid, the product formed is:

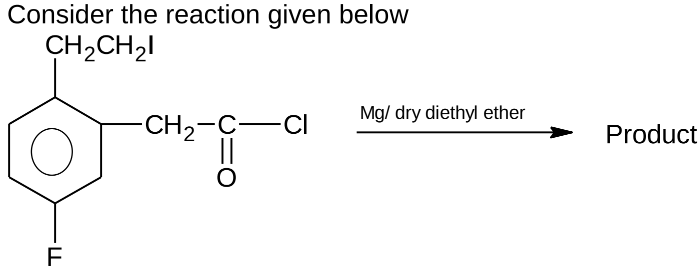
(A) No reaction

(B) 

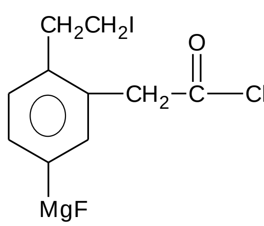
(C) 

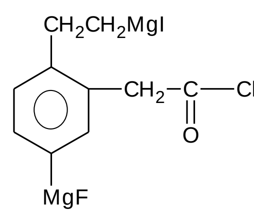
(D) Both (B) and (C) are Correct

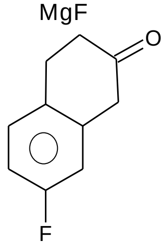
2. Consider the reaction given below

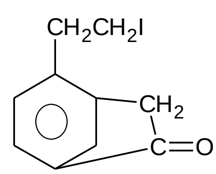


The final product of the reaction is

(A) 

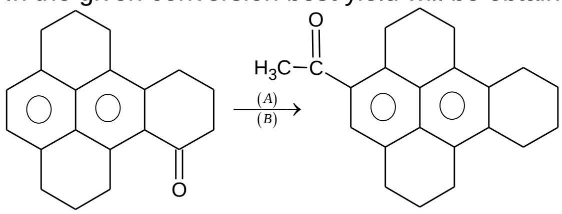
(B) 

(C) 

(D) 

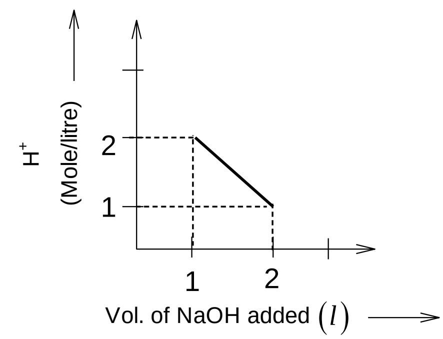
space for rough work

3. In the given conversion best yield will be obtained with:



(A) A = CH_3COCl , $AlCl_3$, B = Zn/Hg, HCl
(B) A = Zn/Hg, HCl, B = CH_3COCl, $AlCl_3$
(C) A = CH_3CH_2Cl, $AlCl_3$, B = Zn/Hg, HCl
(D) A = NH_2 - NH_2/OH^-, B = CH_3CH_2Cl, $AlCl_3$

4. 1M NaOH solution was slowly added to 1000 ml of 196 g impure H_2SO_4 solution and the following plot was obtained. The percentage purity of H_2SO_4 sample and slope of the curve respectively are



(A) 75%, $-\frac{1}{3}$
(B) 80%, $-\frac{1}{2}$
(C) 80%, - 1
(D) 75%, -1

5. In an iodometric estimation, the following reactions occur

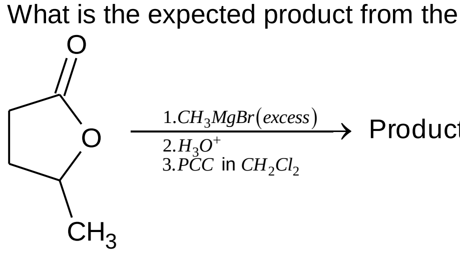
$$2Cu^{+2} + 4I^- \rightarrow Cu_2I_2 + I_2$$

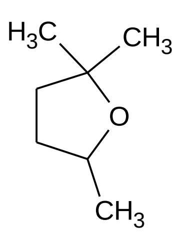
$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

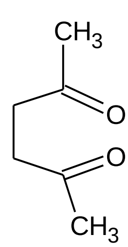
0.12 mole of $CuSO_4$ was added to excess of KI solution and the liberated iodine required 120 ml of hypo. The molarity of hypo solution was:

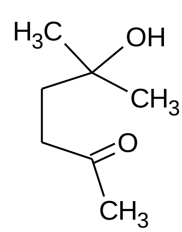
(A) 2
(B) 0.2
(C) 0.1
(D) 1.0

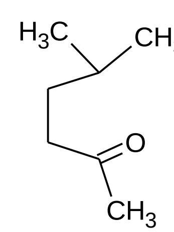
6. What is the expected product from the reaction below?



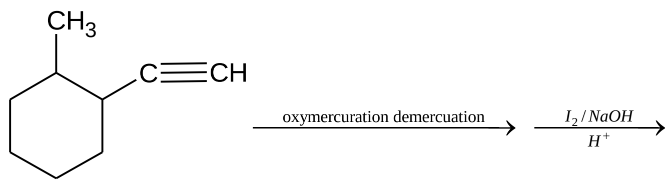
(A) 

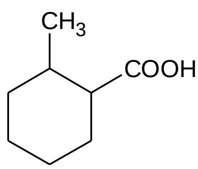
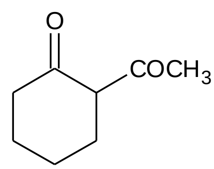
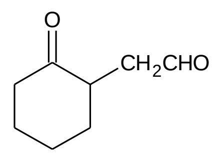
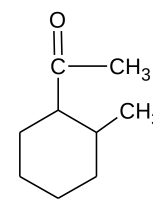
(B) 

(C) 

(D) 

space for rough work

7.  X, X is:

(A) 
(B) 
(C) 
(D) 

8. Consider the following reaction of 1 mole of the reactant with NH_2NHPh.

CHO
|
(CHOH)$_4$ $\xrightarrow{x\,NH_2NHPh}$
|
CH_2OH

CHO
| $\xrightarrow{y\,NH_2NHPh}$
CH_2CH_3

The ratio of $x : y$ in the above reactions is:

(A) 1 : 1 (B) 2 : 1 (C) 3 :1 (D) 1 : 2

9. $(CH_3)_2CO \xrightarrow[HCN]{NaCN} (A) \xrightarrow{H_3O^+} (B)$

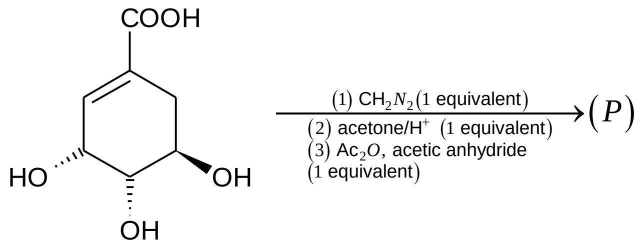
In the above sequence of reactions, (A) and (B) are:

(A) $(CH_3)_2C(OH)CN, (CH_3)_2C(OH)COOH$
(B) $(CH_3)_2C(OH)CN, (CH_3)_2C(OH)_2$
(C) $(CH_3)_2C(OH)CN, (CH_3)_2CHCOOH$
(D) $(CH_3)_2C(OH)CN, (CH_3)_2CO$

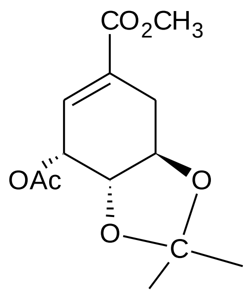
10. A mixture of benzaldehyde and formaldehyde on heating with aqueous NaOH gives:

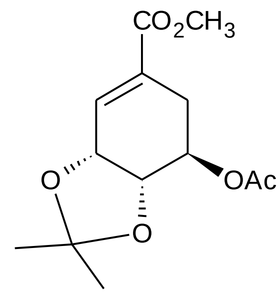
(A) benzyl alcohol and sodium formate
(C) sodium benzoate and methyl alcohol
(C) sodium benzoate and sodium formate
(D) benzyl alcohol and methyl alcohol

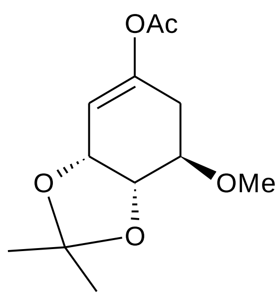
space for rough work

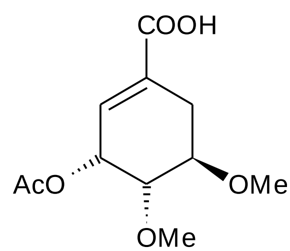
11. 

Product (P) is

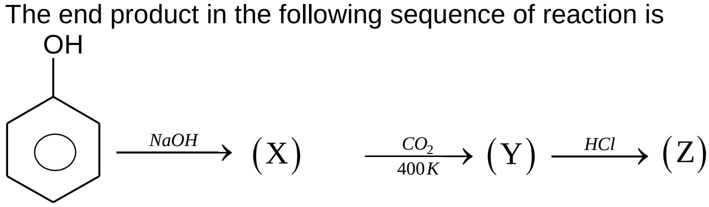
(A) 

(B) 

(C) 

(D) 

12. The end product in the following sequence of reaction is

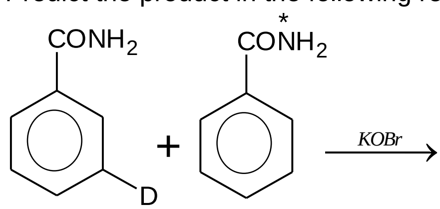


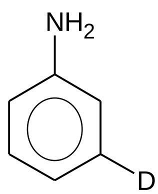
(A) salicylaldehyde
(B) benzoic acid
(C) p-chlorohydroxybenzene
(D) 2-hydroxybenzoic acid

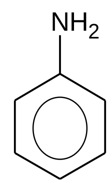
13. Which of the following compounds is oxidized to prepare methyl ethyl ketone?
(A) 2-propanol
(B) 1-butanol
(C) 2-butanol
(D) tert-butylalcohol

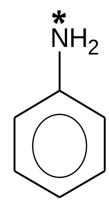
space for rough work

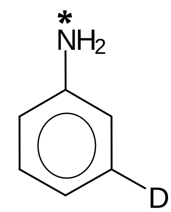
14. Predict the product in the following reaction:



(I) 

(II) 

(III) 

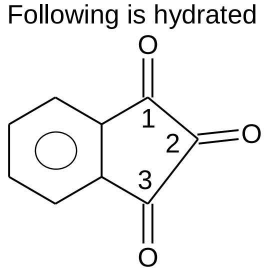
(IV) 

(A) I and II (B) I and III (C) II and III (D) I and IV

15. An aqueous solution of 6.3 g of oxalic acid dihydrate is reacted with 1 M NaOH. The volume of NaOH required to neutralize it completely is:
(A) 0.1 L (B) 0.2 L (C) 0.3L (D) 0.4 L

16. Which of the following oxides of nitrogen is a coloured gas?
(A) N_2O (B) NO (C) N_2O_4 (D) NO_2

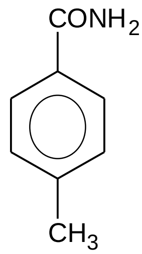
17. Following is hydrated maximum at the position:

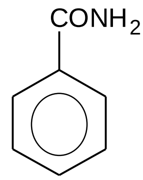


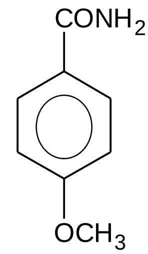
(A) 1 (B) 2 (C) 3 (D) equal

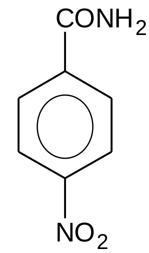
space for rough work

18. Which of the following can undergo Hofmann Bromamide reaction most easily?

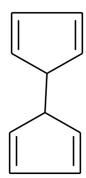
(A) 

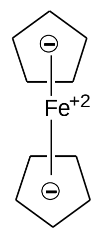
(B) 

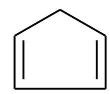
(C) 

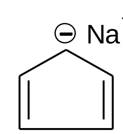
(D) 

19. Consider the following reactions
Cyclopentadiene + Na → C + H_2
2C + $FeCl_2$ → D + 2NaCl
Identify D.

(A) 

(B) 

(C) 

(D) 

20. $\left[Fe(CN)_6\right]^{4-} + H^+ + MnO_4^- \rightarrow Fe^{+3} + CO_2 + NO_3^- + Mn^{+2}$

$Fe^{+3} + Zn(s) \rightarrow Fe^{+2} + Zn^{+2}$

In the above reactions if the mass of $Zn(s)$ used is 0.65 g, then the number of equivalents of $\left[Fe(CN)_6\right]^{4-}$ reacted will be($M_{Zn} = 65$)

(A) 0.061 (B) 1.22 (C) 0.0061 (D) 0.122

space for rough work

21. A nitrate decomposes thermally to give an oxide of group 15 element. The oxide cannot be obtained by direct combination of the element and the oxygen. The trichloride of this group 15 element can hydrolyze only partially. The oxide is
(A) Bi_2O_3 (B) P_2O_3 (C) As_2O_3 (D) N_2O

22. A sample when heated with $dil.H_2SO_4$ does not evolve brown vapour but when heated with concentrated H_2SO_4 brown vapours are obtained. The vapour when brought in contact with silver nitrate solution do not give any precipitate. Therefore, the sample contains
(A) NO_2^- (B) NO_3^- (C) I^- (D) Br^-

23. When an equimolar mixture of Cu_2S and CuS is titrated with $Ba\left(MnO_4\right)_2$ in acidic medium, the final product contains Cu^{+2}, SO_2 and Mn^{+2}. If the molecular weight of Cu_2S, CuS and $Ba\left(MnO_4\right)_2$ are M_1, M_2 and M_3 respectively, then
(A) Equivalent weight of Cu_2S is $\frac{M_1}{8}$
(B) Equivalent weight of CuS is $\frac{M_2}{7}$
(C) Cu_2S and CuS both have same equivalents in mixture
(D) None of these is correct

24. Two gases A and B present separately in two vessels X and Y at the same temperature with molecular weights 'M' and '2 M' respectively are effused out. The orifice in vessel X is circular while that in Y is a square. If the radius of the circular orifice is equal to that of the length of the square orifice, the ratio of rates of effusion of gas A to that of gas B is.
(A) $\sqrt{2}\pi$ (B) $\sqrt{\frac{\pi}{2}}$ (C) 2π (D) $\sqrt{\frac{2}{\pi}}$

25. In both DNA and RNA, the heterocyclic base and phosphate ester linkages are at:
(A) C_5 and C_2 respectively of the sugar molecule
(B) C_2 and C_5 respectively of the sugar molecule
(C) C_1 and C_5 respectively of the sugar molecule
(D) C_5 and C_1 respectively of the sugar molecule

26. Cellulose is a straight chain polysaccharide composed of only
(A) D-Glucose units joined by $\alpha-$glycosidic linkage
(B) D-Glucose units joined by $\beta-$glycosidic linkage
(C) D-Galactose units joined by $\alpha-$glycosidic linkage
(D) D-Galactose units joined by $\beta-$glycosidic linkage

space for rough work

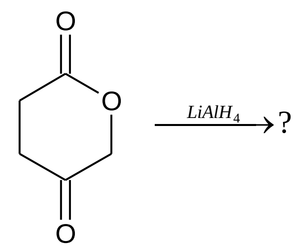
27. The drain cleaner, drainex contains small bits of aluminium which reacts with caustic soda to produce hydrogen. What volume of hydrogen at 20^{0}C and 0.987 atm will be released when 0.15 g of aluminium reacts?

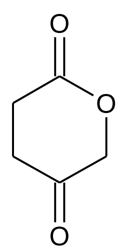
(Use, $M.Wt_{Al} = 27$)

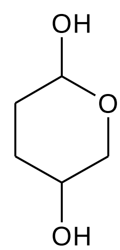
(A) 180 ml (B) 203 ml (C) 30.8 ml (D) 500 ml

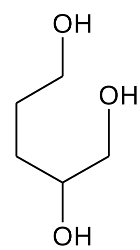
28. One gas bleaches the colour of flowers by reduction, while the other by oxidation, the two gas respectively are:

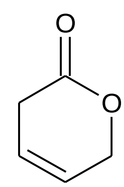
(A) CO and Cl_2 (B) H_2S and Br_2 (C) NH_3 and SO_3 (D) SO_2 and Cl_2

29.  Which of the following is correct product.

(A) 

(B) 

(C) 

(D) 

30. The end products in the Cannizzaro reaction of benzaldehyde is

(A) $PhCOONa, PhCH_2OH$ (B) $PhCOOH, PhCH_2COONa$

(C) $PhCH_2OH, PhCOCH_3$ (D) $PhCOONa, PhCOCH_3$

pace for rough work

Section – III (Mathematics)

1. Ten points are marked on a straight line and 11 points are marked on another straight line. How many triangles can be formed with the vertices from among the above points
(A) 1120 (B) 924 (C) 1092 (D) None of these

2. Rajdhani express going from Bombay to Delhi stops at five intermediate stations, 10 passengers enter the train during the journey with 10 different ticket of two classes. The number of different sets of tickets they may have is
(A) ${}^{15}C_{10}$ (B) ${}^{20}C_{10}$ (C) ${}^{30}C_{10}$ (D) None of these

3. A man is known to speak the truth 3 out of 4 times. He throws a die & reports that it is a six. The probability that it is actually a six is
(A) $\frac{3}{8}$ (B) $\frac{1}{5}$ (C) $\frac{3}{4}$ (D) none of these

4. The probability that a rectangle picked up from a chessboard has the area 6cm^2 where the distance between consecutive parallel lines on the board is 1 cm, is
(A) $\frac{3}{56}$ (B) $\frac{3}{28}$ (C) $\frac{9}{56}$ (D) none of these

5. Probability of a man hitting a target is $\frac{1}{4}$, then the number of times a man must fire to hit a target so that probability of his hitting the target at least once is greater than $\frac{2}{3}$ is
(A) 2 (B) 4
(C) 6 (D) none of these

6. A box contains tickets numbered 1 to N, n tickets are drawn from the box with replacement then the probability of largest number on the ticket is k, is
(A) $\left(\frac{k-1}{N}\right)^{n-1} - \left(\frac{k}{N}\right)^{n-1}$ (B) $\left(\frac{k}{N}\right)^{n} - \left(\frac{k-1}{N}\right)^{n}$
(C) $\left(\frac{k}{N}\right)^{n}$ (D) none of these

7. Three of the six vertices of a regular hexagon are chosen at random. The probability that the triangle with three vertices is equilateral is
(A) $\frac{1}{2}$ (B) $\frac{1}{5}$
(C) $\frac{1}{10}$ (D) $\frac{1}{20}$

space for rough work

8. Let a triangle is formed selecting vertices of a cube as a vertices, then probability that the triangle is right angled triangle is
(A) 3/7 (B) 4/7 (C) 6/7 (D) None of these

9. The number of ways of selecting two numbers from the set {1, 2, …,12} whose sum is divisible by 3 is
(A) 66 (B) 16 (C) 6 (D) 22

10. The number of ways in which 15 boys and 2 girls can sit in a row such that between the girls at the most 2 boys sit is
(A) $17! - (12! \times 3!)$ (B) $17! - ({}^{12}C_3 \times 3!)$ (C) $17! - ({}^{12}C_3 \times 15!)$ (D) $17! - (91 \times 2! \times 15!)$

11. The number of non – negative integral solution of $x_1 + x_2 + x_3 + x_4 \le n$ (where n is a positive integer) is
(A) ${}^{n+3}C_4$ (B) ${}^{n+4}C_4$ (C) ${}^{n+3}C_{n-1}$ (D) None of these

12. In a polygon, no three diagonal are concurrent. If the total number of points of intersection of diagonals interior to the polygon is 70, then the number of diagonals of the polygon is
(A) 2 (B) 4 (C) 6 (D) 8

13. Let x be A.M. and y, z be the two geometric means between any two positive numbers. Then
$\frac{y^3 + z^3}{xyz} = \dots$
(A) 2 (B) 3 (C) 4 (D) $\frac{1}{2}$

14. If $a_1, a_2, a_3, \dots, a_n$ are in H.P., then $a_1a_2 + a_2a_3 + \dots + a_{n-1}a_n =$
(A) a_1a_n (B) na_1a_n (C) $(n-1)a_1a_n$ (D) None

15. Sum of the series
$\frac{1^3}{1} + \frac{1^3 + 2^3}{1+3} + \frac{1^3 + 2^3 + 3^3}{1+3+5} + \dots$ to 16 terms is
(A) 346 (B) 446 (C) 546 (D) None

16. 150 workers were engaged to finish a piece of work in a certain number of ways, 4 workers dropped the second day, 4 more workers dropped the third day and so on. It takes 8 more days to finish the work now. The number of days in which the work was completed is
(A) 15 (B) 20 (C) 25 (D) 30

space for rough work

17. $\sum_{r=0}^{n} {}^nC_r \sin rx$ is equal to

(A) $2^n \cos^n \frac{x}{2}.\sin\frac{nx}{2}$ (B) $2^n \sin^n \frac{x}{2}.\cos\frac{nx}{2}$ (C) $2^{n+1} \cos^n \frac{x}{2}.\sin\frac{nx}{2}$ (D) $2^{n+1} \sin^n \frac{x}{2}.\cos\frac{nx}{2}$

18. In a G.P., the sum of three numbers is 14, if 1 is added to first two numbers and subtracted from third number, the series becomes A.P., then the greatest number is
(A) 8 (B) 4 (C) 24 (D) 16

19. Let p and q be two statements, then $(p \vee q) \vee \sim p$ is
(A) tautology (B) contradiction
(C) Both tautology & contradiction (D) none of these

20. The contrapositive of "if two triangles are identical, then these are similar" is
(A) if two triangle are not similar, then these are not identical
(B) if two triangles are not identical then these are not similar
(C) if two triangles are not identical then these are similar
(D) none of these

21. If $1, \omega, \omega^2$ be the three cube roots of 1 then incorrect statement is
(A) $(2+\omega+\omega^2)^3 + (1+\omega-\omega^2)^8 - (1-3\omega+\omega^2)^4 = 1$
(B) $(1-\omega+\omega^2)(1-\omega^2+\omega^4)(1-\omega^4+\omega^8)(1-\omega^8+\omega^{16}) = 16$
(C) $(1-\omega+\omega^2)(1-\omega^2+\omega^4)(1-\omega^4+\omega^8)(1-\omega^8+\omega^{16}) = 8$
(D) None of these

22. Let *z, w* be complex numbers such that $\bar{z} + i\bar{w} = 0$ and *arg* $zw = \pi$, then *arg z* equals

(A) $5\pi/4$ (B) $\pi/2$ (C) $3\pi/4$ (D) $\pi/4$

23. If the roots of the quadratic equation $x^2 + px + q = 0$ are $\tan 30^0$ and $\tan 15^0$, respectively then the value of $q - p$ is
(A) 1 (B) 2 (C) 3 (D) 4

24. If one root of the equation $x^2 - 30x + \lambda = 0$ is the square of the other, then cube root of λ is not
(A) 5 (B) 6 (C) -6 (D) None of these

space for rough work

25. Let z_1, z_2 and z_3 are three complex numbers such that $|z_1| = |z_2| = |z_3| = 1$ and $\frac{z_1^2}{z_2 z_3} + \frac{z_2^2}{z_1 z_3} + \frac{z_3^2}{z_1 z_2} + 1 = 0$ then integral values of $|z_1 + z_2 + z_3|$ can be

(A) 0 (B) 1 (C) 3 (D) None of these

26. Let $f(x) = x^4 + ax^3 + bx^2 + cx + d$ be a polynomial with real coefficient and real zeroes. If $|f(i)| = 1$ (where i = $\sqrt{-1}$), then

(A) all the roots are zero (B) some of the roots are not zero
(C) $a+b+c+d=1$ (D) $a+b+c+d \neq 0$

27. If an equilateral triangle ABC with vertices z_1, z_2 and z_3 be inscribed is circle $|z| = 2$ then value of $\mathrm{Re}(z_1\bar{z}_2 + z_2\bar{z}_3 + z_3\bar{z}_1)$ is

(A) 6 (B) -6 (C) -12 (D) None of these

28. For the quadratic equation $ax^2 - bx + 12 = 0$, if roots are of opposite sign then

(A) $b^2 \geq 48a$ (B) $a > 15$ (C) $a > 2, b > 3$ (D) None of these

29. $\sum_{r=0}^{n} \frac{2^{r+2}.\,{}^nC_r}{(r+1).(r+2)}$ is equal to

(A) $\frac{3^{n+2} - 2n + 5}{(n+1)(n+2)}$ (B) $\frac{3^{n+2} - 4n + 5}{(n+1).(n+2)}$ (C) $\frac{3^{n+2} - 2n - 5}{(n+1).(n+2)}$ (D) None of these

30. $\sum_{r=1}^{n} r^3.\left(\frac{{}^nC_r}{{}^nC_{r-1}}\right)^2$ is equal to

(A) $\frac{(n+1)(n+2)^2}{12}$ (B) $\frac{n(n+1)^2(n+2)}{12}$ (C) $\frac{n^2(n+1)(n+2)}{12}$ (D) None of these

space for rough work

FIITJEE - JEE **(Mains)**

CPA A-LOT BATCH
PHYSICS, CHEMISTRY & MATHEMATICS
JEE - MAINS 2014
PHASE – 3
SET - A
ANSWERS
PHYSICS

1.	C	2.	A	3.	C	4.	D
5.	C	6.	C	7.	C	8.	B
9.	C	10.	D	11.	D	12.	B
13.	B	14.	A	15.	B	16.	C
17.	D	18.	B	19.	B	20.	D
21.	D	22.	D	23.	B	24.	D
25.	D	26.	A	27.	D	28.	C
29.	C	30.	B				

CHEMISTRY

1.	C	2.	C	3.	B	4.	D
5.	D	6.	C	7.	A	8.	C
9.	A	10.	A	11.	B	12.	D
13.	C	14.	B	15.	A	16.	D
17.	B	18.	C	19.	B	20.	B
21.	A	22.	B	23.	A	24.	A
25.	C	26.	B	27.	B	28.	D
29.	C	30.	A				

MATHEMATICS

1.	D	2.	C	3.	A	4.	D
5.	B	6.	B	7.	C	8.	C
9.	D	10.	D	11.	B	12.	D
13.	A	14.	C	15.	B	16.	C
17.	A	18.	A	19.	A	20.	A
21.	C	22.	C	23.	A	24.	B
25.	B	26.	A	27.	B	28.	D
29.	C	30.	B				

HINTS & SOLUTIONS
Physics

1. C

Sol. From the given V – T diagram. In process AB, $V \propto T$ therefore pressure is constant. In process BC, V = constant

In process CA, Temp = const

2. A

Sol. In a cyclic process

$$\Delta U = 0$$

$$\therefore \; Q_{cyclic} = w_{cyclic}$$

$$5 = w_{A\to B} + w_{B\to C} + w_{C\to A}$$

$$w_{B\to C} = 0 \;(\text{isochoric process})$$

$$w_{A\to B} = 10(2-1) = 10J$$

$$5 = 10 + 0 + w_{C\to A}$$

$$w_{C\to A} = -5J$$

3. C

Sol. Conserving M.E. at surface and centre of earth for both particles

$$\frac{1}{2}mv^2 - \frac{3}{2}\frac{GMm}{R} - \frac{GMm}{R}$$

$v = \sqrt{\frac{Gm}{R}}$ (at the centre of earth)

Conserving momentum after collision

$v' = \frac{v}{3}$, velocity of combined mass

If x is amplitude of motion, further conserving mechanical energy

$$\frac{1}{2}(3m)v'^2 - \frac{3}{2}\frac{GM(3m)}{R} = \frac{-GM(3m)}{2R^3}(3R^2 - x^2)$$

Solving $x = \frac{R}{3}$

4. D

Sol. The speed of spaceship in a circular orbit close to earth's surface is $v_0 = \sqrt{gR}$ and escape velocity is $v_e = \sqrt{2gR}$

$\therefore$ Additional velocity required to escape

$$v_e - v_0 = \sqrt{2gR} - \sqrt{gR}$$

$$= \left(\sqrt{2} - 1\right)\sqrt{gR}$$

5. C

Sol. Rate of flow of heat along PQ

$$\left(\frac{dQ}{dt}\right)_{PQ} = \frac{k_3 A\Delta\theta}{l} \qquad ...(1)$$

Rate of flow of heat long PRQ

$$\left(\frac{dQ}{dt}\right)_{PRQ} = \frac{k_3 A\Delta Q}{2l}$$

For series combination of two rods effective conductivity $k_s = \frac{2k_1k_2}{k_1+k_2}$

$$\left(\frac{dQ}{dt}\right)_{PRQ} = \frac{2k_1k_2}{k_1+k_2}.\frac{A\Delta\theta}{2l}$$

$$= \left(\frac{k_1k_2}{k_1+k_2}\right)\frac{A\Delta\theta}{l} \quad ...(2)$$

From (1) and (2)

$$k_3 = \frac{k_1k_2}{k_1+k_2}$$

6. C

Sol. $dQ = dU + dw$

$$nCdt = nC_v dT + dw$$

$$dw = (C - C_v)dT$$

$$C = \alpha T,\, C_V = \frac{5R}{2}$$

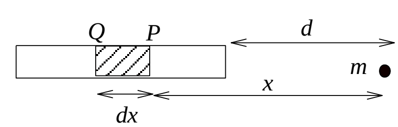
$$dw = \left(\alpha T - \frac{5R}{2}\right)dT$$

$$w = \int_{T_0}^{2T_0}\left(\alpha T - \frac{5R}{2}\right)dT$$

$$w = (3\alpha T_0 - 5R)\frac{T_0}{2}$$

7. C

Sol. Force due to a small element dx at a distance x from the particle



$$dF = \frac{G(dm)m}{x^2}$$

$$dm = \lambda dx$$

$$dF = \frac{G\lambda m}{x^2}dx$$

$$F = \int_{d}^{l+d}\frac{G\lambda m}{x^2}dx$$

$$F = \frac{G\lambda ml}{d(l+d)}$$

8. B

Sol. Use Newton's law of Cooling

9. C

Sol. Potential difference between two points $V_A - V_B = -\int_B^A \vec{E}.d\vec{r}$

10. D

Sol. $\Delta V_L = \Delta V_V$

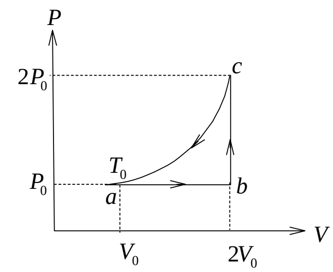
$$\gamma_L V_L = \gamma_V V_V$$

$$\frac{\gamma_L}{\gamma_V} = \frac{V_V}{V_L}$$

$$V_V > V_L \Rightarrow \gamma_L > \gamma_V$$

11. D

Sol. One mole of an ideal monatomic gas(Initial temperature T_0) is made to go through the cycle abca shown in fig. U denotes the internal energy.



For process ab, $\frac{V_0}{T_0} = \frac{2V_0}{T_0}$

$$T_b = 2T_0$$

$$T_b > T_a, U_b > U_a$$

$$U_b - U_a = C_v \Delta T = \frac{3R}{2}\left(2T_0 - T_0\right) = \frac{3RT_0}{2}$$

For Process bc,

$$\frac{P_0}{2T_0} = \frac{2P_0}{T_c}$$

$$T_c = 4T_0$$

$$U_c - U_b = \frac{3R}{2}\left(4T_0 - 2T_0\right) = 3RT_0$$

For the Process ca

$$U_c - U_a = \frac{3R}{2}\left(4T_0 - T_0\right) = \frac{9RT_0}{2}$$

12. B

Sol. Find field due to ring of radius r at point P and flux through small ring is $\phi = BA$.

13. B

Sol. Use $\vec{\tau} = \vec{M} \times \vec{B}$

14. A

Sol. $\vec{F}_m = Q\left(\vec{V} \times \vec{V}\right)$

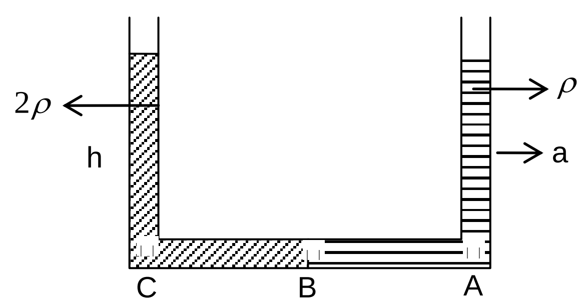
15. B

Sol.

$$P_B - P_A = \rho a \frac{l}{2}$$

$$P_C - P_B = \left(2\rho\right) a \frac{l}{2}$$

$$\Rightarrow P_C - P_A = \frac{3}{2}\rho a l$$



Also $P_A = P_0 + \rho g h,\ P_C = P_0 + 2\rho g h$

$$\Rightarrow \rho g h = \frac{3}{2}\rho a l$$

16. C

Sol. By dimensional analysis.

17. D

Sol. Volume filled in tank till 15 sec

$$V = \int_0^{15} A v dt$$

$$= \int_0^{15} A.10\left(1 - \sin\frac{\pi}{30}t\right)dt$$

$$V = 10\left(15 - \frac{30}{\pi}\right)A$$

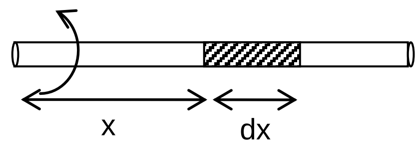
$$h = \frac{V}{10A} = \left(15 - \frac{30}{\pi}\right)A$$

18. B

Sol. $\oint \vec{E}.d\vec{r} = -\left(\frac{dB}{dt}\right)A$ and take the sign of flux according to right hand curl rule.

19. B

Sol. For a small element of length dx



$$dq = \frac{Q}{l}dx$$

Corresponding current $dI = \frac{dq}{T} = (dq)\,f$

Magnetic moment $d\mu = (dI)\,A$

$$d\mu = (\pi x^2)\,f\,\frac{Q}{L}dx$$

$$\mu = \int_0^L \frac{\mu fQ}{L}x^2 dx = \frac{\pi fQL^2}{3}$$

20. D

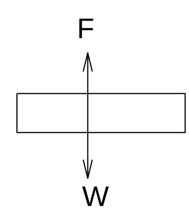
Sol. Considering rotation of diameter about lowest point

$\varepsilon = \frac{B\omega(2r)^2}{2} = 2Bvr$ in (A)

$\varepsilon = -2Bvr$ in (B)

21. D

Sol. $\vec{F}_m = I\left(d\vec{l} \times \vec{B}\right)$



$$\therefore a = \frac{F - W}{m}$$

$\Rightarrow$ Magnitude is constant and direction depend on the mass of rod

22. D

Sol. $I = \frac{\varepsilon}{R}\left[1 - e^{-\frac{Rt}{L}}\right]$

Charge passing through battery

$$q = \int idt$$

$$q = \frac{\varepsilon}{R}\int_0^{L/R}\left(1 - e^{-\frac{Rt}{L}}\right)dt$$

$$q = \frac{\varepsilon L}{eR^2}$$

Work done by battery = $q\varepsilon = \frac{\varepsilon^2 L}{eR^2}$

23. B

Sol. $I_R = \frac{200}{e} \to 2A$

$I' \to \frac{200}{x_C - x_L} = \frac{200}{100} = 2A$[Current in L, C arm]

$I = \sqrt{I_R^2 + \left(I'\right)^2} = 2\sqrt{2}A$

24. D

Sol. Resistance of bulb $R = \frac{V^2}{P} = 100\Omega$

For bulb to be operated at rated power I = 1 A

$I = \frac{V}{\sqrt{R^2 + x_L^2}}$

$\Rightarrow 1 = \frac{200}{\sqrt{100^2 + \left(2\pi \times 50 x_L\right)^2}}$

$L = \frac{\sqrt{3}}{\pi} H$

25. D

Sol. Heat current $I = -KA\frac{dT}{dx}$

$\Rightarrow Idx = -KAdT$

$\Rightarrow I\int_0^L dx = -A\alpha\int_{T_1}^{T_2} TdT$

$\Rightarrow IL = \frac{-A\alpha\left(T_2^2 - T_1^2\right)}{2}$

$I = \frac{A\alpha\left(T_1^2 - T_2^2\right)}{2l}$

26. A

Sol. $P \propto T^4$

$\lambda \propto \frac{1}{T}$

$\Rightarrow P \propto \frac{1}{\lambda^4}$

$\Rightarrow P' = 16P,\ T' = 2T_0$

$\therefore P'T' = 32PT$

27. D

Sol. PV^2 =Constant

From ideal gas equation $VT =$ constant , (i) is correct

$dQ = dV + PdV \qquad \left[\because dV = \frac{-K}{T^2}dT\right]$

$= nC_V dT - \frac{PK}{T^2}dT$

$= nC_V dT - \frac{PVdT}{T}$

$dQ = n\left(C_V - R\right)dT$

If for expansion V increase $\therefore$ T decreases $\Rightarrow dT = -ve$

also $C_V = \frac{3R}{2}$ $\therefore dQ = -ve$ heat is rejected by gas

Also $dW = pdV = \frac{-PV}{T}dT = -nRdT$

If $T \to +ve$ $dW = -ve$

28. C

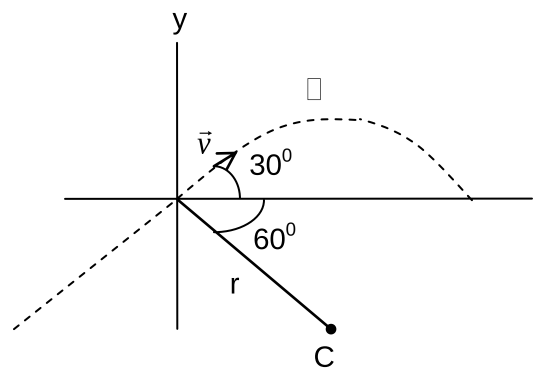
Sol. Field is only due to section parallel to y –axis

$\vec{B} \to \frac{\mu_0 I}{4\pi a\sqrt{2}}\left[\cos 45^0\left(-\hat{i}\right) + \cos 45^0\left(\hat{k}\right)\right]$

$\vec{B} \to \frac{\mu_0 I}{8\pi a}\left[-\hat{i} + \hat{k}\right]$

29. C

Sol. $r = \frac{mv}{qB} = \frac{1\times 1}{1\times 1} = 1m$



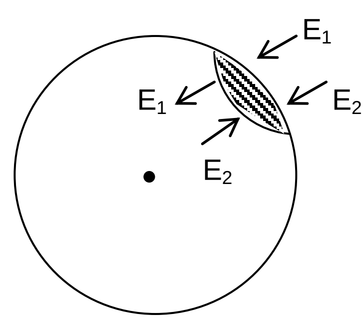
30. B

Sol. $E_2 \to$ field due small area on the shell

$E_1 \to$ field due to remaining portion.

$E_{in} \to$ field inside the complete shell

$E_{out} \to$ field outside the complete shell



$E_{in} = E_1 - E_2 = 0$

$\Rightarrow E_1 = E_2$

$E_q \Rightarrow E_1 + E_2 = \frac{GM}{R^2}$

$\therefore E_1 = E_2 = \frac{GM}{2R^2}$

When small portion is cut out only E_1 is left.

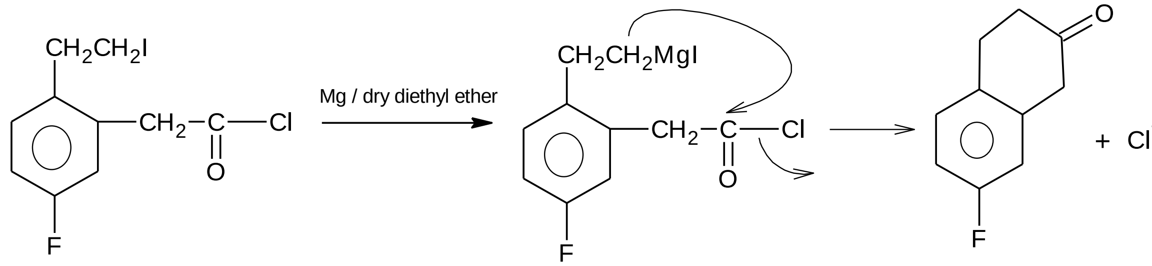
Chemistry

1. C

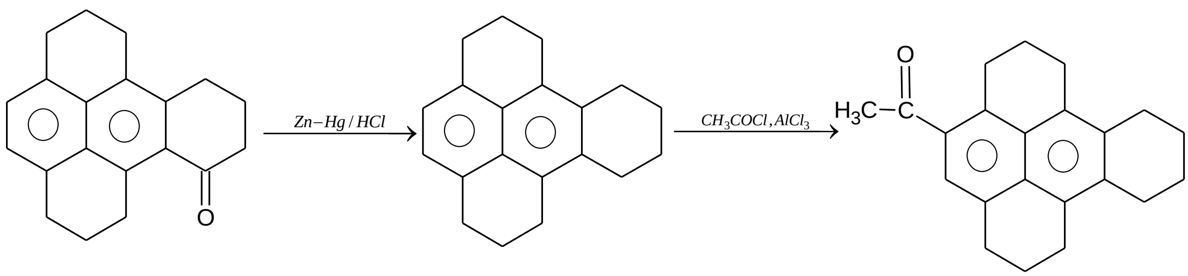
Sol. The reaction is Beckmann rearrangement.

2. C

Sol.



3. B



4. D

Sol.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Moles takes n $1\times1=1$

$n-\frac{1}{2}$ –

$n_{H^+} = 2\left(n-\frac{1}{2}\right) = 2$

$n = 1+\frac{1}{2} = 1.5$

$\Rightarrow m_{H_2SO_4}$ taken = 1.5×98

% purity = $\frac{1.5\times98}{196}\times100 = 75\%$

Slope of graph = $\frac{-3}{3} = -1$

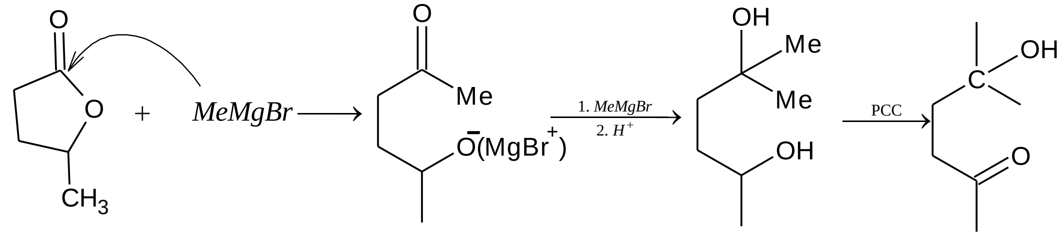
5. D

Sol. Let normality of hypo solution = N

neq hypo = $120\times10^{-3}\times N = neq\ I_2 = neq\,CuSO_4$ reacted = 0.12×1

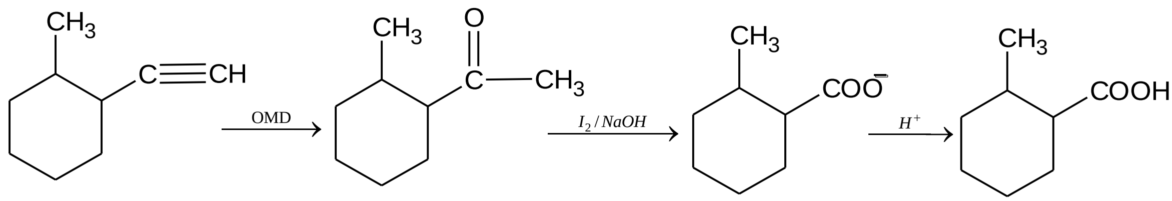
N = 1

6. C

Sol. 

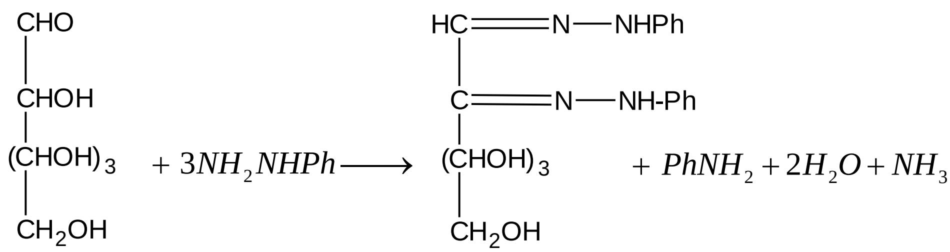
7. A

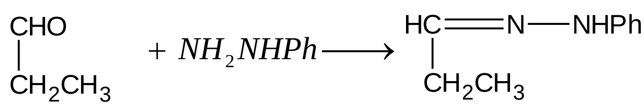
Sol.



8. C

Sol.

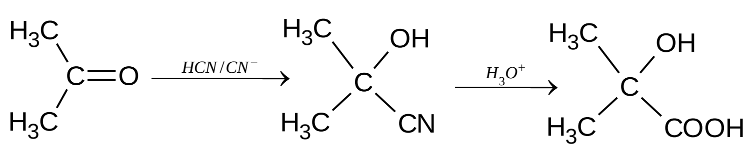




Hence, $x : y = 3 : 1$

9. A

Sol.

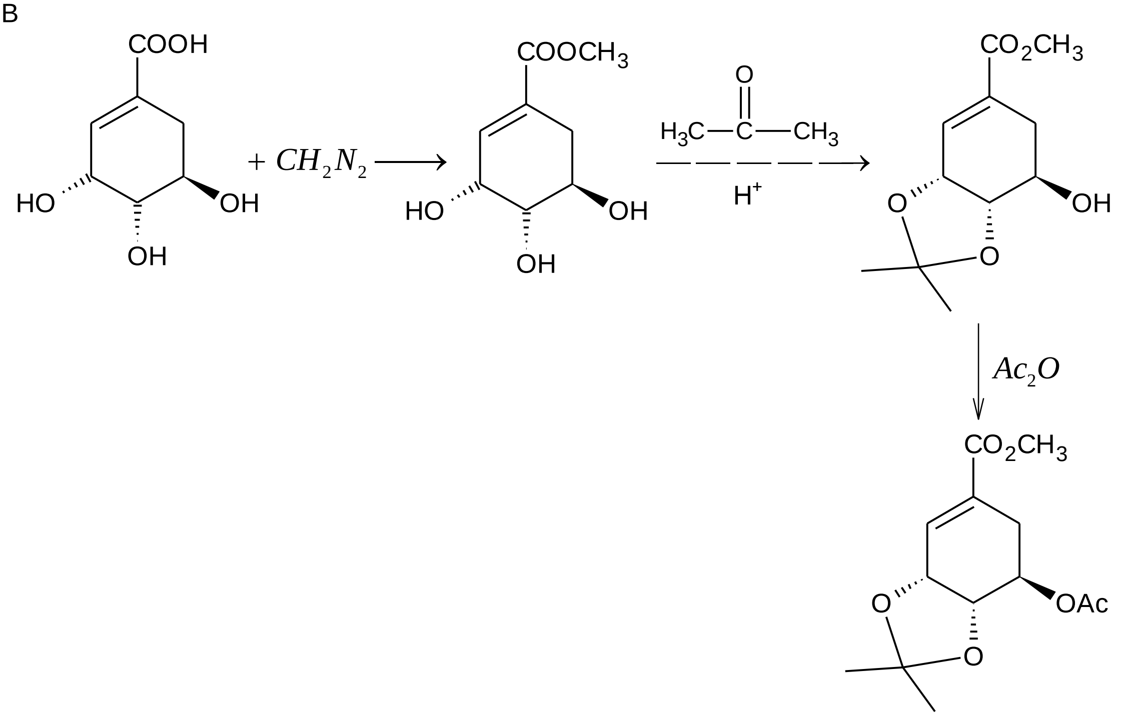


10. A

Sol. This is a crossed Cannizzaro reaction.

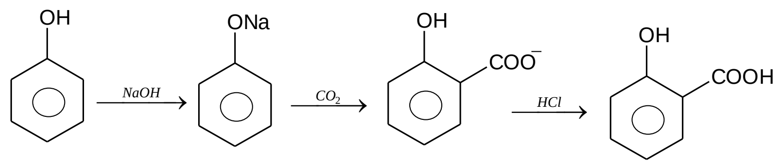
11. B

Sol.



12. D

Sol.



(X) (Y) (Z)

13. C

Sol. $$H_3C-\underset{\displaystyle |}{\overset{OH}{C}}HCH_2CH_3 \xrightarrow{Cu,\ \Delta} H_3C-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$$

14. B

Sol. This is Hoffmann bromamide reaction.

15. A

Sol. neq oxalic acid dihydrate = $\frac{6.3}{126} \times 2 = 1 \times V(l)$

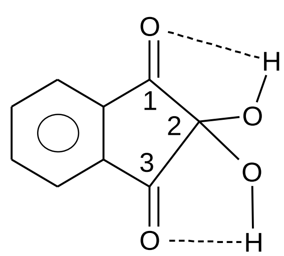
$V(l) = 0.1l$

16. D

Sol. NO_2 is a brown coloured gas

17. B

Sol.

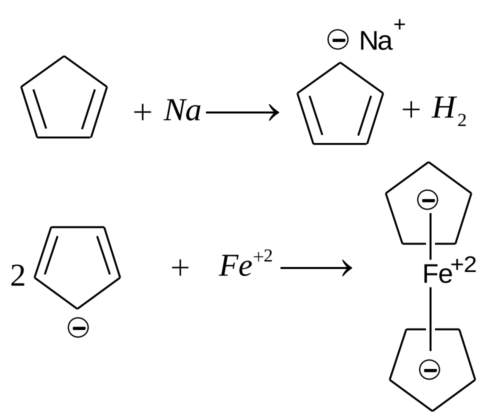


18. C

Sol. - OCH_3 group is most electron releasing.

19. B

Sol.



Ferrocene

20. B

Sol. Moles of Zn = $\frac{0.65}{65} = 0.01$

Equivalents of $Zn = 0.01 \times 2 = 0.02$ = $neq\ Fe^{+3} = nFe^{+3}$

$$\left[Fe(CN)_6\right]^{4-} + H^+ + MnO_4^- \rightarrow \underset{0.02\text{ mole}}{Fe^{+3}} + \underset{0.12\text{mole}}{CO_2} + \underset{0.12\text{ mole}}{NO_3^-} + Mn^{+2}$$

$$\underset{(0.02\text{ mole})}{2Fe^{+3}} + \underset{(0.01\text{ mole})}{Zn(s)} \rightarrow 2Fe^{+2} + Zn^{+2}$$

Equivalents of $\left[Fe(CN)_6\right]^{4-}$ = Equivalent of Fe^{+3} + Equivalents of CO_2 + Equivalent of NO_3^-

$= (0.02\times1) + (0.12\times2) + (0.12\times8) = 1.22$

21. A

Sol. The trioxides of N and Bi cannot be obtained by direct combination with oxygen. But out of N and Bi, NCl_3, hydrolyses completely while $BiCl_3$ hydrolysis is partial. Hence, oxide is Bi_2O_3

$$4Bi(NO_3)_3 \longrightarrow 2Bi_2O_3 + 12NO_2 + 3O_2 \uparrow$$

$$BiCl_3 + H_2O \rightarrow BiOCl + 2HCl$$

22. B

Sol. NO_3^- evolve brown vapour when reacted with concentrated H_2SO_4.

23. A

Sol. $(Cu_2)^{+2} \rightarrow 2Cu^{+2} + 2e^-$

$S^{-2} \rightarrow S^{+4} + 6e^-$

For Cu_2S, E.Wt.= $\dfrac{M_1}{8}$

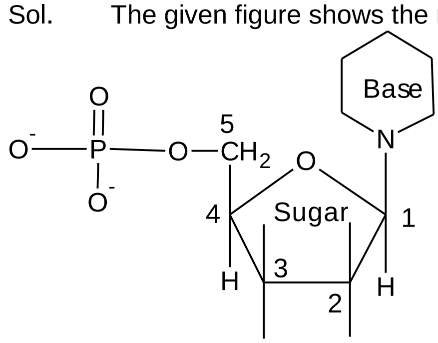
For CuS, E.Wt. = $\dfrac{M_2}{6}$

24. A

Sol. $Rate \propto \dfrac{P\times A}{\sqrt{M}}$

25. C

Sol. The given figure shows the nucleotide present in DNA or RNA



26. B

Sol. Cellulose is straight chain polysaccharide composed of only D-Glucose units joined by $\beta-$ glycosidic linkage.

27. B

Sol. $2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$

Initial moles $\dfrac{0.15}{27}$ 0 0

final moles 0 $\dfrac{3}{2}\times\dfrac{0.15}{27}$

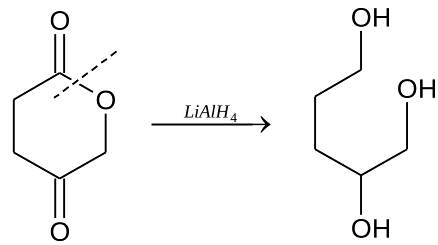
$\therefore$ moles of H_2 = $\dfrac{0.15\times3}{2\times27} = 8.33\times10^{-3}$

Now from ideal gas equation

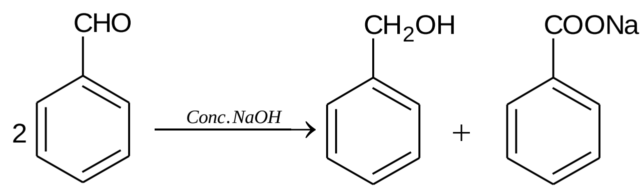
$PV = nRT$

$$0.987 \times V = 8.33 \times 10^{-3} \times 0.0821 \times 293$$
$$\therefore V = 203\,ml$$

28. D
Sol. SO_2 bleaches by reduction and Cl_2 by oxidation.
29. C
Sol. $LiAlH_4$ is strong reducing agent



30. A
Sol.



Mathematics

1. D
Sol. $^{10}C_2 \times {}^{11}C_1 + {}^{10}C_1 \times {}^{11}C_2 = 1045$
2. C
Sol. For a particular class the total number of different tickets from 1st intermediate station is 5. Similarly number of different tickets from second intermediate station is 4. So the total number4 of different tickets is $5+4+3+2+1=15$ and same number of tickets for another class implies total number of ticket different = 30 and number of selection = $^{30}C_{10}$
3. A
Sol. Probability of telling truth $= \frac{3}{4}$

probability of telling lie $= \frac{1}{4}$

probability of that it is a six $= \frac{1}{6}$ $\therefore$ required probability $= \dfrac{\frac{3}{4} \times \frac{1}{6}}{\frac{3}{4} \times \frac{1}{6} + \frac{1}{4} \times \frac{5}{6}} = \frac{3}{3+5} = \frac{3}{8}$

4. D
Sol. Rectangle of dimension $(1 \times 6) = {}^8C_1 \times {}^{(8-6+1)}C_1 = 24$

Rectangle of dimension $(2 \times 3) = {}^{(8-2+1)}C_1 \; {}^{(8-3+1)}C_1 = 42$

$\therefore$ Total number of rectangle of 65cm 2 × 66 = 132

$\therefore$ Total number of rectangle $= {}^9C_2 \; {}^9C_2$

$\therefore$ Required probability $= \frac{132 \times 4}{9 \times 8 \times 9 \times 8} = \frac{11}{108}$

5. B
Sol. p = $\frac{1}{4} \Rightarrow$ q = $\frac{3}{4}$

Given that $1 - q^n > \frac{3}{4} \Rightarrow q_n < \frac{1}{3} \Rightarrow \left(\frac{3}{4}\right)^n < \frac{1}{3} \Rightarrow$ n = 4.

6. B

Sol. Probability of getting largest number 'k' on the tickets = probability of getting numbers from 1 to k in n draws – probability of getting numbers from 1 to (k – 1) in all n draws = $\left(\frac{k}{N}\right)^n - \left(\frac{k-1}{N}\right)^n$.

7. C

Sol. Total number of triangles that can be formed = ${}^6C_3$ = 20

$\therefore$ required probability = $\frac{2}{20} = \frac{1}{10}$

8. C

Sol. Total numbers of triangles ${}^8C_3 = 56$ and right angled triangle = 48

9. D

Sol. Any natural number is either of the form 3 k or 3k – 1 or 3k +1. Sum of two numbers will be divisible by 3 if and only if either both are of the form 3 k or one is of the form 3k-1 and other is of the form 3k+1. This can be done in ${}^4C_2 + {}^4C_1 \times {}^4C_1$ = 6+16 = 22

10. D

Sol. Required no, of ways = the total no of ways – no of ways in which between the girls atleast 3 boys sit.

= 17! – coeff. of x^{12} in $(1 – x)^{-3} \times 2! \times 15!$

= 17! – ${}^{12+3-1}C_2 \times 2! \times 15!$

= 17! – 91$\times$ 2! $\times$ 15!.

11. B

Sol. Let $x_1 + x_2 + x_3 + x_4 + x_5 = 5$

Then required number of solutions = ${}^{n+4}C_n$ or ${}^{n+4}C_4$

12. D

Sol. ${}^nC_4 = 70$

13. A

Sol. If a, b>0, then $x = A.M.$ of a and b $\Rightarrow x = \frac{a+b}{2}$....(1)

a, y, z, b in G.P. $\Rightarrow b = T_4 = ar^3 \Rightarrow r = \left(\frac{b}{a}\right)^{1/3}$

$T_2 = y = ar = a\left(\frac{b}{a}\right)^{1/3} = \left(a^2b\right)^{1/3}, T_3 = z = ar^2 = a\left(\frac{b}{a}\right)^{2/3}$

$= \left(ab^2\right)^{1/3}$. This $\Rightarrow y^3 + z^3 = a^2b + ab^2 = ab(a+b)$ ...(2)

And $xyz = \left(\frac{a+b}{2}\right)\left(a^2b\right)^{1/3}.\left(ab^2\right)^{1/3}$

$= \left(\frac{a+b}{2}\right)ab = \frac{1}{2}\left(y^3 + z^3\right)$, by (2) $\Rightarrow \frac{y^3+z^3}{xyz} = 2$

14. C

Sol. $a_1, a_2, a_3, ..., a_n$ are in H.P.

This $\Rightarrow \frac{1}{a_1}, \frac{1}{a_2}, \frac{1}{a_3}, ..., \frac{1}{a_n}$ are in A.P. with common difference = d

$\therefore \; d = \frac{1}{a_2} - \frac{1}{a_1} = \frac{1}{a_3} - \frac{1}{a_2} = ... \frac{1}{a_n} - \frac{1}{a_{n-1}}$ or $d = \frac{a_1 - a_2}{a_1a_2} = \frac{a_2 - a_3}{a_2a_3} = ... = \frac{a_{n-1} - 1 - a_n}{a_na_{n-1}}$. This $\Rightarrow$

$\Rightarrow da_1a_2 = a_1 - a_2, da_2a_3 = a_2 - a_3, ..., da_na_{n-1} = a_{n-1} - a_n$

Adding, $d\left(a_1a_2 + a_2a_3 + ... + a_na_{n-1}\right) = a_1 - a_n$ ....(1)

Also $T_n = \frac{1}{a_n} = \frac{1}{a_1} + (n-1)d \Rightarrow \frac{a_1 - a_n}{a_n a_1} = (n-1)d$

Put this in (1), $a_1 a_2 + a_2 a_3 + ... + a_n a_{n-1} = (n-1) a_n a_1$

15. B

Sol. $\frac{1^3}{1} + \frac{1^3 + 2^3}{1+3} + \frac{1^3 + 2^3 + 3^3}{1+3+5} + ...$

$$T_n = \frac{1^3 + 2^3 + 3^3 + ... + n^3}{1+3+5+.....\text{n terms}} = \frac{\left[\frac{n}{2}(n+1)\right]^2}{\frac{n}{2}\left[2+2(n-1)\right]} = \frac{(n+1)^2}{4}$$

$S_n = \Sigma T_n \Rightarrow 4S_n = \Sigma(n+1)^2 = \Sigma n^2 + 2\Sigma n + \Sigma 1$

$\Rightarrow 4S_n = \frac{n}{6}(n+1)(2n+1) + 2\frac{n}{2}(n+1) + n$

$= \frac{n}{6}(n+1)\left[2n+7\right] + n$

If $n = 16, S_{16} = \frac{16 \times 17 \times 39}{6 \times 4} + \frac{16}{4}$ = 446

16. C

Sol. $150, 146, 142, ..., a = 150, d = -4$.

Suppose 150 workers complete work in n days

1 worker does in one day $\frac{1}{150n}th$ part of the work.

Under condition II, workers complete the work in $(n+8)$ days. Total workers

$= \left(\frac{n+8}{2}\right)\left[2 \times 150 + (n+8-1)(-4)\right] = (n+8)(136-2n)$

Total workers. $\frac{1}{150n} = 1 \Rightarrow (n+8)(136-2n) = 150n$

$\Rightarrow (n+8)(68-n) = 75n \Rightarrow n^2 + 15n - 544 = 0$

$(n+32)(n-17) = 0 \Rightarrow n = 17 \Rightarrow n+8 = 17+8 = 25$ days.

17. A

Sol. $\sum_{r=0}^{n} {}^nC_r \sin rx = \text{Im}\left(\sum_{r=0}^{n} {}^nC_r e^{irx}\right)$

$= \text{Im}\left(1+e^{ix}\right)^n$

$\text{Im}\left(1+\cos x + i\sin x\right)^n$

18. A

Sol. Let the numbers be a, ar, ar^2

$a + ar + ar^2 = 14 \quad ...(1)$

$(a+1), (ar+1), \left(ar^2 - 1\right)$ are in A.P.

$2(ar+1) = a + ar^2$ ….(2)

Solving (1) and (2)

We get the answer 8.

19. A

Sol.

p	q	$p \vee q$	~ p	$(p \vee q) \vee \sim p$
T	T	T	F	T
T	F	T	F	T
F	T	T	T	T
F	F	F	T	T

20. A

Sol. Contrapositive of $p \Rightarrow q$ is $\sim q \Rightarrow \sim p$

21. C

Sol. (A) $2+\omega+\omega^2=1,\ 1+\omega-\omega^2=-2\omega^2, 1-3\omega+\omega^2=-4\omega$

(B) $1-\omega+\omega^2=-2\omega, 1-\omega^2+\omega^4=-2\omega^2$

22. C

Sol. $\arg z+\arg\omega=\pi \quad ...(1)$

and $\bar{z}=-i\bar{\omega} \Rightarrow \arg z-\arg\omega=\dfrac{\pi}{2} \quad ....(2)$

So $\arg z=\dfrac{3\pi}{4}$

23. A

Sol. $p=-\left(\tan 30^0+\tan 15^0\right)=-\left\{\dfrac{1}{\sqrt{3}}+\left(2-\sqrt{3}\right)\right\}$

And $q=\tan 30^0.\tan 15^0=\dfrac{2-\sqrt{3}}{\sqrt{3}}$

24. B

Sol. Let α & α^2 be the roots of the equation, then $\alpha+\alpha^2=30 \quad \alpha.\alpha^2=\lambda$

$\Rightarrow \lambda^2+91\lambda-27000=0 \Rightarrow \lambda=125,-216$

25. B

Sol. After simplification $z_1^3+z_2^3+z_3^3+z_1z_2z_3=0$

$\Rightarrow\left(z_1+z_2+z_3\right)\left(z_1+z_2+z_3\right)^2-3.z_1z_2-3z_2z_3-3z_3z_1=-4z_1z_2z_3$

$\Rightarrow\left(z_1+z_2+z_3\right)^3=z_1z_2z_3\left(3\left(z_1+z_2+z_3\right)\left(\dfrac{1}{z_1}+\dfrac{1}{z_2}+\dfrac{1}{z_3}\right)-4\right)$

$\Rightarrow\left|z_1+z_2+z_3\right|^3=\left|3\left(\bar{z}_1+\bar{z}_2+\bar{z}_3\right)\left(z_1+z_2+z_3\right)-4\right|$

$\Rightarrow x^3=\left|3x^2-4\right|$

Let $\left\{\left|z_1+z_2+z_3\right|=x\right\} \quad \Rightarrow x=1,2$

26. A

Sol. Let $f(x)=\left(x-x_1\right)\left(x-x_2\right)\left(x-x_3\right)\left(x-x_4\right)$

$\left|f(i)\right|=\sqrt{1+x_1^2}\sqrt{1+x_2^2}\sqrt{1+x_3^2}\sqrt{1+x_4^2}=1$

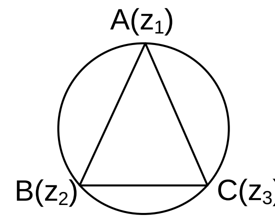
$\Rightarrow a+b+c+d=0$

27. B

Sol. $|z_1 - z_2|^2 = |z_1|^2 + |z_2|^2 - 2\,\mathrm{Re}(z_1\bar{z}_2)$

$\Rightarrow AB^2 = OA^2 + OB^2 - 2\,\mathrm{Re}(z_1\bar{z}_2)$

$\Rightarrow \mathrm{Re}(z_1\bar{z}_2) = -2$



28. D

Sol. Product of roots < 0

$\Rightarrow \frac{12}{a} < 0 \;\Rightarrow a < 0$ 29. C

Sol. $\frac{1}{n+1}\sum_{r=0}^{n}\frac{2^{r+2}\;{}^{n+1}C_{r+1}}{r+2}$

Since $\frac{{}^{n}C_r}{r+1} = \frac{{}^{n+1}C_{r+1}}{n+1}$

30. B

Sol. $\sum_{r=1}^{n} r^3 . \left(\frac{n-r+1}{r}\right)^2$

$= \sum_{r=1}^{n} r\left[(n+1)^2 - 2r(n+1) + r^2\right]$

FIITJEE

BATCHES – 1314

PHYSICS, CHEMISTRY & MATHEMATICS

CPT3 - 1 | **CODE:** | **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 243**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

E. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into two sections: **Section-A & Section-B**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

F. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 09)** contains 9 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (10 – 13) contains 4 Assertion-Reasoning (multiple choice questions) which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (14 – 19) contains 2 paragraphs. Based upon paragraph, 3 multiple choice questions have to be answered. Each question has only one correct answer and carries **+4 marks** for correct answer and **– 1 mark** for wrong answer.

(ii) **Section-B (01)** contains 3 Matrix Match Type question containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+6 marks** for all correct answer. For each correct row **+1 mark** will be awarded. There may be one or more than one correct choice. No marks will be given for any wrong match in any question. There is no negative marking.

Name of the Candidate :________________________________

Batch :____________________ **Date of Examination :**____________________

Enrolment Number :________________________________

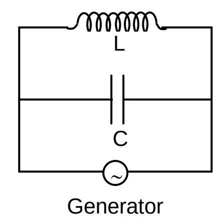
Part-I : PHYSICS

Section – A
(Single Correct Choice Type)

This section contains **9 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

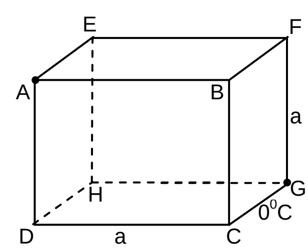
1. An inductance L, a capacitance C and a resistance R may be connected to an AC source of angular frequency ω, in three different combination of RC, RL and LC in series. Assume that $\omega L = \frac{1}{\omega C}$. The power drawn by the three combinations are P_1, P_2, P_3 respectively. Then,
(A) $P_1 > P_2 > P_3$ (B) $P_1 = P_2 < P_3$
(C) $P_1 = P_2 > P_3$ (D) $P_1 = P_2 = P_3$

2. For the circuit shown in the figure, the current through the inductor is 0.6 A, while the current through the capacitor is 0.4 A. The current drawn from the generator is
(A) 1.0 A (B) 0.4 A
(C) 0.6 A (D) 0.2 A



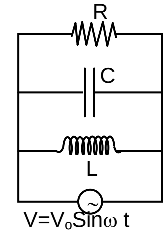
3. Two identical satellites A and B revolve round the earth in circular orbits at distance R and 3R from the surface of the earth (R = radius of the earth). The ratio of the linear momenta of A and B is
(A) 1:1 (B) $1:\sqrt{2}$
(C) $\sqrt{2}:1$ (D) 2 : 1

4. A cubical frame is made by connecting 12 identical uniform conducting rods as shown in the figure. In the steady state the temperature of junction A is 100^0 C while that of G is 0^0C. Then,

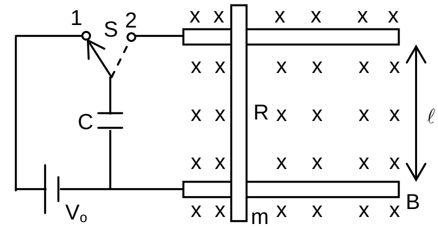


(A) B and H will be at same temperature
(B) Temperature of F is 40^0C
(C) Temperature of D is 66.67^0C
(D) Temperature of E is 40^0C

5. In the circuit shown in figure $X_L = \frac{X_c}{2} = R$, the peak value current i_0 is
(A) $\frac{\sqrt{5}V_0}{2R}$ (B) $\frac{V_0}{2\sqrt{2R}}$
(C) $\frac{V_0}{2R}$ (D) $\frac{V_0}{2\sqrt{3R}}$



6. One end of a horizontal fixed track of gauge ℓ and negligible resistance is connected to a capacitor of capacitance C charged to voltage V_o. The inductance of the assembly is negligible. The system is placed in a homogenous, vertical magnetic field of induction B as shown in the figure.



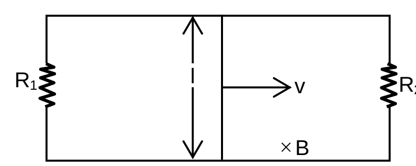
A frictionless conducting rod of mass m and negligible resistance is placed perpendicularly on to the track. The polarity of the capacitor is such that the rod is repelled from the capacitor. Now the switches is turned from 1 to 2.
What is the maximum velocity of the rod?

(A) $\frac{B\ell CV_o}{m+B^2\ell^2C}$
(B) $\frac{2B\ell CV_o}{m+B^2\ell^2C}$
(C) $\frac{B\ell CV_o}{2\left(m+B^2\ell^2C\right)}$
(D) none of these

7. A particle of mass m is transferred from infinity to the centre of the base of a uniform solid hemisphere of mass M and radius R. Work done by gravitational force is

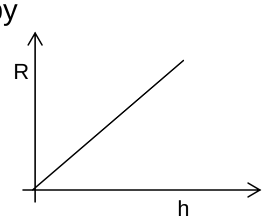
(A) $\frac{3}{8}\frac{GMm}{R}$
(B) $\frac{3GmM}{R}$
(C) $\frac{3}{4}\frac{GMm}{R}$
(D) $\frac{3}{2}\frac{GMm}{R}$

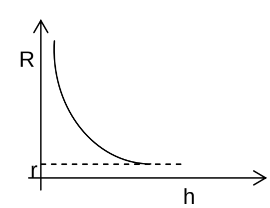
8. A rectangular loop with a slide wire of length l is kept in a uniform magnetic field as shown in figure. The resistance of slider is R. neglecting self inductance of the loop find the current in the connector during its motion with a velocity v.

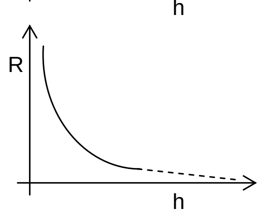


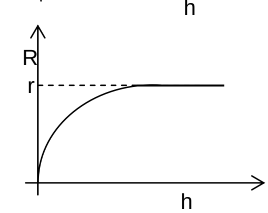
(A) $\frac{Blv}{R_1+R_2+R}$
(B) $\frac{Blv(R_1+R_2)}{R+(R_1+R_2)}$
(C) $\frac{Blv(R_1+R_2)}{RR_1+RR_2+R_1R_2}$
(D) $Blv\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)$

9. A long capillary tube of radius 'r' is initially just vertically completely immerged inside a liquid of angle of contact 0^0. If the tube is slowly raised then relation between radius of curvature of meniscus inside the capillary tube and displacement(h) of tube can be represented by

(A)


(B)


(C)


(D)


Assertion – Reasoning (Single Correct Choice Type)

10. **Statement-1**
V-T graph in a process is rectangular hyperbola. Then P-T graph in the same process will be a parabola.

Statement-2
If V-T graph is rectangular hyperbola, with increase in T, volume will decrease and hence, pressure will increase.
(A) **Statement-1** is true, **Statement-2** is true, **Statement-2** is a correct explanation for **Statement-1**
(B) **Statement-1** is true, **Statement-2** is true, **Statement-2** is not a correct explanation for **Statement-1.**
(C) **Statement-1** is true, **Statement-2** is false.
(D) **Statement-1** is false, **Statement-2** is true.

11. **Statement-1**
When a coil is connected to a cell, no current flows through it initially

Statement-2
When a coil is connected to a cell, the initial emf induced in it is equal to the emf of the cell.
(A) **Statement-1** is true, **Statement-2** is true, **Statement-2** is a correct explanation for **Statement-1**
(B) **Statement-1** is true, **Statement-2** is true, **Statement-2** is not a correct explanation for **Statement-1.**
(C) **Statement-1** is true, **Statement-2** is false.
(D) **Statement-1** is false, **Statement-2** is true.

12. **Statement-1**
Hot wire instruments are used to measure A.C.

Statement-2
Hot wire instruments measure r.m.s. value of the current/voltage.
(A) **Statement-1** is true, **Statement-**2 is true, **Statement-2** is a correct explanation for **Statement-1**
(B) **Statement-1** is true, **Statement-2** is true, **Statement-2** is not a correct explanation for **Statement-1.**
(C) **Statement-1** is true, **Statement-2** is false.
(D) **Statement-1** is false, **Statement-2** is true.

13. **Statement-1**
A planet revolving around the sun gathering mass somehow gets an increase in its speed.

Statement-2
More mass means more weight.
(A) **Statement-1** is true, **Statement-2** is true, **Statement-2** is a correct explanation for **Statement-1**
(B) **Statement-1** is true, **Statement-2** is true, **Statement-2** is not a correct explanation for **Statement-1.**
(C) **Statement-1** is true, **Statement-2** is false.
(D) **Statement-1** is false, **Statement-2** is true.

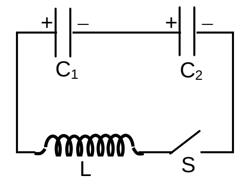
(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **3 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 14 to 16

Concept [14-16]: (i) In L–C circuit energy stored in electric field plus the energy stored in magnetic field remains constant. (ii) $V_L = L\frac{di}{dt}$

In the figure shown C_1 = 1 F, C_2 = 2 F and L = 5 H. Initially C_1 is charged to 50 V and C_2 to 10 V. Switch S is closed at time t = 0. Suppose at some instant charge on C_1 is 20 C with the same polarities as shown in figure.



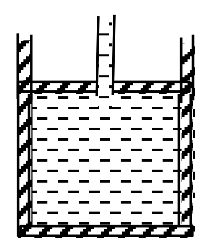
14. Energy stored in capacitor C_2 at this instant will be
(A) 10 J (B) 15 J
(C) 25 J (D) 40 J

15. Current in the circuit at this instant will be
(A) $10\sqrt{2}$ A (B) $15\sqrt{2}$ A
(C) 10 A (D) 20 A

16. Maximum current in the circuit will be
(A) $4\sqrt{30}$ A (B) $16\sqrt{2}$ A
(C) $20\sqrt{3}$ A (D) $12\sqrt{6}$ A

Paragraph for Question no. 17 to 19

A piston weighing 3 kg has the form of a circular disc of radius R = 4 cm. The disc has a hole into which a thin walled pipe of negligible mass of radius 1 cm is inserted. Initially the piston is at the bottom of the cylinder. Now 700 gm of water is poured into the pipe.



17. The height to which the piston will rise is
(A) 5 cm (B) 10 cm
(C) 15 cm (D) 20cm

18. The length of liquid column in the pipe is approximately
(A) 50 cm (B) 54 cm
(C) 60 cm (D) 64 cm

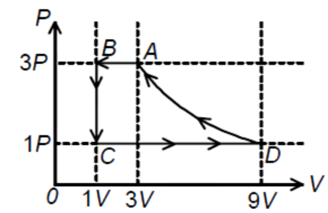
19. The pressure at the bottom of the cylinder is (ρ=density of liquid)
(A) $P_0 + \rho g(55)$ (B) $P_0 + \rho g(59)$
(C) $P_0 + \rho g(70)$ (D) $P_0 + \rho g(74)$

Section – B

Matrix – Match Type

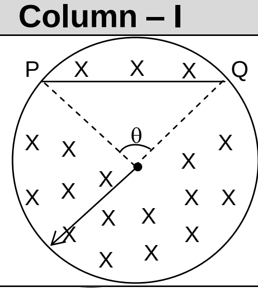
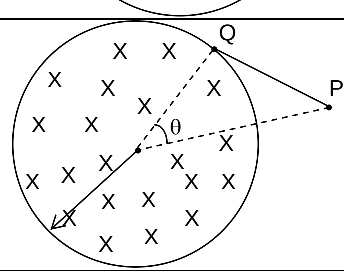
This section contains **03 Matrix Match Type** questions. Each question has four statements (A, B, C and D) given in column I and five statements (p, q, r, s and t) in column II. Any given statement in column I can have correct matching with **One or More** statements(s) given in column II.

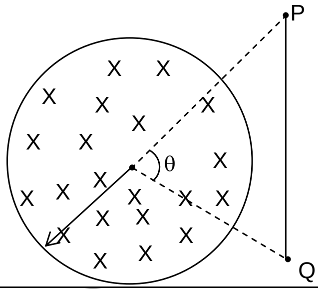
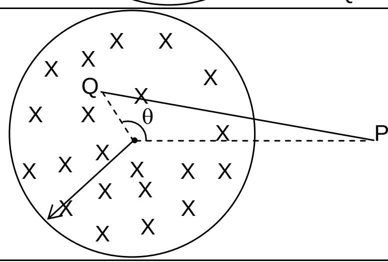
1. One mole of a monatomic ideal gas is taken through a cycle ABCDA as shown in the P-V diagram. Colum II gives the characteristics involved in the cycle. Match them with each of the processes given in Column I. (AD is Isothermal)



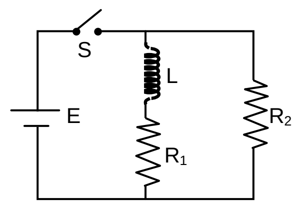
	Column I		**Column II**
(A)	Process $A \rightarrow B$	(P)	Internal energy decreases
(B)	Process $B \rightarrow C$	(Q)	Internal energy increases.
(C)	Process $C \rightarrow D$	(R)	Heat is lost
(D)	Process $D \rightarrow A$	(S)	Heat is gained
		(T)	Work is done on the gas

2. Column I shows the cylindrical region of radius r where a downward magnetic field $\vec{B}$ exists, where $\vec{B}$ is increasing at the rate of $\frac{dB}{dt}$. A rod PQ is placed in different citation as shown. Match the column I with the correct statement in column II regarding the induced emf in rod

Column – I		**Column – II**	
(A)		(P)	Induced emf in rod PQ is $\frac{1}{2}r^2\theta\frac{dB}{dt}$
(B)		(Q)	Induced emf in rod PQ is less than $\frac{1}{2}r^2\theta\frac{dB}{dt}$

(C)		(R)	End P is positive with respect to point Q
(D)		(S)	End Q is positive with respect to point P

3. In the circuit shown in figure E = 18 V, L = 2H, $R_1 = 3\Omega$, $R_2 = 6\Omega$. Switch S is closed at t = 0. Match the following:



Column I		Column II	
(A)	Current through R_1 at t = 0	(P)	6 A
(B)	Current through R_1 at $t = \infty$	(Q)	3 A
(C)	Current through R_2 at t = 0	(R)	Zero
(D)	Current through R_2 at $t = \infty$	(S)	Infinite

Part-II : CHEMISTRY

Section – A

(Single Correct Choice Type)

This section contains **9 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

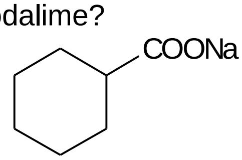
1. $$CH_3-\overset{\overset{\large O}{\|}}{C}-H \longrightarrow CH_3-\underset{\underset{\large CN}{|}}{\overset{\overset{\large OH}{|}}{C}}-H$$

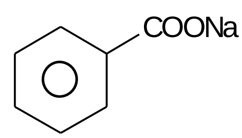
Which of the following reagent or mixture is not used for the above reaction?

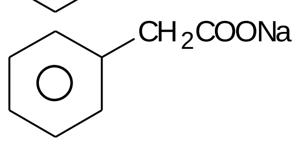
(A) HCN (B) NaCN/HCl

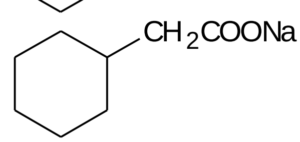
(C) KCN/NaOH (D) HCN/NaOH (Catalytic amount)

2. Which of the following salt undergoes the easiest decarboxylation reaction in presence of sodalime?

(A) 

(B) 

(C) 

(D) 

3. In Hinsberg's method, the amine mixtures are separated from each other. The reagent used in this process is p-toluenesulphonyl chloride. Amines form sulphonamide when treated with the reagent.

The sulphonamide of an amine(X) is insoluble in KOH. Therefore,(X) is:

(A) $CH_3CH_2CH_2CH_2NH_2$ (B) $CH_3CH_2NHCH_2CH_3$

(C) $(H_3C)_2N-C_2H_5$ (D) $PhCH_2CH_2NH_2$

4. Fructose reduces Tollen's reagent due to

(A) oxidation of primary alcoholic group to aldehyde

(B) enolization followed by conversion to aldehyde by base

(C) oxidation of secondary alcoholic group to ketone

(D) presence of asymmetric carbon

5. $$MnO_4^- + FeC_2O_4 + H^+ \longrightarrow Mn^{2+} + Fe^{3+} + CO_2 + H_2O$$

How many moles of FeC_2O_4 can be completely oxidized by one mole of acidified MnO_4^- solution according to above equation?

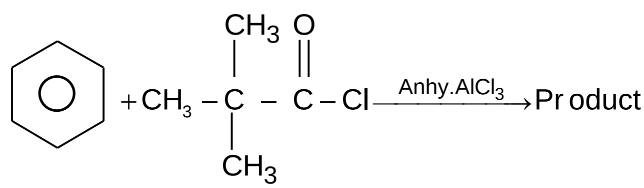
(A) $\frac{2}{5}$ (B) $\frac{3}{5}$

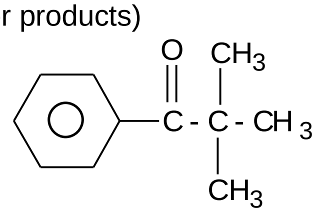
(C) $\frac{5}{2}$ (D) $\frac{5}{3}$

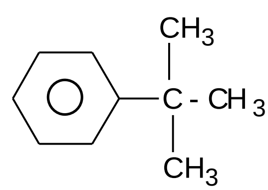
6. Which of the following illustration displays positive deviation of carbon dioxide from ideal behaviour?
(A) 0.1 mole of CO_2 occupies 2.24 litre at NTP
(B) 22 g of CO_2 occupies 10.4 litre at NTP
(C) 4.4 g of CO_2 occupies 4.2 litre at NTP
(D) 0.01 mole of CO_2 occupies 0.126 litre at NTP

7. Which of the following acid can decolourize blue litmus paper?
(A) $HClO_4$ (B) $HClO_3$
(C) $HClO_2$ (D) HClO

8. $XeF_4 + KI \longrightarrow Products$
Which of the following is not a product of above reaction?
(A) Xe (B) KF
(C) I_2 (D) XeI_4

9. 

Which of the following is not a product of above reaction? (consider major as well as minor products)
(A) 

(B) 

(C) CO (D) CO_2

Assertion – Reasoning (Single Correct Choice Type)

10. Assertion: α – Hydrogen atoms in aldehydes and ketones are acidic.
Reasoning: Anions formed after loss of α – hydrogen atoms are stabilized due to resonance not inductive effect.
(A) Assertion is True, Reasoning is true, Reasoning is a correct explanation for Assertion.
(B) Assertion is True, Reasoning is true, Reasoning is NOT a correct explanation for Assertion.
(C) Assertion is True, Reasoning is False.
(D) Assertion is False, Reasoning is True.

11. Assertion: Gases having higher critical temperature can be easily liquefied than those having lower critical temperature.
Reasoning: Higher the critical temperature, stronger is the intermolecular force of attraction between the gas molecules.
(A) Assertion is True, Reasoning is true, Reasoning is a correct explanation for Assertion.
(B) Assertion is True, Reasoning is true, Reasoning is NOT a correct explanation for Assertion.
(C) Assertion is True, Reasoning is False.
(D) Assertion is False, Reasoning is True.

12. Assertion: The hybridization of carbon in CO_2 is sp and that of silicon in SiO_2 is sp^3.
Reasoning: The covalent radius of silicon is larger than that of carbon.
(A) Assertion is True, Reasoning is true, Reasoning is a correct explanation for Assertion.
(B) Assertion is True, Reasoning is true, Reasoning is NOT a correct explanation for Assertion.
(C) Assertion is True, Reasoning is False.
(D) Assertion is False, Reasoning is True.

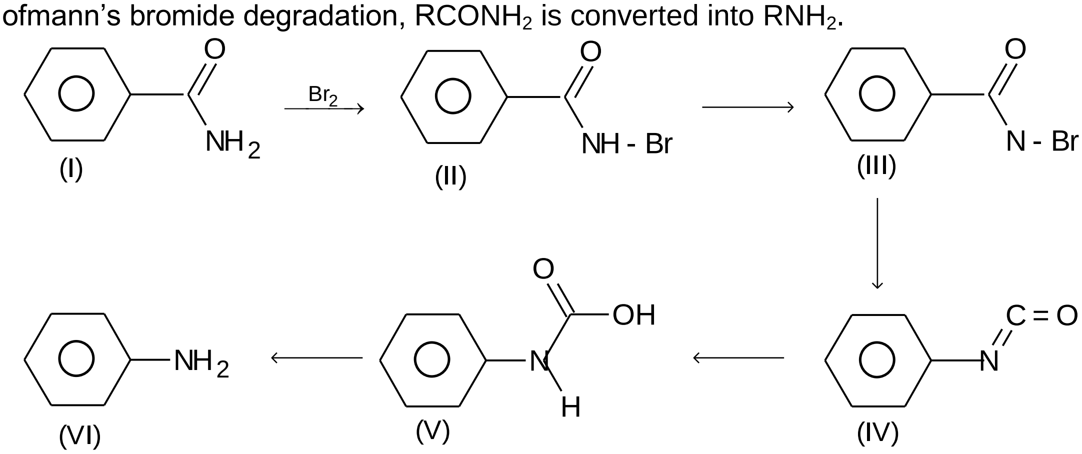
13. Assertion: The equilibrium constant(K_p) of the reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ increases by adding more PCl_5 gas.
Reasoning: Addition of PCl_5 results in shifting of the net reaction towards forward direction till a new equilibrium is set up.
(A) Assertion is True, Reasoning is true, Reasoning is a correct explanation for Assertion.
(B) Assertion is True, Reasoning is true, Reasoning is NOT a correct explanation for Assertion.
(C) Assertion is True, Reasoning is False.
(D) Assertion is False, Reasoning is True.

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **3 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 14 to 16

In Hofmann's bromide degradation, $RCONH_2$ is converted into RNH_2.



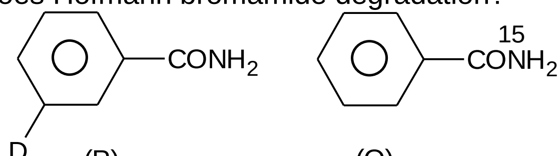
Electron donating group at phenyl activates the reaction. It is an intramolecular reaction:

Answer the following questions on the basis of the above write up.

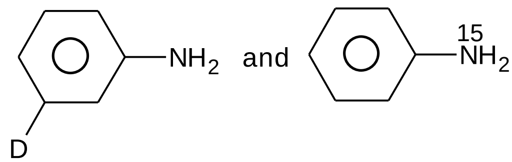
14. Which of the following reagent is used for the conversion of (I) to (II)?
(A) KBr
(B) KBr + C_2H_5ONa
(C) KBr + KOH
(D) Br_2 + KOH

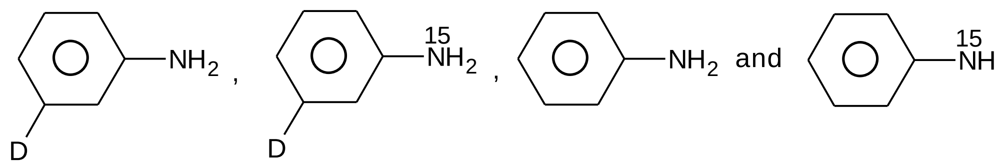
15. Which of the following is the rate determining step?
(A) Formation of (I)
(B) Formation of (II)
(C) Formation of (III)
(D) Formation of (IV)

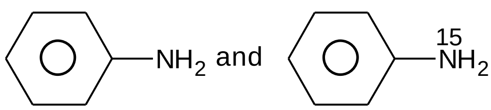
16. Which of the following product(s) is/are formed when the mixture of (P) and (Q) undergoes Hofmann bromamide degradation?

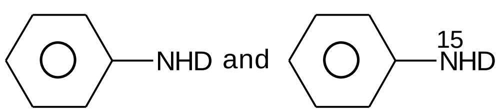


(P) (Q)

(A) 

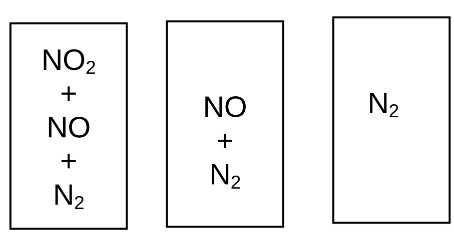
(B) 

(C) 

(D) 

Paragraph for Question no. 17 to 19

Three vessels of identical volume certain the given gases at the mentioned pressures at constant temperature. (Assume no reaction between the gases)



22 atm (I) 12 atm (II) 4 atm (III)

17. What is the partial pressure of NO_2 gas?
(A) 8 atm (B) 10 atm
(C) 7.33 atm (D) 4 atm

18. What would be the ratio of rates of effusion of NO to N_2 through a small orifice made on vessel – II?
(A) 12:25 (B) 24:25
(C) 48:25 (D) 37:25

19. Which gas has the least partial pressure?
(A) NO_2 (B) NO
(C) N_2 (D) Unpredictable

Section – B

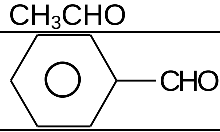
Matrix – Match Type

This section contains **03 Matrix Match Type** questions. Each question has four statements (A, B, C and D) given in column I and five statements (p, q, r, s and t) in column II. Any given statement in column I can have correct matching with **One or More** statements(s) given in column II.

1. Match the oxides of nitrogen mentioned in Column - I with their properties mentioned in Column - II

Column – I		**Column – II**	
(A)	NO_2	(P)	is an acidic oxide
(B)	N_2O_3	(Q)	is a neutral gas
(C)	N_2O_5	(R)	is blue in liquid state
(D)	N_2O	(S)	dimerizes to a colourless solid

2. Match the carbonyl compounds mentioned in Column - I with their properties mentioned in Column - II

Column – I		**Column – II**	
(A)	CH_3CHO	(P)	shows Cannizzaro reaction
(B)		(Q)	shows aldol condensation
(C)	HCHO	(R)	gives Fehling's test
(D)	CH_3COCH_3	(S)	gives Tollen's test

3. Match the chemical substances mentioned in Column - I with the type of polymers and bonds mentioned in Column - II

Column – I		**Column – II**	
(A)	Cellulose	(P)	Natural polymer
(B)	Nylon-6, 6	(Q)	Synthetic polymer
(C)	Protein	(R)	Contains amide linkage
(D)	Sucrose	(S)	Contains glycoside linkage

Part-III : MATHEMATICS

Section – A

(Single Correct Choice Type)

This section contains **9 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. If both roots of equation $ax^2 + x + c - a = 0$ are imaginary and $c > -1$, then
(A) $3a > 2 + 4c$
(B) $3a < 2 + 4c$
(C) $c < a$
(D) none of these

2. The value of a for which the equation $x^3 + 2ax + 2 = 0$ and $x^4 + 2ax^2 + 1 = 0$ have a common root is
(A) $\frac{17}{8}$
(B) $-\frac{17}{8}$
(C) $\frac{15}{8}$
(D) $-\frac{15}{8}$

3. $\sum_{r=1}^{n} \frac{r^2 - r - 1}{r + 1!}$ is equal to
(A) $\frac{n}{(n+1)!}$
(B) $\frac{-1}{(n+1)(n-1)!}$
(C) $\frac{n}{(n+1)!} - 1$
(D) none of these

4. Let S be the set of 6-digit numbers $a_1a_2a_3a_4a_5a_6$ (all digits distinct) where $a_1 > a_2 > a_3 > a_4 < a_5 < a_6$. Then n(S) is equal to
(A) 210
(B) 2100
(C) 4200
(D) 420

5. 6 boys and 4 girls sit in a line so that p is the number of arrangements when no two girls sit together and q is the number of arrangements when all the girls sit together, then $\frac{p}{q}$ is
(A) 1
(B) $\frac{7}{2}$
(C) 5
(D) none of these

6. In a n sided regular polygon the probability that the two diagonal chosen at random will intersect inside the polygon is
(A) $\frac{2\,{}^nC_2}{{}^{({}^nC_2 - n)}C_2}$
(B) $\frac{{}^{n(n-1)}C_2}{{}^{({}^nC_2 - n)}C_2}$
(C) $\frac{{}^nC_4}{{}^{({}^nC_2 - n)}C_2}$
(D) none of these

7. Two 8-faced dice (numbered from 1 to 8) are tossed. The probability that the product of two counts is a square number, is

(A) $\frac{1}{8}$ (B) $\frac{7}{32}$

(C) $\frac{3}{16}$ (D) $\frac{3}{8}$

8. Coefficient of $x^{\frac{n^2+n-14}{2}}$ in , $(x-1)(x^2-2)(x^3-3)(x^4-4)\dots(x^n-n)$, $(n \geq 8)$ is ,

(A) 13 (B) 21

(C) 28 (D) None of these.

9. If ω is any complex number such that $zw = |z|^2$ and $|w+\bar{w}|+|z-\bar{z}|=2$, then as w varies the locus of z is

(A) square (B) circle

(C) straight line (D) two intersecting lines

Assertion – Reasoning (Single Correct Choice Type)

(A) **Statement 1** is true, **Statement 2** is true, **Statement 2** is correct explanation of **Statement 1**

(B) **Statement 1** is true, **Statement 2** is true, **Statement 2** is not correct explanation of **Statement 1**

(C) **Statement 1** is true, **Statement 2** is false

(D) **Statement 1** is false, **Statement 2** is true

10. **Statement-1:** If $\alpha = \cos\left(\frac{2\pi}{7}\right)+i\sin\left(\frac{2\pi}{7}\right)$, $p = \alpha + \alpha^2 + \alpha^4$, $q = \alpha^3 + \alpha^5 + \alpha^6$, then the equation whose roots are p and q is $x^2 + x + 2 = 0$

Statement-2: If α is a root of $z^7 = 1$, then $1 + \alpha + \alpha^2 + \dots + \alpha^6 = 0$.

11. Let A and B are two events such that P(A) = $\frac{3}{5}$ and P(B) = $\frac{2}{3}$, then

Statement–1 : $\frac{4}{15} \leq P(A \cap B) \leq \frac{3}{5}$.

Statement–2 : $\frac{2}{5} \leq P\left(\frac{A}{B}\right) \leq \frac{9}{10}$.

12. **Statement-1 :** $\frac{(n^2)!}{(n!)^n}$ is a natural number for all $n \in N$

Statement-2 : The number of ways of distributing mn things in m groups each containing n things is $\frac{(mn)!}{(n!)^m}$

13. **Statement–1 :** The coefficient of x^{203} in the expression $(x-1)(x^2-2)(x^3-3)\dots(x^{20}-20)$ must be 13.

Statement–2 : The coefficient of x^8 in the expression $(2+x)^2(3+x)^3(4+x)^4$ is equal to 30.

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **3 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 14 to 16

In an argand plane z_1, z_2 and z_3 are respectively the vertices of an isosceles triangle ABC with AC = BC and $\angle CAB = \theta$. If z_4 is incentre of triangle. Then

14. The value of $\left(\frac{AB}{IA}\right)^2\left(\frac{AC}{AB}\right)$

(A) $\frac{(z_2-z_1)(z_1-z_3)}{(z_4-z_1)^2}$ (B) $\frac{(z_2-z_1)(z_3-z_1)}{(z_4-z_1)}$

(C) $\frac{(z_2-z_1)(z_3-z_1)}{(z_4-z_1)^2}$ (D) none of these

15. The value of $(z_4-z_1)^2$ $(1 + \cos\theta)\sec\theta$ is

(A) $(z_2-z_1)(z_3-z_1)$ (B) $\frac{(z_2-z_1)(z_3-z_1)}{(z_4-z_1)}$

(C) $\frac{(z_2-z_1)(z_3-z_1)}{(z_4-z_1)^2}$ (D) $(z_2-z_1)(z_3-z_1)^2$

16. The value of $(z_2 - z_1)^2 \tan\theta \cdot \tan\frac{\theta}{2}$ is

(A) $(z_1+z_2-2z_3)(z_1+z_2-2z_4)$ (B) $(z_1+z_2-z_3)(z_1+z_2-z_4)$

(C) $-(z_1+z_2-2z_3)(z_1+z_2-2z_4)$ (D) none of these

Paragraph for Question no. 17 to 19

There are two die A and B both having six faces. Die A has 3 faces marked with 1, 2 faces marked with 2 and 1 face marked with 3. Die B has 1 face marked with 1, 2 faces marked with 2 and 3 faces marked with 3. Both dice are thrown randomly once. If E be the event of getting sum of the numbers appearing on top faces equal to x and let P(E) be the probability of event E, then

17. P(E) is maximum when x equal to

(A) 5 (B) 3

(C) 4 (D) 6

18. P(E) is minimum when x equals to

(A) 3 (B) 4

(C) 5 (D) 6

19. When x = 4, then P(E) is equal to

(A) $\frac{5}{9}$ (B) $\frac{6}{7}$

(C) $\frac{7}{18}$ (D) $\frac{8}{19}$

Section – B

Matrix – Match Type

This section contains **03 Matrix Match Type** questions. Each question has four statements (A, B, C and D) given in column I and five statements (p, q, r, s and t) in column II. Any given statement in column I can have correct matching with **One or More** statements(s) given in column II.

1. Match the following

	Column-I		Column-II
(A)	In an a.p. S_p = a, s_q = b, s_r = c, then $\frac{a}{p}(q-r)+\frac{b}{q}(r-p)+\frac{c}{r}(p-q)$ is	(P)	3
(B)	In a g.p., t_r = r, t_s = s, t_t = t, then $R^{s-t}\cdot S^{t-r}\cdot T^{r-s}$ is	(Q)	2
(C)	If x, y, z are both in a.p. And g.p., t_m = x, t_n = y, t_p = z, then $x^{y-z}\cdot y^{z-x}\cdot z^{x-y}$ is	(R)	1
(D)	If a, b, c, are both in g.p. And h.p., t_p= a, t_q = b, t_r = c, then a (b – c) log a + b (c – a) log b + c (a – b) log c	(S)	0
		(T)	4

2. Match the following

	Column-I		Column-II
(A)	The minimum value of ab if roots of the equation $x^3 - ax^2 + bx - 2 = 0$ are positive, is	(P)	24
(B)	The number of divisors of the form $12\lambda + 6(\lambda \in n)$ of the number 25200 are	(Q)	3
(C)	The Number Of Quadrilateral Formed In An Octagon Having Two Adjacent Sides Common With The Polygon Are	(R)	12
(D)	The number of solution of the equation [cos x] = tanx where [.] Denotes g.i.f., $\forall$ x $\in$ [0, 6π] are	(S)	18

3. Match the following

	Column-I		Column-II
(A)	f(z) is a complex valued function f(z) = (a + ib)z where a, b $\in$ R and $\lvert a + ib\rvert = \frac{1}{\sqrt{2}}$. It has the property that f(z) is always equidistant from 0 and z, then a – b =	(P)	5
(B)	The number of all positive integers $n = 2^a\, 3^b$ (a, b $\geq$ 0) such that n^6 does not divide 6^n is	(Q)	0
(C)	A is the region of the complex plane {z: z/4 and $4/\bar{z}$ have real and imaginary part in (0, 1)}, then [p] (where p is the area of the region A and [.] denotes the greatest integer function) is	(R)	6
(D)	If 3x + 4y + z = 5, where x, y, z $\in$ R, then minimum value of$26(x^2 + y^2 + z^2)$is	(S)	25

Hints & Solutions

Physics

Section – A

1. **B** (Concept code: P120444)

Sol. $Z_c = Z_L \Rightarrow P_{LC} = 0.$

2. **D** (Concept code: P120445)

Sol. I_L and I_c are in opposite phase.
Hence, $I = I_L - I_c = 0.2$ A

3. **C** (Concept code: P110913)

Sol. $\frac{P_1}{P_2} = \sqrt{\frac{R+3R}{R+R}} = \sqrt{2}$

4. **B** (Concept code: P111203)

Sol. It is equivalent to a combination of resisting with a cell connected across the body diagonal.

5. **A** (Concept code: P120445)

6. **A** (Concept code: P120411)

$+\frac{q}{c} - v\ell B = 0$ ...(i)

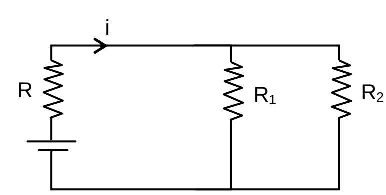
$F_B = -i\ell B = ma$ ...(ii)

7. **D** (Concept code: P110504)

Sol. $W = \Delta U = \frac{1}{2}\times\frac{3}{2}\frac{G2Mm}{R} = \frac{3}{2}\frac{GMn}{R}$.

8. **C** (Concept code: P120406)

Sol. Inductor behaves like a cell of emf, $\varepsilon' = Blv$
and equivalent ckt is
$Blv = \varepsilon'$



Hence, $i = \frac{Blv}{R + \frac{R_1R_2}{R_1+R_2}}$

$= \frac{Blv(R_1+R_2)}{RR_1 + RR_2 + R_1R_2}$

9. **B** (Concept code: P111029)

Sol. $\Delta p = \frac{2T}{R} = \rho gh$

10. **B** (Concept code: P111217)

11. **A** (Concept code: P120403)

12. **B** (Concept code: P120427)

13. **D** (Concept code: P110913)

14 **C** (Concept code: P120424)

Sol. Use $U = \frac{1}{2}C_2V^2$

15 **B** (Concept code: P120424)

Sol. $U_L = \frac{1}{2}Li^2 = \frac{1}{2}CV^2$

16 **A** (Concept code: P120424)

Sol. $\frac{1}{2}Li^2 = \frac{Q^2}{2C}$

17. **B** (Concept code: P111001)

18. **A** (Concept code: P111001)

19. **A** (Concept code: P111001)
Sol. Use $P_2 = P_1 + \rho gh$

Section – B

1. **$A \rightarrow PRT$** **$B \rightarrow PR$** **$C \rightarrow QS$** **$D \rightarrow RT$**
(Concept code: P111216)
AB = Isobaric compression
BC = Isochoric compression
CD = Isobaric expansion

2. **$A \rightarrow QR$; $B \rightarrow P,S$; $C \rightarrow PR$, $D \rightarrow PS$**
(Concept code: P120414)
Use: $\Delta V = -\int \vec{E} \cdot \vec{dl} = -(d\phi / dt)$

3. **$A \rightarrow R$** **$B \rightarrow P$** **$C \rightarrow Q$** **$D \rightarrow Q$**
(Concept code: P120423)

Sol. Emf due to inductor = $L\left|\frac{di}{dt}\right|$

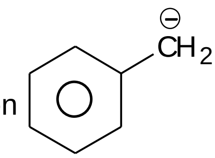
Chemistry

Section – A

1. C (Concept Code: C121206)

Sol. If KCN/NaOH is used, the nucleophiles CN^- and OH^- will complete for addition reaction. Initial polarization of C = O bond will not take place because this is done in slightly acidic medium.

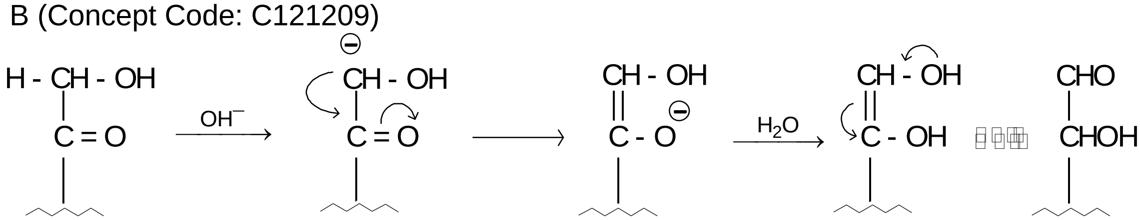
2. C (Concept Code: C121207)

Sol. The intermediate formed in the reaction is carbanion. Benzyl carbanion  is the most stable among the other given carbanions.

3. B (Concept Code: C121208)

Sol. The sulphonamides of primary (1^o) amines are soluble in KOH due to presence of α-hydrogen atoms. The sulphonamides of secondary or 2^o amines are not soluble in KOH due to absence of α-H atoms. Tertiary alcohols do not react with Hinsberg reagent.

4. B (Concept Code: C121209)

Sol. 

5. D (Concept Code: C111102)

Sol. The balanced equation is:

$$3MnO_4^- + 5FeC_2O_4 + 24H^+ \longrightarrow 3Mn^{2+} + 5Fe^{3+} + 10CO_2 + 12H_2O$$

6. C (Concept Code: C111203)

Sol. For positive deviation $Z > 1 \Rightarrow V_{real} > V_{ideal}$

In (C), 4.4g (0.1 mole) of CO_2 should occupy 2.24 L at NTP but it occupies 4.2 litre.

$\therefore$ The real volume (4.2 L) is greater than the ideal volume (2.24 L)

$\therefore$ It shows positive deviation

7. D (Concept Code: C121007)

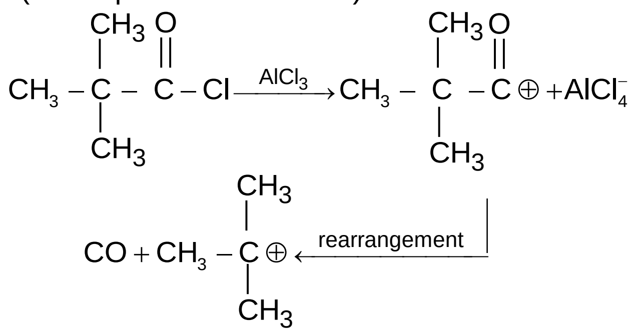
Sol. $HClO \longrightarrow HCl + [O]$

HClO undergoes the above change unlike other oxy-acids of chlorine. Nascent oxygen bleaches colour substance to colourless substance by oxidation.

8. D (Concept Code: C121102)

Sol. $XeF_4 + 4KI \longrightarrow Xe + 4KF + 2I_2$

9. D (Concept Code: C111804)

Sol. 

10. C (Concept Code: C121206)

Sol. The anions formed after loss of α – Hydrogen atoms are stabilized due to resonance not inductive effect.

11. A (Concept Code: C111209)

Sol. Critical temperature (T_C) = $\frac{8a}{27Rb}$

$\therefore T_C \,\alpha\, a$

12. B (Concept Code: C111601)

Sol. SiO_2 is a three dimensional network solid in which each silicon atom forms four sigma bonds with oxygen atoms. CO_2 is a discrete molecule in which carbon atom forms two sigma and two pi-bonds.

13. D (Concept Code: C110402)

Sol. K_p does not change by adding or removing reacting species in the equilibrium state. It changes only by changing temperature.

14. D (Concept Code: C121207)

Sol. KOH removes proton from nitrogen atom followed by the reaction of Br_2

15. D (Concept Code: C121207)

Sol. It is the slowest step of this conversion.

16. A (Concept Code: C121207)

Sol. The overall reaction is intermolecular, so there is no effect on product formation and no migration of N^{15}.

17. B (Concept Code: C111207)

Sol. $P_{NO_2} = P_{NO_2+NO+N_2} - P_{NO+N_2}$ = 22 -12 =10

18. C (Concept Code: C111208)

Sol. $\frac{r_{NO}}{r_{N_2}} = \frac{P_{NO}}{P_{N_2}}\sqrt{\frac{M_{N_2}}{M_{NO}}}$

$= \frac{8}{4}\sqrt{\frac{28}{30}} = \frac{48}{25}$ or $48:25$

19. C (Concept Code: C111207)

Sol. $P_{NO_2} = 10$ atm, $P_{NO} = 8$ atm and $P_{N_2} = 4$ atm

Section – B

1. $A \to PS, B \to PR, C \to P, D \to Q$ (Concept Code: C120806)

Sol. NO_2, N_2O_3 and N_2O_5 give oxy- acids of nitrogen when reacts with water. NO_2 contains one unpaired electron, so it dimerizes to N_2O_4.

2. $A \to QRS, B \to PS, C \to PRS, D \to Q$ (Concept Code: C121206)

Sol. Benzaldehyde does not give Fehling's test. Both benzaldehyde and HCHO give Cannizzaro reaction due to absence of α - H atoms in them. CH_3CHO and CH_3COCH_3 show aldol condensation as they contain α - H atoms.

3. $A \to PS, B \to QR, C \to PR, D \to S$ (Concept Code: C121211)

Sol. Cellulose and proteins are natural polymers. Cellulose contains glycoside linkage (– O –) and protein contains amide linkage (– CONH –).

Mathematics

Section – A

1. B M110102

Sol. Let $f(x) = ax^2 + x + c - a$

$f(1) = c + 1 > 0 \quad (\because c > -1)$

$\therefore$ Given expression is positive for every $x \in R$

So, $f\left(\frac{1}{2}\right) > 0 \Rightarrow \frac{a}{4} + \frac{1}{2} + c - a > 0 \Rightarrow 4c - 3a + 2 > 0$

$\Rightarrow 4c + 2 > 3a$.

2. B M110103

Sol. Let α be a common root then $\alpha^3 + 2a\alpha + 2 = 0$ and $\alpha^4 + 2a\alpha^2 + 1 = 0$

i.e. $\alpha^4 + 2a\alpha^2 + 2\alpha = 0 \quad$ ….(i)

$\alpha^4 + 2a\alpha^2 + 1 = 0 \quad$ …(ii)

From (i) and (ii) $2\alpha - 1 = 0 \Rightarrow \alpha = \frac{1}{2}$

So, $\left(\frac{1}{2}\right)^3 + 2a\frac{1}{2} + 2 = 0 \Rightarrow \frac{1}{8} + a + 2 = 0 \Rightarrow a = -2 - \frac{1}{8} = -\frac{17}{8}$.

3. B M110509

Sol. $\sum_{r=1}^{n} \frac{r^2 - r - 1}{r + 1!} = \sum_{r=1}^{n}\left(\frac{r-1}{r!} - \frac{r}{(r+1)!}\right) = -\frac{n}{(n+1)!}$.

4. B M111210

Sol. First, 6 distinct digits can be selected in ${}^{10}C_6$ ways. Now the position of smallest digit in them is fixed i.e. position 4. Of the remaining 5 digits, two digits can be selected in ${}^{5}C_2$ ways. These two digits can be placed to the right of 4^{th} position in one way only. The remaining three digits to the left of 4^{th} position are in the required order automatically.

So $n(S) = {}^{10}C_6 \times {}^{5}C_2 = 210 \times 10 = 2100$.

5. **C** **M111206**

Sol. Clearly p = 6! $^7P_4$
q = 7! . 4!
$\frac{p}{q} = 5$

6. **C** **M111210**

Sol. When 4 points are selected we get one intersecting point. So probability is $\frac{^nC_4}{^{(^nC_2 - n)}C_2}$.

7. **C** **M121310**

Sol. $n(S) = 8 \times 8 = 64$
Square values that product can take are 1, 4, 9, 16, 25, 36, 49, 64
4 : (1, 4), (2, 2), (4, 1)
16: (2, 8), (4, 4), (8, 2)
For other values, there is only one way of getting the product.
$n(E) = 2 \times 3 + 6 \times 1 = 12$
$P(E) = \frac{12}{64} = \frac{3}{16}$.

8. **A** **M110411**

Sol. $(x-1)(x^2-2)(x^3-3) \ldots\ldots (x^n - n)$
Heighest power of x $= 1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2} = \alpha$
We are looking for the coefficient of $x^{\alpha-7}$
$\Rightarrow$ Either we should leave
$(x^7 - 7)$, $(x-1)(x^6-6)$, $(x^2-2)(x^5-5)$, $(x^3-3)(x^4-4)$, $(x-1)(x^2-2)(x^4-4)$
If we leave $(x^7 - 7)$, coeficient is -7
If we leave $(x-1)(x^6-6) = (x^7 - x^6 - 6x + 6)$, cofficient is 6
If we leave $(x^2-2)(x^5-5)$, coefficient is 10
If we leave $(x^3-3)(x^4-4)$, coefficient is 12
If we leave $(x-1)(x^2-2)(x^4-4)$, coefficient is -8
$\Rightarrow$ Required coefficient = 12 + 10 + 6 – 7 – 8 = 13.

9. **A** **M110304**

Sol. $z\omega = |z|^2 \Rightarrow \omega = \bar{z}$
$\Rightarrow |z + \bar{z}| + |z - \bar{z}| = 2$
$\Rightarrow |\mathrm{Re}(z)| + |\mathrm{Im}(z)| = 1$
Let z = x + iy
$\Rightarrow |x| + |y| = 1$
which is a square

10. **A** **M110405**

Sol. α is seventh root of unity $\Rightarrow 1 + \alpha + \alpha^2 + \ldots + \alpha^6 = 0$
$\Rightarrow p + q = -1$.
$pq = \alpha^4 + \alpha^6 + \alpha^7 + \alpha^5 + \alpha^7 + \alpha^8 + \alpha^7 + \alpha^9 + \alpha^{10} = 3 - 1 = 2$.
$\therefore x^2 + x + 2 = 0$ is the req. equation.

Both A and R are true and R is correct explanation of A.

11. A M121309

Sol. $\because\ P(A\cap B) = P(A) + P(B) - P(A\cup B) \geq P(A) + P(B) - 1$

$\therefore\ P(A \cap B) \geq \frac{3}{5} + \frac{2}{3} - 1 \Rightarrow P(A \cap B) \geq \frac{4}{15}$ . . . (i)

$\because\ P(A \cap B) \leq P(A) \Rightarrow P(A \cap B) \leq \frac{3}{5}$ . . .

from (i) and (ii), $\frac{4}{15} \leq P(A\cap B) \leq \frac{3}{5}$ . . .(

from (iii), $\frac{4}{15P(B)} \leq \frac{P(A\cap B)}{P(B)} \leq \frac{3}{5P(B)} \Rightarrow \frac{2}{5} \leq P\left(\frac{A}{B}\right) \leq \frac{9}{10}$

Hence (a) is the correct answer.

12. A M111215

Sol. The number of ways of distributing mn things in m groups each containing n things is $\frac{(mn)!}{(n!)^m}$

here if m = n, then $\frac{(n^2)!}{(n!)^n}$ which must be a natural number.

'A' is correct.

13. C M110411

Sol. Given expression = $x.\ x^2\ .\ x^3\ .\ .\ .\ x^{20}\left(1-\frac{1}{x}\right)\left(1-\frac{2}{x^2}\right)...\left(1-\frac{20}{x^{20}}\right)$

$= x^{210}.\ P$

where, $P = \left(1-\frac{1}{x}\right)\left(1-\frac{2}{x^2}\right)\left(1-\frac{3}{x^3}\right)...\left(1-\frac{20}{x^{20}}\right)$

Now, coefficient of x^{203} in original expression = coefficient of x^{-7} in P.

But, $P = 1 - \left(\frac{1}{x}+\frac{2}{x^2}+\frac{3}{x^3}+...\right)+\left(\frac{1}{x}.\frac{6}{x^6}+\frac{2}{x^2}.\frac{5}{x^3}+\frac{3}{x^3}.\frac{4}{x^4}\right) - \left(\frac{1}{x}.\frac{2}{x^2}.\frac{4}{x^4}+...\right)$;

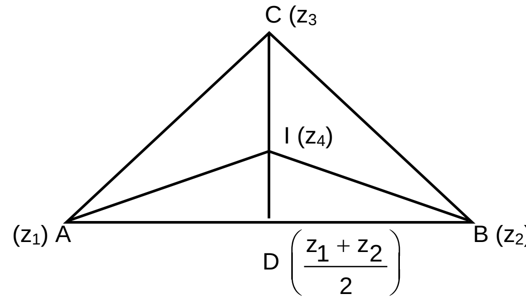
Coefficient of $x^{-7} = -7 + 6 + 10 + 12 - 8 = 13$.

The expression $(2 + x)^2 (3 + x)^3 (4 + x)^4 = x^9 + (2 + 2 + 3 + 3 + 3 + 3 + 4 + 4 + 4 + 4) x^8 +$ . .

$\Rightarrow$ coefficient of $x^8 = 29$.

Hence (c) is the correct answer.

14. C M110402



Sol. $\angle IAB = \frac{\theta}{2}$, $\angle IAC = \frac{\theta}{2}$

$$\frac{z_2 - z_1}{|z_2 - z_1|} = \frac{z_4 - z_1}{|z_4 - z_1|} e^{-\frac{i\theta}{2}}$$

$$\frac{z_3 - z_1}{|z_3 - z_1|} = \frac{z_4 - z_1}{|z_2 - z_1|} e^{-\frac{i\theta}{2}}$$

$$\frac{(z_2 - z_1)(z_3 - z_1)}{|z_2 - z_1||z_3 - z_1|} = \frac{(z_4 - z_1)^2}{|z_4 - z_1|^2} e^{\theta}$$

$$\therefore \frac{(z_2 - z_1)(z_3 - z_1)}{(z_4 - z_1)^2} = \frac{AB \cdot AC}{(IA)^2} = \left(\frac{AB}{IA}\right)^2 \left(\frac{AC}{AB}\right).$$

15. A M110402

Sol. $\frac{(z_2 - z_1)(z_3 - z_1)}{(z_4 - z_1)^2} = 2\left(\frac{AD}{IA}\right)^2 \left(\frac{AC}{AD}\right)$ (Since AB = 2AD)

$(z_4 - z_1)^2$ (1 + cos θ) sec θ $= (z_2 - z_1)(z_3 - z_1)$.

16. C M110402

Sol. $$\frac{-(z_1 + z_2 - 2z_3)(z_1 + z_2 - 2z_4)}{(z_2 - z_1)^2} = \frac{CD}{AD} \cdot \frac{ID}{AD}$$

$$\Rightarrow \frac{-(z_1 + z_2 - 2z_3)(z_1 + z_2 - 2z_4)}{(z_2 - z_1)^2} = \tan\theta \cdot \tan\frac{\theta}{2}$$

17. C M121304

Sol. x can be 2, 3, 4, 5, 6.
The number of ways in which sum 2, 3, 4, 5, 6 can occur are the coefficients of x^2, x^3, x^4, x^5, x^6, in $(3x + 2x^2 + x^3)(x + 2x^2 + 3x^3)$
$= 3x^2 + 8x^3 + 14x^4 + 8x^5 + 3x^6$.
This shows that sum that occurs most often is 4.

18. D M121304

Sol. Sum that occurs minimum times is 2 or 6.

19. C M121304

Sol. The number of ways in which different sums can occur is (3 + 2 + 1)(1 + 2 + 3) = 36
The probability of 4 is $\frac{14}{36} = \frac{7}{18}$.

Section – B

1. A → **S** B → **R** C → **R** D → **S**
M110510

Sol. (A) $s_p = \frac{p}{2}\left[2A+(p-1)d\right] = a$

$\frac{2a}{p} = 2A+(p-1)d$ … (1)

$\frac{2b}{q} = 2A+(q-1)d$ … (2)

$\frac{2c}{r} = 2A+(r-1)d$ … (3)

Multiply (1), (2) and (3) by (q – r), (r – p) and (p – q) and add

$\therefore \sum \frac{a}{p}(q-r) = 0$.

(B) Let common ratio be taken as k and a be the first term

$R = T_r = ak^{r-1}$

$R^{s-t} = a^{s-t}\, k^{(r-1)(s-t)}$

Similarly, $s^{t-r} = a^{t-r}\, k^{(s-1)(t-r)}$

$T^{r-x} = a^{r-s}\, k^{(t-1)(r-s)}$.

Multiplying the above three and knowing that

$A^m A^n A^p = A^{m+n+p}$

$R^{s-t}\, S^{t-r}\, T^{r-s} = a^0 k^0 = 1$.

(C) $x = a + (m-1)d = AR^{m-1}$

$y = a + (n-1)d = AR^{n-1}$

$z = a + (p+1)d = AR^{p-1}$

$y - z = (n-p)d,\ z - x = (p-m)d,\ x - y = (m-n)d$

$x^{y-z} \cdot y^{z-x} \cdot z^{x-y} = \left(AR^{m-1}\right)^{(n-p)d} \cdot \left(AR^{n-1}\right)^{(p-m)d} \cdot \left(AR^{p-1}\right)^{(m-n)d}$

$= A^0R^0 = 1$.

(D) $a = AR^{p-1}$, $b = AR^{q-1}$, $c = AR^{r-1}$ for G.P.

$a = \frac{1}{A_1+(p-1)D},\ b = \frac{1}{A_1+(q-1)D},\ c = \frac{1}{A_1+(r-1)D}$ for H.P.

$\frac{1}{b} - \frac{1}{c} = (q-r)D$ … (1)

log a = log A + (p – 1) log R

= (log A – log R) + (log R) … (2)

$\sum\left(\frac{1}{b}-\frac{1}{c}\right)\log a = D(\log A - \log R)\sum(q-r) + D\log R\sum p(q-r) = 0$

$\therefore \sum \frac{c-b}{bc}\log a = 0$

multiplying by – abc

$\sum a(b-c)\log a = 0$.

2. A $\rightarrow$**S** B $\rightarrow$**R** C $\rightarrow$**P** D $\rightarrow$**Q**
M110109

Sol. (A) $x^3 - ax^2 + bx - 2 = 0$
Let x_1, x_2, x_3 be roots
AM $\geq$ GM
$$\frac{x_1+x_2+x_3}{3}\cdot\frac{\sum x_2x_2}{3} \geq (x_1x_2x_3)^{1/3}(x_1x_2x_3)^{2/3}$$
$$\Rightarrow \frac{a\cdot b}{9} \geq x_1x_2x_3 = 2$$
$\Rightarrow$ ab $\geq$ 18 $\therefore$ (ab) min = 18

(B) $25200 = 2^4 3^2 5^2 7^1$
If divisor is of the form $12\lambda + 6$ i.e. $6(2\lambda + 1)$ then there must be exactly one 2 and at least one 3.
$\therefore$ Number of divisors are 1.2.(2 + 1) (1 + 1) = 12.

(C) Number of quadrilaterals are n(n – 5) = 8 × 3 = 24

(D) [cos x] = tanx
$\Rightarrow$ tan x = –1 and cosx <o
$\Rightarrow$ three solutions

3. A $\rightarrow$**Q** B $\rightarrow$**R** C $\rightarrow$**P** D $\rightarrow$**S**
M110108, 109, 110304

Sol.(A).|a + ib| |z| = |z| |(a – 1) + ib|
$$\Rightarrow \frac{1}{\sqrt{2}} = \sqrt{(a-1)^2 + b^2} \text{ and } a^2 + b^2 = \frac{1}{2}$$
$$\Rightarrow 1 - 2a = 0 \Rightarrow a = \frac{1}{2}$$
$$\text{and } b^2 = \frac{1}{4} \Rightarrow b = \frac{1}{2}$$
$\Rightarrow$ a – b = 0.

(B). We must have either
$6a > 2^a \,.\, 3^b$ or $6b > 2^a \,.\, 3^b$.
If b = 0, then $6a > 2^a \Rightarrow a = 1, 2, 3, 4$.
If a = 0, then $6b > 3^b \Rightarrow b = 1, 2$
suppose a > 0 and b > 0 $\Rightarrow$ if $6a > 2^a \,.\, 3^b$
thus $6^a > 2^a \,.\, 3$ so $2a > 2^a$ (not possible)
similarly if $6b > 2^a \,.\, 3^b$ than $3b > 3^b$ not possible
$\Rightarrow$ only solutions are 2, 4, 8, 76, 3, 9.

(C). $\text{Re}\left(\frac{z}{4}\right) \in (0,\ 1)$, $\text{Im}\left(\frac{z}{4}\right) \in [0,\ 1)$
means that if z = a + ib than a, b $\in$ (0, 4)
$$\text{Now } \frac{4}{a-ib} = \frac{4a}{a^2+b^2} + \frac{4bi}{a^2+b^2}$$
$$\Rightarrow 0 < a, b < \frac{a^2+b^2}{4}$$
$\Rightarrow (a - 2)^2 + b^2 > 4$ and $a^2 + (b - 2)^2 > 4$

so we want area inside the square and outside the two circles
$\Rightarrow$ area = 16 – 4π + (2π – 4)
12 – 2π.

(D). 3x + 4y + z = 5
let $\vec{a} = 3\hat{i} + 4\hat{j} + \hat{k}$
$\vec{b} = x\hat{i} + y\hat{j} + z\hat{k}$
$\Rightarrow (\vec{a} \cdot \vec{b}) \le |\vec{a}||\vec{b}|$
$\Rightarrow 5 \le \sqrt{9+16+1} \cdot \sqrt{x^2 + y^2 + z^2}$
$\Rightarrow 26\left(x^2 + y^2 + z^2\right) \ge \frac{25}{26}$

FIITJEE

BATCHES – 1314

PHYSICS, CHEMISTRY & MATHEMATICS

CPT3 - 2 | **CODE:** | **PAPER - 2**

Time Allotted: 3 Hours **Maximum Marks: 243**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

G. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into three sections: **Section-A, Section-B & Section-C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

H. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 08)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (09 – 12) contains 4 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

Section-A (13 – 17) contains 2 paragraphs. Based upon paragraph, 3 and 2 multiple choice questions have to be answered. Each question has only one correct answer and carries **+4 marks** for correct answer and **– 1 mark** for wrong answer.

(ii) **Section-B (01)** contains 1 Matrix Match Type question containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+6 marks** for all correct answer. For each correct row **+1 mark** will be awarded. There may be one or more than one correct choice. No marks will be given for any wrong match in any question. There is no negative marking.

(iii) **Section-C (01 – 05)** contains 5 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+3 marks** for correct answer. There is no negative marking.

Name of the Candidate :____

Batch :____________________ **Date of Examination :**____________________

Enrolment Number :____

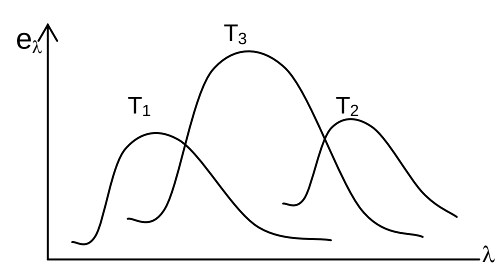
PART– I: PHYSICS

Section – A

(Single Correct Choice Type)

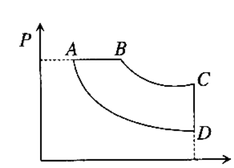
This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

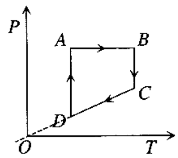
1. The plots of spectral emissive power e_λ versus wavelength of three black bodies at temperatures T_1, T_2 and T_3 are shown. Then,

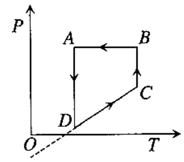


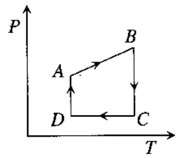
(A) $T_3 > T_2 > T_1$
(B) $T_1 > T_2 > T_3$
(C) $T_2 > T_3 > T_2$
(D) $T_1 > T_3 > T_2$

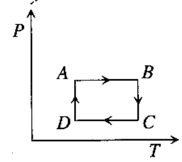
2. A cyclic process ABCD is shown in the following P-V diagram. Which of the following curves represents the same process?



(A) 

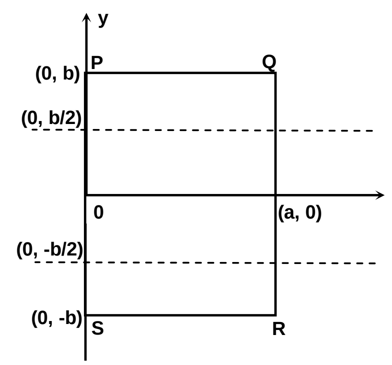
(B) 

(C) 

(D) 

3 A uniform and constant magnetic field exists in a region as under

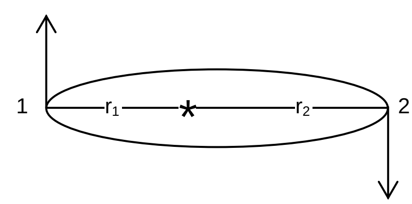
$$\begin{cases} B_o\hat{i} & \text{for } y > \frac{b}{2} \\ -B_o\hat{i} & \text{for } y < -\frac{b}{2} \\ \text{zero for } -\frac{b}{2} \le y \le \frac{b}{2} \end{cases}$$



Then the current that must be passing through the area enclosed by PQRS shown

(A) $\frac{2B_oa}{\mu_o}\left(-\hat{k}\right)$ (B) $\frac{2B_oa}{\mu_o}\left(\hat{k}\right)$ (C) $\frac{2B_ob}{\mu_o}\left(-\hat{k}\right)$ (D) $\frac{2B_ob}{\mu_o}\left(\hat{k}\right)$

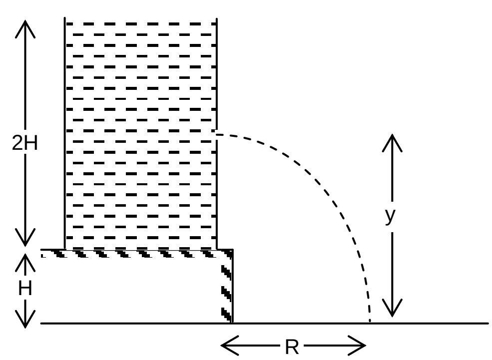
4. The ratio of KE of a planet at the points 1 and 2 is



(A) $\left(\frac{r_1}{r_2}\right)^2$ (B) $\left(\frac{r_2}{r_1}\right)^2$

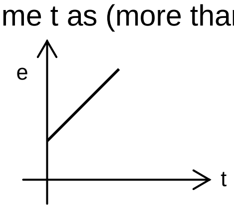
(C) $\frac{r_1}{r_2}$ (D) $\frac{r_2}{r_1}$

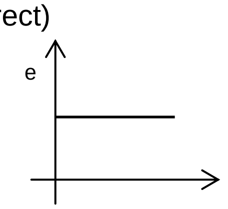
5. A tank is filled upto a height 2H with a liquid and is placed on a platform of height H from the ground. The distance y from the ground where a small hole is made in the tank, to get the maximum horizontal range R is



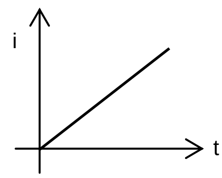
(A) 2H
(B) 3 H/2
(C) 5 H/4
(D) H

6 Two parallel long straight conductors lie on a smooth horizontal surface. Two other parallel conductors rest on them at right angles so as to form a square of side a initially. A uniform magnetic field B exists in vertical direction. Now all the four conductors start moving outwards with a constant velocity v. The induced e.m.f. e and induced current i will vary with time t as (more than one option may be correct)

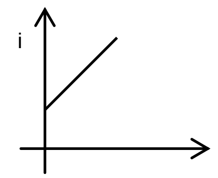
(A) 

(B) 

(C)



(D)

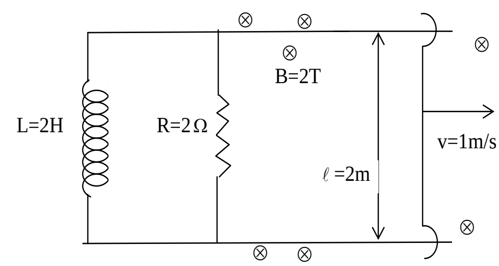


7. The power radiated by a black body is P, and it radiates maximum energy around the wavelength λ_0. If the temperature of black body is now changed so that it radiates maximum energy around a wavelength $\frac{3\lambda_0}{4}$, the new power radiated by it will be

(A) $\frac{4}{3}P$ (B) $\frac{16}{9}P$

(C) $\frac{64}{27}P$ (D) $\frac{256}{81}.P$

8. The given figure shows an inductor and resistance fixed on a conducting wire. A movable wire PQ starts moving on the fixed rails from t = 0 with constant velocity 1 m/s. A constant magnetic field (B = 2T) exist perpendicular to the plane of paper. The work done by the external force on the wire PQ in 2 second is (in joules)



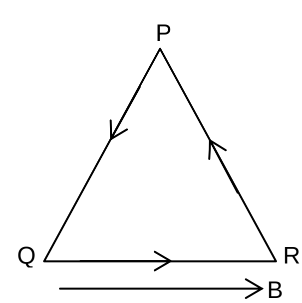
(A) 20 (B) 24
(C) 16 (D) 32

(Multi Correct Choice Type)

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

9. A metal cylinder of mass 0.5 kg is heated electrically by a 12 W heater in a room at 15^oC. The cylinder temperature rises uniformly to 25^oC in 5 min and finally becomes constant at 45^oC. Assuming that the rate of heat loss is proportional to the excess temperature over the surroundings,
(A) the rate of loss of heat of the cylinder to surrounding at 20^oC is 2 W
(B) the rate of loss of heat of the cylinder to surrounding at 45^oC is 12 W
(C) specific heat capacity of metal is $\frac{240}{\ln(3/2)} J/kg^oC$
(D) none of the above

10. An equilateral triangular loop PQR of side l carries a currents I in the direction shown. The loop is kept in uniform magnetic field B, directed parallel to the base of triangle QR as shown. Net force F and torque τ acting on loop is

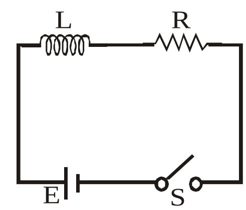


(A) $F = 0$ (B) $F = \sqrt{3}\, ilB$

(C) $\tau = 0$ (D) $\tau = \dfrac{\sqrt{3}\, l^2 iB}{4}$

11. In case of earth:
(A) Potential is minimum at the centre of earth
(B) Potential is same, both at centre and infinity but not zero
(C) Potential is zero, both at centre and infinity
(D) Field is zero, both at centre and infinity

12. In the LR circuit as shown in figure, the switch is closed at $t = 0$. Mark the **correct** statement of the following:



(A)The current increases with time

(B)The current increases with a decreasing rate

(C)The voltage drop across the inductor increases

(D)The voltage drop across the resistor increases

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs 3 and 2 **multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 13 to 15

According to Stefan's Law, heat energy emitted/sec/area by a perfectly black body varies directly as the fourth power of its absolute temperature. The wavelength corresponding to which energy emitted is maximum varies inversely as the temperature of block body (Wien's Law). However, the rate of loss of heat of a liquid varies directly as the difference in temperatures of the liquid and the surroundings, provided this difference is small ($\approx 30^0$C). This is Newton's laws of cooling.

13 Temperature of a black body is made three times. The power radiated becomes
(A) 3 times (B) 9 times
(C) 27 times (D) 81 times

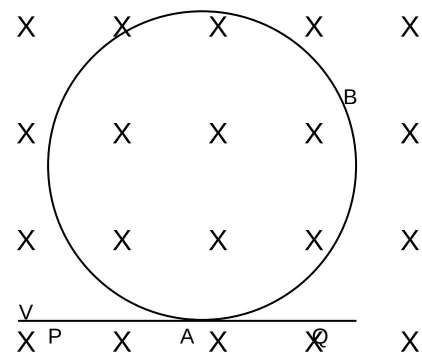
14. The wavelength corresponding to which energy radiated is maximum in the above case becomes n times, where n is
(A) $\dfrac{1}{3}$ (B) $\dfrac{1}{9}$

(C) $\frac{1}{27}$ (D) $\frac{1}{81}$

15. A liquid takes 5 minutes to cool from 60^0C to 50^0C, when temperature of surrounding is 30^0C. How long will it take to cool from 50^0C to 40^0C? (nearly)
(A) 5 minute (B) 4 minute
(C) 9 minute (D) 10 minute

Paragraph for Question no. 16 to 17

A circular conducting loop of radius r_0 (at t = 0) and having resistance per unit length λ is placed in a constant magnetic field B which is perpendicular to plane of loop. The ends P and Q of the wire are pulled in opposite directions with a constant velocity v such that loop remains circular and the radius of the loop goes on decreasing, then answer the following question.



16 Magnitude of the emf inducted in the loop as a function of time t is
(A) $2Bv\left[\frac{r_0}{2}-\frac{vt}{\pi}\right]$ (B) $2Bv\left[r_0-\frac{2vt}{\pi}\right]$
(C) $2Bv\left[r_0-\frac{vt}{\pi}\right]$ (D) $2Bv\left[r_0-\frac{3vt}{2\pi}\right]$

17. Current induced in the loop is
(A) $\frac{Bv}{\pi\lambda}$ (B) $\frac{2Bv}{\pi\lambda}$
(C) $\frac{Bv}{2\pi\lambda}$ (D) $\frac{Bv}{4\pi\lambda}$

Section – B
Matrix – Match Type

This section contains **01 Matrix Match Type** questions. Each question has four statements (A, B, C and D) given in column I and five statements (p, q, r, s and t) in column II. Any given statement in column I can have correct matching with **One or More** statements(s) given in column II.

1. Read the following and write the correct pairs.
m gram of water at 50°C is mixed with M gram ice at -20°C in an adiabatic vessel. Assume heat exchange between water and ice only. The system is left for long time and its final temperature written in column II specific heat of water and ice are 1 & 0.5 cal/g-k and latent heat of fusion for ice is 80 cal/g.

	Column I		**Column II**
(A)	m = 100 gm M = 100 gm	(p)	26.66°C
(B)	m = 100 gm M = 20 gm	(q)	0°C
(C)	m = 10 gm M = 200 gm	(r)	3.33°C
(D)	m = 200 gm M = 100 gm	(s)	– 6.67°C

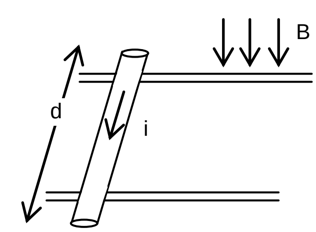
Section – C
(Integer Type)

This section contains **5 questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

1. Three particles, each of mass m, are situated at the vertices of an equilateral triangle of side length a. The only forces acting on the particles are their mutual gravitational forces. It is desired that each particle moves in a circle while maintaining the original mutual separation a. Find the initial velocity that should be given to each particle. $\left(\text{take } a = \frac{GM}{16}\right)$

2. An air bubble of 1 cm radius is rising at a steady rate of 0.5 cm/s through a liquid of density 0.9 g/cm^3. Calculate the coefficient of viscosity of the liquid (In 10^2 g/cm sec) Neglect the density of air.

3. A cylindrical uniform rod of mass 0.72 kg and radius 6 cm rests on two parallel rails, that are d = 50 cm apart. The rod caries a current I = 48A (In the direction shown) and rolls along the rails without slipping. If it starts from rest, uniform magnetic field of magnitudes 0.25 T is directed perpendicular to the rod and the rail, then the friction force(In N) between rod and rails is



4. Gravitational filed in a region is given by $\vec{E} = \left(3\hat{i} - 4\hat{j}\right)$ N/kg. Find out the work done (in J) in displacing a particle by 1m along the line 4y = 3x + 9?

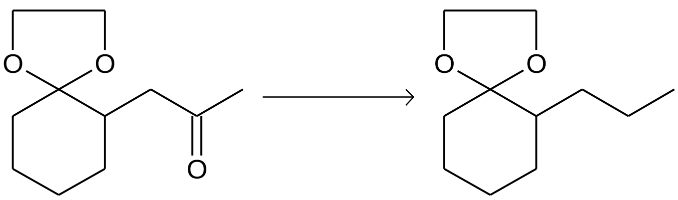
5. One mole of an ideal gas at temperature T_1 expends according to the law $\frac{P}{V^2} = a$ (constant). The work done by the gas till temperature of gas becomes T_2 is $\frac{1}{n}R[T_2\text{-}T_1]$ then n is:

PART– II: CHEMISTRY

Section – A

(Single Correct Choice Type)

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. 

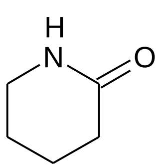
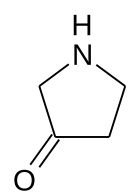
Which of the following reagent is used for the above change?

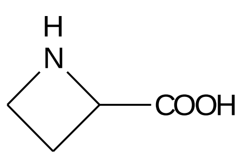
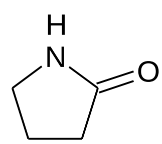
(A) $\dfrac{\text{(i)NaCN}}{\text{(ii)HCl}}$ (B) $\dfrac{\text{(i)}NH_2NH_2}{\text{(ii)KOH},\Delta}$

(C) $\dfrac{\text{Zn}-\text{Hg}}{\text{Conc.HCl}}$ (D) $LiAlH_4$/ether

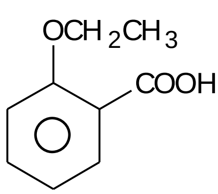
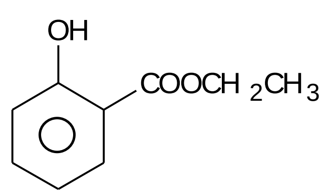
2. $H_2N-CH_2-CH_2-CH_2-COOH \xrightarrow{\text{Heat}} \text{Product}$

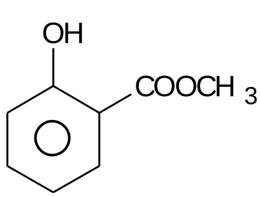
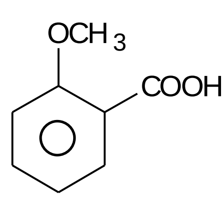
The product of above reaction is:

(A)  (B) 

(C)  (D) 

3. A compound (X) on hydrolysis gives an acid and alcohol. Acid gives violet colour with neutral $FeCl_3$ while alcohol gives yellow precipitate on boiling with I_2 and NaOH, (X) can be

(A)  (B) 

(C)  (D) 

4. Which of the following is not a disproportionation reaction?

(A) $4H_3PO_3 \longrightarrow 3H_3PO_4 + PH_3$

(B) $2H_2O_2 \longrightarrow 2H_2O + O_2$

(C) $2KClO_3 \longrightarrow 2KCl + 3O_2$

(D) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

5. If 'E' is the kinetic energy of one mole of an ideal gas and 'M' is its molecular mass, then the r.m.s velocity of the gas is given by:

(A) $\sqrt{\frac{M}{2E}}$ (B) $\sqrt{\frac{2M}{E}}$
(C) $\sqrt{\frac{2E}{M}}$ (D) $\sqrt{\frac{E}{2M}}$

6. Which of the following two gases on reaction produces a colloidal solution?

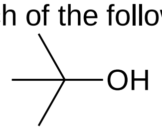
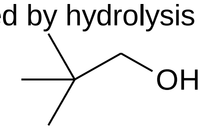
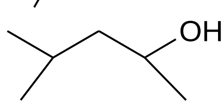
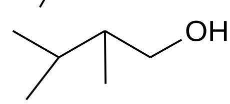
(A) $NH_3 + NO_2$ (B) $SO_2 + H_2S$
(C) $PH_3 + P_2H_4$ (D) $HCl + Cl_2$

7. $XeF_4 + SbF_5 \longrightarrow \text{Product}(s)$

The product(s) of above reaction is/are

(A) XeF_2 and SbF_7 (B) Only $[XeF_2]^+ [SbF_7]^-$
(C) Only $[XeF_3]^+ [SbF_6]^-$ (D) Xe and $[XeF]^+ [SbF_8]^{2-}$

8. Which of the following alcohol cannot be prepared by hydrolysis of an alkene?

(A) 
(B) 
(C) 
(D) 

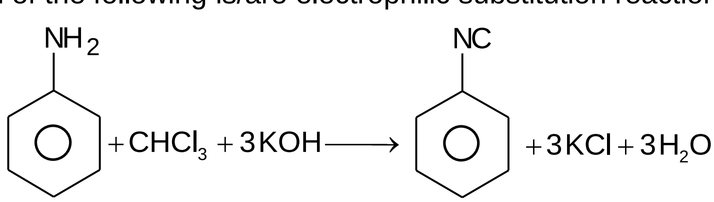
(Multi Correct Choice Type)

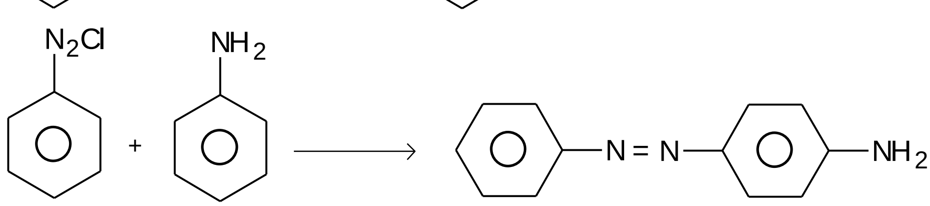
This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

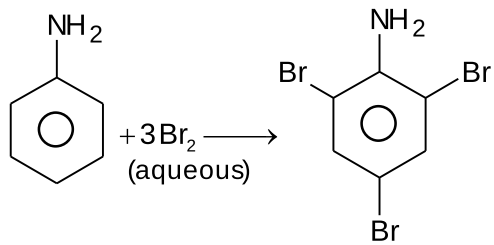
9. Which of the following ester(s) form(s) a single organic product when treated with $LiAlH_4$?

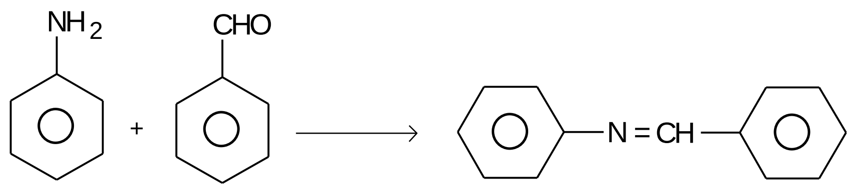
(A) CH_3COOCH_3 (B) $CH_3COOC_2H_5$
(C) $HCOOCH_3$ (D) $C_2H_5COOC_2H_5$

10. Which of the following is/are electrophilic substitution reaction(s)?

(A) 

(B) 

(C) 

(D) 

11. Which of the following solution(s) display(s) common ion effect?
(A) HCN + NaH
(B) NaHS + HCl
(C) NH_4CN + KCN
(D) H_2S + Na_2SO_4

12. Which of the following compound(s) is/are more reactive than C_2H_5Br towards a common S_N2 reaction under identical conditions?
(A) CH_3Br
(B) C_2H_5Cl
(C) C_2H_5I
(D) CH_3I

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs 3 and 2 **multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 13 to 15

300 mL of 1 M $BaCl_2$ solution was mixed with 200 mL of 0.8 M Na_3PO_4 solution for complete reaction. A white precipitate $Ba_3(PO_4)_2$ and NaCl solution are formed as products of the reaction.

Answer the following questions on the basis of above write up.

13. What is the molarity of Ba^{2+} ions in the reaction mixture after completion of the reaction?
(A) 2.4 M
(B) 0.12 M
(C) 1.2 M
(D) 0.24 M

14. The molarity of which of the following ions in the reaction mixture is 0.96 M after completion of the reaction?
(A) Na^+ and PO_4^{3-}
(B) Cl^- and PO_4^{3-}
(C) Na^+ and Cl^-
(D) None of these

15. What is the molarity of PO_4^{3-} ions in the solution after completion of the reaction?
(A) 1.2 M
(B) 0.18 M
(C) 0.86 M
(D) zero

Paragraph for Question no. 16 to 17

There are some deposits of nitrates and phosphates in earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under the laboratory conditions but microbes do it easily. Ammonia forms large number of complexes with transition metal ions. Hybridization easily explains the ease of sigma donation capability of NH_3 and PH_3. PH_3 is flammable gas and is prepared from white phosphorus.

Answer the following questions on the basis of above write up.

16. Which of the following statement is correct?
(A) Phosphates have no biological significance in humans.
(B) Between nitrates and phosphates, phosphates are less abundant in earth's crust.
(C) Between nitrates and phosphates nitrates are less abundant in earth's crust.
(D) Oxidation of nitrates is possible in soil.

17. Which of the following statement is correct?
(A) Between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies spherical s-orbital and is less directional.
(B) Between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional.
(C) Between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional.
(D) Between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electrons occupies spherical s-orbital and is less directional.

Section – B

Matrix – Match Type

This section contains **01 Matrix Match Type** questions. Each question has four statements (A, B, C and D) given in column I and five statements (p, q, r, s and t) in column II. Any given statement in column I can have correct matching with **One or More** statements(s) given in column II.

1. Match the characteristics of gases mentioned in Column - I with their factors mentioned in Column - II

Column – I		Column – II	
(A)	Vapour density	(P)	Temperature
(B)	Liquification	(Q)	Pressure
(C)	R.M.S velocity	(R)	Molecular mass
(D)	Average Kinetic energy	(S)	van der Waal's constant(a)

Section – C

(Integer Type)

This section contains **5 questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

1. How many aldol product(s) is/are formed when a mixture of CH_3CHO and CH_3COCH_3 react with dil.NaOH?

2. The magnitude of the orbital angular momentum vector of an electron is $\sqrt{6}\dfrac{h}{2\pi}$. Into how many components will the vector split if an external magnetic field is applied on it?

3. How many mole(s) of phenyl hydrazine is/are needed by one mole of glucose to form one mole of glucosazone?

4. $CH_3 – CH = CH – CH = CH – CH_3$
How many geometrical isomer(s) is/are possible for the above compound?

5. How many P = O bond(s) is/are present in a molecule of P_4O_{10}?

PART– III: MATHEMATICS

Section – A

(Single Correct Choice Type)

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. The number of complex numbers satisfying $|z + 2| + |z - 2| = 8$ and $|z - 1| + |z + 1| = 2$ is
(A) 4 (B) 2
(C) 0 (D) none of these

2. If $|z_1| = \sqrt{2}$, $|z_2| = \sqrt{3}$, $|z_3| = 2$ and $|z_1z_2 + z_2z_3 + z_3z_1| = k|6z_1 + 4z_2 + 3z_3|$, where z_1, z_2, z_3 are complex numbers, then k^2 is equal to
(A) 6 (B) $\frac{1}{6}$
(C) 36 (D) $\frac{1}{36}$

3. If the roots of the equation $ax^2 - bx + c = 0$ are α, β then the roots of the equation $b^2cx^2 - ab^2x + a^3 = 0$ are
(A) $\frac{1}{\alpha^2+\alpha\beta}, \frac{1}{\beta^2+\alpha\beta}$ (B) $\frac{1}{\alpha^3+\alpha\beta}, \frac{1}{\beta^3+\alpha\beta}$
(C) $\frac{1}{\alpha^4+\alpha\beta}, \frac{1}{\beta^4+\alpha\beta}$ (D) none of these

4. If exactly one of the roots of the equation $x^2 + (a + 3)x + a = 0$ lies in [1, 3] then the minimum value of $\frac{1-a^2}{a}$ is
(A) $\frac{3}{2}$ (B) $\frac{77}{18}$
(C) $-\frac{9}{2}$ (D) – 2

5. Number of natural numbers $< 2.10^4$ which can be formed with the digits 1, 2, 3 only is equal to
(A) $\frac{3^5+2.3^4-3}{2}$ (B) $\frac{3^6-2.3^4+3}{2}$
(C) $\frac{3^7-1}{2}$ (D) none of these

6. Fifteen coupons are numbered 1 to 15. Seven coupons are selected at random, one at a time with replacement. The probability that the largest number appearing on a selected coupon be 9 is
(A) $\left(\frac{1}{15}\right)^7$ (B) $\left(\frac{8}{15}\right)^7$
(C) $\left(\frac{3}{5}\right)^7$ (D) none of these

7. Each of 10 passengers board any of the three buses randomly which had no passenger initially. The probability that each bus has got at least one passenger is

(A) $1-\frac{2^{10}}{3^{10}}$ (B) $1-\frac{{}^{10}C_3 \times 3^7}{3^{10}}$

(C) $\frac{{}^{10}P_3 3^7}{3^{10}}$ (D) $\frac{3^{10}-3.2^{10}+3}{3^{10}}$

8. Let x = $(5\sqrt{2} + 7)^{19}$, then x{x} ({.} denotes the fractional part of x) is equal to

(A) 2^{19} (B) 3^{19}

(C) 0 (D) 1

(Multi Correct Choice Type)

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

9. If $|z_1| = |z_2|$ and $\arg(z_1) + \arg(z_2) = \pi/2$, then

(A) z_1z_2 is purely real

(B) z_1z_2 is purely imaginary

(C) $(z_1+z_2)^2$ is purely imaginary

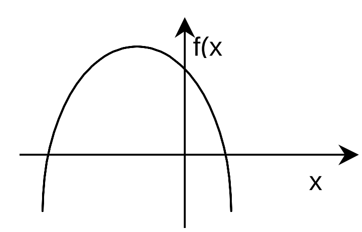
(D) $\arg(z_1^{-1}) + \arg(z_2^{-1}) = -\pi/2$

10. The number $\underbrace{111......1}_{91\text{ times}}$ is a

(A) Prime number (B) Composite number

(C) Divisible by $\frac{10^7-1}{9}$ (D) None of these

11. Consider the graph of $f(x) = ax^2 + bx + c$ in the adjacent figure. We can conclude that



(A) c > 0 (B) a< 0

(C) b < 0 (D) a+ b+ c < 0

12. Let n be a positive integer with f(n) = 1! + 2! + 3! + … + n! and P(x), Q(x) be polynomials in x such that f(n+2) = P(n)f(n+1) + Q(n)f(n) for all $n \geq 1$. Then

(A) P(x) = x + 3 (B) Q(x) = - x - 2

(C) P(x) = - x - 2 (D) Q(x) = x + 3

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs 3 and 2 **multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 13 to 15

If a cricket team of 11 players is to be selected from 8 batsman, 6 bowlers, 4 all rounder and 2 wicket keepers, then

13. The number of selections when atmost 1 all rounder and 1 wicket keeper will play., is
(A) ${}^4C_1 \cdot {}^{14}C_{10} + {}^2C_1 \cdot {}^{14}C_{10} + {}^4C_1 \cdot {}^2C_1\ {}^2C_1 \cdot {}^{14}C_9 + {}^{14}C_{11}$
(B) ${}^4C_1 \cdot {}^{15}C_{11} + {}^{15}C_{11}$
(C) ${}^4C_1 \cdot {}^{15}C_{10} + {}^{15}C_{11}$
(D) none of these

14. Number of selection when 2 particular batsmen don't want to play when a particular bowler will play, is
(A) ${}^{17}C_{10} + {}^{19}C_{11}$ (B) ${}^{17}C_{10} + {}^{19}C_{11} + {}^{17}C_{11}$
(C) ${}^{17}C_{10} + {}^{20}C_{11}$ (D) ${}^{19}C_{10} + {}^{19}C_{11}$

15. Number of selections when a particular batsman and a particular wicket keeper don't want to play together, is
(A) $2 \cdot {}^{18}C_{10}$ (B) ${}^{19}C_{11} + {}^{18}C_{10}$
(C) ${}^{19}C_{10} + {}^{19}C_{11}$ (D) none of these

Paragraph for Question no. 16 to 17

Given A(3 + 4i), B(– 4 + 3i) and C(4 + 3i) be the vertices of ΔABC which is inscribed in a circle S = 0. Let AD, BE, CF are altitudes through A, B, C which meet the circle S = 0 at D(z_1), E(z_2) and F(z_3) respectively.

16. Complex number z_1 is equal to
(A) $\left(2\sqrt{6}+i\right)$ (B) $\left(1+2\sqrt{6}i\right)$
(C) 3 – 4i (D) – 3 – 4i

17. Orthocentre of triangle ABC is at
(A) 2 + 9i (B) 3 + 10i
(C) 3 + 11i (D) none of these

Section – B

Matrix – Match Type

This section contains **01 Matrix Match Type** questions. Each question has four statements (A, B, C and D) given in column I and five statements (p, q, r, s and t) in column II. Any given statement in column I can have correct matching with **One or More** statements(s) given in column II.

1. Match the following

	Column-I		Column-II
(A)	Given positive rational numbers A, B, C such that A + B + C = 1, then $A^AB^BC^C + A^BB^CC^A + A^CB^AC^B$	(P)	Is equal to $-\frac{1}{2}(n-1)$

(B)	If N is a positive integer ≥ **1**, then $\frac{3^n}{2^n + n \cdot 6^{\frac{n-1}{2}}}$	(Q)	Is equal to $\frac{2}{n}$
(C)	If N ∈ N > 1, then sum of real part of roots of $z^N = (z + 1)^N$	(R)	≤ **1**
(D)	If the Quadratic Equations $2x^2 + bx + 1 = 0$ and $4x^2 + ax + 1 = 0$ have a common root, then the value of $\frac{a^2 + 2b^2 - 3ab + 4}{2}$	(S)	**1**

Section – C
(Integer Type)

This section contains **5 questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

1. If $p(x) = ax^2 + bx$ and $q(x) = lx^2 + mx + n$ with $p(1) = q(1)$, $p(2) - q(2) = 1$, and $p(3) - q(3) = 4$, then $p(4) - q(4)$ is equal to

2. If a, b, c are the sides of a triangle, then the minimum value of $\frac{a}{b+c-a} + \frac{b}{c+a-b} + \frac{c}{a+b-c}$ is equal to

3. In a triangle ABC, A, B, C are in G.P. with common ratio 2. Then $\frac{1}{b} + \frac{1}{c} - \frac{1}{a}$ is equal to (where a, b, c are the sides of a triangle opposite to A, B, C respectively).

4. What is unit digit for the sum $(346)^{44} + (344)^{46}$

5. If 5^{40} is divided by 11, then remainder is

Hints & Solutions

Physics

Section – A

1. **D** (Concept code: P111227)
Sol. λT = constant

2. **A** (Concept code: P111216)
Sol. AB is isobaric process, BC isothermal process, CD is isochoric process and DA is isothermal process.

3. **A** (Concept code: P120303)

$$\int B_o.d\ell = \mu_o i_{enc}$$

$B_o.2a = \mu_o\ i_{enc}$

$$i_{enc} = \frac{2B_o a}{\mu_o}$$

4. **B** (Concept code: P110913)
Sol. Use: $mV_1r_1 = mV_2r_2$

5. **B** (Concept code: P111010)
Sol. Range $= \sqrt{\frac{2y}{g}} \times \sqrt{3H - y} \Rightarrow$ Maximum at y = $\frac{3R}{2}$.

6. **A** (Concept code: P120407)
Sol. Use: emf = $B\ell v$

7. **D** (Concept code: P111227)
Sol. λT = constant & $P = \sigma A T^4$

8. **D** (Concept code: P120423)
Sol. Use wire as emf = $B\ell v$ and then as L–R circuit.

9. **ABC** (Concept code: P111201)
At steady state, the rate of heat gain and the rate of heat loss are equal.

10 **AD** (Concept code: P120307)

$$\vec{\tau} = \vec{\mu} \times \vec{B}$$

$$= (i\vec{A}) \times \vec{B}$$

11. **AD** (Concept code: P110917)

$$V_{out} = -\frac{GM}{r}$$

and $V_{in} = -\frac{GM}{2R^3}(3R^2 - r^2)$

12 **ABD** (Concept code: P120423)

Sol. $i = \frac{E}{R}\left(1 - e^{-\frac{tR}{L}}\right)$

13. **D** (Concept code: P111224)

Sol. $P = \sigma A T^4$

14. **A** (Concept code: P111227)

Sol. Use: λT = constant

15. **C** (Concept code: P111226)

Sol. Use: $\frac{\Delta T}{\Delta t} \propto (T - T_s)$

16 **C** (Concept code: P120404)

Sol. $\text{emf} = \frac{d\phi}{dt}$

17. **A** (Concept code: P120405)

Sol. $i = \frac{\text{emf}}{R}$

Section – B

1. **A → Q ; B → P ; C → S ; D → R**
(Concept code: P111201)

Sol. Used: Heat = msAT or mL_f for heat gained or lost.

Section – C

1. **4** (Concept code: P110901)

Sol. $\frac{Gmm}{a^2}\cos 30^o x2 = \frac{mv^2}{\left(a/\sqrt{3}\right)}$

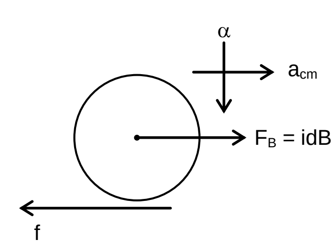
2. **4** (Concept code: P111012)

Sol. Buoyant force = 6π nrv.

3. **2** (Concept code: P120407)

Sol. $f = \frac{F}{3} = \frac{idB}{3}$

$\Rightarrow \frac{48 \times 0.5 \times 0.25}{3} = 2.$



4. **0** (Concept code: P110916)

Sol. $dw = \vec{E}.d\vec{r} = 0$

5. **3** (Concept code: P111213)

Sol. $W = \int PdV$

Chemistry

Section – A

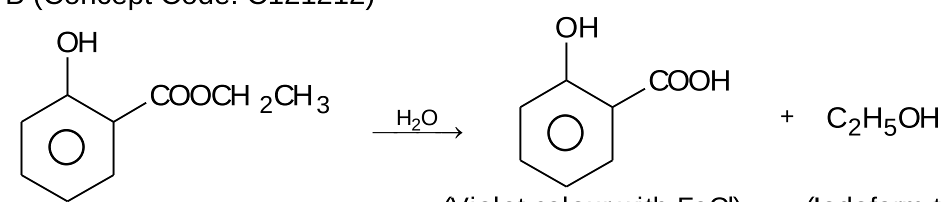
1. B (Concept Code: C121206)

Sol. This is Wolf-Kishner reduction. The reagent is NH_2NH_2/KOH. Clemmensen reagent Zn-Hg/Conc.HCl can't be used since the epoxy ring undergoes cleavage in presence of acid.

2. D (Concept Code: C121207)

Sol. The compound undergoes dehydration on heating.

3. B (Concept Code: C121212)

Sol. 

(Violet colour with $FeCl_3$) (Iodoform test)

4. C (Concept Code: C110205)

Sol. The reaction in (C) is an intramolecular redox reaction not disproportionation reaction in which only one atom undergoes redox change.

5. C (Concept Code: C111206)

Sol. Kinetic energy of one mole of an ideal gas is given by: $E = \frac{3}{2}RT$ or, 3 RT = 2 E

$$C_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{2E}{M}}$$

6. B (Concept Code: C120904)

Sol. $SO_2 + 2H_2S \longrightarrow \underset{\text{(Colloid)}}{3S\downarrow} + 2H_2O$

7. C (Concept Code: C121102)

Sol. $XeF_4 + SbF_5 \longrightarrow [XeF_3]^+[SbF_6]^-$

8. B (Concept Code: C121203)

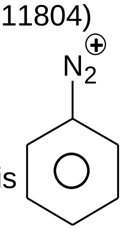
Sol. Cannot be prepared by hydrolysis of alkenes.

9. BC (Concept Code: C121207)

Sol. $CH_3COOC_2H_5 \xrightarrow{LiAlH_4} 2C_2H_5OH$

$HCOOCH_3 \xrightarrow{LiAlH_4} 2CH_3OH$

10. BC (Concept Code: C111804)

Sol. In (B), the electrophile is  and Br^+ is the electrophile in (C).

11. B (Concept Code: C110505)

Sol. $NaHS \longrightarrow Na^+ + HS^-$

$HS^- \rightleftharpoons H^+ + S^{2-}$

$HCl \longrightarrow H^+ + Cl^-$

H^+ is the common ion.

12. ACD (Concept Code: C121201)

Sol. For CH_3Br and CH_3I, steric effect favours for S_N2 reaction. For C_2H_5I, leaving group favours S_N2 reaction.

13. B (Concept Code: C110207)

Sol. The balanced equation is:

	$3BaCl_2$	$+2Na_3PO_4 \longrightarrow$	$Ba_3(PO_4)_2$	$+6NaCl$
M mole before Reaction	300	160	0	0
M mole after Reaction	60	0	80	480

mM of $BaCl_2$ = 60

$\therefore$ Molarity of $BaCl_2$ = Molarity of Ba^{2+} = $\frac{mM}{\text{vol. of soln}} = \frac{60}{500}$ = 0.12 M

14. C (Concept Code: C110207)

Sol. No, PO_4^{3-} ions are left in the solution.

$\therefore$ The option (C) is correct

Molarity of NaCl = Molarity of Na^+ = Molarity of Cl^-

$= \frac{mM}{\text{volume}} = \frac{480}{500} = 0.96\,M$

15. D (Concept Code: C110207)

Sol. All the PO_4^{3-} ions are precipitated. No PO_4^{3-} ions left in the solution.

16. C (Concept Code: C120807)

Sol. Nitrates are more soluble in water than phosphates.

17. C (Concept Code: C120807)

Sol. The p-orbital character of the lone pair of NH_3 is greater than that of PH_3 due to its smaller bond angle.

Section – B

1. A $\rightarrow$ R, B $\rightarrow$ PQRS, C $\rightarrow$ PR, D $\rightarrow$ P (Concept Code: C111205)

Sol. Vapour density = $\frac{\text{Mol.mass}}{2}$

R.M.S velocity $\alpha \sqrt{\frac{T}{M}}$

$\bar{E}_K \, \alpha \, T$

Section – C

1. 4 (Concept Code: C121206)

Sol.

$$CH_3CHO + CH_3CHO \xrightarrow{NaOH} CH_3\underset{}{\overset{\overset{OH}{|}}{C}}HCH_2CHO$$

$$CH_3COCH_3 + CH_3COCH_3 \xrightarrow{NaOH} CH_3 - \overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}} - CH_2COCH_3$$

$$CH_3CHO + CH_3COCH_3 \xrightarrow{NaOH} CH_3\overset{\overset{OH}{|}}{C}HCH_2COCH_3 + CH_3 - \overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}} - CH_2CHO$$

2. 5 (Concept Code: C110107)

Sol. The orbital angular momentum = $\sqrt{\ell(\ell+1)}\dfrac{h}{2\pi} = \sqrt{6}\dfrac{h}{2\pi}$

$\therefore \ell = 2$

$\therefore$ The electron is present in a d-sub shell which splits into five components in the presence of external magnetic field.

3. 3 (Concept Code: C121209)

Sol.

$$\begin{array}{l} CHO \\ | \\ CHOH \\ | \\ (CHOH)_3 \\ | \\ CH_2OH \end{array} + 3C_6H_5NHNH_2 \longrightarrow \begin{array}{l} CH = NNHC_6H_5 \\ | \\ C = NNHC_6H_5 \\ | \\ (CHOH)_3 \\ | \\ CH_2OH \end{array}$$

4. 3 (Concept Code: C111403)

Sol. The isomers are: cis-cis, trans-trans and cis-trans

5. 4 (Concept Code: C120809)

Sol. Follow the structure of P_4O_{10}.

Mathematics

Section – A

1. C M11030

Sol. First equation represent ellipse and second a line segment joining (–1, 0) and (1, 0) totally contained inside ellipse.

2. B M11030

Sol. Using $z_1\bar{z}_1 = 2$ $z_2\bar{z}_2 = 3$, $z_3\bar{z}_3 = 4$, then k = 1/6

3. A M110105

Sol. Multiplying the given equation by $\frac{c}{a^3}$, we get

$$\frac{b^2c^2}{a^3}x^2 - \frac{b^2c}{a^2}x + c = 0$$

$$\Rightarrow a\left(-\frac{bc}{a^2}x\right)^2 - b\left(\frac{bc}{a^2}\right)x + c = 0$$

$$\Rightarrow -\frac{bc}{a^2}x = \alpha,\ \beta$$

$\Rightarrow (\alpha + \beta)\alpha\beta\ x = \alpha, \beta$

$$\Rightarrow x = \frac{1}{(\alpha+\beta)\alpha},\ \frac{1}{(\alpha+\beta)\beta}.$$

4. A M110108

Sol. $(1 + (a + 3) + a)\ (9 + (a + 3)3 + a) \le 0$

$$\Rightarrow -\frac{9}{2} \le a \le -2$$

Now, as $\frac{1-a^2}{a} = \frac{1}{a} - a$ is decreasing in a, its minimum value = $\frac{1}{(-2)} - (-2) = \frac{3}{2}$.

5. A M111202

Sol. Total number of numbers will be equal to the sum of numbers of all possible 1-digit, 2-digit, 3-digit, 4-diigit and 5-digit numbers.

$\Rightarrow$ Total number of numbers = $3 + 3^2 + 3^3 + 3^4 + 3^4$

$$= \frac{3(3^4-1)}{2} + 3^4 = \frac{3^5 + 2.3^4 - 3}{2}$$

6. D M121304

Sol. $\left(\frac{9}{15}\right)^7 - \left(\frac{8}{15}\right)^7$

7. D M121309

Sol. Total ways in which they can seated in the buses are 3^{10}. Applying the principle of Inclusion- exclusion, we get number of favourable ways as $3^{10} - 3.2^{10} + 3$.

8. D M110414

Sol. Let f = $(5\sqrt{2}\ -7)^{19}$

x –f = an integer $\Rightarrow$ [x] + {x} –f = an integer

$\Rightarrow$ {x} –f = an integer, but –1 < {x} –f < 1 $\Rightarrow$ {x} = f

so x{x} = x.f = 1^{19} = 1

9. BCD M110305

Sol. Let $|z_1| = |z_2| = r$

$\Rightarrow z_1 = r\ (\cos\theta + i\sin\theta)$

and $z_2 = r\left(\cos\left(\frac{\pi}{2}-\theta\right)+i\sin\left(\frac{\pi}{2}-\theta\right)\right)$

$\Rightarrow$ $z_1z_2 = r^2 i$, which is purely imaginary

$z_1+z_2 = r\,[(\cos\theta + \sin\theta)+ i\,(\cos\theta + \sin\theta)\,]$

$\Rightarrow (z_1 + z_2)^2 = r^2(2i\,(\cos\theta + \sin\theta))^2$ which is purely imaginary .

Also $\arg(z_1^{-1}) + \arg(z_2^{-1}) = -\pi/2$.

10. BC M110503

Sol. $\underbrace{111\ldots1}_{91\,\text{times}} = 10^{90}+10^{89}+\ldots+1 = \dfrac{10^{91}-1}{10-1} = \dfrac{10^{91}-1}{10^7-1}\times\dfrac{10^7-1}{10-1}$

$= (10^{84}+10^{77}+10^{70}\ldots+1)\,(10^6+10^5+\ldots+1)$

which is the product of two integers.

11. ABC M110109

Sol. Clearly figure represents a downward parabola having its vertex $\left(-\frac{b}{2a},-\frac{D}{4a}\right)$ in the second quadrant.

$\Rightarrow a < 0$, $-b/2a < 0 \Rightarrow b < 0$

also , $ax^2 + bx + c = 0$ has roots of opposite signs

$\Rightarrow c/a < 0 \Rightarrow c > 0$ Obvious, after drawing the locus of z in the argand plane.

12. AB M111202

Sol. $f(n) = 1! + 2! + 3! + \,.\,.\,.\,.\,.\, + n!$

$f(n+1) = 1! + 2! + 3! + \,.\,.\,.\,.\,.\, + (n+1)!$

$f(n+2) = 1! + 2! + 3! + \,.\,.\,.\,.\,.\, + (n+2)!$

$f(n+2) – f(n+1) = (n+2)! = (n+2)(n+1)!$

$= (n+2)[\,f(n+1) – f(n)\,]$

$\Rightarrow f(n+2) = (n+3)f(n+1) – (n+2)f(n)$

$\Rightarrow P(x) = x + 3$, $Q(x) = – x – 2$

13. A M111210

Sol. When 1 all rounder and 10 players from bowlers and batsman play number of ways

$= {}^4C_1 \cdot {}^{14}C_{10}$

when 1 wicket keeper and 10 players from bowlers and batsman play number of ways

$= {}^2C_1 \cdot {}^{14}C_{10}$

when 1 all rounder 1 wicket keeper and 9 from batsmen and bowlers play number of ways

$= {}^4C_1 \cdot {}^2C_1 \cdot {}^{14}C_9$

when all eleven players play from bowlers and batsmen then the number of ways

$= {}^{14}C_{11}$

$\therefore$ Total number of selections $= {}^4C_1 \cdot {}^{14}C_{10} + {}^2C_1 \cdot {}^{14}C_{10} + {}^4C_1 \cdot {}^2C_{10} \cdot {}^{14}C_9 + {}^{14}C_{11}$.

14. B M111210

Sol. If 2 batsmen don't want to play then the rest of 10 players can be selected from 17 other players number of selection $= {}^{17}C_{10}$.

If the particular bowler doesn't play then number of selection $= {}^{19}C_{11}$

If the all three don't play number of selection $= {}^{17}C_{10}$

$\therefore$ Total number of selection = ${}^{17}C_{10} + {}^{19}C_{11} + {}^{17}C_{11}$.

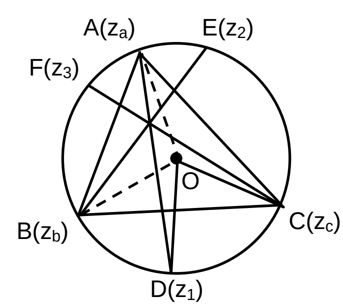
15. B M111210

Sol. If the particular batsman is selected then the rest of 10 players can be selected in ${}^{18}C_{10}$ ways.
If particular wicket keeper is selected then rest of 10 players can be selected in ${}^{18}C_{10}$ ways.
If both are not selected the number of ways = ${}^{18}C_{11}$
$\therefore$ Total number of ways = $2 \cdot {}^{18}C_{10} + {}^{18}C_{11}$
$= {}^{19}C_{11} + {}^{18}C_{10}$.

16. C M110402

17. B M110402

Sol.
Let Centre of Circle S = 0 is at O (0, 0)
$\angle DOC = \pi - 2C$
$\angle AOB = 2C$
Taking rotation at O in sector DOC and AOB



$$\frac{z_c}{z_1} = e^{i(\pi - 2c)}, \quad \frac{z_b}{z_a} = e^{i2c}$$

$$\Rightarrow \frac{z_c z_b}{z_1 z_a} = e^{i\pi} = -1$$

$$\Rightarrow z_1 = -\frac{z_c z_b}{z_a}$$

Similarly, $Z_2 = -\dfrac{z_a z_c}{z_b}$, $Z_3 = -\dfrac{z_a z_b}{z_c}$

(Sol. 16 - 17)

16. $z_1 = -\dfrac{(-4+3i)(4+3i)}{3+4i} = 3 - 4i$.

17. Circumcentre of $\Delta ABC = (0, 0)$
centroid of $\Delta ABC = \dfrac{3+10i}{3}$
orthocentre of $\Delta ABC = 3 + 10i$.

Section – B

1. A $\to$**R** B $\to$**Q** C $\to$**P** D $\to$**RS**
M110510, 110308

1.(A). Using weighted A.M., G.M. inequality,

$$\frac{ca+ab+bc}{a+b+c} \ge \left(a^c b^a c^b\right)^{\frac{1}{a+b+c}}$$

$$\frac{ba+cb+ac}{b+c+a} \ge \left(a^b b^c c^a\right)^{\frac{1}{a+b+c}}$$

$$\frac{aa+bb+cc}{a+b+c} \geq \left(a^a b^b c^c\right)^{\frac{1}{a+b+c}}$$

adding together we get

$1 \geq a^a b^b c^c + a^b b^c c^a + a^c b^a c^b$.

(B). $a^n - b^n = (a - b)(a^{n-1} + a^{n-2} b + a^{n-3}b^2 + \ldots + b^{n-1})$

$3^n - 2^n = 3^{n-1} + 3^{n-2}2 + 3^{n-3}2^2 + \ldots + 2^{n-1}$.

Using A.M. > G.M.

$$\frac{3^{n-1}+3^{n-2}\cdot 2+\ldots+2^{n-1}}{n} > \left[\left(3\cdot 3^2\cdot 3^{n-1}\right)\left(2\cdot 2^2\cdot 2^{n-1}\right)\right]^{1/n}$$

$= 3^{\frac{n-1}{2}}\cdot 2^{\frac{n-1}{2}} = 6^{\frac{n-1}{2}}$

$3^n - 2^n > n \cdot 6^{\frac{n-1}{2}}$

$3^n > 2^n + n\cdot 6^{\frac{n-1}{2}}$.

(C). This equation will have (n – 1) roots $\left(\frac{z+1}{z}\right)^n = 1$

$\left|\frac{z+1}{z}\right| = 1 \Rightarrow |z + 1| = |z|$

$\Rightarrow$ z lies on right bisector of segment joining (0, 0) and (– 1, 0).

Re (z) = $-\frac{1}{2}$

Sum of real part of roots = $-\frac{1}{2}(n - 1)$.

(D). $2x^2 + bx + 1 = 0$ … (1)

$4x^2 + ax + 1 = 0$ … (2)

On subtraction, we get

$2x^2 + (a - b)x = 0$

$x[2x + (a - b)] = 0$

$x = 0$ or $x = \frac{b-a}{2}$.

$$2\left(\frac{b-a}{2}\right)^2 + b\left(\frac{b-a}{2}\right) + 1 = 0$$

$(b - a)^2 + b(b - a) + 2 = 0$

$b^2 + a^2 - 2ab + b^2 - ab + 2 = 0$

$a^2 + 2b^2 - 3ab + 2 = 0$.

Section – C

1. **9** **M110105**

Sol. Let f(x) = p(x) – q(x)

$f(1) = p(1) - q(1) = 0 \Rightarrow f(x) = (x - 1)(t_1x + t_2)$

$f(2) = 1 = 2t_1 + t_2$

$f(3) = 4 = 2(3t_1 + t_2) \Rightarrow t_1 = 1,\ t_2 = -1$

$\Rightarrow f(4) = p(4) - q(4) = 3(4t_1 + t_2) = 3(4 - 1) = 9$

2. **3** **M110510**

Sol. Given expression is $\frac{1}{2}\sum\frac{2a}{b+c-a}=\frac{1}{2}\sum\left(\frac{2a}{b+c-a}+1\right)-\frac{3}{2}$

$=\frac{1}{2}(a+b+c)\sum\left(\frac{1}{b+c-a}\right)-\frac{3}{2}$

Now, as (a + b + c) = $\sum(b+c-a)$

Applying A.M. $\geq$ H.M.

Minimum value of the expression = $\frac{1}{2}\times 9-\frac{3}{2}=3$

3. 0 M110503

Sol. We have B = 2A, C = 4A $\Rightarrow$ 7A = π or A $=\frac{\pi}{7}$, and

$$\frac{1}{b}+\frac{1}{c}-\frac{1}{a}=\frac{1}{2R}\left(\frac{1}{\sin 2A}+\frac{1}{\sin 4A}-\frac{1}{\sin A}\right)=\frac{1}{4R}$$

$$\frac{2\sin A\sin 4A+2\sin A\sin 2A-2\sin 2A\sin 4A}{\sin A\sin 2A\sin 4A}$$

$$=\frac{1}{4R}\left[\frac{\cos 3A-\cos 5A+\cos A-\cos 3A-\cos 2A+\cos 6A}{\sin A\sin 2A\sin 4A}\right]$$

$$=\frac{1}{4R}\left[\frac{-\cos(\pi-2A)+\cos A-\cos 2A+\cos(\pi-A)}{\sin A\sin 2A\sin 4A}\right]$$

$$=\frac{1}{4R}\left[\frac{\cos 2A-\cos 2A+\cos A-\cos A}{\sin A\sin 2A\sin 4A}\right]=0\,.$$

4. 2 M110414

Sol. Power cycle of 6 is 6, 6, 6, 6, …
power cycle of 4 is 4, 6, 4, 6, …
so, last two digits must be 6 + 6 = 12
$\Rightarrow$ unit digit = 2.

5. 1 M110414

Sol. $5^{40}=(22+3)^{20}$, so remainder is same as in 3^{20}
$3^{20}=(11-2)^{10}$, so reminder is same as in 2^{10}
But $2^{10}=1024=11\times 93+1$
So, remainder is 1

FIITJEE - JEE (Mains)

PHYSICS, CHEMISTRY & MATHEMATICS

Phase - 4

SET-A

Time Allotted: 3 Hours **Maximum Marks: 360**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.*
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are ***three*** parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :____

Enrolment Number :____

Batch :__________________________ **Date of Examination :** __________________________

Physics

1. **An experiment measured quantities a,b,c and then x is calculated from $x = ab^2/c^3$. if the percentage errors in a,b,c are $\pm 1\%, \pm 3\%$ and $\pm 2\%$ respectively , the percentage error in x can be :**

(a) $\pm 13\%$ **(b)** $\pm 7\%$

(c) $\pm 4\%$ **(d)** ± 1

2. **Which of the following have same dimensions ?**

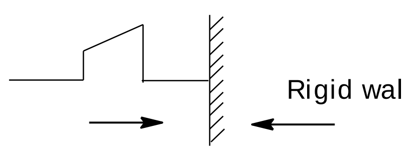
(a) Angular momentum and linear momentum **(b) Work and power**

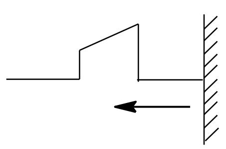
(c) Work and torque **(d) Torque and pressure**

3. **The percentage errors in the measurement of mass and speed are 2% and 3 % respectively/ How much wil be the maximum error in the estimate of the kinetic energy obtained by measuring mass and speed ?**

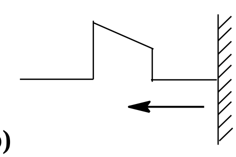
(a) 11% **(b) 8 %**
(c) 5 % **(d) 1%**

4. **If a pulse is incident on a rigid surface (see adjacent figure), then the possible form of reflected pulse is**

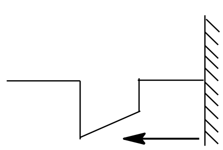




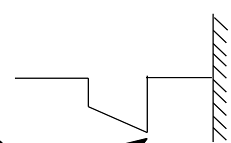
(a)



(b)



(c)



(d)

5. **Acceleration of particle at x =2 m of a longitudinal wave is 5m/s^2 and the slope of waveform at the instant is given by** $\frac{dy}{dx} = 5\sin\frac{\pi}{12}x$ **. Then , the speed of the wave at the point at that instant is given (in m/s) as**

(a) $\sqrt{\frac{24}{\pi\sqrt{3}}}$ **(b)** $\sqrt{\frac{\pi\sqrt{3}}{24}}$

(c) $\sqrt{\frac{24\sqrt{3}}{\pi}}$ **(d)** $\sqrt{\frac{24\pi}{\sqrt{3}}}$

6. **An open organ pipe resonates with frequency 'f_1' and 2nd harmonic . Now one end is closed and the frequency is slowly increased till it resonates with frequency f_2 and nth harmonic then**

(a) $n=3, f_2 = \frac{3}{4} f_1$ **(b)** $n=5, f_2 = \frac{3}{4} f_1$

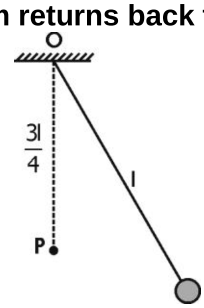
(c) $n = 2, f_2 = \frac{5}{4} f_1$ **(d)** $n = 5, f_2 = \frac{5}{4} f_1$

7. **A police car with a siren of frequency 8 kHz is moving with uniform velocity 36 km/hr towards a tall building which reflects the sound waves. The speed of sound in air is 320 m/s .The frequency of the siren heard by the car driver is**
(a) 8.50 kHz **(b) 8.25kHz**
(c) 7.75 kHz **(d) 7.50kHz**

8. **A wave represented by the equation** $y = a\cos(kx - \omega t)$ **is superposed with another wave to form a stationary wave such that the point x =0 is a node. The equation for the other wave is**
(a) $a\sin(kx + \omega t)$ **(b)** $-a\cos(kx - \omega t)$
(c) $-a\cos(kx + \omega t)$ **(d)** $-a\sin(kx - \omega t)$

9. **A string of length L is stretched by L/20 and speed of transverse wave along it is 'v' . the speed of wave when it is stretched by L/10 will be (Assume Hook's law to be valid).**
(a) 2v **(b)** $\left(v/\sqrt{2}\right)$
(c) $\sqrt{2}v$ **(d) 4v**

10. **A pendulum has time period T for small oscillations. An obstacle P is situated below the point of suspension O at a distance** $\frac{3l}{4}$**. The pendulum is released from rest. Throughout the motion the moving string makes small angle with vertical. Time after which the pendulum returns back to its initial position is :**



(A) T **(B)** $\frac{3T}{4}$ **(C)** $\frac{3T}{5}$ **(D)** $\frac{4T}{5}$

11. **A particle executing SHM while moving from one extremity is found at distances** x_1, x_2 **and** x_3 **from the centre at the end of three successive seconds. The time period of oscillation is :**
(A) $\frac{2\pi}{\theta}$ **(B)** $\frac{\pi}{\theta}$ **(C)** θ **(D)** $\frac{\pi}{2\theta}$

Here $\theta = \cos^{-1}\left(\frac{x_1 + x_3}{2x_2}\right)$**.**

12. **The angular frequency of a spring block system is** ω_0**. This system is suspended from the ceiling of an elevator moving downwards with a constant speed** v_0**. The block is at rest relative to the elevator. Lift is suddenly stopped. Assuming the downward as a positive direction, choose the wrong statement :**

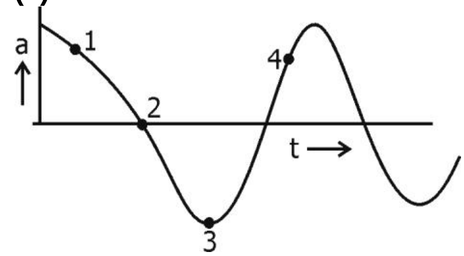
(A) The amplitude of the block is $\frac{v_0}{\omega_0}$

(B) The initial phase of the block is π

(C) The equation of motion for the block is $\frac{v_0}{\omega_0}\sin\omega_0 t$

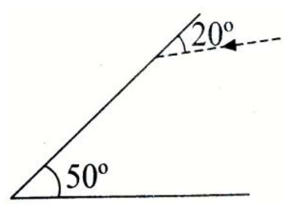
(D) The maximum speed of the block is v_0

13. Acceleration-time graph of a particle executing SHM is as shown in figure. Select the correct alternative(s) :



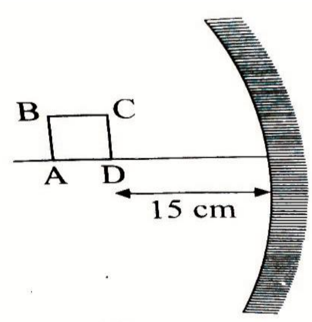
(A) displacement of particle at 1 is positive
(B) velocity of particle at 2 is negative
(C) potential energy of particle at 3 is maximum
(D) speed of particle at 4 is increasing

14. The deviation suffered by ray after three successive reflections in situation is :



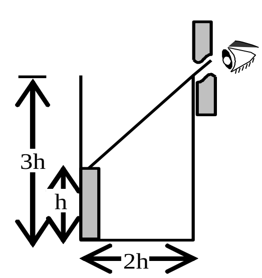
(a) 200^0 clockwise
(b) 200^0 anticlockwise
(c) 220^0 anticlockwise
(d) 220^0 clockwise

15. A square ABCD of side 1 mm is kept at distance 15 cm in front of the concave mirror as shown in the figure . The focal length of the mirror is10 cm. The length of the perimeter of its image will be :



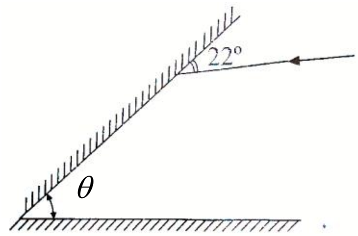
(a) 8 mm
(b) 2mm
(c) 12 mm
(d) 6 mm

16. An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius h. when the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is:



(A) $\frac{5}{2}$ (B) $\sqrt{\frac{5}{2}}$ (C) $\sqrt{\frac{3}{2}}$ (D) $\frac{3}{2}$

17. **Two plane mirrors are inclined at some angle with each other . A ray of light falls on one of the mirrors at 22^0 (with the mirror surface) the ray of light finally retraces its path , after suffering two reflections .the angle between the two plane mirror , θ (as shown in fig) is :**



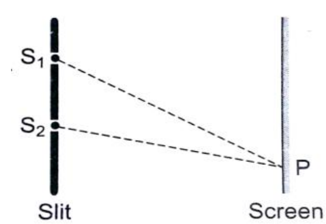
(a) 34^0 **(b) 68^0**
(c) 45^0 **(d) 37^0**

18. **Unit vector along a ray of light that is incident on a plane mirror is $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$ and unit vector along the normal to the mirror at the point incidence is $\frac{1}{\sqrt{2}}\left(\hat{i}+\hat{j}\right)$.unit vector along the reflected ray can be expressed as :**

(a) $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$ **(b)** $\frac{1}{\sqrt{3}}\left(-\hat{i}-\hat{j}-\hat{k}\right)$
(c) $\frac{1}{\sqrt{3}}\left(-\hat{i}-\hat{j}+\hat{k}\right)$ **(d)** $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}-\hat{k}\right)$

19. **An object is moved at constant speed from infinity to the focus of a concave mirror , then**
(a) image will move at constant speed from focus to infinity
(b) image will move slower in the beginning and faster later on, away from the mirror
(c) image will move faster in the beginning and slower later on , away from the mirror
(d) image will move away from the mirror in the beginning and towards the mirror later on but with a constant speed

20. **In a young's double slit experimental arrangement shown here , if a mica sheet of thickness t and refractive index μ is placed in front of the slit S_1, then the path difference ($S_1P - S_2P$) :**



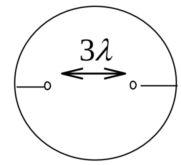
(a) decreases by $(\mu-1)t$ **(b) increases by $(\mu-1)t$**
(c) does not change **(d) increases by μt**

21. **If the ratio of intensities of two waves causing interference be 9 : 4, then the ratio of the resultant maximum and minimum intensities will be :**
(a) 9 : 4 **(b) 3 : 2**
(c) 25 :1 **(d) 5 :1**

22. **A slit of width a is illuminated by white light. The first minimum for red light $\left(\lambda = 6500\,\overset{\circ}{A}\right)$ will fall at $\theta = 30^\circ$, when a will be :**

(a) 3250 $\overset{\circ}{A}$ **(b) $6.5\times10^{-4}cm$**
(c) 1.3 micron **(d) $2.6\times10^{-4}cm$**

23. **If two coherent sources are placed at a distance 3λ from each other symmetric to the centre of the circle shown in the figure, then number of bright fringes shown on the screen placed along the circumference is :**

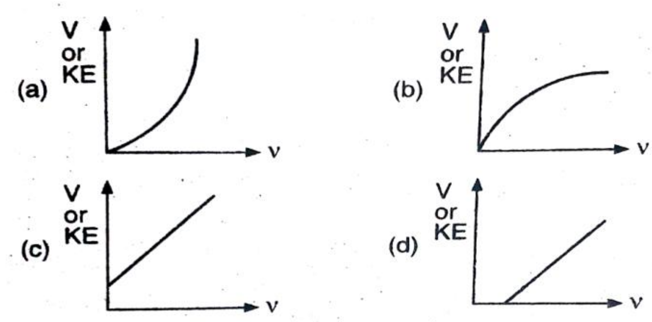


(a) 16 **(b) 12**
(c) 8 **(d) 4**

24. **The angle of incidence at which reflected light is totally polarised for reflection from air to glass (refractive index n) is**
(a) $\sin^{-1}(n)$ **(b)** $\sin^{-1}(1/n)$
(c) $\tan^{-1}(1/n)$ **(d)** $\tan^{-1}(n)$

25. **In a Young's double slit experiment, the separation of the two slits is doubled. To keep the same spacing of fringes, the distance D of the screen from the slits should be made :**
(a) $\frac{D}{2}$ **(b)** $\frac{D}{\sqrt{2}}$
(c) 2D **(d) 4D**

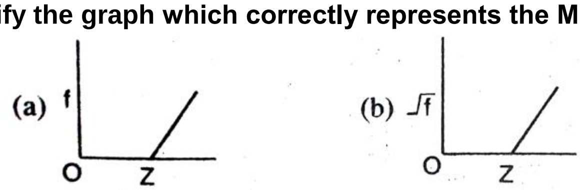
26. **For a photoelectric cell , the graph showing the variation of cut-off voltage or maximum KE of ejected photoelectrons with frequency of incident light is :**



27. **Monochromatic light of frequency f_1 is incident on a photocell and the stopping potential is found to be V_1. What is the new stopping potential of the cell if it is radiated by monochromatic light of frequency f_2 ?**
(a) $V_1 - \frac{h}{e}(f_2 - f_1)$ **(b)** $V_1 + \frac{h}{e}(f_1 + f_2)$
(c) $V_1 - \frac{h}{e}(f_1 + f_2)$ **(d)** $V_1 + \frac{h}{e}(f_2 - f_1)$

28. **If e/m of electron is 1.76×10^{11} C kg^{-1} and the stopping potential is 0.71 V, then the maximum velocity of the photoelectron is :**
(a) 150 km s^{-1} **(b) 200 km s^{-1}**
(c) 500 km s^{-1} **(d) 250 km s^{-1}**

29. **Identify the graph which correctly represents the Moseley's law:**



30. Electrons having de – Broglie wavelength λ are incident on a target in a X-ray tube . CUT-off wavelength of emitted X –rays :

(a) $\lambda_0 = \frac{2mc\lambda^2}{h}$
(b) $\lambda_0 = \frac{2h}{mc}$
(c) $\lambda_0 = \frac{2m^2c^2\lambda^2}{h^2}$
(d) $\lambda_0 = 0$

Chemistry

1. An aqueous solution of a gas x change the colour of an acidified $K_2Cr_2O_7$ solution . On passing H_2S gas in the solution a white turbidity is obtained . The gas x is

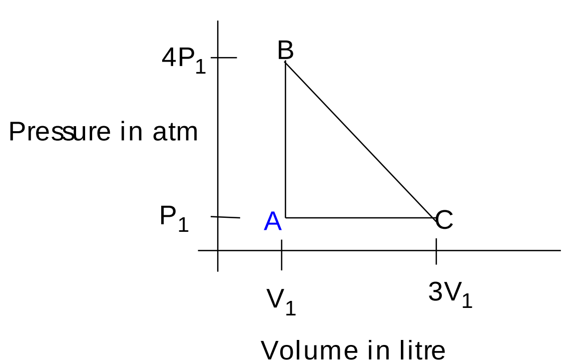
(a) NH_3
(b) SO_2
(c) CO_2
(d) I_2

2. For the process

$$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$$

(a) $\Delta H = +Ve, \Delta S = +Ve$
(b) $\Delta H = -Ve, \Delta S = +Ve$
(c) $\Delta H = +Ve, \Delta S = -Ve$
(d) $\Delta H = -Ve, \Delta S = -Ve$

3. For the ideal gas , work done in the process ABCA

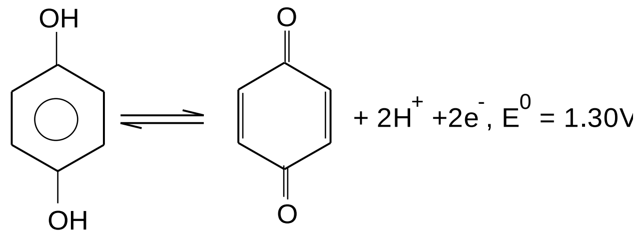


(a)$12P_1V_1$
(b) $6P_1V_1$
(c) $3P_1V_1$
(d) P_1V_1

4. The standard Reduction potential of three metallic cation X^+,Y^+ and Z^+ are 0.52, -3.03 and -1.18 volt respectively . The order of reducing power of the corresponding metal is

(a) Y > Z >X
(b) X > Y > Z
(c) Z > Y > X
(d) Z > X > Y

5. The cell Reaction involving quinhydrone elecdrode is



What will be the electrode potenttial at pH =3

(a) 1.48 V **(b) 1.20 V**
(c) 1.10 V **(d) 1.30 V**

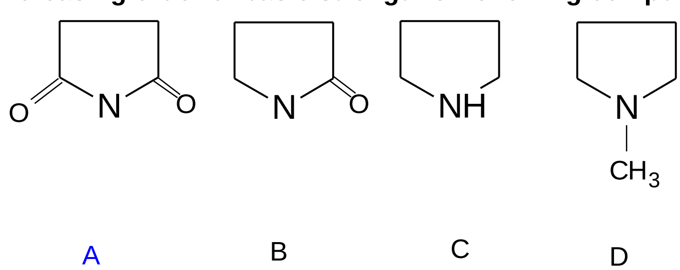
6. Find the oxidation Number of metal Mn in the product of alkaline oxidative fusion of MnO_2.

(a) 4 **(b) 6**
(c) 2 **(d) 7**

7. Paramagnetism is not exhibited by

(a) $CuSO_4.5H_2O$ **(b) $CuCl_2.H_2O$**
(c) $NiSO_4.6H_2O$ **(d) CuI**

8. Increasing order of basic strength of following compund are .



(a) A < C < B < D **(c) D < C < B < A**
(c) A < B < C < D **(d) C < A < B < D**

9. For different aqueous solution of 0.1 N urea, 0.1 N NaCl , 0.1 N Na_2SO_4 and 0.1 N Na_3PO_4 solution at 27^0 C select the incorrect statement

(a) The order of osmotic pressure NaCl > Na_2SO_4 > Na_3PO_4 > urea

(b) osmotic pressure = $\frac{\Delta T_b}{K_b} \times RT$

(c) Addition of salt on ice increase its melting point

(d) Addition of salt on ice bring melting of ice earlier

10. In the kjeldahl method , nitrogen present in organic compound is estimated as

(a) N_2 **(b) NO_2**
(c) NH_3 **(d) N_2O_5**

11. Glycolysis is a series of enzyme catalysed reactions leading to oxidation of

(a) glycine **(b) glocose**

(c) cholestrol
(d) guanine

12. How many geometrical isomers are possible for the complex
$[Pt(NO_2)(Py)(NH_2)(NH_2OH)]NO_2$
(a) 3
(b) 4
(c) 5
(d) 2

13. The number of tetrahedral and octahedral voids in hexagonal primitive unit cell are:
(A) 8, 4
(B) 2, 1
(C) 12, 6
(D) 6, 12

14. Sodium metal crystallizes in a Body centred cubic lattice withe the cell edge a =3.29 A^0 what is radius of sodium atom
(a) 1. 8574 A^0
(b) 1.645 A^0
(c) 1.299 A^0
(d) 1.424 A^0

15. The standard heat of formation value of SF_6 (g) , S(g) and F(g) are -1100, 275 and 80 kJ/ mol respectively then S-F Bond energy
(a) +57.5 kJ
(b) 309 kJ
(c) -57.5 kJ
(d) -309 kJ

16. Which of the following statement is incorrect
(a) Trapping of an electron in the lattice lead to the formtion of F centre .
(b) frenkel defect is a dislocation defect.
(c) Tetrahedral void = 2 x octahedral void is true for only c.c.p and h.c.p arrangement
(d) A hexagonal and cubic closed packed structre for a given element would expected to have different density .

17. For coagulating As_2S_3 sol , the coagulating power of which salt (considering fully ionisation of the salt) is maximum .
(a) 0.1 M $AlCl_3$
(b) 0.1 M $Zn_3(PO_4)_2$
(c) 0.1 M $K_4[Fe(CN)_6]$
(d) 0.1 M $PbCl_4$

18. The metal that can not be produced by reduction of its oxide by Al metal
(a) K
(b) Mn
(c) Cr
(d) Fe

19. The standard reduction potential for NO_3^- / NO_2 couple is 0.78 V . What is the state of reaction in a neutral solution .

$$NO_3^- + 2H^+ + e^- \longrightarrow NO_2 + H_2O$$

(1M) (g)

(a) Nonspontaneous with E_{RP} = -0.046 V
(b) spontaneous with E_{RP} = +0.046 V
(c) equilibrium with E_{RP} = -.78 V
(c) Can not be predicted

20. Which of the following statement is incorrect

(a) In concentration cell the electrode having more dilute solution act as anode .

(b) Rusting of Iron is faster in presence of saline water .

(c) Colour of KI solution containing starch paper turm blue on addition of Cl_2 gas.

(d) $CuSO_4$ solution is stored in Iron Bottle

21. A current of 0.250 A is passed through 544 ml of 2.0 M solution of NaCl for 35 minute . What will be the pH of solution after the current is turned off.

(a) 10 **(b) 12**

(c) 2 **(d) 12.13**

22. Which of the following is a state function as well as an extensive property

(a) Internal energy **(b) heat capacity**

(c) Entropy **(d) all of above**

23. Black sulphide is not formed By

(a) Cu^{+2} **(b)** Sb^{+3}

(c) Pb^{+2} **(d)** Bi^{+3}

24. Which of the following statement is true .

(a) $K_2Cr_2O_7$ and $KMnO_4$ show colour due to charge transfer from O atom to vacant metal d orbital.

(b) $Ni(CO)_4$ is dimagnetic and tetrahedrd geometry

(c) In $K_4[Fe(CN)_6]$ the central atom have 5 unpaired electron

(d) $K_4[FeBr_6]$ is more stable complex as compare to $K_4[FeF_6]$

25. Which of the following is less than zero for ideal solution

(a) $\Delta Hmix$ **(b)** $\Delta Vmix$

(c) $\Delta Gmix$ **(d)** $\Delta Hmix$

26. Consider the following reaction

$$C + O_2(g) \longrightarrow CO_2 + XkJ$$

(S) (g)

$$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2 + YkJ$$

(g)

The Heat of formation of CO(g) is (in kJ / mole)

(a) – (x +y) **(b) (x- y)**

(c) (y –x) **(d) none of these**

27. At 18^0C the conductance of H^+ and CH_3COO^- at infinite dilution are 315 and 35 s cm^2 eq^{-1} respectively . The conductivity of 0.001 N solution of Acetic Acid is 4.1×10^{-5} s cm^{-1} the degree of Ionisation of CH_3COOH is

(a) 0.117 (b) 0.234

(c) 0.011 (d) 0.127

28.In the electrolytic cell flow of electron is from .

(a) Cathode to anode in solution

(b) Anode to cathode through external supply

(c) Cathode to anode through internal supply

(d) anode to cathode through internal supply.

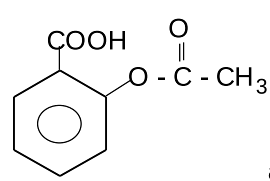
29. During the presence of SO_3^{-2} and S^{-2} in a mixture , with the additian of dil H_2SO_4 one can notice that

(a)SO_2 and H_2S not formed

(b) SO_2 and H_2S undergoes a redox reaction forming colloidal sulphur hence no smell of rotten egg

(c) A smell of rotten egg

(d) A smell of burning sulphur

30. The compond  act as

(a) Antacid (b) Antiseptic

(c) Analgesic (d) Antifertility drug

Mathmatics

1. The point of intersection of the xy plane and the line passing through the points $A\equiv(3,4,1)$ and $B\equiv(5,1,6)$ is

(a) $\left(-\frac{13}{5},\frac{23}{5},0\right)$ **(b)** $\left(\frac{13}{5},\frac{23}{5},0\right)$

(c) $\left(\frac{13}{5},-\frac{23}{5},0\right)$ **(d)** $\left(-\frac{13}{5},-\frac{23}{5},0\right)$

2. The equation of a plane passing through (1, 2, -3), (0, 0, 0) and perpendicular to the plane 3x -5 y +2z = 11, is

(a) $3x+y+\frac{5}{3}z=0$ **(b)** $4x+y+2z=0$

(c) $3x-y+\frac{z}{3}$ **(d)** $x+y+z=0$

3. Centorid f the tetrahedron OABC, where $A\equiv(a,2,3), B\equiv(1,b,2), C\equiv(2,1,c)$ **and O is the origin is (1, 2, 3) . The value of** $a^2+b^2+c^2$ **is equal to**

(a) 75 **(b) 80**

(c) 121 **(d) none of these**

4. The point of intersection of the lines $\frac{x+1}{3}=\frac{y+3}{5}=\frac{z+5}{7}$ **and** $\frac{x-2}{1}=\frac{y-4}{3}=\frac{z-6}{5}$ **is**

(a) $\left(\frac{1}{3},-\frac{1}{3},-\frac{2}{3}\right)$ **(b)** $\left(\frac{1}{2},-\frac{1}{2},-\frac{3}{2}\right)$

(c) $\left(\frac{1}{2},\frac{1}{2},\frac{2}{2}\right)$ **(d)** $\left(\frac{1}{3},\frac{1}{3},\frac{2}{3}\right)$

5. Reflection of the line $\frac{x-1}{-1}=\frac{y-2}{3}=\frac{z-3}{1}$ **in the plane x +y +z =7 is**

(a) $\frac{x-1}{3}=\frac{y-2}{1}=\frac{z-4}{1}$ **(b)** $\frac{x-1}{-3}=\frac{y-2}{-1}=\frac{z-4}{1}$

(c) $\frac{x-1}{-3}=\frac{y-2}{1}=\frac{z-4}{-1}$ **(d)** $\frac{x-1}{3}=\frac{y-2}{1}=\frac{z-4}{1}$

6. If $\vec{a}$ **and** $\vec{b}$ **be two non-collinear unit vectors such that**

$$\vec{a}\times\left(a\times\vec{b}\right)=\frac{1}{2}\vec{b}$$

Then the angle between $\vec{a}$ **and** $\vec{b}$ **is equal to**

(a) $\frac{\pi}{2}$ **(b)** $\frac{\pi}{4}$

(c) informations are inconsistent **(d) None of these**

7. Value of $\left[\vec{a}\times\vec{b},\vec{a}\times\vec{c},\vec{d}\right]$ is always equal to

(a) $(\vec{a}.\vec{d})[\vec{a}\vec{b}\vec{c}]$ **(b)** $(\vec{a}.\vec{c})[\vec{a}\vec{b}\vec{c}]$

(c) $(\vec{a}.\vec{b})[\vec{a}\vec{b}\vec{c}]$ **(d) None of these**

8. For any two vectors $\vec{a}$ and $\vec{b}$ the experession $(\vec{a}\times\hat{i}).(\vec{b}\times\hat{i})+(\vec{a}\times\hat{j}).(\vec{b}\times\hat{j})+(\vec{a}\times\hat{k}).(\vec{b}\times\hat{k})$ is akways equal to

(a) $\vec{a}.\vec{b}$ **(b)** $2\vec{a}.\vec{b}$

(c) Zero **(d) None of the**

9. Let $\vec{a},\vec{b},\vec{c}$ be three non coplanar vectors and $\vec{r}$ be any arbitry vector, then the expression $(\vec{a}\times\vec{b})\times(\vec{r}\times\vec{c})+(\vec{b}\times\vec{c})\times(\vec{r}\times\vec{a})+(\vec{c}\times\vec{a})\times(\vec{r}\times\vec{b})$ is always equal to

(a) $[\vec{a},\vec{b},\vec{c}]\vec{r}$ **(b)** $2[\vec{a},\vec{b},\vec{c}]\vec{r}$

(c) $3[\vec{a},\vec{b},\vec{c}]\vec{r}$ **(d) none of these**

10. Let $\vec{a}$ and $\vec{b}$ are two non collinear vector such that $|\vec{a}|=1$. The angle of a triangle whose two sides are represented by the vector $\sqrt{3}(\vec{a}\times\vec{b})$ and $\vec{b}-(\vec{a}.\vec{b})\vec{a}$ are

(a) $\frac{\pi}{2},\frac{\pi}{4},\frac{\pi}{4}$ **(b)** $\frac{\pi}{2},\frac{\pi}{3},\frac{\pi}{6}$

(c) $\frac{\pi}{2},\frac{5\pi}{12},\frac{\pi}{12}$ **(d) None of these**

11. If $2ax-2y+3z=0, x+ay+2z=0$ and $2x+az=0$ have a non-trivial solution , then

(a) a = 2 **(b) a = 1**

(c) a = 0 **(d) None of these**

12. If $\begin{vmatrix} x & 1 & 1 \\ 1 & y & 1 \\ 1 & 1 & z \end{vmatrix} > 0,$ **then**

(a) $xyz > -2$ **(b)** $xyz > 1$

(c) $xyz > -8$ **(d) None of these**

13. If $A=\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ **and** $A(adj(A))=\lambda\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ **then λ is equal to**

(a) 1 **(b) 2**

(c) 3 **(d) ½**

14. If 'A' is a matrix of order $m\times n$, and I_m, I_n represent the unit matrices of order 'm' and 'n' respectively , then

(a) $I_m A = A = AI_n$ **(b)** $AI_m = A = I_n A$

(c) $AI_m = A = AI_n$ **(d)** $I_m A = A = I_n A$

15. If $A = \lfloor a_{ij} \rfloor_{2\times 2}$ **where** $a_{ij} = \begin{cases} i+j, & i \neq j \\ i-j, & i = j \end{cases}$**, then A⁻¹ is equal to**

(a) $\begin{bmatrix} 0 & \frac{1}{3} \\ \frac{1}{3} & 0 \end{bmatrix}$ **(b)** $\begin{bmatrix} \frac{2}{9} & \frac{1}{3} \\ \frac{1}{3} & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & \frac{1}{3} \\ \frac{1}{3} & \frac{2}{9} \end{bmatrix}$ **(d) none of these**

16. If $f(x) = \sin^6 x + \cos^6 x$**, then range of** $f(x)$ **is**

(a) $\left[\frac{1}{4}, 1\right]$ **(b)** $\left[\frac{1}{4}, \frac{3}{4}\right]$

(c) $\left[\frac{3}{4}, 1\right]$ **(d) None of these**

17. If $a\sin x + b\cos(x+\theta) + b\cos(x-\theta) = d$ **then the minimum value of** $|\cos\theta|$ **is equal to**

(a) $\frac{1}{2|b|}\sqrt{d^2 - a^2}$ **(b)** $\frac{1}{2|a|}\sqrt{d^2 - a^2}$

(c) $\frac{1}{2|d|}\sqrt{d^2 - a^2}$ **(d) None of these**

18. In triangle $ABC, \angle C = \frac{2\pi}{3}$**, then the value of** $\cos^2 A + \cos^2 B - \cos A.\cos B$ **is equal to**

(a) $\frac{3}{4}$ **(b)** $\frac{3}{2}$

(c) $\frac{1}{2}$ **(d)** $\frac{1}{4}$

19. If $2\cos x + \sin x = 1$**, then value of** $7\cos x + 6\sin x$ **is equl to**

(a) 2 or 6 **(b) 1 or 3**

(c) 2 or 3 **(d) None of these**

20. Complete solution set of $\sin^{-1} x \leq \cos^{-1} x$ **is**

(a) $x \in \left[\frac{1}{\sqrt{2}}, 1\right]$

(b) $x \in \left[-\frac{1}{\sqrt{2}}, 1\right]$

(c) $x \in \left[-1, \frac{1}{\sqrt{2}}\right]$

(d) $x \in \left[-\frac{1}{\sqrt{2}}, \frac{1}{2}\right]$

21. $\sum_{r=1}^{n} \tan^{-1}\left(\frac{2^{r-1}}{1+2^{2r-1}}\right)$ **is equal to**

(a) $\tan^{-1}(2^n)$

(b) $\tan^{-1}(2^n) - \frac{\pi}{4}$

(c) $\tan^{-1}(2^{n+1})$

(d) $\tan^{-1}(2^{n+1}) - \frac{\pi}{4}$

22. Total number of solutions of $81^{\sin^2 x} + 81^{\cos^2 x} = 30$ **for** $x \in [0, 2\pi]$ **is equal to**

(a) 4

(b) 8

(c) 2

(d) 10

23. The compleate set of the positive real values of the parameter 'a' for which the equation $|\sin 2x| - |x| - a = 0$ **does not have any real solution , is**

(a) $\left(\frac{3\sqrt{3}+\pi}{6}, \infty\right)$

(b) $\left(\frac{3\sqrt{3}-\pi}{6}, \infty\right)$

(c) $\left(\frac{3\sqrt{3}-\pi}{12}, \infty\right)$

(d) $\left(\frac{3\sqrt{3}+\pi}{12}, \infty\right)$

24. Complete solution set of the equation $[\cot^{-1} x] + 2[\tan^{-1} x] = 0$**, where [.] denotes the greatest integer function**

(a) (0, cot1)

(b) (0, tan1)

(c) $(\tan 1, \infty)$

(d) $(\cot 1, \tan 1)$

25. If in triangle $ABC, \angle A = \frac{\pi}{4}, \angle C = \frac{5\pi}{12}$**, then the value of** $a + c\sqrt{2}$ **is equal to**

(a) b

(b) 2b

(c) 3b

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

26. In triangle ABC, line joining circumentre and incentre is parallel to side AC, then $\cos A + \cos C$ **is equal to**

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

(b) 1

(c) $\frac{3}{4}$ **(d) 2**

27. If in the triangle $ABC, \angle B = \frac{\pi}{2}$**, then** $\frac{1}{r_1^2}+\frac{1}{r_2^2}+\frac{1}{r_3^2}+\frac{1}{r^2}$ **is eqaul to**

(a) $\frac{4b^2}{a^2c^2}$ **(b)** $\frac{2b^2}{a^2c^2}$

(c) $\frac{8b^2}{a^2c^2}$ **(d)** $\frac{b^2}{a^2c^2}$

28. In any triangle ABC the expression (a +b - c) (b + c - a) (c +a - b) – abc Is always

(a) non – negative **(b) non – mositive**

(c) negative **(d) positive**

29. In triangle $ABC, a:b:c = (1+x):1:(1-x)$

Where $x \in (0,1)$

If $\angle A = \frac{\pi}{2} + \angle C$, **then x is equal to**

(a) $\frac{1}{\sqrt{6}}$ **(b)** $\frac{1}{2\sqrt{3}}$

(c) $\frac{1}{\sqrt{7}}$ **(d)** $\frac{1}{2\sqrt{7}}$

30. ABCD is a square plot . the angle of elevation of the top of a pole standing at D from A or C is 30° **& that from B is** θ **than** $\tan\theta$ **is equal to**

(a) $\sqrt{6}$ **(b)** $\frac{1}{\sqrt{6}}$

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

ANSWER

SR. NO	PHYSICS	CHEMISTRY	MATHS
1.	A	B	B

2.	C	D	D
3.	B	C	A
4.	C	A	B
5.	A	A	C
6.	D	B	C
7.	A	D	A
8.	C	C	B
9.	C	C	B
10.	B	C	B
11.	A	B	A
12.	B	A	D
13.	C	C	A
14.	D	D	A
15.	C	B	A
16.	B	D	A
17.	B	D	A
18.	C	A	A
19.	B	A	A
20	B	D	C
21.	C	B	B
22.	C	D	B
23.	B	B	B
24.	D	A	D
25.	C	C	D
26.	D	C	B
27.	D	A	C
28.	C	B	B
29.	B	B	C
30.	A	C	B

Hint & soluction

Physics

1. (A)

$$\frac{\Delta x}{x} = \frac{\Delta a}{a} + 2\frac{\Delta b}{b} + 3\frac{\Delta c}{c}$$
$$= \pm 1 \pm (2\times 3) \pm (3\times 2) = 13$$
$$\frac{\Delta x}{x}\times 100 = 13\%$$

2. (C)

$$[W] = [ML^2T^{-2}]$$
$$[\tau] = [ML^2T^{-2}]$$

3. (B)

$$\frac{\Delta K}{K}\times 100 = \left|\frac{\Delta M}{M} + 2\frac{\Delta V}{V}\right|\times 100\%$$

4. (C)

Rigid wall behave like a denser medium boundary for a wave and of a wave reflects from denser medium boundary , the phase change will be π.

5. (A)

General eq^n of wave

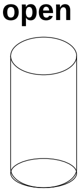
$$\frac{d^2y}{dt^2} = \upsilon^2 \frac{d^2y}{d^2x}$$
$$and\left|\frac{d^2y}{dt^2}\right| = |a| = 5m/s^2$$

$$\Rightarrow 5 = \upsilon^2\left(5\sin\frac{\pi}{12}x\right) \quad \textbf{at (x = 2)}$$

$$\upsilon = \sqrt{\frac{24}{\pi\sqrt{3}}m/s}$$

6. (D)

For open organ pipe



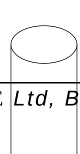
Fundamental

$$f = \frac{\upsilon}{2l}$$

And $f_1 : f_2 : f_3 = 1:2:3......$

For closed organ pipe

Fundamental

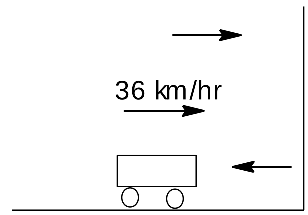


$$f = \frac{\upsilon}{4l}$$

And $f_1 : f_2 : f_3 = 1:3:5......$

7. (A)

Doppler's effect



f' **for building as observer point** $f' = f\left(\frac{\upsilon}{\upsilon - \upsilon_s}\right) Hz, \upsilon_s = 36 km/hrs.$ **Now** f' **is taken as soure (stationary) and observer is moving toward source (building).**

$$f'' = f\left(\frac{\upsilon + \upsilon_0}{\upsilon}\right) Hz, \upsilon_0 = 36 km/hrs.$$

8. (C)

stationary wave concept

9. (C)

$$\upsilon = \frac{1}{2L}\sqrt{\frac{T}{M}}$$

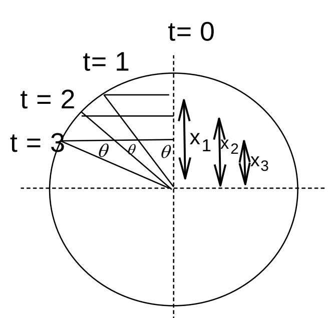
When T is tension m string and $|T| = |k(\Delta x)| = k.\frac{L}{20}$ **in case (1)**

And $|T'| = k\frac{L}{10}$ **in case (2)**

Also M is mass per unit length

10. (B)

11. (A)



$x_1 = A\cos\theta$
$x_2 = A\cos 2\theta$
$x_3 = A\cos 3\theta$

And $\theta = \omega \times t$

$$\theta = \frac{2\pi}{T} \times (1)$$

$$T = \frac{2\pi}{\theta}$$

And also $\frac{x_1 + x_3}{2x_2} = \frac{\cos\theta + \cos 3\theta}{2\cos 2\theta} = \cos\theta$

12. (B)

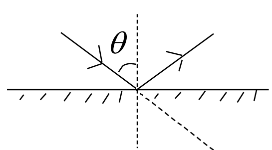
13. (C)

$a = -\omega^2 x$

And particale speed $\upsilon_p = -\upsilon$ **(slope)**

14. (D)

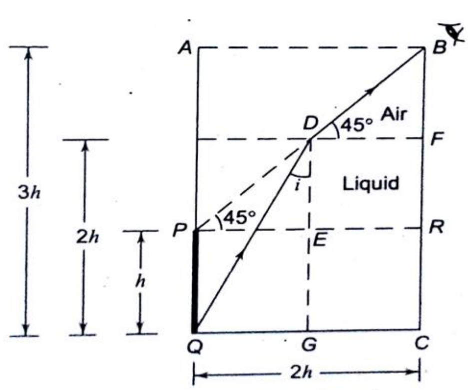
In reflection



deviation = (180 -2θ)

15. (C)

16. (B)

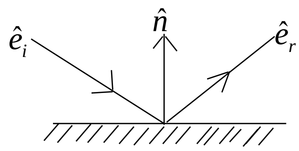


$$\frac{1}{\mu} = \frac{\sin i}{\sin r} = \frac{QG/QD}{\sin 45^\circ} = \frac{h/\sqrt{5}h}{1/\sqrt{2}}$$

$$\mu = \sqrt{\frac{5}{2}}$$

17. (B)

18. (C)



$$\hat{e}_r = \hat{e}_{\hat{i}} - 2\left(\hat{e}_{\hat{i}}.\hat{n}\right)\hat{n}$$

$$\left(\hat{e}_{\hat{i}}.\hat{n}\right) = \frac{2}{\sqrt{3}.\sqrt{2}}$$

$$\hat{e}_r = \frac{1}{\sqrt{3}}\left(\hat{i} + \hat{j} + \hat{k}\right) - 2\left(\frac{2}{\sqrt{3}.\sqrt{2}}\right).\frac{1}{\sqrt{2}}\left(\hat{i} + \hat{j}\right)$$

$$= \frac{1}{\sqrt{3}}\left(-\hat{i} - \hat{j} + \hat{k}\right)$$

19 (B)

$\frac{1}{v} + \frac{1}{u} + \frac{1}{f}$ **for spherical mirror, differentiation with respect to time, we will get**

$$\frac{dv}{dt} = -\left(\frac{v^2}{u^2}\right)\frac{du}{dt}$$

Image speed **object speed**

20. (B)

Shift produced by a slab of thickness $t(R.I. = \mu)$

$$\Delta x = (\mu - 1)t$$

21. (C)

$$I_{\max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 \ \& \ I_{\min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$$

22. (C)

Diffeaction

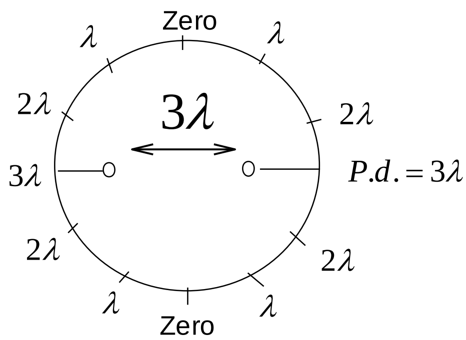
$$a \sin\theta = \eta\lambda$$

$$\Rightarrow a \sin 30° = 1 \times \left(6500 \times 10^{-10}\right)$$

$$a = 1.3 \times 10^{-6}$$

Or $a = 1.3 micron$

23. (B)



Total no of maxima = 12

24. (D)

Brewester law $n = \tan Lp$

25. (C)

If new value of distance of screen form double slit be D' , then

$$\beta' = \frac{\lambda D'}{d'} = \frac{\lambda D'}{1d} = \frac{\lambda D}{d} = \beta$$
$$D' = 2D$$

26. (D)

27. (D)

Maximum kinetic energy

$$\frac{1}{2} m \upsilon^2{}_{\max} = eV_s$$

According ts Einstein's photoeletric equation

$$hf = eV_s + \phi$$
$$eV_s = hf - \phi$$

As per question

$$ev_1 = hf_1 = \phi$$
$$ev_2 = hf_2 - \phi$$
$$e(v_1 - v_2) = h(f_1 - f_2)$$
$$ev_2 = hf_2 - hf_1 + ev_1$$
$$v_2 = \frac{h}{e}(f_2 - f_1) + v_1$$

28. (C)

$$K_{\max} = \frac{1}{2} m \upsilon^2{}_{\max} = ev_{\&}$$
$$\upsilon_{\max} = \sqrt{2\frac{e}{m} v_{\&}}$$

29. (B)

30. (A)

$$p = \sqrt{2mk}$$
$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mk}}$$
$$k = \frac{h^2}{2m\lambda^2}$$
$$\frac{hC}{\lambda_0} = k = \frac{h^2}{2m\lambda^2}$$
$$\lambda_0 = \frac{2mc\lambda^2}{h}$$

Chemistry

1. (B)

$$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3[O]$$
$$H_2O + SO_2 + O \longrightarrow H_2SO_4$$
$$H_2S + SO_2 \longrightarrow 2H_2O + 3S$$

2. (D)

Neutrilisation reaction

3. (C)

Work done in Cyclic process

= area uncer curve ABCA

= $\frac{1}{2} AC \times AB$

= $\frac{1}{2} 2V_1 3P_1 = 3P_1V_1$

4. (A)

5. (A)

$$E = E^0 - \frac{.059}{2}\log[H^+]^2$$
$$= 1.48V$$

6. (B)

$$2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

7. (D)

In CuI the oxidatian number of Cu is +1.

8. (C)

D is 3^0 amine

9. (C)

$\pi = iCRT$

I for NaCl =2

Na_2SO_4 = 3

Na_3PO_4 =4

Urea =1

For dilute solution molanity = molality

$\pi = CRT$ $\quad\quad [\Delta T_b = K_b m]$

$\pi = \frac{\Delta T_b}{K_b} RT$.

Addition of salt lower the melting point

10. (C)

NH_3 which further react with acid

11. (B)

12. (A)

13. (C)

14. (D)

$r = \frac{\sqrt{3}a}{4} = \frac{\sqrt{3} \times 3.29}{4} = 1.424 A^0$

15 (B)

$SF_6 \longrightarrow S_{(g)} + 6F_{(g)} \quad \Delta H = 1855 kJ$

Bond energy = $\frac{1855}{6} = 309 kJ$

16. (D)

Packing fraction of both is 0.74 and same C.No 12 so some density .

17. (D)

As_2S_3 s a negative colloid .

18. (A)

K is a better R.A.

19. (A)

$E_{RP} = E^0 + \frac{.059}{n} \log[H^+]^2$

$E_{RP} = 0.78 + \frac{.059}{1} \log[10^{-7}]^2$

$E_{RP} = -0.046 V$

20. (D)

NO

$$CuSO_4 + Fe \longrightarrow FeSO_4 + Cu$$

21. (B)

$$NaCl \xrightarrow{elctrolysis} NaOH$$

Namber of mole of NaOH oftained 5.44×10^{-3} **By the passage of** 5.44×10^{-3} **F of electricity So**

$M = \dfrac{5.44 \times 10^{-3}}{5.44 \times 10^{-1}} = 10^{-2}$ **, POH= 2, pH= 12**

22. (D)

23. (B) Sb_2S_3= orange ppt

24. (A)

25. (C)

26. (C)

Calculate heat of tarmation of CO as

$$C + \frac{1}{2}O_2 \longrightarrow CO$$

(S) (g) (g)

27. (A)

$$\Lambda^0_{eq} = 350 cm^2 eq^{-1}$$

$$\Lambda_{eq} = k \times \frac{1000}{N}$$

$$= 413\ sm^2 eq^{-1}$$

$$\Lambda = \frac{\Lambda_{eq}}{\Lambda^0_{eq}} = \frac{41}{350}$$

= 0.117

28. (B)

29. (B)

$2H_2S + So_2 \longrightarrow 2H_2O + 35$ **colloidal Sulphur**

30. (C)

Aspirin is used as a pain killer .

Mathamatics

1. (B)

Direction ratios of AB are 2, -3, 5.

Thus equation of Ab is ,

$$\frac{x-3}{2}=\frac{y-4}{-3}=\frac{z-1}{5}$$

For the point of intersection of this line with xy-plane, we have

$$z=0$$

$$\Rightarrow \frac{x-3}{2}=\frac{y-4}{-3}=-\frac{1}{5}$$

$$\Rightarrow x=3-\frac{2}{5}=\frac{13}{5}, y=4+\frac{3}{5}=\frac{23}{5}$$

Hence, the required point is $\left(\frac{13}{5},\frac{23}{5},0\right)$**.**

2. (D)

Let the required plane be

ax +by + cz =0

We have

3a - 5b +2c = 0 , a + 2b - 3c =0

$$\Rightarrow \frac{a}{15-4}=\frac{b}{2+9}=\frac{c}{6+5}$$

$$\Rightarrow a:b:c=11:11:11$$

Thus plane is x + y + z = 0

3. (A)

We have

4 = a + 1 + 2 + 0,

$\Rightarrow$ **a =1,**

8 = 2 + b + 1 + 0,

$\Rightarrow$ **b = 5**

12 = 3 + 2 + c +0 ,

$\Rightarrow$ **c = 7**

$$\therefore \quad a^2+b^2+c^2=1+25+49=75.$$

4. (B)

Any point on the first line is

$$\left(3r_1-1,5r_1-3,7r_1-5\right)$$

And any point on the second line is

$(r_2+2, 3r_2+4, 5r_2+6)$

At the point of intersection , we must have

$$3r_1-1=r_2+2$$
$$5r_1-3=3r_2+4,$$
$$7r_1-5=5r_2+6.$$

Thus , $r_1=\frac{1}{2}, r_2=-\frac{3}{2}.$

Hence required point is $\left(\frac{3}{2}-1, \frac{5}{2}-3, \frac{7}{2}-5\right)$**.**

i.e., $\left(\frac{1}{2}, -\frac{1}{2}, -\frac{3}{2}\right)$

5. (C)

6. (C)

$$\vec{a}\times(\vec{a}\times\vec{b})=\frac{1}{2}\vec{b}$$

$$\Rightarrow (\vec{a}.\vec{b})\vec{a}-(\vec{a}.\vec{a})\vec{b}=\frac{1}{2}\vec{b}$$

$\vec{a}.\vec{b}=0, \vec{a}.\vec{a}=-\frac{1}{2}$ **(which is not possible)**

Thus information are inconsistent.

7. (A)

$$\left[\vec{a}\times\vec{b}, \vec{a}\times\vec{c}, \vec{d}\right]$$
$$=(\vec{a}\times\vec{b}).((\vec{a}\times\vec{c})\times\vec{d})$$
$$=(\vec{a}\times\vec{b}).((\vec{a}.\vec{d})\vec{c}-(\vec{c}.\vec{d})\vec{a})$$
$$=(\vec{a}.\vec{d})\left[\vec{a}\vec{b}\vec{c}\right]$$

8. (B)

9. (B)

10. (B)

11. (A)

For bo trival solution , we must have

$$\begin{vmatrix} 2a & -2 & 3 \\ 1 & a & 2 \\ 2 & 0 & a \end{vmatrix}=0$$

$\Rightarrow 2a\left(a^2-0\right)+2(a-4)+3(0-2a)=0$

$\Rightarrow 2a^3+2a-8+0-6a=0$

$\Rightarrow 2a^3-4a-8=0$

$\Rightarrow a^3-2a-4=0$

$\Rightarrow a^3-2a^2+2a^2-4a+2a-4=0$

$\Rightarrow a^2(a-2)+2a(a-2)+2(a-2)=0$

$\Rightarrow (a-2)\left(a^2+2a+2\right)=0$

$\Rightarrow a=2$

12. (D)

$$\begin{vmatrix} x & 1 & 1 \\ 1 & y & 1 \\ 1 & 1 & z \end{vmatrix} > 0$$

$\Rightarrow x(yz-1)-1(z-1)+1(1-y)>0$

$\Rightarrow xyz > x+y+z-2$

13. (A)

$$A(adj.(A)) = |A|\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$\Rightarrow \lambda = |A|.$

$$Now |A| = \begin{vmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{vmatrix}$$

$= \cos^2\theta + \sin^2\theta = 1$

14. (A)

It is clear that $A_{m\times n}$ can be post multiplied by a matrix of the type $(n\times p)$and can be pre-multiplied by a matrix of the type $(r\times m)$.

Thus , $I_m A = A = AI_n$.

15. (A)

$$a_{ij} = \begin{cases} i-j, i \neq j \\ i-j, i = j \end{cases}$$

$$\Rightarrow a_{11} = 0, a_{12} = 3, a_{21} = 3, a_{22} = 0$$

$$\Rightarrow A = \begin{bmatrix} 0 & 3 \\ 3 & 0 \end{bmatrix}$$

$$\Rightarrow |A| = -9$$

$$Adj.(A) = \begin{bmatrix} 0 & -3 \\ -3 & 0 \end{bmatrix}^T$$

$$= \begin{bmatrix} 0 & -3 \\ -3 & 0 \end{bmatrix}$$

$$\Rightarrow A^{-1} = -\frac{1}{9}\begin{bmatrix} 0 & -3 \\ -3 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & \frac{1}{3} \\ \frac{1}{3} & 0 \end{bmatrix}$$

16. (A)

$$f(x) = \cos^6 x + \sin^6 x = \left(\cos^2 x + \sin^2 x\right)$$

$$\left(\sin^4 x + \cos^4 x - \cos^2 x.\sin^2 x\right)$$

$$= \left(\left(\sin^2\theta + \cos^2\theta\right)^2 - 3\sin^2 x.\cos^2 x\right)$$

$$= 1 - \frac{3}{4}\sin^2 2x$$

$$\Rightarrow f(x) \in \left[\frac{1}{4}, 1\right]$$

17. (A)

$$a\sin x - b\cos(x+\theta) + b\cos(x-\theta) = d$$

$$\Rightarrow a\sin x + 2b.\cos x.\cos\theta = d$$

$$\Rightarrow \frac{d^2 - a^2}{4b^2} \leq \cos^2\theta$$

$$\Rightarrow |\cos\theta| \geq \frac{\sqrt{d^2 - a^2}}{2|b|}$$

18. (A)

$\angle C = \frac{2\pi}{3}$

$\Rightarrow A + B = \frac{\pi}{3}$

$Now, \cos^2 A + \cos^2 B - \cos A.\cos B$

$= \frac{1}{2}\left(2 + \cos 2A + \cos 2B - \cos(A+B) - \cos(A-B)\right)$

$= \frac{1}{2}\left(2 + 2\cos(A+B).\cos(A-B) - \frac{1}{2} - \cos(A-B)\right)$

$= \frac{3}{4}$

19. (A)

Let $I = 7\cos x + 6\sin x$

$= 6(2\cos x + \sin x) - 5\cos x$

$= 6 - 5\cos x$

Now, $2\cos x + \sin x = 1$

$\Rightarrow \sin x = 1 - 2\cos x$

$\Rightarrow \sin^2 x = 1 + 4\cos^2 x - 4\cos x$

$= 1 - \cos^2 x$

$\Rightarrow 5\cos^2 x - 4\cos x = 0$

$\Rightarrow \cos^2 x = 0 or \frac{4}{5}$

$\Rightarrow I = 6 or 2$

20. (C)

$\cos^{-1} x \geq \sin^{-1} x$

$\Rightarrow \frac{\pi}{2} \geq 2\sin^{-1} x$

$\Rightarrow \sin^{-1} x \leq \frac{\pi}{4}$

$\Rightarrow -1 \leq x \leq \sin^{-1}\left(\frac{\pi}{4}\right)$

$\Rightarrow x \in \left[-1, \frac{1}{\sqrt{2}}\right]$

21. (B)

$\sum_{r=1}^{n} \tan^{-1}\left(\frac{2^{r-1}}{1 + 2^{2r-1}}\right)$

$$= \sum_{r=1}^{n} \tan^{-1}\left(\frac{2^{r-1}}{1+2^r.2^{r-1}}\right)$$
$$= \sum_{r=1}^{n} \tan^{-1}\left(\frac{2^r - 2^{r-1}}{1+2^r.2^{r-1}}\right)$$
$$= \sum_{r=1}^{n} \left[\tan^{-1}\left(2^r\right) - \tan^{-1}\left(2^{r-1}\right)\right]$$
$$= \tan^{-1}\left(2^n\right) - \tan^{-1}(1)$$
$$= \tan^{-1}\left(2^n\right) - \frac{\pi}{4}$$

22. (B)

$$81^{\sin^2 x} + 81^{\cos^2 x} = 30$$
$$\Rightarrow 81^{\sin^2 x} + 81^{\left(1-\sin^2 x\right)} = 30$$

Let $t = 81^{\sin^2 x}$

$$\Rightarrow t + \frac{81}{t} = 30$$
$$\Rightarrow t^2 - 30t + 81 = 0$$
$$\Rightarrow (t-27)(t-3) = 0$$
$$\Rightarrow t = 3,27$$
$$\Rightarrow 81^{\sin^2 x} = 3,27$$
$$\Rightarrow \sin^2 x = \frac{1}{4}, \frac{3}{4}$$
$$\Rightarrow \sin x = \pm\frac{1}{2}, \pm\frac{\sqrt{3}}{2}$$

Thus there are 8 solutions in $[0,2\pi]$

23. (B)

24. (D)

$$\left[\cot^{-1} x\right] + 2\left[\tan^{-1} x\right] = 0$$
$$\Rightarrow \left[\cot^{-1} x\right] = 0, \left[\tan^{-1} x\right] = 0$$
$$or \left[\cot^{-1} x\right] = 2, \left[\tan^{-1} x\right] = -1$$
$$if \left[\cot^{-1} x\right] = 0, then$$
$$x \in (\cot, \infty)$$
$$if \left[\tan^{-1} x\right] = 0, then$$
$$x \in [0, \tan 1)$$
$$\Rightarrow \left[\cot^{-1} x\right] = \left[\tan^{-1} x\right] = 0$$
$$\Rightarrow x \in (\cot 1, \tan 1)$$

25. (D)

$$B = \pi - \left(\frac{\pi}{4} + \frac{5\pi}{12}\right) = \pi - \frac{2\pi}{3} = \frac{\pi}{3}$$

$$Now, a + \sqrt{2}.c = 2R\left(\sin A + \sqrt{2}.\sin C\right)$$

$$= 2R\left(\frac{1}{\sqrt{2}} + \sqrt{2}\sin\left(\frac{\pi}{4} + \frac{\pi}{6}\right)\right)$$

$$= 2R\left(\frac{1}{\sqrt{2}} + \sqrt{2}\left(\frac{1}{\sqrt{2}}.\frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}}.\frac{1}{2}\right)\right)$$

$$= 2R\left(\frac{1}{\sqrt{2}} + \frac{\sqrt{3}}{2} + \frac{1}{2}\right)$$

$$= 2R\left(\sin A + \sin B + \sin B\right)$$

$$= a + b + \frac{b}{\sqrt{3}}$$

26. (B)

Distance of cicumcentre from side AC =R cosB

And, distance of incentre from side AC= r

$$\Rightarrow R\cos B = r$$

$$\Rightarrow \frac{r}{R} = \cos B$$

$$\Rightarrow \frac{r}{R} = 1 + \frac{r}{R} - \cos A - \cos C$$

$$\Rightarrow \cos A + \cos C = 1$$

27.(C)

$$\frac{1}{r_1^2} + \frac{1}{r_2^2} + \frac{1}{r_3^2} + \frac{1}{r^2}$$

$$= \frac{1}{\Delta^2}\left[(s-a)^2 + (s-b)^2 + (s-c)^2 + s^2\right]$$

$$= \frac{1}{\Delta^2}\left(4s^2 - 2s(a+b+c) + a^2 + b^2 + c^2\right)$$

$$= \frac{1}{\Delta^2}\left(a^2 + b^2 + c^2\right)$$

$$= \frac{2b^2}{\Delta^2} = \frac{2b^2}{\frac{1}{4}a^2c^2} = \frac{8b^2}{a^2c^2}$$

28. (B)

$$(a+b-c)(b+c-a)(c+a-b)-abc$$
$$=8(s-c)(s-a)(s-b)-abc$$
$$=8.\frac{\Delta^1}{s}-R.4\Delta$$
$$=4\Delta\left(\frac{2\Delta}{s}-R\right)$$
$$=4\Delta(2r-R)\leq 0$$

29. (C)

30. (B)

FIITJEE

PHYSICS, CHEMISTRY & MATHEMATICS

CPT1 - 1 | **CODE:** | **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 210**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

BATCHES – 1314

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

I. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into two sections: **Section-A & Section-C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

J. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 10)** contains 10 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (11 – 15) contains 5 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

(ii) **Section-C (01 – 05)** contains 5 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer. There is no negative marking..

Name of the Candidate :____

Batch :____________________ **Date of Examination :**____________________

Enrolment Number :____

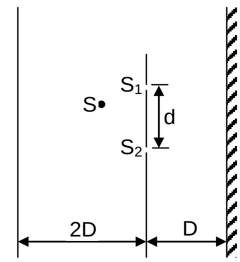
Physics Part – I

Section – A

Single Correct Answer Type

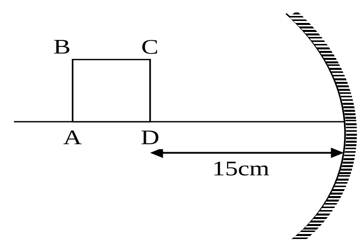
This section contain **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. A double slit, $S_1 - S_2$ is illuminated by light source S emitting light of wavelength λ. The slits are separated by a distance d. A plane mirror is placed at a distance D in front of the slits and a screen is placed at a distance 2D behind the slits. The screen receives light reflected only by the plane mirror. The fringe-width of the interference pattern on the screen is:



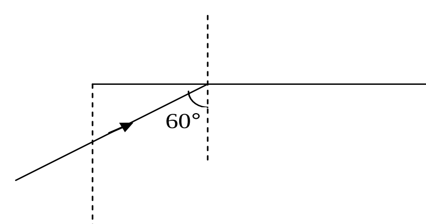
(A) $\frac{D\lambda}{d}$ (B) $\frac{2D\lambda}{d}$
(C) $\frac{3D\lambda}{d}$ (D) $\frac{4D\lambda}{d}$

2. A square $ABCD$ of side 1 mm is kept at distance 15 cm in front of the concave mirror as shown in the figure. The focal length of the mirror is 10 cm. The length of the perimeter of its image will be:



(A) 8 mm (B) 2 mm
(C) 12 mm (D) 6 mm

3. A light ray from air is incident at one end of a glass fibre $(\mu = 1.5)$ making an angle 60° on the lateral surface so that it undergoes total internal reflection. How much time would it take to traverse the straight fibre of length 1 km?



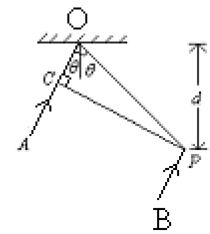
(A) 3.33 μs (B) 6.67 μs
(C) 5.77 μs (D) 3.85 μs

4. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The line PQ cuts the surface at point O, and PO = OQ. The distance PO is equal to :
(A) 5R (B) 3R (C) 2R (D) 1.5R

Rough Work

5. The decay constant of a radioactive sample is λ. The half-life and mean-life of the sample are respectively given by:
(A) $1/\lambda$ and $(\ell n\ 2)/\lambda$ (B) $(\ell n\ 2)/\lambda$ and $1/\lambda$
(C) $\lambda(\ell n\ 2)$ and $1/\lambda$ (D) $\lambda/(\ell n\ 2)$ and $1/\lambda$

6. In the adjacent diagram, CP represents a wave-front and AO and BP the corresponding two parallel rays. Find the condition on θ for constructive interference at P between the ray BP and reflected ray OP.



(A) $\cos\theta = \dfrac{3\lambda}{2d}$ (B) $\cos\theta = \dfrac{\lambda}{4d}$
(C) $\sec\theta - \cos\theta = \dfrac{\lambda}{d}$ ((D) $\sec\theta - \cos\theta = \dfrac{4\lambda}{d}$

7. A plano-convex lens made of a material of refractive index 1.5 is silvered on the convex surface. The radius of curvature of the curved surface is, (silvered lens has focal length of 20 cm):
(A) 10 cm (B) 20 cm (C) 30 cm (D) 60 cm

8. To ionize He^{+} ion by bombarding with a photon it should have a minimum wave length of (assume bohr model to be applicable)
(A)13 nm nearly (B)23 nm nearly (C)33 nm nearly (D)43 nm nearly

9. The mean lives of a radioactive substance are 1620 years and 405 years for α and β emission respectively. If the substance is decaying by both α and β emission simultaneously, then the time during which three fourth of the sample will decay is nearly $(take \ln 2 = 0.697)$
(A)250 years (B)350 years (C)450 years (D)750 years

10. The electron in a hydrogen atom makes a transition form an excited state to the ground state. Which of the following statement is true?
(A) Its kinetic energy increases and its potential and total energy decreases.
(B) Its kinetic energy decreases, potential energy increases and its total energy remains the same.
(C) Its kinetic and total energy decreases and its potential energy increases.
(D) Its kinetic, potential and total energy decreases.

Rough Work

Multiple Correct Answer(s) Type

The section contains **5 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

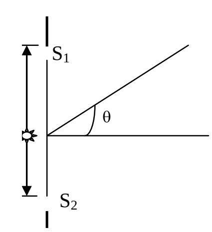
11. Out of the following, select the correct statements:
(A) refractive index, frequency and deviation are maximum for red colour
(B) if there were no atmosphere, the length of the day on the earth would increase
(C) for greater value of μ, the angle of deviation increases
(D) if the critical angle for the medium of a prism is θ_C and the angle of prism is A, there will be no emergent ray when A > $2\theta_C$

12. Fundamental frequency of a string fixed at both ends is 20 Hz then 3rd harmonic of the string.
(A) is equal to second overtone of the string
(B) is 60 Hz
(C) is equal to third overtone
(D) is 90 Hz

13. A neutron collides head-on with a stationary hydrogen atom in ground state. Which of the following statements are correct (Assume that the hydrogen atom and neutron has same mass) :
(A)if kinetic energy of the neutron isles than 20.4 eV collision must be elastic.
(B) if kinetic energy of the neutron is less than 20.4 eV collision may be inelastic
(C)Inelastic collision may be take place only when initial kinetic energy of neutron is greater than 20.4 eV.
(D)perfectly inelastic collision cannot take place

14. The wavelength of K_α X – rays for lead isotopes $Pb^{208}, Pb^{206}, Pb^{204}$ are λ_1, λ_2 and λ_3 respectively. Then
(A) $\lambda_1 = \lambda_2 = \lambda_3$
(B) $\lambda_1 > \lambda_2 > \lambda_3$
(C) $\lambda_1 < \lambda_2 < \lambda_3$
(D) $\lambda_2 = \sqrt{\lambda_1 \lambda_3}$

15. In an interference arrangement similar to Young's double-slit experiment, the slits $S_1 and S_2$ are illuminated with coherent microwave sources, each of frequency 10^6 Hz. The sources are synchronized to have zero phase difference. The slits are separated by a distance *d* = 150.0m. The intensity $I(\theta)\, for 0 \le \theta \le 90°$ is given by : (I_0 denotes the maximum intensity)



(A) $I(\theta) = I_0 / 2\, for \theta = 30^0$
(B) $I(\theta) = I_0 / 4\, for \theta = 90^0$
(C) $I(\theta) = I_0\, for \theta = 0^0$
(D) $I(\theta)$ is constant for all values of θ

Rough Work

Section – C
Integer Answer Type

This section contains **5 questions**. The answer to each question is **a single digit integer**, ranging from 0 to 9 (both inclusive)

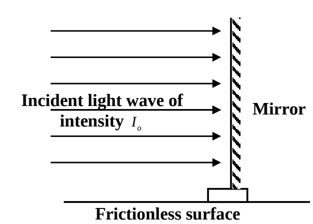
N1. Velocity of sound is measured in hydrogen and oxygen gases at a given temperature. The ratio of the two velocities will be:

N2. Three waves of equal frequencies having amplitudes 10μ m, 4μ m and 7μ m arrive at a given point with successive phase difference of $\pi/2$. The amplitude of the resulting wave in μ m is given by:

N3. Light ray falls on one of the three mutually perpendicularly placed plane mirror at an angle of incidence 30^0. The deviation of final reflected ray, taking only one reflection from each mirror is $X(30^0)$. The value of X is

N4. Characteristic X-rays of frequency $4.2\times10^{18}\,\mathrm{Hz}$ are emitted from a metal due to transition from L- to K-shell in a certain target materials. If the atomic no of metal is 6*x* by using Moseley's Law. Find the value of *x.* Take Rydberg constant $\mathrm{R} = 1.1\times10^{7}\,\mathrm{m}^{-1}$.

N5. If a mirror with support of total mass 2 kg is kept on a frictionless surface and a light wave of intensity I_o is normally incident on it (as shown in figure) and the light is totally reflected back. If the mirror is accelerating with 1 m/s^2 and I_o is $x\times10^8\ W/m^2$. Find the value of *x*. (Surface area of mirror is $1.5m^2$ and the area of support is negligible, speed of light wave is $3\times10^8 m/s$).



Rough Work

Chemistry   Part – II

Section – A

Single Correct Answer Type

This section contain **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. Given the half-cell reactions

$Cu^{+}(aq) + e \longrightarrow Cu(s),\ E^{0} = +0.52V$

$Cu^{2+}(aq) + e \longrightarrow Cu^{+}(aq), \quad E^{0} = +0.16V$

the equilibrium constant for the disproportionation reaction $2Cu^{+}(aq) \longrightarrow Cu(s) + Cu^{2+}(aq)$ at 298 K is

(A) 6×10^{4} (B) 6×10^{6} (C) 1.2×10^{6} (C) 1.2×10^{-6}

2. The specific conductance of a saturated AgCl solution is found to be 1.86×10^{-6} S cm^{-1} and that for water is 6.0×10^{-8} S cm^{-1}. The solubility of AgCl is (Λ_0 = 137.2 S equiv^{-1} cm^{2})

(A) 1.7×10^{-3} mol L^{-1} (B) 1.3×10^{-5} mol L^{-1}
(C) 1.3×10^{-4} mol L^{-1} (D) 1.3×10^{-6} mol L^{-1}

3. Brown ring test for nitrates is due to the formation of

(A) $\left[Fe(H_2O)_5 NO\right]^{2+}$ (B) $\left[Fe(H_2O)_6\right]^{2+}$
(C) $\left[Fe(H_2O)(NO)_5\right]^{2-}$ (D) $\left[Fe(CN)_5 NO\right]^{2+}$

4. The octahedral voids in a face-centred cubic (fcc or cpp) structure are located at

(A) 6 at edge centres and 8 along body diagonals
(B) 12 at edge centres and one at body centre
(C) 8 along body diagonal and 6 at edge centres
(D) all the edge centres only

5. Which of the following does not have optical isomer?

(A) $\left[Co(NH_3)_3 Cl_3\right]$ (B) $\left[Co(en)_3\right]Cl_3$
(C) $\left[Co(en)_2 Cl_2\right]Cl$ (D) $\left[Co(en)(NH_3)_2 Cl_2\right]Cl$

Rough Work

6. The vapour pressure liquid 'A' is 70 torr at $27^\circ C$. It forms an ideal solution with another liquid B. The mole fraction of B is 0.2 and total pressure of the solution is 84 torr at $27^\circ C$. The vapour pressure of pure liquid B at $27^\circ C$ is
(A) 14 (B) 56 (C) 140 (D) 70

7. When ZnS and PbS minerals are present together, then NaCN is added to separate them in the froth floatation process as a depresent, because
(A) $Pb(CN)_2$ is precipitated while no effect on Zns
(B) Zns forms soluble complex $Na_2[Zn(CN)_4]$
(C) PbS forms soluble complex $Na_2[Pb(CN)_4]$
(D) bothPbS and ZnS get precipitated and can be separated by fractional crystallization

8. For which of the following reactions: $\Delta H = \Delta U$
(A) $H_2(g) + I_2(g) \longrightarrow 2HI(g)$ (B) $PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$
(C) $2H_2O(\ell) \longrightarrow 2H_2(g) + O_2(g)$ (D) $2C(s) + O_2(g) \longrightarrow 2CO(g)$

9. Which of the following statements is applicable for the process, super cooled water (–10°C) $\rightarrow$ ice (–10°C)?
(A) $\Delta S_{system} = -ve,\ \Delta S_{surr} = +ve;\quad \Delta S_{system + surr} > 0$
(B) $\Delta S_{system} = +ve,\ \Delta S_{surr} = -ve;\quad \Delta S_{system + surr} < 0$
(C) $\Delta S_{system} = -ve,\ \Delta S_{surr} = -ve;\quad \Delta S_{system + surr} < 0$
(D) $\Delta S_{system} = +ve,\ \Delta S_{surr} = -ve;\quad \Delta S_{system + surr} > 0$

10. The complex showing spin-only magnetic moment 2.82 BM is
(A) $Ni(CO)_4$ (B) $[NiCl_4]^{2-}$
(C) $[Ni(PPh_3)_4]$ (D) $[Ni(CN)_4]^{2-}$

Rough Work

Multiple Correct Answer(s) Type

The section contains **5 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

11. In anti fluorite structure
(A) Oxide ions are face centered
(B) Cations are present in all the tetrahedral voids
(C) $r_{Li^+} + r_{O^{2-}} = \sqrt{3}a/4$
(D) Cations are face centred and anions are present in all the tetrahedral voids

12. Which of the following form ideal solution?
(A) $C_6H_5Cl - C_6H_5Br$
(B) $C_6H_6 - C_6H_5CH_3$
(C) Hexane – Heptane
(D) Ethanol – Cyclohexane

13. A binary liquid (AB) shows positive deviation from Raoult's law when
(A) $P_A > P_A^O X_A^{liq}$ and $P_B > P_B^O X_B^{liq}$
(B) Intermolecular forces: A – A, B – B > A – B
(C) $\Delta V_{mix} > O$
(D) $\Delta H_{mix} > 0$

14. If $E^0_{Ni^{2+}/Ni} = -0.25$, $E^0_{Fe^{3+}/Fe^{2+}} = 0.77$ $E^0_{Fe^{2+}/Fe} = -0.44$, $E^0_{Ca^{2+}/Ca} = -2.87$ then which of the following is/are feasible cell(s).
(A) $Ni|Ni^{2+}||Fe^{3+}|Fe^{2+}$
(B) $Fe^{2+}|Fe^{3+}||Fe^{2+}|Fe$
(C) $Ca|Ca^{2+}||Fe^{3+}|Fe^{2+}$
(D) $Fe|Fe^{2+}||Ni^{2+}|Ni$

15. Select the correct statement(s).
(A) Schottky defect is shown by CsCl
(B) Frenkel defect is shown by ZnS
(C) HCP & CCP structure has same co-ordination no. 12
(D) At high pressure, the coordination number increases

Rough Work

Section – C
Integer Answer Type

This section contains **5 questions**. The answer to each question is **a single digit integer**, ranging from 0 to 9 (both inclusive)

N1. Al_2O_3 is electrolysed for the production of aluminium metal. For a given quantity of electricity if the volume of O_2 gas obtained is 151.2L at STP. Then how many moles of aluminiumis obtained.

N2. A complex is represented as $CoCl_3 \cdot xH_2O$. Its 0.1 m solution in aqueous medium shows ΔT_f = –0.558 k. K_f of water is 1.86 and assuming 100% ionization of complex having co-ordination number 6, the value of x is ______
(Co forms 6 coordinate bonds with electron donors)

N3. A black coloured compound (B) is formed on passing H_2S through a solution of a compound (A) in NH_4OH. Compound A is a compound of Co.

$\underset{\text{(black)}}{B} \xrightarrow[KClO_3]{HCl} A \xrightarrow{KCN}$. Buff coloured precipitate $\xrightarrow{KCN} C(\text{soluble complex})$

$C \xrightarrow[(O)]{H_2O\Delta} D + KOH$

$A \xrightarrow{\text{excess } NaHCO_3} E \xrightarrow{Br_2/H_2O} F(\text{green})$

The number of moles of metal atom in one mole of F is ___________.

N4. The pH of the following cell: $Pt / H_{2(1atm)} / H^+_{(H_2SO_4)}$ $\quad E = 0.3V$

N5. How many of the following will dissolve in $(NH_4)_2 S_x$?
Ag_2S, AS_2S_3, Sb_2S_3, Sn5, SnS_2, MnS, Bi_2S_3, PbS, CuS, CdS

Rough Work

Mathematics Part – III

Section – A

Single Correct Answer Type

This section contain **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. The solution set of (2cosx - 1) (3 + 2cosx) = 0 in the interval $0 \le x \le 2\pi$ is
   (A) $\left\{\frac{\pi}{3}\right\}$
   (B) $\left\{\frac{\pi}{3}, \frac{5\pi}{3}\right\}$
   (C) $\left\{\frac{\pi}{3}, \frac{5\pi}{3}, \cos^{-1}(-3/2)\right\}$
   (D) none of these

2. In any Δ ABC, the least value of $\left(\frac{\sin^2 A + \sin A + 1}{\sin A}\right)$ is
   (A) 3
   (B) $\sqrt{3}$
   (C) 9
   (D) none of these

3. Number of pairs (x, y) satisfying $\sin^{-1} x + \sin^{-1} y = \frac{2\pi}{3}$ and $\cos^{-1} x - \cos^{-1} y = \frac{\pi}{3}$ is
   (A) 0
   (B) 1
   (C) 2
   (D) none of these

4. Number of real values of a $(a \in Z)$ satisfying the equation $[sinx]^2 + \sin x - 2a = 0$ is (Where $[.]$ is greatest integer function)
   (A) 0
   (B) 1
   (C) 2
   (D) 3

5. Equation of the line of intersection of planes x + y + z = 1 and x = 0 is
   (A) x + y = 1
   (B) y – z = 1
   (C) y + z = 1
   (D) x + z = 1

Rough Work

6. A line passing through A (1, 2, 3) and having direction ratios (3, 4, 5) meets a plane x + 2y – 3z = 5 at B, then distance AB is equal to

(A) $\frac{9}{4}$ (B) $\frac{11}{4}$ (C) $\frac{13}{4}$ (D) none of these

7. The projection of the vector $\hat{i}+\hat{j}+\hat{k}$ on the line whose vector equation is $\bar{r}=(3+\lambda)\hat{i}+(2\lambda-1)\hat{j}+3\lambda\hat{k}$, λ being the scalar parameter, is

(A) 6 (B) $\frac{1}{\sqrt{14}}$ (C) $\frac{6}{\sqrt{14}}$ (D) none of these

8. The value of x, so that the matrix $\begin{bmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{bmatrix}$ is non-singular is

(A) $x \neq 0$ (B) x = a + b + c
(C) $x \neq 0,\ x \neq -(a+b+c)$ (D) x = 0 and x = a + b + c

9. If $\Delta_1 = \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{vmatrix}$, $\Delta_2 = \begin{vmatrix} 1 & bc & a \\ 1 & ca & b \\ 1 & ab & c \end{vmatrix}$, then

(A) $\Delta_1 + \Delta_2 = 0$ (B) $\Delta_1 + 2\Delta_2 = 0$
(C) $\Delta_1 = \Delta_2$ (D) none of these

10. $\begin{vmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix}$ = ? Given $a_1, a_2, a_3 \ldots\ldots a_9$ are all consecutive odd integers.

(A) $\sqrt{a_1a_2a_3\ldots\ldots a_9}$ (B) $(a_1 + a_2 + a_3 + \ldots\ldots + a_9)$
(C) 0 (D) none of these

Rough Work

Multiple Correct Answer(s) Type

The section contains **5 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

11. If $\Delta_r = \begin{vmatrix} 2^{r-1} & \frac{1}{r(r+1)} & \sin r\theta \\ x & y & z \\ 2^n - 1 & \frac{n}{n+1} & \frac{\sin\left(\frac{n+1}{2}\right)\theta \sin\frac{n}{2}\theta}{\sin\frac{\theta}{2}} \end{vmatrix}$ then $\sum_{r=1}^{n} \Delta_r$ is equal to

(A) 0
(B) Independent of n
(C) independent of θ
(D) Independent of x, y and z

12. The lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar if

(A) $k = 0$
(B) $k = -1$
(C) $k = 2$
(D) $k = -3$

13. If OABC is a tetrahedron such that $OA^2 + BC^2 = OB^2 + CA^2 = OC^2 + AB^2$ then

(A) OA is perpendicular to BC
(B) OB is perpendicular to CA
(C) OC is perpendicular to AB
(D) AB is perpendicular to BC

14. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}, \vec{b} = \hat{i} + 2\hat{j} - \hat{k}, \vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ be three vectors. A vector in the plane of $\vec{b}$ and $\vec{c}$ whose projection on $\vec{a}$ is of magnitude $\sqrt{\frac{2}{3}}$ is

(A) $2\hat{i} + 3\hat{j} - 3\hat{k}$
(B) $2\hat{i} + 3\hat{j} + 3\hat{k}$
(C) $-2\hat{i} - \hat{j} + 5\hat{k}$
(D) $2\hat{i} + \hat{j} + 5\hat{k}$

15. $2\sin x \cos^4 x = \sum_{m=1}^{n} a_m \sin mx$ is an identity in x, then

(A) $a_3 = 3/8, a_2 = 0$
(B) $n = 6, a_1 = 1/2$
(C) $n = 5, a_1 = 1/4$
(D) $\sum a_m = 3/4$

Rough Work

Section – C
Integer Answer Type

This section contains **5 questions**. The answer to each question is **a single digit integer**, ranging from 0 to 9 (both inclusive)

N1. In a ΔABC, b cot B + c cot C = 2 (r + R). If the base AC = 3 units and $\angle C$ = 60° than BC is ___

N2. If $sin^{-1}x \in \left(0, \frac{\pi}{2}\right)$, then the value of $\tan\left(\frac{cos^{-1}(sin(\cos^{-1}x) + sin^{-1}(cos(sin^{-1}x)))}{2}\right)$ is _______

N3. If the equation $x^2 + 4 + 3sin(ax+b) - 2x = 0$ has at least one real solution where $a, b, \in [0, 2\pi], then\ \ 1 + sin(a+b)$ is equal to ___

N4. If the planes $x - cy - bz = 0,\ cx - y + az = 0$ and $bx + ay - z = 0$ pass through a line, then the value of $a^2 + b^2 + c^2 + 2abc$ is___

N5. If $\vec{a}, \vec{b}$ and $\vec{c}$ are unit vectors, then $\left|\vec{a} - \vec{b}\right|^2 + \left|\vec{b} - \vec{c}\right|^2 + \left|\vec{c} - \vec{a}\right|^2$ does not exceed ____

FIITJEE

PHYSICS, CHEMISTRY & MATHEMATICS

CPT1 - 1 **CODE:** **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 210**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

TCHES – 1314

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

K. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into two sections: **Section-A & Section-C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

L. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 10)** contains 10 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (11 – 15) contains 5 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

(ii) **Section-C (01 – 05)** contains 5 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer. There is no negative marking..

Name of the Candidate :____

Batch :____________________ **Date of Examination :**____________________

Enrolment Number :____

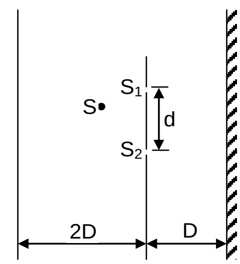
Physics — Part – I

Section – A

Single Correct Answer Type

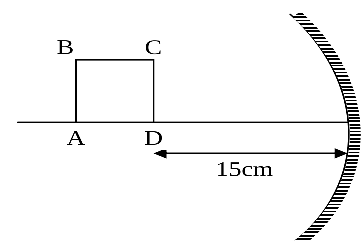
This section contain **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

16. A double slit, $S_1 - S_2$ is illuminated by light source S emitting light of wavelength λ. The slits are separated by a distance d. A plane mirror is placed at a distance D in front of the slits and a screen is placed at a distance $2D$ behind the slits. The screen receives light reflected only by the plane mirror. The fringe-width of the interference pattern on the screen is:



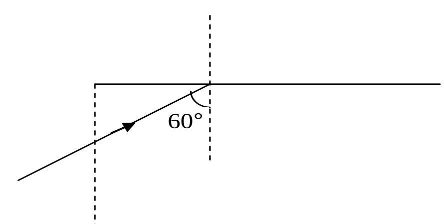
(A) $\frac{D\lambda}{d}$ (B) $\frac{2D\lambda}{d}$
(C) $\frac{3D\lambda}{d}$ (D) $\frac{4D\lambda}{d}$

17. A square $ABCD$ of side 1 mm is kept at distance 15 cm in front of the concave mirror as shown in the figure. The focal length of the mirror is 10 cm. The length of the perimeter of its image will be:



(A) 8 mm (B) 2 mm
(C) 12 mm (D) 6 mm

18. A light ray from air is incident at one end of a glass fibre $(\mu = 1.5)$ making an angle 60° on the lateral surface so that it undergoes total internal reflection. How much time would it take to traverse the straight fibre of length 1 km?



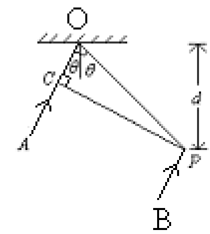
(A) 3.33 μs (B) 6.67 μs
(C) 5.77 μs (D) 3.85 μs

19. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The line PQ cuts the surface at point O, and PO = OQ. The distance PO is equal to :
(A) $5R$ (B) $3R$ (C) $2R$ (D) $1.5R$

Rough Work

20. The decay constant of a radioactive sample is λ. The half-life and mean-life of the sample are respectively given by:
(A) $1/\lambda$ and $(\ell n\ 2)/\lambda$
(B) $(\ell n\ 2)/\lambda$ and $1/\lambda$
(C) $\lambda(\ell n\ 2)$ and $1/\lambda$
(D) $\lambda/(\ell n\ 2)$ and $1/\lambda$

21. In the adjacent diagram, CP represents a wave-front and AO and BP the corresponding two parallel rays. Find the condition on θ for constructive interference at P between the ray BP and reflected ray OP.



(A) $\cos\theta = \frac{3\lambda}{2d}$
(B) $\cos\theta = \frac{\lambda}{4d}$
(C) $\sec\theta - \cos\theta = \frac{\lambda}{d}$
((D) $\sec\theta - \cos\theta = \frac{4\lambda}{d}$

22. A plano-convex lens made of a material of refractive index 1.5 is silvered on the convex surface. The radius of curvature of the curved surface is, (silvered lens has focal length of 20 cm):
(A) 10 cm (B) 20 cm (C) 30 cm (D) 60 cm

23. To ionize He^{+} ion by bombarding with a photon it should have a minimum wave length of (assume bohr model to be applicable)
(A)13 nm nearly (B)23 nm nearly (C)33 nm nearly (D)43 nm nearly

24. The mean lives of a radioactive substance are 1620 years and 405 years for α and β emission respectively. If the substance is decaying by both α and β emission simultaneously, then the time during which three fourth of the sample will decay is nearly $(take \ln 2 = 0.697)$
(A)250 years (B)350 years (C)450 years (D)750 years

25. The electron in a hydrogen atom makes a transition form an excited state to the ground state. Which of the following statement is true?
(A) Its kinetic energy increases and its potential and total energy decreases.
(B) Its kinetic energy decreases, potential energy increases and its total energy remains the same.
(C) Its kinetic and total energy decreases and its potential energy increases.
(D) Its kinetic, potential and total energy decreases.

Rough Work

Multiple Correct Answer(s) Type

The section contains **5 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

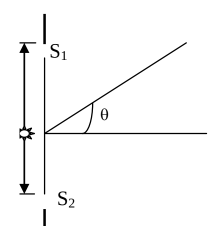
26. Out of the following, select the correct statements:
(A) refractive index, frequency and deviation are maximum for red colour
(B) if there were no atmosphere, the length of the day on the earth would increase
(C) for greater value of μ, the angle of deviation increases
(D) if the critical angle for the medium of a prism is θ_C and the angle of prism is A, there will be no emergent ray when A > $2\theta_C$

27. Fundamental frequency of a string fixed at both ends is 20 Hz then 3rd harmonic of the string.
(A) is equal to second overtone of the string
(B) is 60 Hz
(C) is equal to third overtone
(D) is 90 Hz

28. A neutron collides head-on with a stationary hydrogen atom in ground state. Which of the following statements are correct (Assume that the hydrogen atom and neutron has same mass) :
(A)if kinetic energy of the neutron isles than 20.4 eV collision must be elastic.
(B) if kinetic energy of the neutron is less than 20.4 eV collision may be inelastic
(C)Inelastic collision may be take place only when initial kinetic energy of neutron is greater than 20.4 eV.
(D)perfectly inelastic collision cannot take place

29. The wavelength of K_α X – rays for lead isotopes $Pb^{208}, Pb^{206}, Pb^{204}$ are λ_1, λ_2 and λ_3 respectively. Then
(A) $\lambda_1 = \lambda_2 = \lambda_3$
(B) $\lambda_1 > \lambda_2 > \lambda_3$
(C) $\lambda_1 < \lambda_2 < \lambda_3$
(D) $\lambda_2 = \sqrt{\lambda_1 \lambda_3}$

30. In an interference arrangement similar to Young's double-slit experiment, the slits $S_1 and S_2$ are illuminated with coherent microwave sources, each of frequency 10^6 Hz. The sources are synchronized to have zero phase difference. The slits are separated by a distance *d* = 150.0m. The intensity $I(\theta)\ for 0 \le \theta \le 90°$ is given by : (I_0 denotes the maximum intensity)



(A) $I(\theta) = I_0 / 2\ for \theta = 30^0$
(B) $I(\theta) = I_0 / 4\ for \theta = 90^0$
(C) $I(\theta) = I_0\ for \theta = 0^0$
(D) $I(\theta)$ is constant for all values of θ

Rough Work

Section – C

Integer Answer Type

This section contains **5 questions**. The answer to each question is **a single digit integer**, ranging from 0 to 9 (both inclusive)

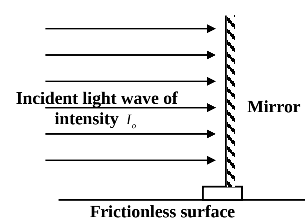
N1. Velocity of sound is measured in hydrogen and oxygen gases at a given temperature. The ratio of the two velocities will be:

N2. Three waves of equal frequencies having amplitudes 10μ m, 4μ m and 7μ m arrive at a given point with successive phase difference of $\pi/2$. The amplitude of the resulting wave in μ m is given by:

N3. Light ray falls on one of the three mutually perpendicularly placed plane mirror at an angle of incidence 30^0. The deviation of final reflected ray, taking only one reflection from each mirror is $X(30^0)$. The value of X is

N4. Characteristic X-rays of frequency $4.2\times10^{18}\,\text{Hz}$ are emitted from a metal due to transition from L- to K-shell in a certain target materials. If the atomic no of metal is 6*x* by using Moseley's Law. Find the value of *x.* Take Rydberg constant $\text{R} = 1.1\times10^7\,\text{m}^{-1}$.

N5. If a mirror with support of total mass 2 kg is kept on a frictionless surface and a light wave of intensity I_o is normally incident on it (as shown in figure) and the light is totally reflected back. If the mirror is accelerating with 1 m/s^2 and I_o is $x\times10^8\ W/m^2$. Find the value of *x*. (Surface area of mirror is $1.5m^2$ and the area of support is negligible, speed of light wave is $3\times10^8 m/s$).



Rough Work

Chemistry Part – II

Section – A

Single Correct Answer Type

This section contain **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

16. Given the half-cell reactions

$Cu^{+}(aq) + e \longrightarrow Cu(s),\ E^0 = +0.52V$

$Cu^{2+}(aq) + e \longrightarrow Cu^{+}(aq),\qquad E^0 = +0.16V$

the equilibrium constant for the disproportionation reaction $2Cu^{+}(aq) \longrightarrow Cu(s) + Cu^{2+}(aq)$ at 298 K is

(A) 6×10^4 (B) 6×10^6 (C) 1.2×10^6 (C) 1.2×10^{-6}

17. The specific conductance of a saturated AgCl solution is found to be 1.86×10^{-6} S cm^{-1} and that for water is 6.0×10^{-8} S cm^{-1}. The solubility of AgCl is (Λ_0 = 137.2 S $equiv^{-1}$ cm^2)

(A) 1.7×10^{-3} mol L^{-1} (B) 1.3×10^{-5} mol L^{-1}
(C) 1.3×10^{-4} mol L^{-1} (D) 1.3×10^{-6} mol L^{-1}

18. Brown ring test for nitrates is due to the formation of

(A) $\left[Fe(H_2O)_5 NO\right]^{2+}$ (B) $\left[Fe(H_2O)_6\right]^{2+}$
(C) $\left[Fe(H_2O)(NO)_5\right]^{2-}$ (D) $\left[Fe(CN)_5 NO\right]^{2+}$

19. The octahedral voids in a face-centred cubic (fcc or cpp) structure are located at
(A) 6 at edge centres and 8 along body diagonals
(B) 12 at edge centres and one at body centre
(C) 8 along body diagonal and 6 at edge centres
(D) all the edge centres only

20. Which of the following does not have optical isomer?

(A) $\left[Co(NH_3)_3 Cl_3\right]$ (B) $\left[Co(en)_3\right]Cl_3$
(C) $\left[Co(en)_2 Cl_2\right]Cl$ (D) $\left[Co(en)(NH_3)_2 Cl_2\right]Cl$

Rough Work

21. The vapour pressure liquid 'A' is 70 torr at $27^\circ C$. It forms an ideal solution with another liquid B. The mole fraction of B is 0.2 and total pressure of the solution is 84 torr at $27^\circ C$. The vapour pressure of pure liquid B at $27^\circ C$ is
(A) 14 (B) 56 (C) 140 (D) 70

22. When ZnS and PbS minerals are present together, then NaCN is added to separate them in the froth floatation process as a depresent, because
(A) $Pb(CN)_2$ is precipitated while no effect on Zns
(B) Zns forms soluble complex $Na_2[Zn(CN)_4]$
(C) PbS forms soluble complex $Na_2[Pb(CN)_4]$
(D) bothPbS and ZnS get precipitated and can be separated by fractional crystallization

23. For which of the following reactions: $\Delta H = \Delta U$
(A) $H_2(g) + I_2(g) \longrightarrow 2HI(g)$
(B) $PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$
(C) $2H_2O(\ell) \longrightarrow 2H_2(g) + O_2(g)$
(D) $2C(s) + O_2(g) \longrightarrow 2CO(g)$

24. Which of the following statements is applicable for the process, super cooled water (–10°C) $\rightarrow$ ice (–10°C)?
(A) $\Delta S_{system} = -ve,\ \Delta S_{surr} = +ve;\quad \Delta S_{system+surr} > 0$
(B) $\Delta S_{system} = +ve,\ \Delta S_{surr} = -ve;\quad \Delta S_{system+surr} < 0$
(C) $\Delta S_{system} = -ve,\ \Delta S_{surr} = -ve;\quad \Delta S_{system+surr} < 0$
(D) $\Delta S_{system} = +ve,\ \Delta S_{surr} = -ve;\quad \Delta S_{system+surr} > 0$

25. The complex showing spin-only magnetic moment 2.82 BM is
(A) $Ni(CO)_4$
(B) $[NiCl_4]^{2-}$
(C) $[Ni(PPh_3)_4]$
(D) $[Ni(CN)_4]^{2-}$

Rough Work

Multiple Correct Answer(s) Type

The section contains **5 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

26. In anti fluorite structure
(A) Oxide ions are face centered
(B) Cations are present in all the tetrahedral voids
(C) $r_{Li^+} + r_{O^{2-}} = \sqrt{3}a/4$
(D) Cations are face centred and anions are present in all the tetrahedral voids

27. Which of the following form ideal solution?
(A) $C_6H_5Cl - C_6H_5Br$
(B) $C_6H_6 - C_6H_5CH_3$
(C) Hexane – Heptane
(D) Ethanol – Cyclohexane

28. A binary liquid (AB) shows positive deviation from Raoult's law when
(A) $P_A > P_A^O X_A^{liq}$ and $P_B > P_B^O X_B^{liq}$
(B) Intermolecular forces: A – A, B – B > A – B
(C) $\Delta V_{mix} > O$
(D) $\Delta H_{mix} > 0$

29. If $E^0_{Ni^{2+}/Ni} = -0.25$, $E^0_{Fe^{3+}/Fe^{2+}} = 0.77$ $E^0_{Fe^{2+}/Fe} = -0.44$, $E^0_{Ca^{2+}/Ca} = -2.87$ then which of the following is/are feasible cell(s).
(A) $Ni|Ni^{2+}||Fe^{3+}|Fe^{2+}$
(B) $Fe^{2+}|Fe^{3+}||Fe^{2+}|Fe$
(C) $Ca|Ca^{2+}||Fe^{3+}|Fe^{2+}$
(D) $Fe|Fe^{2+}||Ni^{2+}|Ni$

30. Select the correct statement(s).
(A) Schottky defect is shown by CsCl
(B) Frenkel defect is shown by ZnS
(C) HCP & CCP structure has same co-ordination no. 12
(D) At high pressure, the coordination number increases

Rough Work

Section – C
Integer Answer Type

This section contains **5 questions**. The answer to each question is **a single digit integer**, ranging from 0 to 9 (both inclusive)

N1. Al_2O_3 is electrolysed for the production of aluminium metal. For a given quantity of electricity if the volume of O_2 gas obtained is 151.2L at STP. Then how many moles of aluminiumis obtained.

N2. A complex is represented as $CoCl_3 \cdot xH_2O$. Its 0.1 m solution in aqueous medium shows ΔT_f = –0.558 k. K_f of water is 1.86 and assuming 100% ionization of complex having co-ordination number 6, the value of x is ______
(Co forms 6 coordinate bonds with electron donors)

N3. A black coloured compound (B) is formed on passing H_2S through a solution of a compound (A) in NH_4OH. Compound A is a compound of Co.

$\underset{(\text{black})}{B} \xrightarrow[KClO_3]{HCl} A \xrightarrow{KCN}$. Buff coloured precipitate $\xrightarrow{KCN} C(\text{soluble complex})$

$C \xrightarrow[(O)]{H_2O\Delta} D + KOH$

$A \xrightarrow{\text{excess } NaHCO_3} E \xrightarrow{Br_2/H_2O} F(\text{green})$

The number of moles of metal atom in one mole of F is ___________.

N4. The pH of the following cell: $Pt / H_{2(1atm)} / H^+_{(H_2SO_4)}$ $\quad E = 0.3V$

N5. How many of the following will dissolve in $(NH_4)_2 S_x$?
Ag_2S, AS_2S_3, Sb_2S_3, Sn5, SnS_2, MnS, Bi_2S_3, PbS, CuS, CdS

Rough Work

Mathematics Part – III

Section – A

Single Correct Answer Type

This section contain **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

5. The solution set of (2cosx - 1) (3 + 2cosx) = 0 in the interval $0 \le x \le 2\pi$ is
(A) $\left\{\frac{\pi}{3}\right\}$ (B) $\left\{\frac{\pi}{3}, \frac{5\pi}{3}\right\}$
(C) $\left\{\frac{\pi}{3}, \frac{5\pi}{3}, \cos^{-1}(-3/2)\right\}$ (D) none of these

6. In any Δ ABC, the least value of $\left(\frac{\sin^2 A + \sin A + 1}{\sin A}\right)$ is
(A) 3 (B) $\sqrt{3}$ (C) 9 (D) none of these

7. Number of pairs (x, y) satisfying $\sin^{-1} x + \sin^{-1} y = \frac{2\pi}{3}$ and $\cos^{-1} x - \cos^{-1} y = \frac{\pi}{3}$ is
(A) 0 (B) 1 (C) 2 (D) none of these

8. Number of real values of a $(a \in Z)$ satisfying the equation $[\sin x]^2 + \sin x - 2a = 0$ is (Where $[.]$ is greatest integer function)
(A) 0 (B) 1 (C) 2 (D) 3

6. Equation of the line of intersection of planes x + y + z = 1 and x = 0 is
(A) x + y = 1 (B) y – z = 1 (C) y + z = 1 (D) x + z = 1

Rough Work

14. A line passing through A (1, 2, 3) and having direction ratios (3, 4, 5) meets a plane x + 2y – 3z = 5 at B, then distance AB is equal to

(A) $\frac{9}{4}$ (B) $\frac{11}{4}$ (C) $\frac{13}{4}$ (D) none of these

15. The projection of the vector $\hat{i}+\hat{j}+\hat{k}$ on the line whose vector equation is $\bar{r}=(3+\lambda)\hat{i}+(2\lambda-1)\hat{j}+3\lambda\hat{k}$, λ being the scalar parameter, is

(A) 6 (B) $\frac{1}{\sqrt{14}}$ (C) $\frac{6}{\sqrt{14}}$ (D) none of these

16. The value of x, so that the matrix $\begin{bmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{bmatrix}$ is non-singular is

(A) $x \neq 0$ (B) x = a + b + c
(C) $x \neq 0,\ x \neq -(a+b+c)$ (D) x = 0 and x = a + b + c

17. If $\Delta_1 = \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{vmatrix}$, $\Delta_2 = \begin{vmatrix} 1 & bc & a \\ 1 & ca & b \\ 1 & ab & c \end{vmatrix}$, then

(A) $\Delta_1 + \Delta_2 = 0$ (B) $\Delta_1 + 2\Delta_2 = 0$
(C) $\Delta_1 = \Delta_2$ (D) none of these

18. $\begin{vmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix}$ = ? Given $a_1, a_2, a_3 \ldots.. a_9$ are all consecutive odd integers.

(A) $\sqrt{a_1a_2a_3.....a_9}$ (B) $(a_1 + a_2 + a_3 + \ldots..+ a_9)$
(C) 0 (D) none of these

Rough Work

Multiple Correct Answer(s) Type

The section contains **5 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

19. If $\Delta_r = \begin{vmatrix} 2^{r-1} & \frac{1}{r(r+1)} & \sin r\theta \\ x & y & z \\ 2^n - 1 & \frac{n}{n+1} & \frac{\sin\left(\frac{n+1}{2}\right)\theta \sin\frac{n}{2}\theta}{\sin\frac{\theta}{2}} \end{vmatrix}$ then $\sum\limits_{r=1}^{n} \Delta_r$ is equal to

(A) 0
(B) Independent of n
(C) independent of θ
(D) Independent of x, y and z

20. The lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar if

(A) $k=0$
(B) $k=-1$
(C) $k=2$
(D) $k=-3$

21. If OABC is a tetrahedron such that $OA^2 + BC^2 = OB^2 + CA^2 = OC^2 + AB^2$ then

(A) OA is perpendicular to BC
(B) OB is perpendicular to CA
(C) OC is perpendicular to AB
(D) AB is perpendicular to BC

14. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}, \vec{b} = \hat{i} + 2\hat{j} - \hat{k}, \vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ be three vectors. A vector in the plane of $\vec{b}$ and $\vec{c}$ whose projection on $\vec{a}$ is of magnitude $\sqrt{\frac{2}{3}}$ is

(A) $2\hat{i} + 3\hat{j} - 3\hat{k}$
(B) $2\hat{i} + 3\hat{j} + 3\hat{k}$
(C) $-2\hat{i} - \hat{j} + 5\hat{k}$
(D) $2\hat{i} + \hat{j} + 5\hat{k}$

15. $2\sin x \cos^4 x = \sum\limits_{m=1}^{n} a_m \sin mx$ is an identity in x, then

(A) $a_3 = 3/8, a_2 = 0$
(B) $n = 6, a_1 = 1/2$
(C) $n = 5, a_1 = 1/4$
(D) $\sum a_m = 3/4$

Rough Work

Section – C
Integer Answer Type

This section contains **5 questions**. The answer to each question is **a single digit integer**, ranging from 0 to 9 (both inclusive)

N1. In a ΔABC, b cot B + c cot C = 2 (r + R). If the base AC = 3 units and $\angle C$ = 60° than BC is ___

N2. If $sin^{-1}x \in \left(0, \frac{\pi}{2}\right)$, then the value of $\tan\left(\frac{cos^{-1}(sin(\cos^{-1}x)+sin^{-1}(cos(sin^{-1}x)))}{2}\right)$ is _______

N3. If the equation $x^2+4+3sin(ax+b)-2x=0$ has at least one real solution where $a,b,\in[0,2\pi], then\ \ 1+sin(a+b)$ is equal to ___

N4. If the planes $x-cy-bz=0,\ cx-y+az=0$ and $bx+ay-z=0$ pass through a line, then the value of $a^2+b^2+c^2+2abc$ is___

N5. If $\vec{a},\vec{b}$ and $\vec{c}$ are unit vectors, then $\left|\vec{a}-\vec{b}\right|^2+\left|\vec{b}-\vec{c}\right|^2+\left|\vec{c}-\vec{a}\right|^2$ does not exceed ____

Rough Work

FIITJEE

PHYSICS, CHEMISTRY & MATHEMATICS

CPT1 - 2 | **CODE:** | **PAPER - 2**

Time Allotted: 3 Hours | **Maximum Marks: 198**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

TCHES – 1314

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

M. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into one section: **Section-A**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

N. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 08)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 marks** for wrong answer.

Section-A (09 – 14) contains 3 paragraphs. Based upon paragraph, 2 multiple choice questions have to be answered. Each question has only one correct answer and carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (15 – 20) contains 6 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

Name of the Candidate :____

Batch :_____________________ **Date of Examination :**____________________

Enrolment Number :____

Physics Part – I

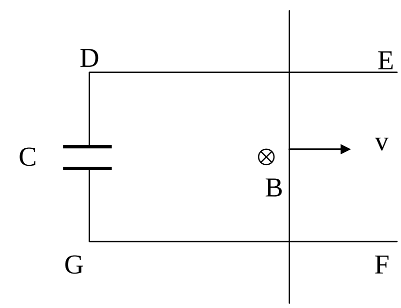
Section – A

Single Correct Answer Type

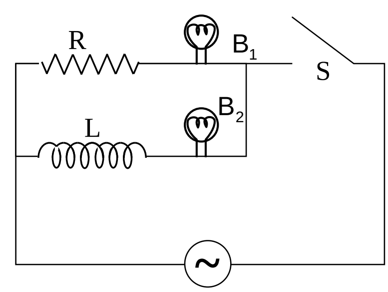
This section contain **8 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

31. A photon collides with a stationary hydrogen atom in ground state in elastically. Energy of the colliding photon is 10.2eV. After a time interval of the order of micro sec. Another photon collides with same hydrogen atom in elastically with an energy of 15 eV. What will be observed by the detector?
(A) 2 photon of energy 10.2eV
(B) 2 photon of energy of 1.4 eV
(C) One photon of energy 10.2eV and an electron of energy 1.4eV
(D) One photon of energy 10.2eV and another photon of energy 1.4eV

32. In the figure shown the section EDGF is fixed. A rod having resistance 'R' is moved with constant velocity in a uniform magnetic field B as shown in the figure. DE and GF are smooth and resistanceless, Initially capacitor is uncharged. The charge on the capacitor:
(A) remains constant
(B) increases exponentially with time
(C) increases linearly with time
(D) oscillates



33. Figure shows two bulbs B_1 and B_2, resistor R and an inductor L. When the switch S is turned off :
(A) both B_1 and B_2 die out promptly
(B) both B_1 and B_2 die out with some delay
(C) B_2 dies out promptly but B_1 with some delay
(D) B_1 dies out promptly but B_2 with some delay



Rough Work

34. A radioactive sample with half – life = T emits $\alpha-$particles. Its total activity is A_i at some time and A_t at a later time. The number of $\alpha-$particles emitted by the sample between these two points in time is :

(A) $A_i - A_t$ (B) $\frac{T}{\ln 2}(A_i - A_t)$

(C) $\frac{\ln 2}{T}(A_i - A_t)$ (D) $\frac{T}{\ln 2}\left[\frac{1}{A_t} - \frac{1}{A_i}\right]$

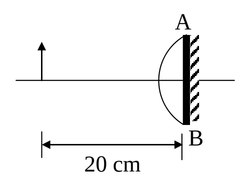
35. The electron in H – atom makes transition from $n = n_2$ to $n = n_1$. If time period of the electron in the initial state is 27 times that in the final state, possible values of n_2 and n_1 are :

(A) $n_2 = 27, n_1 = 1$ (B) $n_2 = 3, n_1 = 1$ (C) $n_2 = 2, n_3 = 1$ (D) $n_2 = 5, n_1 = 3$

36. In an ideal double slit experiment, when a glass plate (refractive index 1.5) of thickness t is introduced in the path of one of the interfering beams (wavelength λ), the intensity at the position where the central maximum occurred previously remains unchanged. The minimum thickness of the glass plate is:

(A) 2λ (B) $2\lambda/3$ (C) $\lambda/3$ (D) λ

37. A point object is placed at a distance of 20 cm from a thin plano – convex lens of focal length 15 cm. If the plane surface is silvered, the image will form at :



(A) 60 cm left of AB (B) 30 cm left of AB
(C) 12 cm left of AB (D) 60 cm right of AB

38. Refractive index of the material of a prism is $\sqrt{2}$ and its refracting angle is 30^0. One of the refracting surfaces of the prism is made a mirror inwards. A beam of monochromatic light entering the prism from the other face will retrace its path after reflection from the mirrored surface if its angle of incidence on the prism is:

(A) 0^0 (B) 60^0 (C) 45^0 (D) 30^0

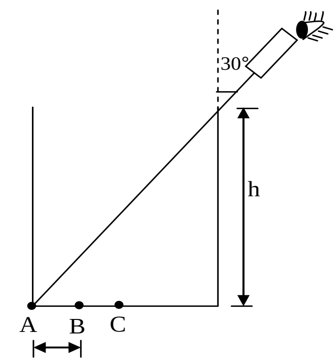
Rough Work

Comprehension Type

This section contains 3 groups of question. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 9 and 10

As shown in the given figure, a person looking through a telescope *T* just sees the point *A* at the bottom of a cylindrical vessel when the vessel is empty. Without moving the telescope or the vessel, when the vessel is half filled with a liquid of refractive index 'μ', he observes the image of point *B*, *AB* = 10cm. If the vessel is completely filled, he observes the image of a point '*C*' lying at the centre of bottom. Given that the angle which the line of observation of the person makes with the vertical is 30°, answer the following questions :

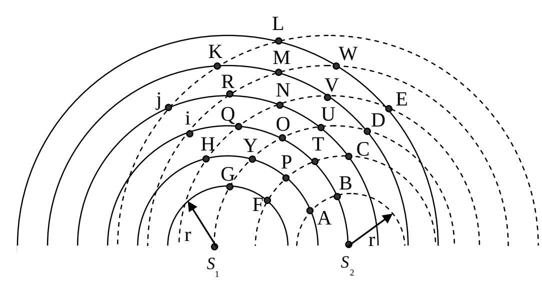


39. Radius of the cylindrical vessel is :
(A) 20 cm (B) 30 cm (C) 10 cm (D) 12.5 cm

40. When the vessel is completely filled, height of liquid in the vessel, *h* is :
(A) 40.2 cm (B) 51.4 cm (C) 69.3 cm (D) 82.5 cm

Paragraph for Question Nos. 11 and 12

Two coherent point sources of sound wave S_1 and S_2 produce sound of same frequency 50 Hz and wavelength 2 cm with amplitude $2\times10^{-3}m$. Each circular arc represents a wavefront at a particular time and is separated from next arc by a distance 1 cm. Both the sound waves propagate through the medium and interfere with each other. Bold circular lines denote wavefront of source S_1 and dotted circular lines denote wavefront of source S_2.



Read paragraph carefully and answer the following questions. [r = 1 cm]

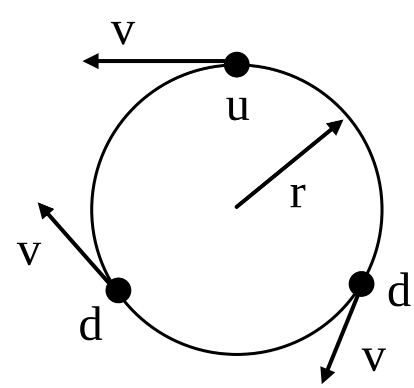
41. The point(s) where constructive interference occurs
(A) G only (B) P and A (C) G and F (D) T and U

Rough Work

42. How many of the points shown in the figure represent maxima
(A) 10 (B) 12 (C) 13 (D) 14

Paragraph for Question Nos. 13 and 14

Quark Model of the Neutron: The neutron is a particle with zero charge but with a nonzero magnetic moment with z–component 9.66×10^{-27} Am^2. If the neutron is considered to be a fundamental entity with no internal structure, the two properties listed above seem to be contradictory. According to present theory in practical physics, a neutron is composed of three more fundamental particles called quarks. In this model the neutron consists of an "up quark" having a charge of +2e/3 and two "down quarks", each having a charge of –e/3. The combination of the three quarks produces a net charge of 2e/3 – e/3 –e/3 = 0, as required, and if the quarks are in motion, they could also produce a nonzero magnetic moment. As a very simple model, suppose the up quark is moving in the xy–plane in a counterclockwise circular path and the down quarks are moving in the xy–plane in a clockwise path, all with radius r and all with the same speed v.



43. Obtain an expression for the current due to the circulation of the up quark.
(A) $\frac{ev}{6\pi r}$ (B) $\frac{ev}{3\pi r}$ (C) $\frac{ev}{\pi r}$ (D) $\frac{ev}{12\pi r}$

44. Obtain an expression for the magnetic of the magnetic moment of the three–quark system.
(A) zero (B) $\frac{evr}{2}$ (C) $\frac{evr}{3}$ (D) $\frac{2evr}{3}$

Rough Work

Multiple Correct Answer(s) Type

The section contains **6 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

45. The *K* shell ionization energies for cobalt, copper and molybdenum are 7.8, 9.0 and 20.1 keV respectively. If an X-ray tube operates at 15 kV with any of the above metals as targets, then :
(A) characteristic X-rays of *K* series will be emitted only from cobalt
(B) characteristic X-rays of *K* series will be emitted only from copper and cobalt
(C) characteristic X-rays of *K* series will be emitted from cobalt, copper and molybdenum
(D) the shortest wavelength of continuous X-rays emitted is the same for the three metals

46. A beam of ultraviolet light of all wavelengths passes through hydrogen gas at room temperature, in the x-direction. Assume that all photons emitted due to electron transition inside the gas emerge in the y-direction. Let A and B denote the lights emerging from the gas in the s and y directions respectively.
(A) Some of the incident wavelengths will be absent in A.
(B) Only those wavelengths will be present in B which are absent in A.
(C) B will contain some visible light.
(D) B will contain some infrared light.

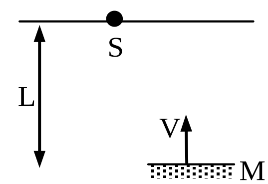
47. A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen, then:
(A) Half of the image will disappear
(B) Complete image will be formed
(C) Intensity of the image will increase
(D) Intensity of the image will decrease

48. White light is used to illuminate the two slits in a Young's double slit experiment. The separation between the slits is b and the screen is at a distance $d\left(>>b\right)$ from the slits. At a point on the screen directly in front of one of the slits, certain wavelengths are missing. Some of these missing wavelengths are:
(A) $\lambda = b^2/d$
(B) $\lambda = 2b^2/d$
(C) $\lambda = b^2/3d$
(D) $\lambda = 2b^2/3d$

Rough Work

49. In photoelectric effect, stopping potential depends on
(A) frequency of the incident light
(B) intensity of the incident light by varies source distance
(C) emitter's properties
(D) frequency and intensity of the incident light

50. A plane mirror M is arranged parallel to a wall W at a distance L from it. The light produced by a point source S kept on the wall is reflected by the mirror and produces a patch of light on the wall. The mirror moves with velocity v towards the wall. Which of the following statement(s) is/are correct?



(A) The patch of light will move with speed v on the wall.
(B) The patch of light will not move on the wall.
(C) As the mirror comes closer, the patch of light will become larger and shift away from the wall with speed larger than v.
(D) The size of the patch of light on the wall remains the same

Rough Work

Chemistry **Part – II**

Section – A

Single Correct Answer Type

This section contain 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. The freezing point (in ^0C) of a solution containing 0.1 g of $K_3\left[Fe(CN)_6\right]$ (mol wt.329) in 100 g of water $\left(K_f = 1.86 K.kg\ mol^{-1}\right)$ is ______________

(A) -2.3×10^{-2} (B) -5.7×10^{-2} (C) -5.7×10^{-3} (D) -1.2×10^{-2}

2. The correct order of equivalent conductance at infinite dilution of $LiC\ell, NaC\ell$ and $KC\ell$ is ________________

(A) $LiC\ell > NaC\ell > KC\ell$ (B) $KC\ell > NaC\ell > LiC\ell$
(C) $NaC\ell > kC\ell > LiC\ell$ (D) $LiC\ell > kC\ell > NaC\ell$

3. The rusting of iron takes place as follows:

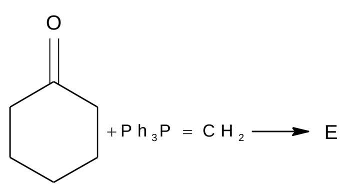
$$2H^+ + 2e + \frac{1}{2}O_2 \rightarrow H_2O_{(\ell)}; E^0 = +1.23V$$

$$Fe^{+2} + 2e^{(-)} \rightarrow Fe_{(s)}; E^0 = -0.44V$$

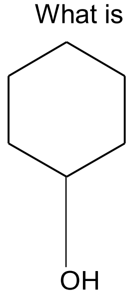
The ΔG^0 for the net process is __________

(A) – 322 kJ mol^{-1} (B) – 161 kJ mol^{-1}
(C) – 152 kJ mol^{-1} (D) – 76 kJ mol^{-1}

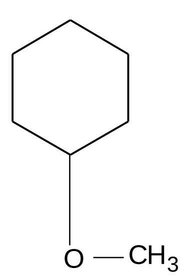
4.



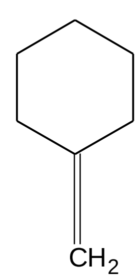
What is 'E'?



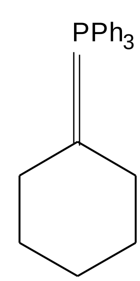
(A)



(B)



(C)



(D)

Rough Work

5. Bezoyl chloride is prepared from benzoic acid by __________________
(A) $Cl_2, h\gamma$ (B) $SO_2C\ell_2$ (C) $SOC\ell_2$ (D) $C\ell_2, H_2O$

6. Two moles of an ideal gas expanded isothermally and reversibly from 1 litre to 10 litre at 300 K. the enthalpy change (in kJ) for the process is ______________
(A) 11.4 (B) – 11.4 (C) 0 (D) 4.8

7. ΔHf^0 for $CO_{2(g)}, CO_{(g)}$ and $H_2O_{(g)}$ are – 393.5, –110.5 and –241.8 kJ mol^{-1} respectively. The standard enthalpy change (in kJ) for given reaction is ____________
$CO_{2(g)} + H_{2(g)} \rightarrow CO_{(g)} + H_2O_{(g)}$
(A) +524.1 (B) +41.2 (C) –262.5 (D) – 41.2

8. In which of the following crystals alternative tetrahedral voids are occupied?
(A) $NaC\ell$ (B) ZnS (C) CaF_2 (D) Na_2O

Comprehension Type

This section contains 3 groups of question. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 9 and 10

The hydrogen like species Li^{+2} is in a spherically symmetric state S_1 with one radial node. Upon absorbing light the ion undergoes to transition to a state S_2. The state S_2 has one radial node and its energy is equal to the ground state of the H – atom

9. The state S_1 is:
(A) 1s (B) 2s (C) 2p (D) 3s

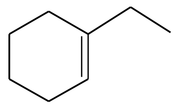
10. The orbital angular momentum quantum number of the state S_2 is ____________
(A) 0 (b) 1 (c) 2 (d) 3

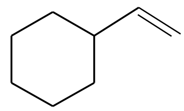
Rough Work

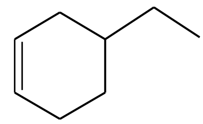
Paragraph for Question Nos. 11 and 12

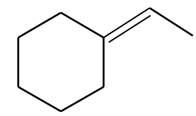
The stability of alkene depends upon the heat of hydrogenation and no. of hyper conjugative structures. Hydrogenation of alkene takes place with the help of catalyst (Like Ni, Pt etc).

11. In which of the following the reaction is most exothermic

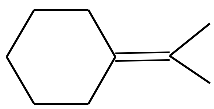
(A)


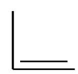
(B)


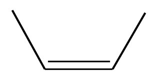
(C)


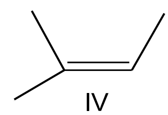
(D)


12. The relative rate of catalytic hydrogenation of following alkene is


I


II


III


IV

(A) II > III > IV > I
(B) I > IV > III > II
(C) III > IV > I > II
(D) II > IV > I > III

Paragraph for Question Nos. 13 and 14

In stereo isomerism, the isomers differ only in the spatial arrangement of groups about the central metal atom. It is of two types: (i) Geometrical isomerism. This isomerism arises in heteroleptic isomerism. This isomerism arises in heteroleptic complexes due to the difference in geometrical arrangement of the ligands around the central atom. (ii) Optical isomerism. This isomerism is shown by chiral molecules, i.e., the molecules which do not have plane of symmetry.

13. For the square planar complex [M (A) (B) (C) (D)] (where M = central metal and A, B, C and D are monodentate ligands), the number of possible geometrical isomers are

(A) 1
(B) 2
(C) 3
(D) 4

14. Which of the following will exhibit optical isomerism?

(A) $\left[Cr(en)(H_2O)_4\right]^{3+}$
(B) $\left[Cr(en)_3\right]^{3+}$
(C) $trans-\left[Cr(en)(Cl_2)(NH_3)_2\right]^{+}$
(D) $trans-\left[Cr(en)_2Cl_2\right]^{+}$

Rough Work

Multiple Correct Answer(s) Type

The section contains **6 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

15. In which of the crystal forms is $a = b \neq c$?
(A) tetragonal (B) hexagonal (C) orthorhombic (D) monoclinic

16. Sulphide ores include
(A) Cassiterite (B) Zinc blende (C) Iron pyrites (D) Galena

17. Find the correct statement among the following:
(A) In an antifluorite structure, cations are present in all tetrahedral voids
(B) If the radii of the anion and cation are 0.95pm and 0.35pm respectively, coordination number of cation is 4
(C) An atom or an ion is shifted from a lattice point to an interstitial position in a frenkel defect
(D) Density of a crystal always decreases in a point defect.

18. Which of the following is correct about the chemical equilibrium ?
(A) $(\Delta G^0)_{T.P} = 0$
(B)Eq. Constant is independent of initial concentration of reactants
(C)catalyst has no effect on equilibrium state
(D)reaction stops at equilibrium

19. Given that $\mathrm{Ni^{2+}/Ni = 0.25\ V}$, $\mathrm{Cu^{2+}/Cu = 0.34V}$, $\mathrm{Ag^{+}/Ag = 0.80V}$ and $\mathrm{Zn^{2+}/Zn = -0.76V}$ Which of the following reactions under standard condition will not take place in the specified direction?
(A) $\mathrm{Ni^{2+}(aq) + Cu(s) \rightarrow Ni(s) + Cu^{2+}(aq)}$
(B) $\mathrm{Cu(s) + 2Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)}$
(C) $\mathrm{Cu(s) + 2H^{+}(aq) \rightarrow Cu^{2+}(aq) + H_2(g)}$
(D) $\mathrm{Zn(s) + 2H^{+}(aq) \rightarrow Zn^{2+}(aq) + 3H_2(g)}$

20. Which among the following are diamagnetic?
(A) $\mathrm{Cu^{2+}}$ (B) $\mathrm{Zn^{2+}}$ (C) $\mathrm{Ag^{+}}$ (D) $\mathrm{Cu^{+}}$

Rough Work

Mathematics **Part – III**

Section – A

Single Correct Answer Type

This section contain 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. An equation of common tangent to parabola $y^2 = 8x$ and the hyperbola $3x^2 - y^2 = 3$ is $4x - 2y + \frac{k}{\sqrt{2}} = 0,$ then k is equal to

(A) $\sqrt{2}$ (B) $\sqrt{3}$ (C) $\sqrt{8}$ (D) $\sqrt{41}$

2. If $\overline{x}$ is the mean of 'n' observations $x_1, x_2, \ldots\ldots, x_n,$ then

(A) $\sum_{i=1}^{n}\left(x_i - \overline{x}\right) = 0$

(B) $\sum_{i=1}^{n}\left(x_i - \overline{x}\right) = n$

(C) $\overline{x}$ divides the observation $x_1, x_2, \ldots\ldots, x_n$ into two equal groups

(D) none of these

3. If $c_1 \equiv y = \frac{1}{1+x^2}$ and $c_2 \equiv y = \frac{x^2}{2}$ be two curve lying in XY plane. Then

(A) area bounded by curve $y = \frac{1}{1+x^2}$ and y = 0 is $\frac{\pi}{2}$

(B) area bounded by C_1 and C_2 is $\frac{\pi}{2} - 1$

(C) area bounded by C_1 and C_2 is $\frac{\pi}{2} - \frac{1}{3}$

(D) area bounded by curve $y = \frac{1}{1+x^2}$ and x-axis is $\frac{\pi}{2}$

Rough Work

4. The quadratic equations $x^2+\left(a^2-2\right)x-2a^2=0$ and $x^2-3x+2=0$ have
(A) no common root for all $a \in R$
(B) exactly one common root for all $a \in R$
(C) two common roots for some $a \in R$
(D) none

5. If one root of the equation $x^2-\lambda x+12=0$ is even prime, while $x^2+\lambda x+\mu=0$ has equal roots, then μ is
(A) 8 (B) 32 (C) 24 (D) 16

6. If $\begin{vmatrix} 1+x & x & x^2 \\ x & 1+x & x^2 \\ x^2 & x & 1+x \end{vmatrix} = ax^5+bx^4+cx^3+dx^2+ex+f$ then the value of $a-b-c+d$ is ________
(A) 0 (B) 1 (C) 4 (D) 3

7. The normal y = mx – 2am – am^3 to the parabola y^2 = 4ax subtends a right angle at the vertex if m equals to
(A) $\sqrt{2}$ (B) $\sqrt{3}$ (C) $\sqrt{8}$ (D) $\sqrt{41}$

8. Match the column I to column II

	COLUMN – I Line Equation		**COLUMN – II** It's Property
P	$\frac{x-2}{3}=\frac{y-7}{4}=\frac{z+5}{2}$	1	perpendicular to the plane 3x + 4y + 2z = 1
Q	$\frac{x+1}{3}=\frac{y-2}{4}=\frac{z-7}{2}$	2	passes through(2, 7, –5)
R	$\frac{x-5}{1}=\frac{y+2}{3}=\frac{z-2}{4}$	3	direction cosines are $\frac{2}{\sqrt{30}},\frac{5}{\sqrt{30}},\frac{1}{\sqrt{30}}$
S	$\frac{x-1}{2}=\frac{y+1}{5}=\frac{z+1}{1}$	4	lies in the plane 7x – y –z = 35

	P	Q	R	S
(A)	3	4	1	2
(B)	2	3	1	1
(C)	3	1	4	2
(D)	2	1	4	3

Rough Work

Comprehension Type

This section contains 3 groups of question. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 9 and 10

Let $A=\begin{pmatrix}1&0&0\\1&0&1\\0&1&0\end{pmatrix}$ satisfies $A^n = A^{n-2}+A^2-I, \text{for } n \ge 3$ and trace of a square matrix X is equal to the sum of elements in the principal diagonal. Further consider a matrix $U_{3\times3}$ with its column as U_1, U_2, U_3 such that $A^{50}U_1=\begin{pmatrix}1\\25\\25\end{pmatrix}; A^{50}U_2=\begin{pmatrix}0\\1\\0\end{pmatrix}; A^{50}U_3=\begin{pmatrix}0\\0\\1\end{pmatrix}$ then

9. Value of $|A^{50}|$ (Determinant of A^{50}) equals to ……….

(A) 0 (B) 1 (C) 3^{50} (D) 2^{50}

10. Trace of A^{50} equals to ….

(A) 0 (B) 1 (C) 2 (D) 3

Paragraph for Question Nos. 11 and 12

Let S_1 be the set of all those solutions of the equation $(1+a)\cos\theta\cos(2\theta-b)=(1+a\cos2\theta)\cos(\theta-b)$ which are independent of a and b and S_2 be the set of all such solutions which are dependent on a and b.

11. The sets $S_1 \; and \; S_2 \; are$

(A) $\{n\pi\} \; and \; \frac{1}{2}\{n\pi+(-1)^n sin^{-1}(a\sin b)\} \; n\in z$

(B) $\left\{\frac{n\pi}{2}\right\} and \; \{n\pi+(-1)^n sin^{-1}(a\sin b)\}, n\in z$

(C) $\left\{\frac{n\pi}{2}\right\} and \; \{n\pi+(-1)^n sin^{-1}\left(\frac{a}{2}sinb\right)\}, n\in z$

(D) none of these

Rough Work

12. Conditions that should be imposed on a and b such that S_2 is non-empty

(A) $\left|\frac{a}{2}Sin\, b\right| < 1$

(B) $\left|\frac{a}{2}Sin\, b\right| \le 1$

(C) $|a\sin b| \le 1$

(D) none of these

Paragraph for Question Nos. 13 and 14

If p_1, p_2, p_3 are altitudes of a triangle ABC from the vertices A, B, C respectively and Δ is the area of the triangle and s is semi perimeter of the triangle.

***On the basis of above information, answer the following questions*:**

13. If $\frac{1}{p_1}+\frac{1}{p_2}+\frac{1}{p_3}=\frac{1}{2}$, then the least value of $p_1p_2p_3$ is

(A) 8 (B) 27 (C) 125 (D) 216

14. The value of $\frac{\cos A}{p_1}+\frac{\cos B}{p_2}+\frac{\cos C}{p_3}$ is

(A) $\frac{1}{r}$ (B) $\frac{1}{R}$ (C) $\frac{a^2+b^2+c^2}{2R}$ (D) $\frac{1}{\Delta}$

Rough Work

Multiple Correct Answer(s) Type

The section contains **6 multiple choice question.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

15. Let a, b, c be the lengths of the sides of a triangle ABC such that $b+c \neq 1, c-b \neq 1.$ *If* $\log_{b+c} a + \log_{c-b} a = 2\log_{c+b} a.\log_{c-b} a$ *then*

(A) $sin^2 A + sin^2 B = sin^2 C$
(B) $\tan A + \tan B = 1$
(C) $A + B = C$
(D) $cos^2 A + cos^2 B = 1$

16. Given that $0 < x < \frac{\pi}{4}$ and $\frac{\pi}{4} < y < \frac{\pi}{2}$ and $\sum_{k=0}^{\infty}(-1)^k \tan^{2k} x = a, \sum_{k=0}^{\infty}(-1)^k \cot^{2k} y = b,$ then $\sum_{k=0}^{\infty}\tan^{2k} x \cot^{2k} y$ is

(A) $\frac{1}{a}+\frac{1}{b}-\frac{1}{ab}$
(B) a + b – ab
(C) $\frac{1}{\frac{1}{a}+\frac{1}{b}-\frac{1}{ab}}$
(D) $\frac{ab}{a+b-1}$

17. If in $\Delta ABC,\ a^4+b^4+c^4 = 2a^2\left(b^2+c^2\right),$ then $\angle A$ is equal to

(A) 45°
(B) 60°
(C) 90°
(D) 135°

18. A plane meets the coordinate axes in A, B, C such that the centroid of the triangle ABC is the point $(1, r, r^2)$. The plane passes through the point (4, –8, 15) if r is equal to

(A) –3
(B) 3
(C) 5
(D) –5

19. The lines $\frac{x-2}{1}=\frac{y-3}{1}=\frac{z-4}{-k}$ and $\frac{x-1}{k}=\frac{y-4}{2}=\frac{z-5}{1}$ are coplanar if

(A) k =0
(B) k = –1
(C) k = 2
(D) k = –3

20. Let $\vec{A}$ be vector parallel to line of intersection of plane P_1 and P_2 through origin. P_1 is parallel to the vectors $2\hat{i}+3\hat{k}$ and $4j-3\hat{k}$ and P_2 is parallel to $\hat{j}-\hat{k}$ and $3\hat{i}+3\hat{j}$, then the angle between vector $\vec{A}$ and $2\hat{i}+\hat{j}-2\hat{k}$ is

(A) $\frac{\pi}{2}$
(B) $\frac{\pi}{4}$
(C) $\frac{\pi}{6}$
(D) $\frac{3\pi}{4}$

Rough Work