FIITJEE - JEE (Mains)

PHYSICS, CHEMISTRY & MATHEMATICS
BATCHES: Two Year CRP (1719) (B-LOT)
PHASE TEST-II

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

PART – I

Straight Objective Type

This part contains **30 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

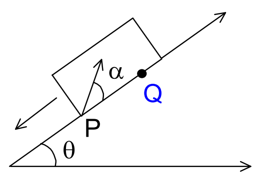
1. An object of mass m is thrown vertically upwards in air with an initial speed v_0. The air applies a drag force which is proportional to the instantaneous velocity of the particle in the opposite direction of the motion of ball. Then the time it takes to reach maximum height above ground is [v_T = mg/c] $\left[\vec{F} = -c\left(\vec{v}\right)\right]$

   (A) $\frac{v_T}{g}\ln\left[1-\frac{v_0}{g}\right]$ (B) $\frac{v_T}{g}\ln\left[1+\frac{v_0}{v_T}\right]$ (C) $\frac{v_T}{2g}\ln\left[1+\frac{2v_0}{v_T}\right]$ (D) $\frac{v_T}{g}\ln\left[1+\frac{2v_0}{v_T}\right]$

2. An object of mass m is thrown in air with an initial speed v_0 at an angle θ with horizontal. It experiences an air drag force also $\left[\vec{F} = -c\left(\vec{v}\right)\right]$ where c is a constant. Then the horizontal velocity of the projectile after time t is

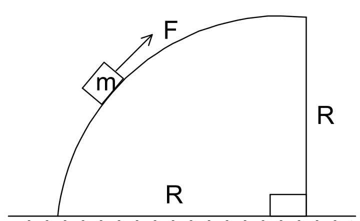
   (A) $v_x = v_0\cos\theta$ (B) $v_x = v_0\cos\theta e^{-\frac{ct}{2m}}$ (C) $v_x = v_0\cos\theta e^{-\frac{2ct}{m}}$ (D) $v_x = v_0\cos\theta e^{-\frac{ct}{m}}$

3. A large heavy box is sliding without friction down a smooth plane of inclination θ = 30°. From a point P on the bottom of the box, a particle is projected inside the box. The initial speed of the particle with respect to the box is v = 10 m/s and the direction of projection makes any angle α with the bottom as shown in the figure. Find the maximum distance along the bottom of the box between the point of projection P and the point Q where the particle lands. (Assume that the particle does not hit any other surface of the box. Neglect air resistance) ($g = 10\ m/s^2$)



   (A) $\frac{5}{\sqrt{3}}$m (B) $\frac{10}{\sqrt{3}}$m (C) $\frac{20}{\sqrt{3}}$m (D) $10\sqrt{3}$ m

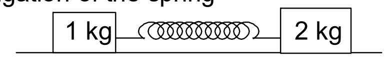
4. An object of mass m is taken up on a quarter – circular path as shown in the figure, by a variable tangential force F such that its speed is always constant. The coefficient of kinetic friction between the block and track is μ_k. Then the magnitude of work done by kinetic friction in taking the block up the plane is



   (A) $\mu_k$mgR (B) greater then $\mu_k$mgR
   (C) smaller than $\mu_k$mgR (D) $\sqrt{2}\mu_k$mgR

Space For Rough Work

5. Two blocks of masses 1 kg and 2 kg are connected by an upstretched spring of constant k = 10 N/m. If the block of mass 1 kg is pulled by a force of 3 N and the block of mass 2 kg is pushed by a force of 6 N. Then find the maximum elongation of the spring

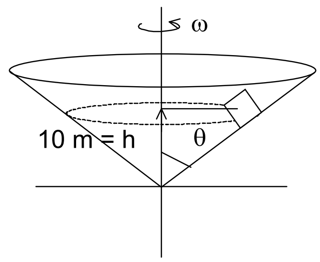


(A) 0.8 m (B) 0.4 m (C) 0.2 m (D) zero

6. A ball of mass 10 kg is dropped onto a floor from a height h = 5 m. The collision between ball and the floor are completely elastic. The average value of force exerted by the ball on the floor during a long interval of time is ($g = 10\ m/s^2$)

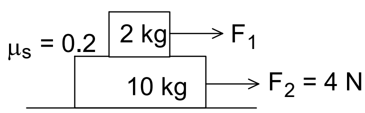
(A) 20 N (B) 40 N (C) 50 N (D) 100 N

7. A body of mass m = 5 kg placed inside a hollow cone, rotating with an angular velocity ω as shown in figure. What is the range of ω for which the block neither slips up nor skids down. (Given the coefficient of static friction between the cone & block is 0.4) $[h = 10\ m\ \&\ \tan\theta = 2]$



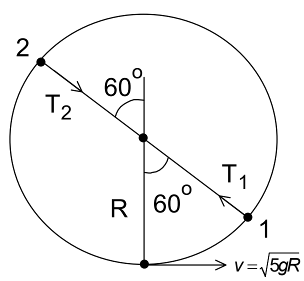
(A) $0.104 < \omega < 0.204$ (in rad/sec) (B) $0.204 < \omega < 0.5$ (in rad/sec)
(C) $0.204 < \omega < 0.75$ (in rad/sec) (D) $0.104 < \omega < 0.5$ (in rad/sec)

8. A 2 kg block is placed over a 10 kg block and both are placed over smooth horizontal surface. The coefficient of static friction between the blocks is 0.2. Find the minimum value of F_1 such that sliding starts between the blocks



(A) 5.6 N (B) 4.6 N (C) 2.4 N (D) 4 N

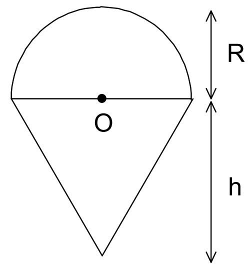
9. A ball of mass m is swinging in a vertical circle with its initial velocity at bottom as $v = \sqrt{5gR}$. Then the value of $T_1 + T_2$ will be



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

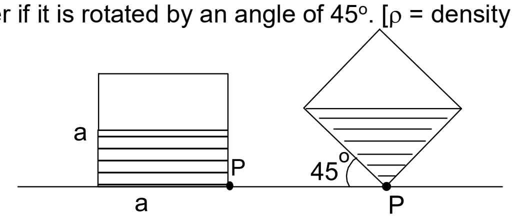
Space For Rough Work

10. In a softy, ice-cream is completely filled in a cone of height h with hemi-spherical portion of radius R over it, find the ratio of $\frac{h}{R}$ such that centre of mass of the system remains at O. Assume uniform density of ice – cream & material of cone



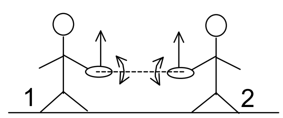
(A) $\sqrt{3}$ (B) $\sqrt{2}$ (C) $\sqrt{\frac{3}{4}}$ (D) $\sqrt{\frac{3}{2}}$

11. A cube of side 'a' half-filled with water is hinged at point P as shown in the figure. Find the change in potential energy of the water if it is rotated by an angle of 45°. [ρ = density of water]



(A) $\rho g\frac{a^4}{4}$ (B) $\left(2\sqrt{2}-3\right)\rho g\frac{a^4}{24}$ (C) $\left(2\sqrt{3}-2\right)\rho g\frac{a^4}{24}$ (D) $\left(4\sqrt{2}-3\right)\rho g\frac{a^4}{24}$

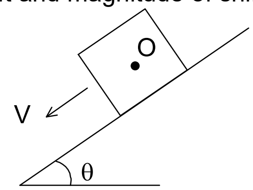
12. Two players toss two coins up with $v_{cm/1} = 4\ m/s$ and $v_{cm/2} = 2\ m/s$ and $\omega_1 = 2\ rad/s$ and $\omega_2 = 4\ rad/\sec$. The angular velocity of coins is about the horizontal axis parallel to ground and passing through centre of each coin. Find the ratio of their maximum height reached from the tossing hand positon. $\left(find\ \frac{h_1}{h_2}\right)$ [M_{coin} = 0.1 kg, g = 10 m/s^2, R_{coin} = 10 cm) [h_1 & h_2 are maximum height attained by COM of coins]



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

Space For Rough Work

13. A cubical block of mass 'm' and edge 'a' slides down a rough inclined plane of inclination θ with a uniform speed. Find the direction of shift and magnitude of shift of normal reaction from O on cube



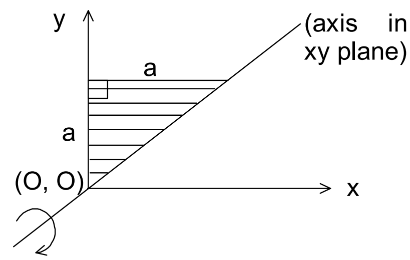
(A) N shifts up the plane by $\frac{a\cot\theta}{2}$

(B) N shifts up the plane by $\frac{a\tan\theta}{2}$

(C) N shifts down the plane by $\frac{a\tan\theta}{2}$

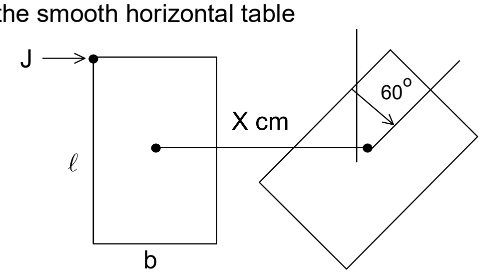
(D) N shifts down the plane by $\frac{a\cot\theta}{2}$

14. A right angled triangular plate is kept in x – y plane as shown in the figure. Find the moment of inertia of the plate about its diagonal in the x – y plane. [M = mass of plate]



(A) $\frac{Ma^2}{12}$ (B) $\frac{Ma^2}{6}$ (C) $\frac{Ma^2}{3}$ (D) $\frac{2Ma^2}{3}$

15. A student hits his cell phone at its corner imparting an impulse J to it. Assuming the cell phone to be a thin uniform rectangular plate of mass M with length ℓ and breadth b. Find the distance moved by its COM till it rotates by 60° on the smooth horizontal table



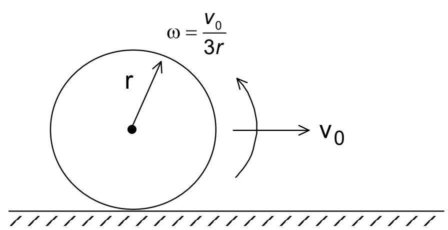
(A) $\frac{\pi}{18L}\left(\ell^2+b^2\right)$ (B) $\frac{\pi\left(\ell^2+b^2\right)}{36L}$ (C) $\frac{\pi\left(\ell^2+b^2\right)}{9L}$ (D) $\frac{\pi\left(\ell^2+b^2\right)}{6L}$

Space For Rough Work

16. A solid sphere of mass m rolls down without slipping on an inclined plane of inclination $\theta = \tan^{-1}\left(\frac{1}{2}\right)$.
Choose the value of friction μ for which there be rolling with slipping on the inclined plane.
(A) $\mu = \frac{3}{14}$ (B) $\mu = \frac{3}{8}$ (C) $\mu = \frac{3}{20}$ (D) $\mu = \frac{1}{8}$

17. A ring of radius R and mass M is rolling on a rough horizontal surface. It is pulled by a horizontal force F acting tangentially from the highest point. Find the value of friction acting on the ring. [R = 1 m, F = 5 N, M = 2 kg, μ_s = 0.2 & μ_k = 0.18]
(A) 0 (B) 0.5 N (C) 1.5 N (D) 2.5 N

18. A disc of mass M and radius r slips on a rough horizontal plane. At some instant of time, it has translational velocity v_0 and rotational velocity $\omega = \frac{v_0}{3r}$. Find the translational velocity of the disc after it starts pure rolling.



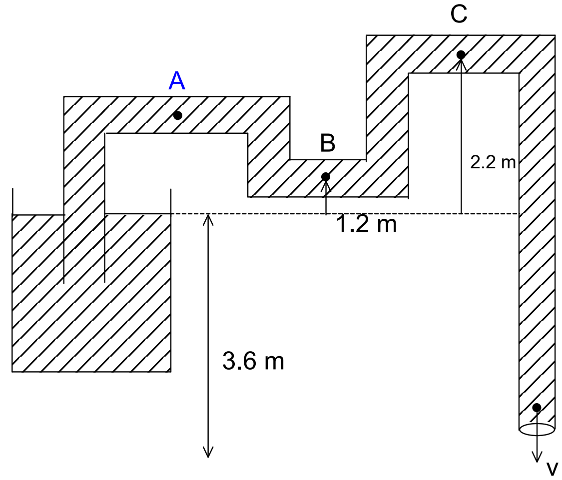
(A) $\frac{v_0}{3}$ (B) $\frac{3v_0}{5}$ (C) $\frac{5v_0}{9}$ (D) $\frac{3v_0}{7}$

19. An air sealed spherical tank of 1.2 m radius is half filled with oil of relative density 0.8. If the tank is given a horizontal acceleration of 10 m/s^2. The maximum pressure at any point on the tank is [Assume near vaccum condition]
(A) $4800\sqrt{2}$ N/m^2 (B) 4800 N/m^2 (C) $9600\sqrt{2}$ N/m^2 (D) 9600 N/m^2

20. A solid ball of density half that of water falls freely under gravity from a height of 19.6 m and then enters water. Find the depth till which ball goes inside water?
(A) 4.9 m (B) 19.6 m (C) 24.5 m (D) 9.8 m

Space For Rough Work

21. A siphon has a uniform circular base of diameter $\frac{8}{\sqrt{\pi}}cm$ with its outlet 3.6 m below the horizontal level. The efflux velocity v and the absolute pressure of point A. [g = 10 m/s^2]



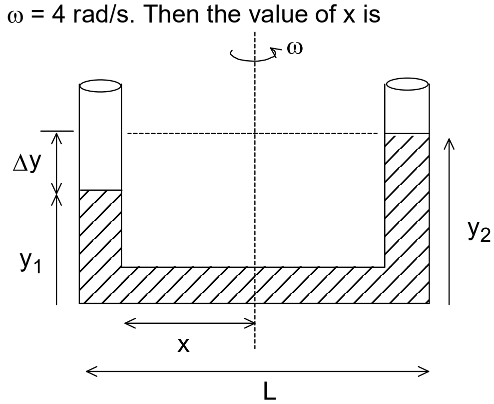
(A) $v = \sqrt{6}$ m/s & $P_A = 4.5 \times 10^4$ N/m^2

(B) $v = 6\sqrt{2}$ m/s & $P_A = 5.2 \times 10^4$ N/m^2

(C) $v = \sqrt{72}$ m/s & $P_A = 4.2 \times 10^4$ N/m^2

(D) $v = \sqrt{72}$ m/s & $P_A = 4.6 \times 10^4$ N/m^2

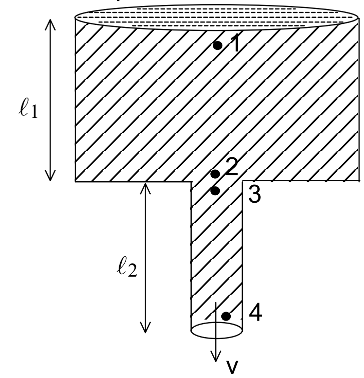
22. An U-shaped tube contains a liquid of density ρ and it rotates about an axis as shown in the figure. Given L = 2 m, Δy = 1.6 m & ω = 4 rad/s. Then the value of x is



(A) 0.25 m (B) 0.5 m (C) 0.75 m (D) 1 m

Space For Rough Work

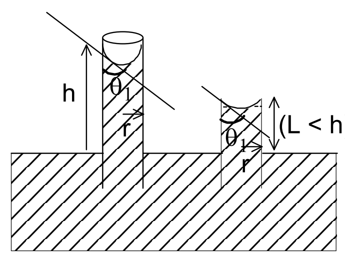
23. A cylindrical funnel containing any liquid to height ℓ_1 in the top part and the funnel pipe length is ℓ_2 as shown in figure. The funnel is open to atmosphere. Then



(A) $P_1 = P_0$ is minimum pressure in the system
(B) $P_2 = P_0 + \rho g\ell_1$ is maximum pressure in the system
(C) $P_3 = P_0 = \rho g\ell_1$ is the maximum pressure in the system
(D) $P_4 = P_0 + \rho g\ell_1 + \rho g\ell_2$ is the maximum pressure in the system

24. A capillary tube of inner radius r having sufficient length is slightly dipped in a liquid in vertical position. If the angle of contact between the tube and the liquid is θ, then the radius of meniscus is
(A) $r\cos\theta$ (B) $r\sin\theta$ (C) $r\sec\theta$ (D) $r\tan\theta$

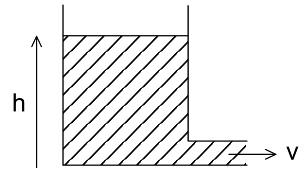
25. Two capillary tubes of same radius are dipped vertically in a liquid as shown in figure. The height of second tube is L (< h). The liquid rises to a height h in the first tube. Then choose the correct statement. [θ_1 & θ_2 are contact angles of liquid in tube 1 & 2, R_1 & R_2 are radius of meniscus in tube 1 & 2]

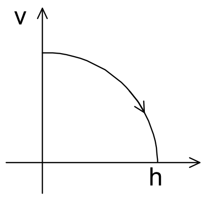


(A) $R_1h = R_2L$ & $R_1\cos\theta_1 = R_2\cos\theta_2$
(B) $R_1L = R_2h$ & $R_1\cos\theta_1 = R_2\cos\theta_2$
(C) $R_1h = R_2L$ & $\frac{R_1}{\cos\theta_1} = \frac{R_2}{\cos\theta_2}$
(D) $R_1L = R_2h$ & $\frac{R_1}{\cos\theta_1} = \frac{R_2}{\cos\theta_2}$

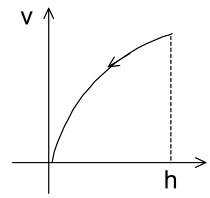
Space For Rough Work

26. A rectangular tank is filled completely with water to a height h. A small hole at its bottom is unplugged. The graph between the velocity of efflux (through a small hole) vs height of water h from the base of the tank.

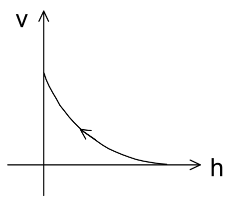




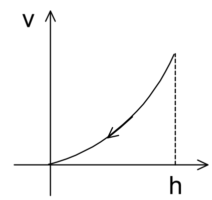
(A)



(B)



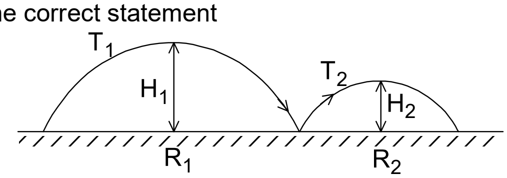
(C)



(D)

27. A raindrop reaching the ground with terminal velocity has kinetic energy K. Another raindrop of twice the radius, also reaching the ground with terminal velocity, will have kinetic energy
(A) 4 K (B) 128 K (C) 16 K (D) 32 K

28. A projectile is thrown from horizontal ground, it strikes the ground and rebounds as shown in the figure. T = time of flight, R = range of projectile & H = maximum height above ground. If e = coefficient of restitution then choose the correct statement



(A) $R_2 = eR_1,\ T_2 = eT_1\ \&\ H_2 = eH_1$

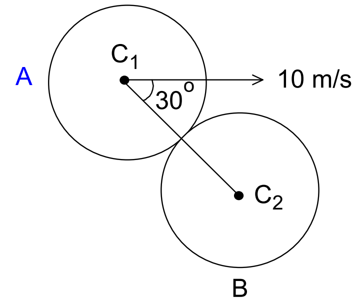
(B) $R_2 = eR_1,\ T_2 = \frac{T_1}{e}\ \&\ H_2 = e^2H_1$

(C) $R_2 = eR_1,\ T_2 = eT_1\ \&\ H_2 = eH_1$.

(D) $R_2 = eR_1,\ T_2 = eT_1\ \&\ H_2 = e^2H_1$

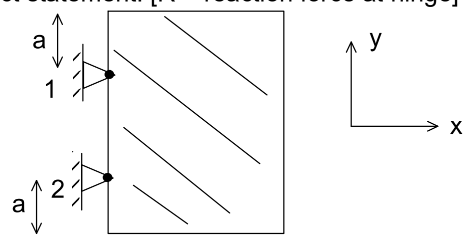
Space For Rough Work

29. A ball 'A' collides elastically with an another identical ball B with velocity 10 m/s at an angle of 30° from the line joining their centres C_1 & C_2. Select the correct statement



(A) velocity of ball A after collision is 4 m/s
(B) velocity of ball A after collision is 5 m/s
(C) velocity of ball B after collision is $3\sqrt{5}$ m/s
(D) velocity of ball B after collision is $4\sqrt{3}$ m/s

30. A window frame is hinged symmetrically from two hinges 1 & 2. The frame is free to rotate about Y axis. Then choose the incorrect statement. [R = reaction force at hinge]



(A) R_1y & R_2y are in +y direction
(B) R_1x is in +x direction & R_2x is in −x direction
(C) R_1x is in −x direction & R_2x is in +x direction
(D) $R_{1/net}$, $R_{2/net}$ & mg passes through C.O.M of the frame

Space For Rough Work

Mathematics

PART – III

Straight Objective Type

This part contains 30 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. The curve represented by the equation

$$\frac{x^2}{Sin\sqrt{2}-Sin\sqrt{3}}+\frac{y^2}{Cos\sqrt{2}-Cos\sqrt{3}}=1 \text{ is}$$

(A) An ellipse with the foci on the x-axis (B) A hyperbola with the foci on the x-axis
(C) An ellipse with the foci on the y-axis (D) A hyperbola with the foci on the y-axis

2. Assume that $M=\{(x,y)\,|\,x^2+2y^2=3\}$, and $N=\{(x,y)\,|\,y=mx+b\}$. If $M\cap N\neq\varnothing$ for all $m\in R$, then b takes values

(A) $\left[\frac{-\sqrt{6}}{2},\frac{\sqrt{6}}{2}\right]$ (B) $\left(\frac{-\sqrt{6}}{2},\frac{\sqrt{6}}{2}\right)$ (C) $\left(\frac{-\sqrt{6}}{2},\frac{\sqrt{6}}{2}\right]$ (D) $\left[\frac{-2\sqrt{3}}{3},\frac{2\sqrt{3}}{3}\right]$

3. Let $f(x)=ax^2+bx+c, a\neq 0$ and Δ = b^2-4ac. If $\alpha+\beta, \alpha^2+\beta^2$ and $\alpha^3+\beta^3$ are in G.P, then

(A) $\Delta\neq 0$ (B) $b\Delta=0$ (C) $c\Delta=0$ (D) $bc\neq 0$

4. The Value of $(0.16)^{\log_{(2.5)}\left(\frac{1}{3}+\frac{1}{3^2}+\frac{1}{3^3}+...\infty\right)}$ is

(A) 3 (B) 4 (C) 5 (D) None

5. If $ax^2+2bx-3c=0$ has no real roots and $\frac{3c}{4}<a+b$ then range of c is

(A) $(-1,1)$ (B) $(0,1)$ (C) $(0,\infty)$ (D) $(-\infty,0)$

6. The locus of the point P from which two tangents PA and PB touches a parabola at A and B such that AB subtend a right angle at the vertex is

(A) pair of lines (B) circle (C) parabola (D) A straight line

7. If the normal at an end of a latus-rectum of an ellipse passes through an end of the minor-Axis, then e^4+e^2 equals to

(A) $\frac{1}{2}$ (B) $\frac{3}{4}$ (C) 2 (D) None

Space For Rough Work

8. Let α, β be the roots of the equation $x^2 - px + r = 0$ and $\frac{\alpha}{2}, 2\beta$ be the roots of the equation $x^2 - qx + r = 0$ then the value of r is

(A) $\frac{2}{9}(p-q)(2q-p)$
(B) $\frac{2}{9}(q-p)(2p-q)$
(C) $\frac{2}{9}(q-2p)(2q-p)$
(D) $\frac{2}{9}(2p-q)(2q-p)$

9. If a,b,c are real numbers such that $0<a<1, 0<b<1$ and $0<c<1$ such that $a+b+c=2$ then the maximum value of $\frac{a}{1-a}.\frac{b}{1-b}.\frac{c}{1-c}$ is

(A) 8
(B) 1
(C) $\frac{27}{8}$
(D) None

10. A hyperbola, having the transverse axis of length 2Sinθ, is confocal with the ellipse $3x^2 + 4y^2 = 12,$ then its equation is

(A) $x^2 Co\sec^2\theta - y^2 Sec^2\theta = 1$
(B) $x^2 S\text{ec}^2\theta - y^2 Cosec^2\theta = 1$
(C) $x^2 Sin^2\theta - y^2 Cos^2\theta = 1$
(D) $x^2 Cos^2\theta - y^2 Sin^2\theta = 1$

11. If $2x^3 + ax^2 + bx + 4 = 0$ (a and b are positive real numbers) has three real roots, then

(A) $a \ge 4(2)^{\frac{1}{3}}$
(B) $a \ge (2)^{\frac{1}{3}}$
(C) $a \ge 6(2)^{\frac{1}{3}}$
(D) $a \ge 2(2)^{\frac{1}{3}}$

12. The product of the positive roots of the equation $\sqrt{2018}x^{\log_{2018}x} = x^3$

(A) 2018
(B) 1009
(C) $(2018)^2$
(D) None

13. The $x^4 + 15x^2 + 7x - 11 = 0$ has

(A) No real roots
(B) Two negative real roots
(C) Two positive real roots
(D) One negative and one positive real roots

14. The focal chord to $y^2 = 16x$ is tangent to $(x-6)^2 + y^2 = 2,$ then the possible values of the slope of this chord are

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

Space For Rough Work

15. Let $t_n = \sum_{n=1}^{n} n(n+1)$ then $\lim_{n\to\infty}\sum_{i=1}^{n}(\frac{1}{t_i})$ equals to

(A) $\frac{1}{6}$ (B) $\frac{1}{12}$ (C) $\frac{1}{3}$ (D) None

16. If the roots of the equation $x^2+ax+b=0$ are c and d then one root of the equation $x^2+c(2x+c)+\mathrm{a(x+c)}+\mathrm{b}=0$ is

(A) c (B) d-c (C) 1 (D) d^2+c^2

17. If x,y,z are in G.P and $a^x=b^y=c^z$ then

(A) $\log_b a=\log_a c$ (B) $\log_c b=\log_a c$

(C) $\log_b a=\log_c b$ (D) $\log_x a=\log_y b=\log_z c$

18. The number of common tangents between two hyperbola $\frac{x^2}{16}-\frac{y^2}{9}=1$ and $\frac{x^2}{9}-\frac{y^2}{16}=-1$ is

(A) 0 (B) 1 (C) 2 (D) 4

19. Let a,b,c,d be positive integers and $\log_a b=\frac{3}{2},\log_c d=\frac{5}{4}.$ if $a-c=9,$ then $b-d$ is equal to

(A) 39 (B) 63 (C) 93 (D) None

20. Suppose points F_1 & F_2 are the foci of the ellipse $\frac{x^2}{9}+\frac{y^2}{4}=1,$ P is a point on the ellipse, and $PF_1:PF_2=2:1.$ Then the area of ΔPF_1F_2 is equal to

(A) 2 (B) 4 (C) $4\sqrt{5}$ (D) $2\sqrt{5}$

21. 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 maximum value of ab, is

(A) 4 (B) 2 (C) 1 (D) None of these

Space For Rough Work

22. Three positive distinct number x,8,z are three terms of G.P in an order and the numbers $x+8, 8+z, z+x$ are three terms of an A.P in that order, if $x^8 8^z z^x = kx^x z^z$ then the largest prime number which divides k is
(A) 27 (B) 13 (C) 11 (D) None

23. If a,b,c are real numbers satisfying the equation $9(25a^2+c^2)+25b^2-15(5ab+bc+3ca)=0$ then a,b,c are in
(A) A.P (B) H.P (C) G.P (D) None

24. Let $y=(x+2)^5(7-x)^4$ where $x \in (-2,7)$. The maximum value of y is $a^a b^b$ then $\left|\frac{a+b}{a-b}\right|$ equals to
(A) $\frac{5}{9}$ (B) $\frac{9}{5}$ (C) $\frac{1}{9}$ (D) 9

25. An ellipse and hyperbola are confocal and conjugate axis of hyperbola is equal to minor axis of ellipse. If e_1 and e_2 are eccentricities of the ellipse and hyperbola the $\frac{1}{e_1^2}+\frac{1}{e_2^2}$ equals to
(A) 3 (B) 2 (C) 5/2 (D) none

26. a,b,c,d,e are integers such that a,b,c form an AP and b,c,d form a G.P and c,d,e form a H.P. If $a=2, e=18$ and d<0 then c=
(A) 6 (B) -6 (C) 8 (D) -10

27. The straight line $\frac{x}{4}+\frac{y}{3}=1$ intersects the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ at two points A & B. There is a point P on this ellipse such that the area of ΔPAB is equal to 3. How many such point/points P are there?
(A) 1 (B) 2 (C) 3 (D) 4

28. Consider a curve $ax^2+2hxy+by^2=1$ and a point P not on the curve. A line drawn from P intersects the curve at points Q and R. If the product PR.PQ is independent of the slope of the line, then the curve is
(A) parabola (B) circle (C) ellipse (D) hyperbola

29. The solution set of the inequality $\sqrt{\log_2 x - 1} + \frac{1}{2}\log_{\frac{1}{2}} x^3 + 2 > 0$ is
(A) [2,3) (B) (2,3] (C) [2,4) (D) (2,4]

30. Locus of centre of circle touching two given unequal intersecting circles externally is
(A) parabola (B) ellipse (C) hyperbola (D) none

Space For Rough Work

FIITJEE COMMON TEST

BATCHES: Two Year CRP (1719) (B-LOT)

PHYSICS, CHEMISTRY & MATHEMATICS

JEE MAIN-PHASE-II

ANSWER KEY

PART – I (PHYSICS)		PART – II (CHEMISTRY)		PART – III (MATHEMATICS)	
1.	B	1.	B	1.	C
2.	D	2.	C	2.	A
3.	C	3.	B	3.	C
4.	C	4.	C	4.	B
5.	D	5.	A	5.	D
6.	D	6.	B	6.	D
7.	C	7.	B	7.	D
8.	A	8.	A	8.	D
9.	C	9.	B	9.	A
10.	A	10.	D	10.	A
11.	D	11.	A	11.	C
12.	C	12.	D	12.	D
13.	C	13.	B	13.	D
14.	A	14.	C	14.	A
15.	A	15.	A	15.	D
16.	D	16.	B	16.	B
17.	A	17.	B	17.	C
18.	C	18.	B	18.	D
19.	C	19.	B	19.	C
20.	B	20.	B	20.	B
21.	D	21.	D	21.	A
22.	B	22.	B	22.	D
23.	B	23.	A	23.	A
24.	C	24.	D	24.	D
25.	A	25.	A	25.	B
26.	B	26.	C	26.	B
27.	B	27.	D	27.	B
28.	D	28.	A	28.	B
29.	B	29.	D	29.	C
30.	B	30.	C	30.	C

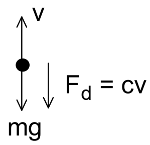
FIITJEE COMMON TEST

BATCHES: Two Year CRP (1719) (B-LOT)

JEE MAIN-PHASE-II

HINTS & SOLUTIONS - PHYSICS

1. $a = -g - \frac{c}{m}v$



$$\frac{dv}{dt} = -g - \frac{cv}{m}$$

$$\int_{v_0}^{0} \frac{dv}{-g - \frac{cv}{m}} = \int_0^{tup} dt$$

On solving we get $tup = \frac{v_T}{g}\ln\left[1 + \frac{v_0}{v_T}\right]$

2.

$$\frac{md\vec{v}}{dt} = m\vec{g} - c\vec{v}$$

$$or\ m\left[\frac{dv_x}{dt}\hat{i} + \frac{dv_y}{dt}\hat{j}\right] = -mg\hat{j} - c\left[v_x\hat{i} + v_y\hat{j}\right]$$

Taking x components only, we get

$$\frac{dv_x}{dt} = -g\frac{v_x}{v_T}\left[\frac{mg}{c} = v_T\right]$$

$$\int_{v_0\cos\theta}^{v} \frac{dv_x}{v_x} = -\frac{g}{v_T}\int_0^t dt$$

On solving we get $v = v_0 \cos\theta\, e^{-\frac{gt}{m}}$

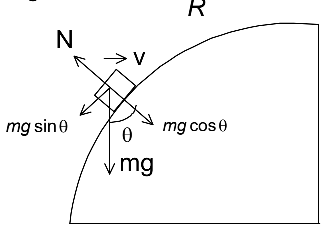
3.

$\vec{a}$ ball/box = $g\cos\theta$ ⊥r to inclined plane.

$\therefore R_{PQ} = \frac{u^2 \sin 2\alpha}{g\cos\theta}$ will be maximum when $2\alpha = 90^o$

$$\therefore \frac{R_{PQ}}{\max} = \frac{u^2}{g\cos\theta} = \frac{20}{\sqrt{3}}$$

4. $mg\cos\theta - N = \frac{mv^2}{R}$



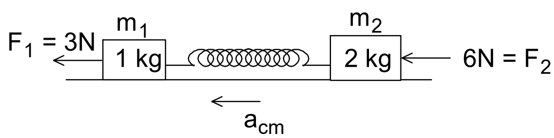
$$\therefore N = mg\cos\theta - \frac{mv^2}{R}$$

$$\therefore W.D_f = -\int \mu_k \, N.dr = -\left[\mu_k mg \int \cos\theta dr - \frac{mv^2}{R}\int dr\right]$$

$$\left|W.D_f\right| = \mu_k mgR - \frac{mv^2}{R}.\frac{\pi R}{2}$$

$$W.D_f = \mu_k mgR - \frac{mv^2\pi}{2}$$

5. $$a_{cm} = \frac{F_1 + F_2}{m_1 + m_2}$$



From centre of mass frame, we calculate net force on m_1 & m_2
Applying W.E theorem & solving we get

$$x_1 + x_2 = \frac{2(m_2F_1 - m_1F_2)}{k(m_1 + m_2)} = 0$$

6. $$N = \frac{\Delta p}{\Delta t} = \frac{2m\sqrt{2gh}}{\Delta t}$$

$$N_{abg}(cycle) = \frac{\int Ndt}{T_{cycle}} = \frac{2m\sqrt{2gh}}{2\sqrt{\frac{2h}{g}}}$$

$$= mg$$

7. For banking with friction

$$\sqrt{\frac{gR(\mu - \tan\theta)}{(1+\mu\tan\theta)}} \le v \le \sqrt{\frac{gR(\mu + \tan\theta)}{(1-\mu\tan\theta)}}$$

Put $90^o - \theta$ for cone & use v = ωr & $\tan\theta = \frac{r}{h}$

$0.204 \le \omega \le 0.5$

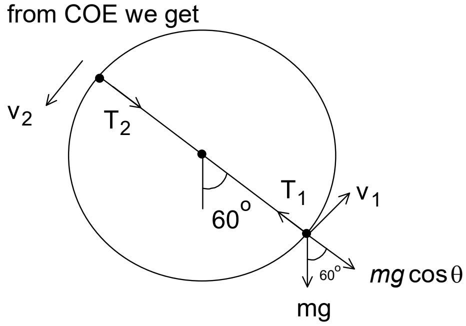
8.

$$a_{10/\max} = \frac{8}{10} = 0.8$$

$$\therefore F_1 - 4 = 2 \times 0.8$$

$$F_1 = 4 + 1.6 = 5.6\,N$$

9. from COE we get

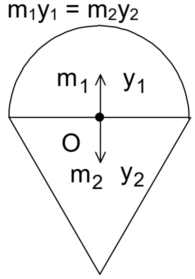


$v_1 = \sqrt{4gR}$ & $v_2 = \sqrt{2gR}$

$T_1 = 4.5\,mg$ & $T_2 = 1.5\ mg$

10. for COM to remain at O

$m_1y_1 = m_2y_2$

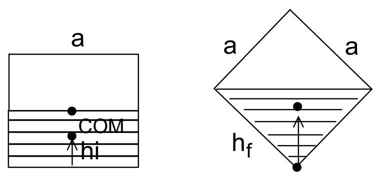


$$\frac{\rho 2\pi R^3}{3}.\frac{3R}{8} = \frac{\rho.\pi R^2.h}{3}.\frac{h}{4}$$

$$3R^2 = h^2$$

$$\sqrt{3}\,R = 4$$

11.



$$hi = \frac{a}{4} \qquad h_f = \left(\frac{\sqrt{2}}{3}\right)a$$

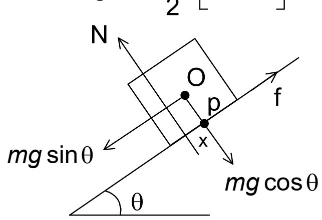
$$\Delta PE = mg\left(h_f - h_i\right) = \frac{\rho V}{2}g\left(\frac{\sqrt{2}a}{3} - \frac{a}{4}\right)$$

$$= \frac{\rho a^3}{2}ga\left(\frac{4\sqrt{2}-3}{12}\right)$$

12. $$\frac{h_1}{h_2} = \frac{v_1^2}{2g\left(\frac{v_2^2}{2g}\right)} = \left(\frac{v_1}{v_2}\right)^2 = \left(\frac{4}{2}\right)^2 = 4$$

Note both coins will keep rotating with constant angular velocity in their motion, since the torque due to only force present mg is zero about axis of rotation.

13. $N.x = mg\sin\theta\frac{a}{2}$ $\left[\vec{\tau}_P = 0\right]$



$$Mg\cos\theta\ x = Mg\sin\theta\frac{a}{2}$$

$$\therefore\ x = \frac{a\tan\theta}{2}$$

14. We know for square plate of mass 2 M

$I_{x'} = I_{y'} = \frac{(2M)a^2}{12}$

If we cut the square plate there is symmetry about diagonal axis

$2I_{x'} = \frac{2Ma^2}{12}$

$I_{x'} = \frac{Ma^2}{12}$

15. $F\Delta t = Mv_{cm} \quad (I)$

$F\frac{\ell}{2}\Delta t = \frac{M(\ell^2 + b^2)\omega}{12} \quad (II)$

Equation (II) ÷ (I), we get

$\frac{\ell}{2} = \frac{\omega(\ell^2 + b^2)}{12v_{cm}}$

Now $\theta = \omega t$ (III)

& $x_{cm} = v_{cm}.t$ (IV)

$\therefore x_{cm} = v_{cm}\frac{\theta}{\omega} = \frac{(\ell^2 + b^2)}{6\ell}\frac{\pi}{3} = \frac{\pi(\ell^2 + b^2)}{18\ell}$

16. $mg\sin\theta - f = ma_{cm}$ (I)

$f.R = \frac{2}{5}mR^2\alpha$ (II)

condition of rolling $a_{cm} = \alpha R$

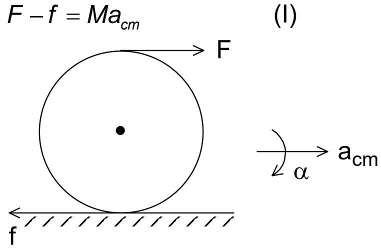
also $f < \mu N$ on solving, we get

$\mu > \frac{2}{7}\tan\theta$

Or $\mu > \frac{1}{7}\left(\tan\theta = \frac{1}{2}\right)$

$\therefore$ D is incorrect

17. $F - f = Ma_{cm}$ (I)



$(f + F)R = MR^2.\alpha$ (II)

& $a_{cm} = \alpha R$ (III)

$\therefore$ On solving we get

f = 0

18. Since all three forces pass through bottom most point.

$\therefore \tau_{p/net} = 0$

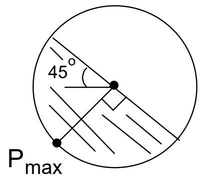
Or $L_i = L_f$ {apply COAM about P}

$mv_0r - \frac{mr^2}{2}.\frac{v_0}{3r} = mv_f.r + \frac{mr^2}{2}.\omega_f \quad \left[\omega_f = \frac{v_f}{r}\right]$

$\frac{5}{6}mv_0r = \frac{3}{2}mv_fr$

$or\ v_f = \frac{5}{9}v_0$

19. $\tan\theta = \frac{a}{g} = \frac{10}{10} = 1$



Or $\theta = 45^o$

$P_{max} = \rho g h = 9600\sqrt{2}\ N/m^2$

20. $a = \frac{mg - v\rho g}{m}$

$= \frac{mg - 2mg}{m}$

$a = -g$

$v = \sqrt{2gh} = \sqrt{2\times 9.8\times 19.6} = 9.8\times 2 = 19.6\ m/s\ \{motion\ in\ air\}$

$or\ o = (19.6)^2 - 2\times 9.8\times h\ \{motion\ in\ water\}$

$or\ h = 19.6\ m$

21. $v_{efflux} = \sqrt{2g\times 3.6} = \sqrt{72}\ m/s$

$P_A = P_0 - \rho g(3.6 + 1.8) = 10^5 - 54000$

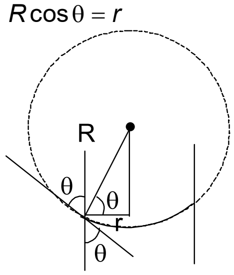
$= 4.6 \times 10^4\ N/m^2$

22. $\frac{2g\Delta y}{\omega^2} = (L-x)^2 - x^2$

On solving we get x = 0.5

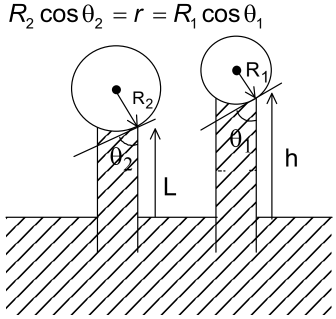
23. $P_2 = P_0 + \rho g \ell_1$ [under hydrostatic condition] is the maximum pressure in the system.
$P_1 = P_0 - \rho g \ell_2$ [from Bernoulli's equation] is the minimum pressure in the system.

24. $R\cos\theta = r$



$or\ R = \frac{r}{\cos\theta} = r\sec\theta$

25. $R_2\cos\theta_2 = r = R_1\cos\theta_1$



$h = \frac{2s}{\rho g R_1}\left[P_0 = P_0 - \frac{2s}{R_1} + \rho g h\right]$

& $L = \frac{2s}{\rho g h}\left[P_0 = P_0 - \frac{2s}{R_2} + \rho g L\right]$

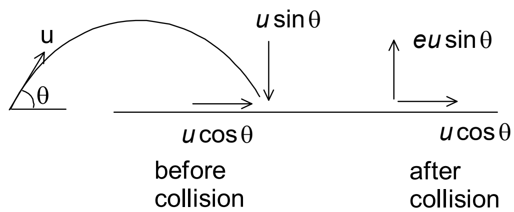
$\therefore hR_1 = hL$

26. $v = \sqrt{2gh}$ $\{parabolic\ graph\}$

27. $v_T \propto r^2$

$KE = \frac{mv^2}{2} = \rho V \frac{v^2}{2} \propto \rho \frac{4\pi}{3} r^3 . \left(r^2\right)^2 \propto r^7$

28. use $R = u_x.T$



$T = \frac{2u_\perp}{g}$

$H = \frac{u_\perp^2}{2g}$

$R = u_x.T$

29. Apply conservation of linear momentum along common normal for (A + B) & use

$e = \left[\frac{v_{recede}}{v_{approach}}\right]_{common\ normal}$

30. $R_1 y + R_2 y = mg$

Taking torque about point 2,

$\tau_{R_1 x}$ is in anticlockwise direction to balance clockwise torque of mg

Also $F_{net/x} = 0$

Or $R_1 x = R_2 x$

CHEMISTRY (HINT AND SOLUTIONS)

1. $A_{(g)} \rightleftharpoons 2\,B_{(g)}$

2

2-x 2x

$$\frac{(2x)^2}{(2-x)} = 4 \Rightarrow \frac{x^2}{2-x} = 1$$

$$x^2 = 2 - x$$

$$x^2 + x - 2 = 0$$

$$x^2 + 2x - x - 2 = 0$$

$$x(x+2) - 1(x+2) = 0$$

$$x = 1$$

$$x = 1$$

$So,$

$$\underset{1}{A_{(g)}} \rightleftharpoons \underset{2}{2B_{(g)}}$$

$now,$

$$\log\frac{K_2}{K_1} = \frac{\Delta H}{RX2.303}\left(\frac{1}{T1} - \frac{1}{T2}\right)$$

$T_2 \to \text{inf}\,inity,$

$$so, \frac{1}{T_2} \to 0$$

$$\log\frac{K_2}{K_1} = \frac{\Delta H}{RX2.303} X \frac{1}{298K}$$

$$= \frac{2.303X8.314X298J/mol}{8.314J/mol.K\,X2.303X298K} = 1$$

$$\frac{K_2}{K_1} = 10 \Rightarrow K_2 = 10X4 = 40$$

$$\underset{1-y}{A_{(g)}} \rightleftharpoons \underset{2+2y}{2B_{(g)}}$$

$so,$

$$40 = \frac{(2+2y)^2}{1-y} \Rightarrow 10 = \frac{(1+y)^2}{1-y}$$

$$\Rightarrow 10 - 10y = 1 + y^2 + 2y$$

$$y^2 + 12y - 9 = 0$$

$$y = \frac{-12 \pm \sqrt{(12)^2 - 4X1X(-9)}}{2}$$

$$= \frac{-12 \pm \sqrt{144+36}}{2}$$

$$=\frac{-12\pm 13.4}{2}$$

$$=\frac{-12+13.4}{2}$$

$$=\frac{1.4}{2}=0.7$$

So, mole of B is 2+2y
=2+2x0.7
=2+1.4
=3.4

Conc. of I= $\frac{3.4}{1}=3.4M$

2. $${}_{Z}^{M}A_{(g)} \rightarrow {}_{Z-4}^{M-8}B_{(g)} + 2{}_{2}^{4}He_{(g)}$$

$t_{\frac{1}{2}}$	$\frac{1}{2}$	$\frac{1}{2}$	1
$t_{\frac{1}{2}}$	$\frac{1}{4}$	$\frac{1}{2}+\frac{1}{4}$	$1+\frac{1}{2}$

Mole total $=\frac{1}{4}+\frac{1}{4}+\frac{1}{2}+\frac{1}{2}+1$

PV=nRT $\Rightarrow P=\frac{5}{2}\text{X}\frac{0.082\text{X}300}{1}atm$

P=61.5 atm

3. $$AgNO_3 \rightleftharpoons Ag^+ + NO_3^-$$

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$[\text{Cl}^-]=\frac{10^{-5}}{2}M$$

$$(\text{Ag}^+)=\frac{10^{-8}}{2}M$$

$$Q_{ip}=\frac{10^{-5}}{2}\text{X}\frac{10^{-8}}{2}<K_{sp}$$

No ppt will take place.

4. Buffer solution,

$$(H^+)=10^{-8}$$

$$(OH^-)=\frac{10^{-14}}{10^{-8}}=10^{-6}$$

5. $$H_2O \rightleftharpoons H^+ + OH^-$$

$$55.55(1-\alpha) 55.55\alpha 55.55\alpha$$

$$55.55\alpha = 2\text{X}10^{-11}$$

$$\alpha = 3.6\text{X}10^{-13}$$

$$\alpha\% = 3.6\text{X}10^{-13}\text{X}100$$

$$=3.6\text{X}10^{-11}\%$$

6. Carbon has small size and forms a π bond with good overlap whereas silicon has larger size hence ϕ has a poor π-overlap.

7. Ring structure of the formula $(SiO_3)_n^{2n-}$
So, n=-12

8. K decreases as the temperature rises.

9. Arrehenius equation:
$$d(\ln k) = \frac{E_a}{RT^2} dT$$
Here, T and dT same and positive.
$$d(\ln k) \alpha E_a$$
$$\ln k_2 - \ln k_1 \alpha E_a$$
$$\ln \frac{K_2}{K_1} \alpha E_a$$
So, if temperature increases, then rate of reaction having more E_a increase more sharply.

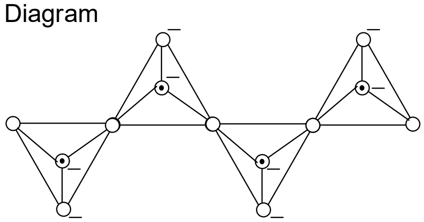
10. $$\frac{K}{K_\infty} = e^{\frac{-E_a}{RT}} = \frac{10^{-8}}{100} = 10^{-10}$$
$$K_\infty = \frac{K}{10^{-10}} = \frac{0.693}{0.0346} X10^{10} X10$$
$$= 2X10^{11} \min^{-1}$$

11. $$3A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} 2B$$
$$\frac{d(B)}{dt} = 2K_1[A] - 2K_2[B]^\circ$$
$$= 2K_1[A] - 2K_2$$

12. $$\Delta H = \Delta U + \Delta n_g RT$$

13. $$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \text{ -------(1)}$$
$$H_2(g) \rightarrow 2H(g) \qquad \Delta H = x_1$$
$$O_2(g) \rightarrow 2O(g) \quad \Delta H = x_2$$
$$H_2O(l) \rightarrow H_2O(g) \qquad \Delta H = x_4$$
$$H_2O(g) \rightarrow 2H(g) + O(g) \qquad \Delta H = 2x_3$$
Using all four, we find (1)
$$x_1 + \frac{x_2}{2} - x_4 - 2x_3$$

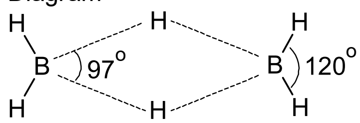
14. Diagram



15. $C^{4-}, C_2^{2-}, C_3^{4-}$ in Al_4C_3, CaC_2, Mg_2C_3 respectively.

16. Graphite is thermodynamically most stable form of carbon.

17. Diagram



18. $q + w = \Delta u$

19. $\underset{(0^\circ C)}{ice} \xrightarrow[q_1]{} \underset{(0^\circ C)}{water} \xrightarrow[q_2]{} \underset{(100^\circ C)}{water} \xrightarrow[q_3]{} \underset{(100^\circ C)}{vapour}$

$$q = q_1 + q_2 + q_3 = (80X5 + msdT + 540X5)\,\text{cal}$$

=3600 cal.

20. For constant volume, reaction quorient (Q) will remain constant.
For constant pressure, reaction quotient (Q) will remain constant when $\Delta n_g = 0$

21. $Ag(CN)_2^- \rightleftharpoons Ag^+ + 2CN^-$

T=0 0 0.03 0.1

0.03M $\underset{(\text{verysmall})}{xM}$ 0.1-0.03x2

$$\frac{x(0.04)^2}{0.03} = 4X10^{-19} \Rightarrow x = 7.5X10^{-18}M$$

22. $K_c = \dfrac{1}{(O_2)^5}$

(23)

$N_2 + O_2 \rightleftharpoons 2NO$

$K = \dfrac{3^2}{2X1}$ ---------(I)

$N_2 + O_2 \rightleftharpoons 2NO$

1-Z 2+y-z 2z+3

$K = \dfrac{(3+2Z)^2}{(2+y-z)(1-Z)}$ ---------(II)

Given, 3+2Z=4

$\Rightarrow z = \dfrac{1}{2}$

$(I) = (II) \Rightarrow y = \dfrac{101}{18}$

24. $K_p = K_c(RT)^{\Delta n_g} = K_c(RT)^{2-1} = K_cRT$

$$T = \frac{K_p}{K_c} X \frac{1}{R} = \frac{1}{0.0821} = 12.18K$$

25. $\Delta G = \Delta G^\bullet + RT\ln k$

At equilibrium

$\Delta G = 0$

26. $\Delta S = nC_{p,m} \ln \frac{T_2}{T_1}$

$= 2.5X(18X4.2)\ln(\frac{360}{300})$

$= 34.02 J/K$

27. $\Delta G = \underset{-ve}{\Delta H} - \underset{-ve}{T\Delta S}$ below T=569K.

$\Delta G < 0,$

28. P^H of amphiprotic salts and weak acid-weak base salt is independent of its concentration.

29. Remove H^+ from OH^- to get conjugate base that is O^{2-}

30. $P^H = P^{Ka} + \log \frac{(In^-)}{(HIn)}$

$6 = 5 + \log \frac{(In^-)}{(HIn)} \Rightarrow \frac{(In^-)}{(HIn)} = 10$

$\Rightarrow \frac{(In^-)}{(In^-) + (HIn)} = \frac{10}{11}$