FIITJEE **COMMON TEST**

BATCHES–Two Year CRP (1820) B LOT

PHYSICS, CHEMISTRY & MATHEMATICS

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

Time Allotted: 3 Hours **Maximum Marks: 300**

- 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 Sections.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each part is further divided into **Three Parts: Parts-A, B & 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 ***Blue/Black Ball Point Pen*** 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) **Part-A (01 – 04) contains 4 multiple choice questions** which have **only one correct answer**. Each question carries **+5 marks** for correct answer and **– 3 mark** for wrong answer.

(ii) **Part-A (05 – 10)** contains **6 multiple choice questions** which have **one or more than one correct** answer. Each question carries **+4 marks** for correct answer and **– 1 mark** for wrong answer.

(iii) **Part-B (01 - 04)** contains **4 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 **+8 marks** for all correct answer. For each correct row **+2 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

(iv) **Part-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 and **– 1 mark** for wrong answer.

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

SECTION-I : PHYSICS

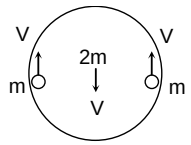
PART– A (Single Correct Choice Type)

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

1. A square hole of side length ℓ is made at a depth of y and a circular hole is made at a depth of 4y from the surface of water in a water tank kept on a horizontal surface. If equal amount of water comes out of the vessel through the holes per second then the radius of the circular hole is equal to(r, ℓ << y):

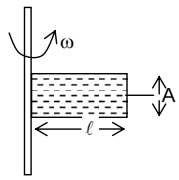
(A) $\ell / \sqrt{2}$ (B) $\ell / 2$ (C) $\ell / \sqrt{\pi}$ (D) $\ell / \sqrt{2\pi}$

2. A smooth uniform dish plate of mass 2m is placed on a smooth horizontal table. Two particles each of mass m are placed at diametric opposite positions. Disc and both particles are given speed v simultaneously as shown. The speed of the particles when they collide is



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

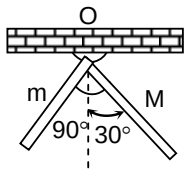
3. A closed cylinder of length 'ℓ' containing a liquid of variable density $\rho(x)=\rho_0(1+\alpha x)$. Find the net force exerted by the liquid on the axis of rotation. (Take the cylinder to be massless and A = cross sectional area of cylinder)



(A) $\rho_0 A\omega^2 \ell^2 \left[\frac{1}{2}+\frac{1}{3}\alpha\ell\right]$ (B) $\rho_0 A\omega^2\ell^2\left[\frac{1}{2}+\frac{2}{3}\alpha\ell\right]$

(C) $\rho_0 A\omega^2 \ell^2 \left[\frac{1}{2}+\alpha\ell\right]$ (D) $\rho_0 A\omega^2\ell^2\left[\frac{1}{2}+\frac{4}{3}\alpha\ell\right]$

4. Two uniform rods of equal length but different masses are rigidly joined to form an L-shaped body, which is then pivoted as shown in the figure. If in equilibrium the body is in the shown configuration, ratio M/m will be:



(A) 2 (B) 3

(C) $\sqrt{2}$ (D) $\sqrt{3}$

(One or More Than One Options Correct Type)

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. What would be the pressure inside a spherical air bubble of radius 0.1 mm situated 1m below the free surface of water? (Surface tension of water = 0.07 N/m, density of water = 1000 kg/m^3 and atmospheric pressure = 10^5Pa) :

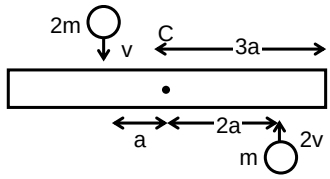
(A) 1.112×10^5 Pa (B) 2.224×10^5 Pa

(C) Always greater than the outside pressure

(D) May be greater than or equal to the outside pressure.

Space For Rough Work

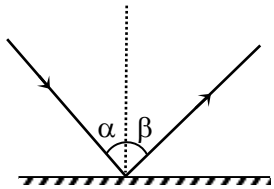
6. A uniform bar of length 6a and mass 8m lies on a smooth horizontal table. Two point masses m and 2m moving in the same horizontal plane with speed 2v and v, respectively, strike the bar simultaneously [as shown in the figure.] and stick to the bar after collision. Denoting angular velocity total energy and centre of mass velocity by ω, E and V_C respectively, we have after collision:



(A) $V_C = 0$ (B) $\omega = \frac{3v}{5a}$ (C) $\omega = \frac{v}{5a}$ (D) $E = \frac{3mv^2}{5}$

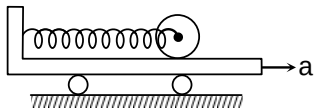
7. When an air bubbles rises from the bottom of a deep lake to a point just below the water surface, the pressure of air inside the bubble.
(A) is greater than the pressure outside it (B) is less than the pressure outside it
(C) increases as the bubble moves up (D) decreases as the bubble moves up

8. A ball strikes the smooth ground at an angle α and rebound at an angle β with the vertical as shown in the figure. Then



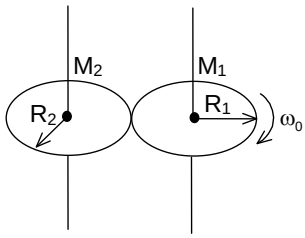
(A) coefficient of restitution is $\frac{\tan\alpha}{\tan\beta}$
(B) if $\alpha < \beta$ the collision is inelastic
(C) if $\alpha = \beta$ the collision is elastic
(D) if $\alpha > \beta$ the collision is inelastic

9. A solid uniform sphere is connected with a moving trolley car by a light spring. The trolley car moves with an acceleration a. If the sphere remains at rest relative to the trolley car, then :



(A) Spring force = ma
(B) Friction between the sphere and trolley car is equal to zero
(C) Friction between the sphere and trolley car is equal to $\frac{ma}{2}$
(D) Spring force is equal to $\frac{ma}{2}$

10. A circular disc of mass M_1 & radius R_1 initially moving with an angular speed ω_0 about centroidal axle is brought in contact with other stationary circular disc of mass M_2 & radius R_2. They have parallel axles.

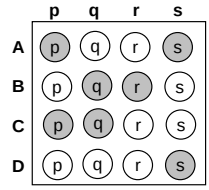


(A) Friction force decelerates the disc M_1 & accelerates the disc M_2
(B) Friction force disappears when both the disc have same linear speed at the point of contact.
(C) The angular momentum of the system is conserved about the point of contact.
(D) The final rotational energy is less than the initial rotational energy.

Space For Rough Work

PART – B: Matrix-Match Type Questions

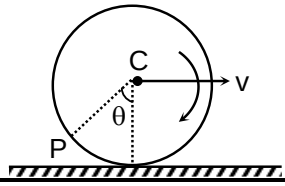
This Section contains **4 questions.** Each question has **four statements** (A, B, C and D) given in **Column-I** and **four statements** (p, q, r and s) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, 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. If body of mass m elastically collide stationary with another body of mass m. Then

	Column-I		Column-II
(A)	Fractional loss of K.E. is $\frac{8}{9}$, if n is equal to	(p)	n = 3
(B)	If after the collision the first body, half of the previous velocity, then n=t	(q)	n = 2
(C)	Maximum transfer of K.E. of colliding when n equal to	(r)	n = 1
(D)	Fractional loss of K.E. is $\frac{3}{4}$, then n is equal to	(s)	$n=\frac{1}{3}$

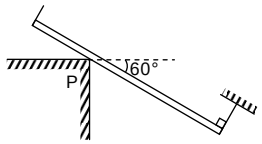
2. Read the following and write the correct pairs.
A disc rolls on ground without slipping. Velocity of centre of mass is v. There is a point P on circumference of disc at angle θ. Suppose v_p is the speed of this point. Then, match the following table



	Column-I		Column-II
(A)	If θ = 60°	(p)	$v_p=\sqrt{2}v$
(B)	If θ = 90°	(q)	$v_p=v$
(C)	If θ = 120°	(r)	$v_p=2v$
(D)	If θ = 180°	(s)	$v_p=\sqrt{3}v$

Space For Rough Work

3. A uniform rod of mass m and length ℓ is in equilibrium under the action of contact forces, gravity and tension in string as shown in the figure.



	Column-I		Column-II
(A)	The tension is the string is	(p)	$\frac{2mg}{7}$
(B)	The frictional force acting on the rod is	(q)	$\frac{mg}{3}$
(C)	If the string is cut, then just after it normal reaction on the rod is	(r)	$\frac{mg}{6}$
(D)	Just before the string is cut, the normal reaction on the rod is	(s)	$\frac{\sqrt{3}mg}{2}$

4. Match the Column I and Column II

	Column-I		Column-II
(A)	For a body for which relative density is greater than one	(p)	Body will be partially merged inside the water.
(B)	For a body for which relative density is less than one	(q)	Body will be completely merged inside the water.
(C)	For a body for which relative density is equal to one.	(r)	Buoyant force will act in upward direction
(D)	Inside the liquid, if acceleration of the body is zero	(s)	Weight of the body is equal to the force of Buoyancy.
		(t)	Weight of the body is greater than the force of Buoyancy.

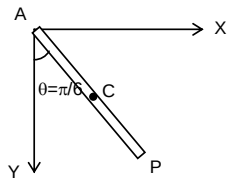
Space For Rough Work

PART – C : Single digit integer

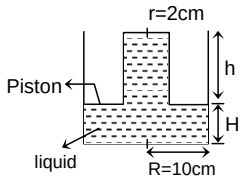
This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

1. A circular disc of radius R is removed from a bigger circular disc of radius 2R, such that the circumference of the discs coincide. The centre of mass of the new disc is at a distance of αR from the centre of the bigger disc. Find the value of $1/\alpha$.

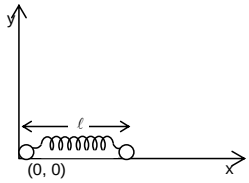
2. A uniform rod of length 1 m and mass 4 kg can rotate freely in a vertical plane about its end A. The rod is initially held in a horizontal position and then released. The angular velocity of the rod at the time the rod makes an angle 30^0 with the vertical is approximately.



3. A smooth light piston of mass M=8 kg is in equilibrium by the hydrostatic force of a liquid of mass m=2 kg. Find the value of h/H.

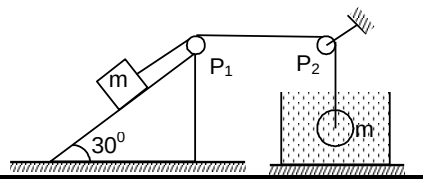


4. Two particles of same mass m are connected by a light spring of natural length ℓ. This system is placed along x-axis as shown in figure. If at t = 0 particle at origin is given a velocity $v_0\,\hat{i}$ then the position of centre of mass at any time t is $\left(\ell + v_0 t\right)\frac{1}{n}$. Find the value of n.



5. A uniform disc of radius R = 4 m is set into rotation about its axis at an angular speed ω = 3 rad/s. This rotating disc is now placed on a rough horizontal surface with its axis horizontal. Because of friction at the contact, the disc accelerates forward and its rotation decelerates till the disc starts pure rolling on the surface. Find the linear speed (in m/s) of the disc after it starts pure rolling.

6. A block of mass m is kept over a fixed smooth wedge. Block is attached to a sphere of same mass through fixed massless pulley P_1 and P_2. Sphere is dipped inside water as shown. If specific gravity of material of sphere is 2, then find the acceleration of the sphere.



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SECTION–II: CHEMISTRY

PART-A (Single Correct Choice Type)

This section contains 4 multiple choice questions. Each question has four choices (A), B), (C) and (D) out of which only one option is correct.

1. In the following first order competing reactions

$A \xrightarrow{k_1} B,\ C \xrightarrow{k_2} D$,

the ratio of $\frac{k_1}{k_2}$, if only 94% of A have been reacted whereas 50% of C has been reacted, is

(A) 4.06 (B) 0.246 (C) 2.06 (D) 0.06

2. At 518° the rate of decomposition of a sample of gaseous acetaldehyde initially at a pressure of 363 torr was 1.00 torr S^{-1} when 5% had reacted and 0.5 torrS^{-1} when 33% had reacted. The order of reaction in

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

3. What is the pH of solution which have NH_3 conc. 0.1 M and $(NH_4)_2SO_4$ concentration 0.05 M. Given that $Kb(NH_3)=10^{-5}$

(A) 5 (B) 9 (C) 4.74 (D) 8.26

4. Orthoboric acid behaves as a weak monobasic acid giving H_3O^+ and :

(A) $[B(OH)_4]^+$ (B) $H_2BO_2^+$ (C) $[B(OH)_4]^-$ (D) $H_2BO_2^-$

(One or More Than One Options Correct Type)

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. Identify the correct statement about othoboric acid

(A) It has a layer structure in which planar BO_3 units are joined by hydrogen bonds
(B) H_3BO_3 is a weak monobasic Lewis acid
(C) On heating orthoboric acid from metaboric acid and on further heating to red hot, forms boric oxide anhydride
(D) It is obtained by reacting borax with HCl using phenolphthalein as an indicator

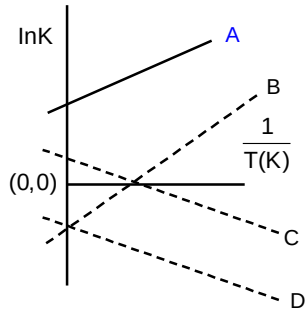
6. When an inorganic compound (X) having 3C–2e as well as 2C–2e bonds reacts with ammonia gas at certain temperature, gives a compound Y, isostructural with benzene. Compound (X) with ammonia at a high temperature produces a substance (Z).

(A) X is B_2H_6 (B) (Z) is known as inorganic Graphite
(C) (Y) is $B_3N_3H_6$ (D) (Z) is soft like graphite

space For Rough Work

7. Which of the following lines not correctly show the temperature dependence of equilibrium constant K for an exothermic reaction?

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



8. According to the Arrhenius equation

(A) A high activation energy usually implies a fast reaction
(B) Rate constant increases with increase in temperature. This is due to a greater number of collision whose energy exceeds the activation energy
(C) Higher the magnitude of activation energy, stronger is the temperature dependence of rate constant
(D) The pre exponential factor is a measure of the rate at which collision occur, irrespective of their energy

9. Which of following is extensive property?

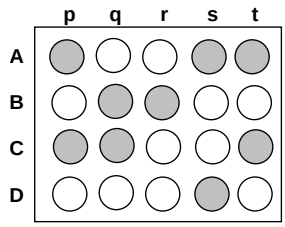
(A) Refractive Index
(B) Temperature
(C) Enthalpy
(D) Volume

10. Which of following is true about Fullerences?

(A) Each carbon is sp^2 hybridized
(B) It is made from interlocking hexagonal and pentagonal rings of carbon atoms
(C) Each carbon is sp^3 hybridized
(D) None of these

PART– B (Matrix– Match Type)

This section contains 4 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 s, and t. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct match are A-p,s,t; B-q,r; C-p,q,t; and D-s, then the correctly bubbled 4×5 matrix should be as follows.



space For Rough Work

1. Match the following

	Column – I		Column – II
A)	Colemanite	p)	$Ca_2B_6O_{11}.5H_2O$
B)	Bauxite	q)	$Al_2O_3.2H_2O$
C)	Borax	r)	$B_3N_3H_6$
D)	Inorganic benzene	s)	$Na_2B_4O_7.10H_2O$

2. Match the following

	Column – I		Column – II
A)	Zero order reaction	p)	$t_{1/2} = \frac{0.693}{K}$
B)	First order reaction	q)	$t_{1/2} = \frac{1}{K[A]_0}$
C)	Second order reaction	r)	$t_{1/2} = \frac{1}{[A]_0^{n-1}}$
D)	n^{th} order reaction	s)	$t_{1/2} = \frac{[A]_0}{2[K]}$

3. Match the following

	Column – I		Column – II
A)	$CO_2(s) \longrightarrow CO_2(g)$	p)	Phase transition
B)	$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$	q)	Allotropic change
C)	$2H \longrightarrow H_2(g)$	r)	ΔH is positive
D)	$P_{(white,solid)} \longrightarrow P_{(red,solid)}$	s)	ΔS is positive
		t)	ΔS is negative

space For Rough Work

4. Match the following

	Column – I		Column – II
A)	$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ in a closed system	p)	$\Delta H < \Delta E$
B)	$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ in a closed system	q)	$\Delta H = \Delta E \neq 0$
C)	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ in a closed system	r)	$\Delta H > \Delta E$
D)	$CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$ in an isolated system	s)	$\Delta E = 0$
		t)	$\Delta H = 0$

PART– C: Single Digit Integer

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

1. No of sp^2 hybridized atom in borazine is 'x' is no of sp^2 hybridized atom in diborane is 'y' then x+y is

2. No of compound does exist among following
H_2^{2-}, He_2^{2+}, He_2^{+}, H_2^{-}, N_2, N_2^{+}, NO^{+}

3. The solubility product of sparingly soluble salt Ag_2CrO_4 is 4×10^{-12}. The molar solubility of the salt is 10^{-x} mol/L? What is the value of 'x'

4. When 1 mol of Al_4C_3 react with water to produce CH_4 then 4X mole of H_2O are required, value of 'X' is

5. $A(g) + 3B(g) \rightleftharpoons 4C(g)$. initial concentration of A is equal to that of B. The equilibrium concentration of A & C are equal. Value of K_c for this reaction is

6. Number of $3C–2e^-$ bond is 'x' & $2C–2e^-$ bond is 'y' in B_2H_6 then x+y is

space For Rough Work

SECTION – III : MATHEMATICS

PART– A (Single Correct Choice Type)

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

1. The number of points on the ellipse $\frac{x^2}{50}+\frac{y^2}{20}=1$ from which a pair of perpendicular tangents is drawn to the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ is

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

2. If $\log_2 x+\log_2 y \geq 6,$ then the least value of x + y is

   (A) 4 (B) 8 (C) 16 (D) 32

3. If the roots of the equation $(a-1)(x^2+x+1)^2 = (a+1)(x^4+x^2+1)$ are real and distinct then the value of $a \in$

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

4. If $H_1, H_2, \ldots, H_{20}$ are 20 harmonic means between 2 and 3, then $\frac{H_1+2}{H_1-2}+\frac{H_{20}+3}{H_{20}-3}=$

   (A) 20 (B) 21 (C) 40 (D) 38

Space For Rough Work

PART A : (One or More Than One Options Correct Type)

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. If two distinct chords of a parabola $y^2 = 4ax$ passing through (a, 2a) are bisected on the line x + y = 1, then the length of the latus rectum can be

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

6. If foci of $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ coincide with the foci of $\frac{x^2}{25} + \frac{y^2}{9} = 1$ and eccentricity of the hyperbola is 2, then

(A) $a^2 + b^2 = 16$
(B) there is no director circle to the hyperbola
(C) centre of the director circle of ellipse is (0,0)
(D) length of latus rectum of the hyperbola=12

7. If the equation $x^{\log_a x^2} = \frac{x^{k-2}}{a^k}, a \neq 0$, has exactly one solution for x, then the value of k is/are

(A) $6 + 4\sqrt{2}$ (B) $2 + 6\sqrt{3}$ (C) $6 - 4\sqrt{2}$ (D) $2 - 6\sqrt{3}$

8. For a positive integer n, let $f_n(\theta) = \left(\tan\frac{\theta}{2}\right)(1+\sec\theta)(1+\sec 2\theta)(1+\sec 4\theta)\ldots(1+\sec 2^n\theta)$. Then

(A) $f_2\left(\frac{\pi}{16}\right) = 1$ (B) $f_3\left(\frac{\pi}{32}\right) = 1$ (C) $f_4\left(\frac{\pi}{64}\right) = 1$ (D) $f_5\left(\frac{\pi}{128}\right) = 1$

9. If a, b, c $\in$ R and abc < 0, then the equation $bcx^2 + 2(b + c - a)x + a = 0$ has

(A) both positive roots (B) both negative roots
(C) real roots (D) one positive and one negative root

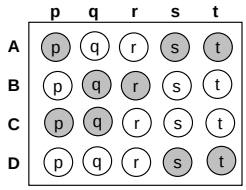
10. Let $a_1, a_2, a_3, \ldots a_n$ be in G.P. such that $3a_1 + 7a_2 + 3a_3 - 4a_5 = 0$. Then common ratio of G.P. can be

(A) 2 (B) $\frac{3}{2}$ (C) $\frac{5}{2}$ (D) $-\frac{1}{2}$

Space For Rough Work

PART B : (Matrix Match type questions)

This Section contains **4 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 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.

Consider the triangle formed by the lines
$y + 3x + 2 = 0$, $3y - 2x - 5 = 0$, $4y + x - 14 = 0$

	Column I		Column II
(A)	Values of α if $(0, \alpha)$ lies inside the triangle	(p)	$(-\infty, 7/3) \cup (13/4, \infty)$
(B)	Values of α if $(\alpha, 0)$ lies inside the triangle	(q)	(-4/3 , 1/2)
(C)	Values of α if $(\alpha, 2)$ lies inside the triangle	(r)	ϕ
(D)	Values of α if $(1, \alpha)$ lies outside the triangle	(s)	(5/3 , 7/2)

2. Match the following and write the correct pairs.

	Column I		Column II
(A)	An ellipse passing through the origin has its foci (3,4) and (6,8), then length of its minor axis is	(p)	8
(B)	If PQ is focal chord of ellipse $\frac{x^2}{25}+\frac{y^2}{16}=1$ which passes through S≡(3,0) and PS=2, then length of chord PQ is	(q)	$10\sqrt{2}$
(C)	If the line $y = x + K$ touches the ellipse $9x^2+16y^2=144$, then the difference of values of K is	(r)	10
(D)	The sum of distances of a point on the ellipse $\frac{x^2}{9}+\frac{y^2}{16}=1$ from the foci is	(s)	12

Space For Rough Work

3. Match the following and write the correct pairs.

For all real values of θ

	Column I		Column II
(A)	$A = \sin^2\theta + \cos^4\theta$	(p)	$A \in [-1,1]$
(B)	$A = 3\cos^2\theta + \sin^4\theta$	(q)	$A \in \left[\frac{3}{4},1\right]$
(C)	$A = \sin^2\theta - \cos^4\theta$	(r)	$A \in [2\sqrt{2},\infty)$
(D)	$A = \tan^2\theta + 2\cot^2\theta$	(s)	$A \in [1,3]$

4. Match the following and write the correct pairs.

	Column I		Column II
(A)	$y = \frac{x^2-2x+4}{x^2+2x+4}$, $x \in R$, then y can be	(p)	1
(B)	$y = \frac{x^2-3x-2}{2x-3}$, $x \in R$, then y can be	(q)	4
(C)	$y = \frac{2x^2-2x+4}{x^2-4x+3}$, $x \in R$ then y can be	(r)	-3
(D)	$x^2-(a-3)x+2<0, \forall x \in [-2,-1]$ then a can be	(s)	-10

Space For Rough Work

PART C : (Single digit integer)

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

1. A vertical line passing through the point (h, 0) intersects the ellipse $\frac{x^2}{4}+\frac{y^2}{3}=1$ at the points P and Q. Let the tangents to the ellipse at P and Q meet at the point R. If $\Delta(h)$ = area of the triangle PQR, $\Delta_1=\max_{1/2\le h\le 1}\Delta(h)$ and $\Delta_2=\min_{1/2\le h\le 1}\Delta(h)$, then $\frac{8}{\sqrt{5}}\Delta_1-8\Delta_2=$

2. The line 2x + y = 1 is tangent to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$. If this line passes through the point of intersection of the nearest directrix and the x–axis, then the eccentricity of the hyperbola is

3. Line y = 2x–b cuts the parabola $y = x^2–4x$ at points A and B and O be origin. then the value of b for which $\angle AOB$ is a right angle is _____

4. A circle $x^2+y^2+4x-2\sqrt{2}\,y+c=0$ is the director circle of the circle S_1, and S_1 is the director circle of circle S_2, and so on. If the sum of radii of all these circles is 2, then the value of c is $k\sqrt{2}$, where the value of k is _____

5. Number of integers satisfying the inequality $\log_{1/2}|x-3|>-1$ is ____

6. Let S_k, k = 1, 2, ….. , 100, denote the sum of the infinite geometric series whose first term is $\frac{k-1}{k!}$ and the common ratio is $\frac{1}{k}$. Then the value of $\frac{100^2}{100!}+\sum_{k=1}^{100}\left|\left(k^2-3k+1\right)S_k\right|$ is

Space For Rough Work

FIITJEE COMMON TEST

BATCHES: Two Year CRP (1820) B LOT

PHASE TEST-II: PAPER-I

JEE ADVANCED LEVEL

ANSWER KEY

Paper Code
SET-A

Section – I (PHYSICS)	Section – II (CHEMISTRY)	Section – III (MATHS)
PART – A	**PART-A**	**PART-A**
1. D P112031	1. A C122110	1. D M111018
2. A P110604	2. B C122102	2. C M113210
3. A P111002	3. B C110502	3. B M110102
4. D P111801	4. C C113206	4. C M113206
5. A, C P112040	5. A,B,C,D C113206	5. A,B,D M110906
6. A, C, D P110720	6. A,B,C,D C113204	6. A,B,D M111129
7. A, D P112038	7. A,C,D C110403	7. A,C M112403
8. A, B, C P110607	8. B,C,D C110603	8. A,B,C,D M113507
9. A, B P111831	9. C,D C111901	9. C,D M110102
10. A, B, D P111822	10. A,B C113207	10. B,D M113203
PART – B	**PART– B**	**PART– B**
1. A–q; B–s; C–r; D–p P110604	1. A–p; B–q, C–s, D–r C113205	1. A-s,B-r, C-q, D-p M110739
2. A–q; B–p; C–s; D–r P111826	2. A–s; B–p ; C–q ; D–r C122102	2. A-q, B-r, C-r, D-p M111002
3. A–r; B–s; C–p; D–q P111801	3. A–p,r,s; B–r,s ; C–t ; D–p,q,t C123204 , C123205, C123206	3. A-q, B-s, C-p, D-r M111411
4. A–r,t; B–p,r; C–q,r,s; D–q, r,s P111031	4. A–r; B–q ; C–p ; D–s,t C110403	4. A-p, B-p,q,r,s,C-p,q,s, D-r,s M110109
PART – C	**PART– C**	**PART– C**
1. 3 P110602	1. 6 C113206	1. 9 M111013
2. 5 P111819	2. 6 C110307	2. 2 M111106
3. 5 P111014	3. 4 C110501	3. 7 M110920
4. 2 P110604	4. 3 C113208	4. 4 M110825
5. 4 P111825	5. 8 C110402	5. 2 M110203
6. 0 P111019	6. 6 C113206	6. 3 M110516

FIITJEE COMMON TEST

BATCHES: Two Year CRP (1820) B LOT (CPT2-1)

PHASE TEST-II: PAPER-I

HINT & SOLUTIONS – SECTION-I : PHYSICS

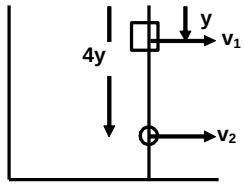
PART–A : (Single Correct Choice Type)

1. D P112031

$A_1v_1 = A_2v_2$, as equal amount of water comes out.

Where the velocities of efflux $v_1 = \sqrt{2gy}$ and

$v_2 = \sqrt{2g(4y)}$ & the area of cross section of the holes are $A_1 = \ell^2$ and $A_2 = \pi R^2$.



Putting all the values, we obtain $(\ell^2)\sqrt{2gy} = \left\{\sqrt{2g(4y)}\right\}\pi R^2 \Rightarrow R = \frac{\ell}{\sqrt{2\pi}}$.

2. A P110604

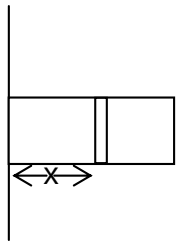
$\vec{p} = 0$ and kinetic energy will be constant.

3. A P111002

$\int df = \int dm\omega^2 x$

$\Rightarrow F = \int_0^{\ell} \rho_0 (1+\alpha x) A dx.\omega^2 x = \rho 0 A \omega 2 \int_0^{\ell} (1+\alpha x)\, x.dx = \rho 0\, A\omega 2 \left[\frac{x^2}{2} + \alpha\frac{x^3}{3}\right]_0^{\ell}$

$F = \rho 0 A \omega 2\, \ell^2 \left[\frac{1}{2} + \alpha\frac{\ell}{3}\right]$



4. D P111801
5. A, C P112040
6. A, C, D P110720

The two point masses stick to the rod thus $2m \times v - m \times 2v = 0$

Therefore the velocity of centre of mass or $V_C = 0$ or (A) correct.

After sticking of masses, centre of mass remaining at C.

Now by conservation of angular momentum, about C, we get

$$2mva + m(2v)(2a) = \frac{1}{12}8m(6a)^2\omega + 2ma^2\omega + m(2a)^2\omega \Rightarrow 6mVa = 30\, ma^2\omega$$

or $\omega = \frac{v}{5a}$

Thus C is also correct.

Total moment of inertia about centre of mass C,

$I = 2m\,a^2 + 4m\,a^2 + 24ma^2 = 30\, ma^2$

And total Energy after collision is $= \frac{1}{2}I\omega^2 = \frac{1}{2} \times 30ma^2 \times \left(\frac{v}{5a}\right)^2 = \frac{3}{5}mv^2$

7. A, D P112038
8. A, B, C P110607

Due to collision only the component of the initial velocity along the normal to the surface is changed in magnitude and direction.

9. A, B P111831

w.r.t. trolley, $\vec{F}=0$ & $\vec{\tau}_{cm}=0$

10. A, B, D P111822

Change in Angular momentum = Angular Impulse.

PART–B : Matrix Match Type Questions

1. A–q; B–s; C–r; D–p P110604
2. A–q; B–p; C–s; D–r P111826
3. A–r; B–s; C–p; D–q P111801

(A) $\frac{mg}{2}\frac{\ell}{4}=T\frac{3\ell}{4}\Rightarrow T=\frac{mg}{6}$

(B) $f_r=mg\frac{\sqrt{3}}{2}$

(C) $N=\frac{mg}{2}\times\frac{4}{7}=\frac{2mg}{7}$

(D) $N=\frac{mg}{2}-\frac{mg}{6}=\frac{mg}{3}$

4. A–r, t; B–p, r; C–q, r, s; D–q, r, s P111031

PART–C : Single digit integer

1. 3 P110602

$$\alpha R=\frac{\sigma\pi(2R)^2\times 0-\sigma\pi R^2\times R}{\sigma\pi(2R)^2-\sigma\pi R^2}$$

2. 5 P111819

Apply energy conservation, $Mg\frac{\ell}{2}\cos\theta=\frac{1}{2}\frac{M\ell^2}{3}\omega^2$

$\omega^2=\frac{3g\cos\theta}{\ell}=15\sqrt{3}$ rad/sec $\Rightarrow$ $\omega\approx 5.1$ rad/sec.

3. 5 P111014

R = 10 cm; r = 2 cm

$$\frac{h}{H}=\frac{MR^2}{mR^2-(M+m)r^2}\Rightarrow\frac{h}{H}=5.$$

4. 2 P110604

$v_{cm}=\frac{mv_0+m(0)}{2m}=\frac{v_0}{2}$, so $x(t)=\frac{\ell}{2}+\frac{v_0 t}{2}$.

5. 4 P111825

6. 0 P111019

Force acting on block along the face of wedge

$T-mg\sin 30^\circ=ma$ .....(1)

Force acting on sphere

Weight (mg) – Buoyant force $\left(F'=\frac{m}{2}g\right)-T=ma$ .....(2)

Solving we get, a = 0

SECTION-II : CHEMISTRY (HINT AND SOLUTION)
PART–A

PART-A

1. A C122110

$k_1 = \frac{2.303}{t_1}\log\frac{100}{6}$ for 94% (A) reacted

$k_2 = \frac{2.303}{t_2}\log\frac{100}{50}$ for 50% (C) reacted

$\therefore \frac{k_2}{k_1} = \frac{t_2}{t_1} \times \frac{0.3010}{1.2218}$

Since $t_2 = t_1$

$\therefore \frac{k_2}{k_1} = \frac{0.3010}{1.2218} = 0.246$

$\therefore \frac{k_1}{k_2} = 4.06$

2. B C122102
3. B C110502
4. C C113206

$B(OH)_3 + 2H_2O \longrightarrow [B(OH)_4]^- + H_3O^+$

5. A,B,C,D C113206
6. A,B,C,D C113204

Diborane, B_2H_6, is a compound consisting 2C–2e and 2C–2e bonds

$B_2H_6 + 2NH_3\ (X) \xrightarrow{\text{Low temp}} B_2H_6.2NH_3 \xrightarrow{200^\circ C} B_3N_3H_6\ (Y)$

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

7. A,C,D C110403
8. B,C,D C110603
9. C,D C111901
10. A,B C113207

PART– B

1. A–p; B–q, C–s, D–r C113205
2. A–s; B–p ; C–q ; D–r C122102
3. A–p,r,s; B–r,s ; C–t ; D–p,q,t C123204 , C123205, C123206
4. A–r; B–q ; C–p ; D–s,t C110403

A – R

$\Delta n = +ve,\ \Delta H > \Delta E$

B – Q

$\Delta n = 0,\ \Delta H = \Delta E \neq 0$

C – P

$\Delta n = -ve, \Delta H < \Delta E$

D – S, T

$q_p = 0 = \Delta H, q_v = 0 = \Delta E$

PART– C

1. 6 C113206
2. 6 C110307
3. 4 C110501
4. 3 C113208
5. 8 C110402
6. 6 C113206

HINTS & SOLUTIONS
MATHEMATICS

1. D M111018

Equation of director circle $\Rightarrow x^2 + y^2 = 25$

Which cut the ellipse at 4 distinct points.

2. C M113210

$xy \geq 64$

$\therefore \ \frac{x+y}{2} \geq \sqrt{xy} \geq 8$

$\therefore \ x + y \geq 16$

3. B M110102

$(a-1)(x^2+x+1) = (a+1)(x^2-x+1) \Rightarrow x^2-ax+1=0,$

$a^2 - 4 > 0 \Rightarrow (-\infty, -2) \cup (2, \infty)$

4. C M113206

$$\frac{H_1+2}{H_1-2}+\frac{H_{20}+3}{H_{20}-3}=\frac{\frac{1}{2}+\frac{1}{H_1}}{\frac{1}{2}-\frac{1}{H_1}}+\frac{\frac{1}{3}+\frac{1}{H_{20}}}{\frac{1}{3}-\frac{1}{H_{20}}}$$

$$=\frac{\frac{1}{2}+\frac{1}{2}+d}{\frac{1}{2}-d-\frac{1}{2}}+\frac{\frac{1}{3}+\frac{1}{3}-d}{\frac{1}{3}+d-\frac{1}{3}}=\frac{\frac{2}{2}+d}{-d}+\frac{\frac{2}{3}-d}{d}$$

$$=\frac{\frac{2}{3}-1}{d}-2$$

$=2\times21-2$ [as also, $\frac{1}{3}=\frac{1}{2}+21d$]

$= 40$

5. A,B,D M110906

Let α, $1-\alpha$ is the point. Equation of chord $2a(x+\alpha)-y(1-\alpha)=4a\alpha - (1-\alpha)^2$

$\therefore$ final equation $\alpha^2-2\alpha + 1 - 2a + 2a^2 = 0$ as $D > 0$

$0 < a < 1$

6. A,B,D M111129

Clearly focus $(4,0)$, $a^2 = 4$, $b^2 = 12$.

7. A,C M112403

$\left(\log_a x^2\right)\log_a x = (k-2)\log_a x - k$, let $\log_a x = t, 2t^2 - (k-2)t + k = 0$

$D = 0 \Rightarrow k^2 - 12k + 4 = 0$

8. A,B,C,D M113507

$= \tan\theta / 2 \ \frac{1+\cos\theta}{\cos\theta} \times (1+ \sec 2\theta) \text{ -- - - } (1+ \sec 2^n \theta)$

$$=\frac{\sin\theta/2}{\cos\theta/2}\frac{2\cos^2\theta/2}{\cos\theta}(1+\sec^2\theta)\ldots\ldots$$

$= \tan\theta \ (1+ \sec 2\theta)\ldots\times (1+ \sec 2^n\theta)$

Proceeding in this way, we get

$f_n(\theta) = \tan 2^n\theta$

$f_2\left(\frac{\pi}{16}\right) = \tan\frac{\pi}{4} = 1$

$f_3\left(\frac{\pi}{32}\right) = \tan\frac{\pi}{4} = 1$

$f_4\left(\frac{\pi}{64}\right) = \tan\left(\frac{\pi}{4}\right) = 1$

$f_5\left(\frac{\pi}{128}\right) = \tan\frac{\pi}{4} = 1$

9. C,D M110102

$D = (b+c-a)^2 - abc \geq 0$ also product of Roots $\frac{a}{bc} = \frac{a^2}{abc} < 0$

$\therefore$ Real roots and roots are of opposite sign.

10. B,D M113203

Given $3a_1 + 7a_2 + 3a_3 - 4a_5 = 0$

$\Rightarrow 7(a_1 + a_2 + a_3) = 4(a_1 + a_3 + a_5)$

$\Rightarrow 7(1+r+r^2) = 4(1+r^2 + r^4)$

$\Rightarrow 7 = 4(r^2 - r + 1)$

$\Rightarrow 4r^2 - 4r + 1 = 4$

$\Rightarrow (2r-1)^2 = 4$

$\Rightarrow 2r - 1 = \pm 2$

$\Rightarrow r = \frac{3}{2}, -\frac{1}{2}.$

1. A-s, B-r, C-q, D-p M110739

2. A-q, B-r, C-r, D-p M111002

A. The points are O(0,0), P(3,4), and Q(6,8). Then 2a = OP + OQ

= 5 + 10 = 15

or $a = \frac{15}{2}$

Also, the distance between the foci

$2ae = \sqrt{(6-3)^2 + (8-4)^2} = 5$

or $e = \frac{1}{3}$

or $b^2 = \frac{225}{4}\left(1 - \frac{1}{9}\right) = 50$

or $b = 5\sqrt{2}$

or $2b = 10\sqrt{2}$

B. We know that $\frac{1}{SP} + \frac{1}{SQ} = \frac{2a}{b^2}$

or $\frac{1}{2} + \frac{1}{SQ} = \frac{10}{16}$

or SQ = 8

or PQ = 10

C. If the line $y = x + k$ touches the ellipse $9x^2 + 16y^2 = 144$, then $k^2 = 16(1)^2 + 9$
or $k = \pm 5$

D. The sum of the distances of a point on the ellipse from the foci is $2a = 8$

3. A-q, B-s, C-p, D-r M111411

A. $A = \sin^2\theta + \cos^4\theta$

$$= \frac{1-\cos 2\theta}{2} + \left(\frac{1+\cos 2\theta}{2}\right)^2$$

$$= \frac{1}{2} - \frac{1}{2}\cos 2\theta + \frac{1}{4} + \frac{1}{2}\cos 2\theta + \frac{1}{4}\cos^2 2\theta$$

$$= \frac{3}{4} + \frac{1}{4}\left(\frac{\cos 4\theta + 1}{2}\right) = \frac{3}{4} + \frac{1}{8} + \frac{1}{8}\cos 4\theta$$

Now, $-1 \le \cos 4\theta \le 1$

$$\Rightarrow \frac{-1}{8} \le \frac{\cos 4\theta}{8} \le \frac{1}{8}$$

$$\Rightarrow \frac{3}{4} + \frac{1}{8} - \frac{1}{8} \le \frac{3}{4}\left(\frac{1+\cos 4\theta}{2}\right) \le \frac{3}{4} + \frac{1}{8} + \frac{1}{8}$$

$$\Rightarrow \frac{3}{4} \le A \le 1$$

B. $A = 3\cos^2\theta + \sin^4\theta = 3\frac{1+\cos 2\theta}{2} + \left(\frac{1-\cos 2\theta}{2}\right)^2$

$$\frac{3+3\cos 2\theta}{2} + \frac{1-2\cos 2\theta + \cos^2 2\theta}{4}$$

$$= \frac{7+4\cos 2\theta + \cos^2 2\theta}{4} = \frac{(\cos 2\theta + 2)^2 + 3}{4}$$

Now, $1 \le \cos 2\theta + 2 \le 3$

$$\Rightarrow 1 \le \frac{(\cos 2\theta + 2)^2 + 3}{4} \le 3$$

C. $A = \sin^2\theta - \cos^4\theta$

$$= \frac{1-\cos 2\theta}{2} - \left(\frac{1+\cos 2\theta}{2}\right)^2$$

$$= \frac{1}{2} - \frac{1}{2}\cos 2\theta - \frac{1}{4} - \frac{1}{2}\cos 2\theta - \frac{1}{4}\cos^2 2\theta$$

$$= \frac{1}{4} - \cos 2\theta - \frac{1}{4}\cos^2 2\theta$$

$$= -\left(\frac{1}{4}\cos^2 2\theta + \cos 2\theta - \frac{1}{4}\right)$$

$$= \frac{5}{4} - \left(\frac{1}{2}\cos 2\theta + 1\right)^2$$

Now, $-\frac{1}{2} \le \frac{1}{2}\cos 2\theta \le \frac{1}{2}$

$$\Rightarrow \frac{1}{2} \le \frac{1}{2}\cos 2\theta + 1 \le \frac{3}{2}$$

$$\Rightarrow \frac{1}{4} \le \left(\frac{1}{2}\cos 2\theta + 1\right)^2 \le \frac{9}{4}$$

$$\Rightarrow -\frac{9}{4} \le -\left(\frac{1}{2}\cos 2\theta + 1\right)^2 \le -\frac{1}{4}$$

$$\Rightarrow -1 \le \frac{5}{4} - \left(\frac{1}{2}\cos 2\theta + 1\right)^2 \le 1$$

D. $A = \tan^2\theta + 2\cot^2\theta = (\tan\theta - \sqrt{2}\cot\theta)^2 + 2\sqrt{2} \ge 2\sqrt{2}$

4. A-p, B-p,q,r,s, C-p,q,s, D-r,s M110109

A. $y = \dfrac{x^2 - 2x + 4}{x^2 + 2x + 4}$

$x^2y + 2xy + 4y = x^2 - 2x + 4$

$\Rightarrow (y-1)x^2+2(y+1)x+4(y-1) = 0$

$D \ge 0$

$\Rightarrow 4(y + 1)^2 - 16(y-1)^2 \ge 0$

or $(y + 1)^2 - (2y-2)^2 \ge 0$

or $(3y - 1)(3-y) \ge 0$

or $(3y-1)(y-3) \le 0 \Rightarrow y \in \left[\frac{1}{3}, 3\right]$

$\Rightarrow \{1\} \Rightarrow p$

B. $y = \dfrac{x^2 - 3x - 2}{2x - 3}$

or $x^2-3x-2=2xy-3y$

or $x^2 - (3+2y)x+(3y-2)=0$

$D \ge 0$

$\Rightarrow (3+2y)^2 - 4(3y-2) \ge 0$

or $9+4y^2+12y-12y+8 \ge 0$

or $4y^2 + 17 \ge 0$

which is always true. Hence, $y \in R \Rightarrow \{1, 4, -3, -10\} \Rightarrow p,q,r,s$

C. $y = \dfrac{2x^2 - 2x + 4}{x^2 - 4x + 3}$

or $x^2y-4xy + 3y = 2x^2 - 2x + 4$

$(y-2)\, x^2+2(1-2y)x+3y-4 = 0$

$D \ge 0$

$4(1-2y)^2 - 4(y-2)(3y-4) \ge 0$

or $1 + 4y^2-4y-(3y^2-10y+8) \ge 0$

or $y^2 + 6y-7 \ge 0$

or $(y+7)(y-1) \ge 0$

$\Rightarrow y \ge 1$ or $y \le -7$

$\Rightarrow \{1, 4, -10\} \Rightarrow p, q, s$

D. $f(x) = x^2 - (a-3)x+2<0, \forall\, x \in [-2, -1]$

$\Rightarrow f(-2) < 0$ and $f(-1) < 0$

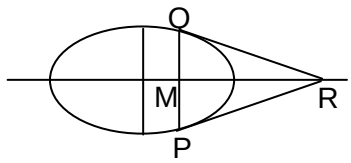
$\Rightarrow 4 + 2(a-3) + 2<0$ and $1+(a-3)+2<0$

$\Rightarrow a < 0$ and $a < 0$

$\Rightarrow a < 0$

$\Rightarrow a \in \{-10, -3\}$

1. 9 M111013



$PQ = \sqrt{3}\left(\sqrt{4-h^2}\right)$

$MR = \left(\frac{4}{h} - h\right)$ {PQ is chord of contact for R}

$\Delta = \frac{1}{2}\sqrt{3}\left(4-h^2\right)^{3/2}$

$\frac{d\Delta}{dh} = -12\sqrt{3}\left(\frac{4}{h^2}-1\right)^{1/2}\frac{1}{h^3} < 0$

= decreasing

At $h = \frac{1}{2}$ $\Delta_1 = \max$

h = 1 $\Delta_2 = \min$

$\frac{8}{\sqrt{5}}\Delta_1 = 45$

$8\Delta_2 = 36$

$\Rightarrow \frac{8}{\sqrt{5}}\Delta_1 - 8\Delta_2 = 9$

2. 2 M111106

(a/e, 0) in y = –2x + 1

a = e/2

also $1 = \sqrt{a^2m^2 - b^2}$

$b^2 = a^2(e^2 - 1)$

$\therefore$ a = 1, e = 2

3. 7 M110920

Homogenisation of y = 2x – b with $y = x^2 - 4x$

b – 8 + 1 = 0 $\Rightarrow$ b = 7

4. 4 M110825

The radius of the given circle $x^2 + y^2 + 4x - 2\sqrt{2}\,y + c = 0$ is $\sqrt{4+2-c} = \sqrt{6-c} = a$ (let)

Now, radius of circle $S_1 = \frac{a}{\sqrt{2}}$

Radius of circle $S_2 = \frac{a}{2}$

and so on.

Also, $a + \frac{a}{\sqrt{2}} + \frac{a}{2} + ... + \infty = 2$ (Given)

Then $a\left(\frac{1}{1-\frac{1}{\sqrt{2}}}\right) = 2$

or $\frac{a\sqrt{2}}{\sqrt{2}-1} = 2$

or $a = 2 - \sqrt{2} = \sqrt{6-c}$

or $4 + 2 - 4\sqrt{2} = 6 - c$

or c = $4\sqrt{2}$

5. 2 M110203

$\log_{1/2}|x-3|>-1$

$\Rightarrow |x-3|<2$

$\Rightarrow -2<x-3<2$

$\Rightarrow 1<x<5,\ x\neq 3$

$\therefore x\in\{2,4\}$

6. 4 M110516

$$S_k=\frac{a}{1-r}=\frac{k-1}{\lfloor k\left(1-\frac{1}{k}\right)}=\frac{1}{\lfloor(k-1)}$$

Now, $t_k=\left(k^2-3k+1\right)\frac{1}{\lfloor k-1}=\frac{1}{\lfloor k-3}-\frac{1}{\lfloor k-1}$

$$(t_k)=\left|\frac{1}{\lfloor k-3}-\frac{1}{\lfloor k-1}\right|$$

$$\sum_{k=1}^{100}(t_k)=\sum_{k=1}^{100}\left|\frac{1}{\lfloor k-3}-\frac{1}{\lfloor k-1}\right|\Rightarrow\{k\geq 2\}$$

$$(t_1)=\left|0-\frac{1}{\lfloor 0}\right|=1$$

$$(t_2)=\left|0-\frac{1}{\lfloor 1}\right|=1$$

$$(t_3)=1-\frac{1}{\lfloor 2}$$

$$(t_4)=\frac{1}{\lfloor 1}-\frac{1}{\lfloor 3}$$

: :

: :

$$(t_{98})=\frac{1}{\lfloor 95}-\frac{1}{\lfloor 97}$$

$$(t_{99})=\frac{1}{\lfloor 96}-\frac{1}{\lfloor 98}$$

$$(t_{100})=\frac{1}{\lfloor 97}-\frac{1}{\lfloor 99}$$

$$\Rightarrow \sum_{k=1}^{100}\left(\frac{1}{\lfloor k-3}-\frac{1}{\lfloor k-1}\right)=4-\frac{1}{\lfloor 98}-\frac{1}{\lfloor 99}=4-\frac{100}{\lfloor 99}$$

Now,

$$\frac{100^2}{\lfloor 100}+\sum_{k=1}^{100}\left|\left(k^2-3k+1\right)S_k\right|=\frac{100}{\lfloor 99}+4-\frac{100}{\lfloor 99}=4$$