FIITJEE Phase Test (JEE-Advanced)

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - 3	QP Code:	RIT- 3

Time Allotted: 3 Hours **Maximum Marks: 183**

- 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. All the section can be filled in **PART-A** of OMR.
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 Only One Part.

(i) **Part-A (01-07) –** Contains seven (07) multiple choice questions which have ONLY ONE CORRECT answer Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(ii) **Part-A (08-14) –** Contains seven (07) multiple choice questions which have **One or More** correct answer.
Full Marks: **+4** If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: **+1** For darkening a bubble corresponding **to each correct option,** provided NO incorrect option is darkened.
Zero Marks: **0** If none of the bubbles is darkened.
***Negative Marks*: –1 In all other cases**.
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** marks, as a wrong option is also darkened.

(iii) **Part-A (15-18) -** This section contains Two paragraphs. Based on each paragraph, there are Two multiple choice questions. Each question has only one correct answer and carries **+3 marks** for the correct answer and **-1 marks** for wrong answer.

Name of the Candidate :_____

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

Enrolment Number :_____

BATCHES – NWCM822O1S, NWCM2022S1W, NWCM2022A1R, NWCM2022A2R + DEHRADUN-2022R, NWCM2022A3R, NWCM2022B1R, NWCM2022B1W, NWCM2022G1, NWCM2022A1W, NWCM2022A2W, NWCM2022A3W, NWCM2022A4W, NWCM2022A5W, NWCM2022A6W, NWCM2022A7W, NWCM2022A8W, PANINI2022-G1, PANINI2022-XII 1, PANINI2022-XII 2, PANINI2022-XII 3, NWCM2022E1R+NWCM2022E1W, NWCM2022EW, RCM2022B1R, RCM2022B1W, PANINI2022B01

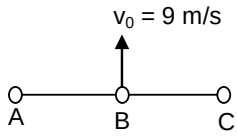
SECTION-1 : PHYSICS

PART – 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.**

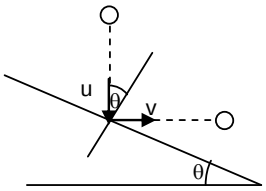
1. Three identical balls each of mass 5 kg are connected with each other as shown in figure, and rests over a smooth horizontal table. At moment *t = 0* ball *B* is given velocity 9 m/sec (in the horizontal plane), then velocity of *A* in direction of velocity of *B* just before collision is:



(A) 9 m/sec (B) zero
(C) 3 m/sec (D) 6m/sec

1. **C**

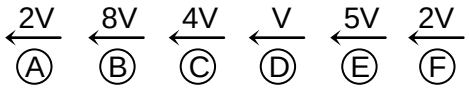
2. A ball is dropped on an inclined plane and is observed to move horizontally after the impact. The coefficient of restitution between plane and ball is e. The angle θ is:



(A) 45° (B) $\tan^{-1} e$
(C) $\tan^{-1}\sqrt{e}$ (D) $\tan^{-1}\frac{e}{2}$

2. **C**

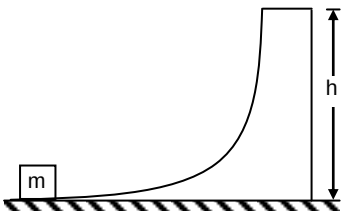
3. In the given set of balls all are identical and all the collisions are elastic. Final velocity of ball D will be:



(A) V towards left (B) 5V towards right
(C) 2V towards left (D) none of these

3. **C**

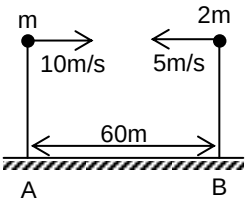
4. As situation shown in figure a small body of mass 'm' placed over a large mass M whose surface is horizontal near the smaller mass and gradually curves to become vertical. The smaller mass is pushed on the longer one at a speed u towards right. Assume that all the surfaces are frictionless. The maximum speed of larger mass will be



(A) $\frac{u}{1+M/m}$ (B) $\frac{2u}{1+M/m}$
(C) $\frac{u}{\sqrt{1+M^2/m^2}}$ (D) none of these

4. **B**

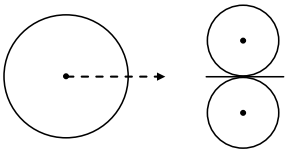
5. Two particles one of mass m and the other of mass 2m are projected horizontally towards each other from the same level above the ground with velocities 10 m/s and 5 m/s respectively. They collide in air and stick to each other. The distance from A where the combined mass finally land is



(A) 40 m (B) 20 m
(C) 30 m (D) 45 m

5. **A**

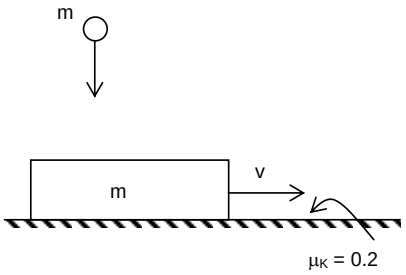
6. Two equal discs initially at rest are in contact on a smooth horizontal table. A third disc of same mass but of double radius strikes them symmetrically and comes to rest after impact. the coefficient of restitution is



(A) $\frac{3}{4}$ (B) $\frac{9}{16}$ (C) $\frac{3}{16}$ (D) $\frac{4}{9}$

6. **B**

7. A ball of mass m falls vertically from a height h and collides with a block of equal mass m moving horizontally with a velocity v on a surface. The coefficient of kinetic friction between the block and the surface is $\mu_k = 0.2$, while the coefficient of restitution (e) between the ball and the block is 0.5. There is no friction acting between the ball and the block. The velocity of the block just after the collision decreases by (if it is still in motion)



(A) $0.5\sqrt{2gh}$ (B) 0

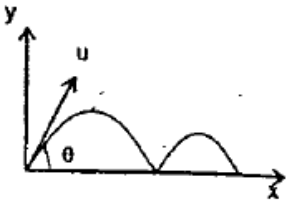
(C) $0.1\sqrt{2gh}$ (D) $0.3\sqrt{2gh}$

7. **D**

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

8. A projectile is fired from a horizontal ground. Coefficient of restitution between projectile and ground is e. Let a, b and c be the ratio of time of flight $\left(\frac{T_1}{T_2}\right)$ maximum height $\left(\frac{H_1}{H_2}\right)$ and horizontal range $\left(\frac{R_1}{R_2}\right)$ in first two collisions with the ground. Then



(A) $a = \frac{1}{e}$

(B) $b = \frac{1}{e^2}$

(C) $c = \frac{1}{e^2}$

(D) all of the above

8 **AB**

9. Three identical blocks kept in a straight line on a friction less horizontal surface. The coefficient of restitution of them $e = \frac{1}{2}$. If the left mass block has been given a velocity 'u' towards right as shown in figure, then finally

(A) speed of left most block = $\frac{1}{4}u$

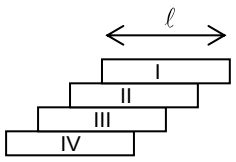
(B) speed of left most block = $\frac{13}{64}u$

(C) speed of middle block = $\frac{3}{16}u$

(D) speed of middle block = $\frac{15}{64}u$

9. **BD**

10. Four bricks each of length l are put on the top of one another in such a way that part of each extends beyond the one beneath. The largest equilibrium extension are



(A) top brick over hanging the one below by $\frac{\ell}{2}$

(B) second brick from top over hanging the one below $\frac{\ell}{4}$

(C) third brick from top overhanging by bottom one by $\frac{\ell}{6}$

(D) the total overhanging length on the edge of the bottom brick is $\frac{11}{12}\ell$

10. **ABCD**

11. A ball moving with velocity v hits a massive wall moving towards the ball with a velocity u. An elastic impact lasts for time Δt

(A) the average elastic force acting on the ball is $\frac{m(u+v)}{\Delta t}$

(B) the average elastic force acting on the ball is $\frac{2m(u+v)}{\Delta t}$

(C) the kinetic energy of the ball increases by $2mu(u+v)$

(D) the kinetic energy of the ball remain the same after the collision

11. **BC**

12. Two friends P and Q (each weighing 40 kg) are sitting on a frictionless platform at some distance d apart. P rolls a ball of mass 4 kg towards Q which Q catches. Then, Q rolls the ball towards P and P catches it. The ball keeps on moving back and forth between P and Q. The ball has a fixed speed 5 ms^{-1} on the platform. Choose the correct option(s).

(A) Speed of P after he catches the ball for the first time is $\frac{10}{11}ms^{-1}$

(B) Speed of P after he catches the ball for the first time is $\frac{10}{9}ms^{-1}$

(C) The centre of mass of the system remains stationary irrespective of the direction of motion of the ball.

(D) P can roll the ball only for 6 times.

12. **ACD**

13. A cannon shell is fired to hit a target at a horizontal distance R, however it breaks into two equal parts at its highest point, One part returns to the cannon. The other part

(A) will falls at a distance R beyond target

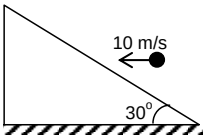
(B) will falls at a distance 3R beyond target

(C) will hit the target

(D) have nine times kinetic energy of first

13. **AD**

14. A ball of mass 1 kg strikes a wedge of mass 4 kg horizontally with a velocity of 10 m/s. just after collision velocity of wedge becomes 4 m/s. Friction is absent every where and collision is elastic. Select the correct alternative (s):



(A) Speed of ball after collision is 6 m/s
(B) Speed of ball after collision is 8 m/s
(C) Impulse between ball and wedge during collision is 16 N –s
(D) Impulse between ball and wedge during collision is 32 N –s

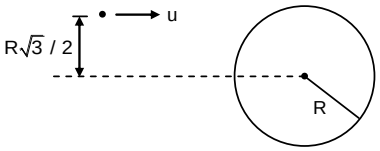
14. **AD**

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **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. 15 to 16

A small particle travelling with a speed u towards right collides with a spherical body of equal mass as shown in figure. The centre of this spherical body is located a distance $\frac{\sqrt{3}}{2}R$ away from the direction of motion of the particle. The coefficient of restitution between them is $\frac{1}{2}$.



Then answer the following questions.

15. The speed of the sphere after the collision

(A) $\frac{4}{8}$ (B) $\frac{3u}{8}$

(C) $\frac{3u}{4}$ (D) none of these

15. **B**

16. The speed of the small particle after the collision

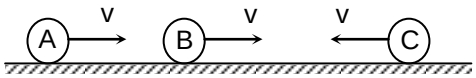
(A) $\frac{4u}{8}$ (B) $\frac{7u}{8}$

(C) $\frac{3u}{8}$ (D) none of these

16. **B**

Paragraph for Question no. 17 to 18

Two spheres A and B are moving on a smooth horizontal surface with same velocity v having some separation between them. A third sphere C is moving in opposite direction on same surface with same speed. All the spheres are of equal mass. The collisions are elastic. Let v_{cm} represents the centre of mass velocity of all the three spheres.



17. If A and B are connected to each other by a massless rigid rod, then the value of v_{cm} after all the possible collisions have occurred will be

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

17. **A**

18. If A and B are connected to each other by a massless rigid rod, then during all the possible collisions

(A) momentum of A and B is conserved

(B) momentum of B and C is conserved

(C) momentum of B and C is not conserved

(D) momentum of A will remain constant

18. **C**

SECTION-2 : CHEMITRY

PART – 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. $2A(g) \rightleftharpoons 2B(g) + C(g)$

One mole of A(g) is taken in a one litre container. The decomposition reaction attains equilibrium, when the concentration of A(g) becomes equal to that of B(g). Select the correct statement.

(A) The equilibrium constant (K_C) is found out to be 4.
(B) The mole fraction of C(g) in 0.2
(C) The equilibrium concentration of A(g) is 0.75M
(D) $K_P < K_C$

1. B

2. In a first order chemical reaction, the fraction of molecules those overcome the energy barrier(threshold energy) is 10^{-4} at 500 K. What is the activation energy of the reaction in Kcal mol^{-1} unit?

(A) 12.6 (B) 8.36
(C) 9.21 (D) 14.2

2. C

3. $M(OH)_2(s) \rightleftharpoons M^{2+}(aq) + 2OH^-(aq)$

Above equilibrium exists in water by the sparingly soluble base $M(OH)_2$. The pH of the saturated solution of the base is 11. What is it's solubility product constant?

(A) 16×10^{-9} (B) 4×10^{-9}
(C) 5×10^{-10} (D) 32×10^{-9}

3. C

4. Under which of the following conditions, the product of the given reaction is called most thermodynamically stable product?

$2A(g) + 3B(g) \rightleftharpoons A_2B_3(g)$

(A) T = 300 K, $K_P = 83.4 \times 10^{-6}$ (B) T = 200 K, $K_P = 6.2 \times 10^{-3}$
(C) T = 500 K, $K_P = 2.6 \times 10^{3}$ (D) T = 400 K, $K_P = 5.4 \times 10^{4}$

4. D

5. $A(s) \rightleftharpoons 2P(g) + 4Q(g) + 3R(g)$

Above reaction takes place in a one liter container. If the concentration of 'P' and 'R' are doubled at equilibrium, then how many times will the concentration of 'Q' change at the new equilibrium?

(A) $\left(\frac{1}{16}\right)^{\frac{1}{4}}$ (B) $\left(\frac{1}{32}\right)^{4}$

(C) $\left(\frac{1}{32}\right)^{\frac{1}{4}}$ (D) $\left(\frac{1}{16}\right)^{4}$

5. C

6. 500 mL of 1.6 M NaOH solution was mixed with 500 mL of 0.8 M HCl. After complete reaction, 48 g of glacial acetic acid was added to the mixture. What is the pH of the resulting solution?
[K_a of $CH_3COOH = 10^{-5}$]
(A) 4.5 (B) 5
(C) 5.5 (D) 4

6. B

7. $2X(g) \rightleftharpoons Y(g) + Z(g)$
The equilibrium concentration of X(g), Y(g) and Z(g) are respectively 4, 2, and 2 M. How many moles of X(g) is to be added so that the concentration of 'Y'(g) becomes 3M at the new equilibrium?
(A) 4 (B) 1
(C) 2 (D) 3

7. A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

8. $SO_2(g) + 2H_2S(g) \longrightarrow 3S(s) + 2H_2O(\ell)$
The rate of above reaction is equal to
(A) $-\frac{d[SO_2]}{dt}$ (B) $-\frac{1}{2}\frac{d[H_2S]}{dt}$
(C) $\frac{1}{3}\frac{d[S]}{dt}$ (D) $\frac{1}{2}\frac{d[H_2O]}{dt}$

8. AB

9. $NaCN + H_2O \rightleftharpoons HCN + Na^+ + OH^-$
0.1 mole of NaCN was dissolved in water to form one litre solution. K_a of HCN = 10^{-10}. Choose the correct statement(s)
(A) pH of the solution is 11.5
(B) Equilibrium constant of the reaction is 10^{-4}
(C) The degree of hydrolysis increases by adding water
(D) Addition of NaCl decreases the rate of hydrolysis of CN^- ion

9. ABC

10. $2A(g) \rightleftharpoons 4B(g) + C(g)$
Which of the following change(s) is/are observed if the volume of reaction container is reduced to half of it's initial volume?
(A) The equilibrium constant K_C will be doubled
(B) Concentration of all species will be doubled
(C) Combination reaction dominates over decomposition reaction
(D) Decomposition reaction dominates over combination reaction

10. BC

11. The data of the reaction, $X(g) \longrightarrow$ Product is given below:

Expt	$[X]_0$ in mol L^{-1}	$t_{½}$ in s	Rate in mol L^{-1} s^{-1}
1.	0.1	40	z
2.	0.4	160	1.25×10^{-3}
3.	Y	320	

Choose correct statement(s) following the above data.
(A) The value of 'z' in the table is 1.25×10^{-3}.
(B) 'y' in the table is 0.6
(C) the rate of reaction is independent of the concentration of reactant
(D) the reaction, $X(g) \longrightarrow$ Product is an elementary reaction

11. AC

12. $CH_4(g) + Cl_2(g) \xrightarrow{h\nu} CH_3Cl(g) + HCl(g)$

The mechanism of above reaction is given below

$Cl_2(g) \xrightarrow{h\nu} \dot{Cl}(g) + \dot{Cl}(g) \text{ -----(1)}$

$CH_4(g) + \dot{Cl}(g) \longrightarrow \dot{CH}_3(g) + HCl(g) \text{ -----(2)}$

$\dot{CH}_3(g) + Cl_2(g) \longrightarrow CH_3Cl(g) + \dot{Cl}(g) \text{ -----(3)}$

$\dot{CH}_3(g) + \dot{Cl}(g) \longrightarrow CH_3Cl(g) \text{ -----(4)}$

Choose correct statement(s)
(A) The activation energy for reaction in step (4) is the lowest among all steps
(B) The concentration of $\dot{CH}_3$ and $\dot{Cl}$ remains constant through out the reaction
(C) Step-4 is the slowest reaction
(D) The reaction intermediates are formed only in step-1

12. AB

13. The pH of which of the following aqueous solution is greater than seven at room temperature?
(A) 0.01 M NaCl
(B) 10^{-3} M CH_3COONa(K_a of $CH_3COOH = 10^{-5}$)
(C) 10^{-2} M NH_4Cl(K_b of $NH_4OH = 10^{-5}$)
(D) 0.02 M CH_3COONH_4

13. B

14. The solubility product constant of a base $M(OH)_2 = 5 \times 10^{-7}$. It ionizes as

$M(OH)_2(s) \rightleftharpoons M^{2+}(aq) + 2OH^-(aq)$

Choose correct statement(s)
(A) The molarity of OH^- ion in the saturated solution of the base is 0.01 M
(B) The solubility of the base at pH = 10 is greater than 5×10^{-3} mol L^{-1}.
(C) The solubility of the base increases by adding NH_4Cl solution.
(D) Addition of the soluble salt MCl_2 decreases solubility.

14. ABCD

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **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. 15 to 16

There are two aqueous solution of given concentrations.

Solution of $NH_4OH = \frac{1}{4}M$

Solution of $HCl = \frac{1}{6}M$

These two solutions are mixed in different quantities and poured in the following vessels.

(I)	(II)	(III)
400 mL of NH_4OH 600 mL HCl	200 mL of NH_4OH 60 mL HCl	200 mL of NH_4OH 360 mL HCl

Answer the following questions

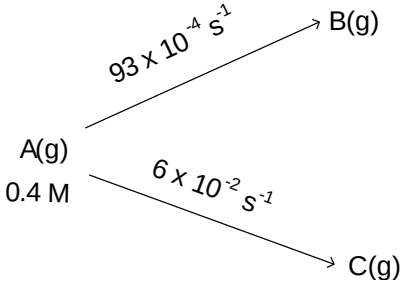
15. If the pH of the solution mixture in vessel-I is 4.5, what will be the pH of the solution mixture in vessel-II? [log4 = 0.602]
(A) 6.61 (B) 8.6
(C) 5.4 (D) 4.94

15. B

16. What will be the pH of the solution mixture in vessel-III if 440 mL of water is added to it?
(A) 3 (B) 4
(C) 2 (D) 1

16. C

Paragraph for Question no. 17 to 18



A parallel reaction is given above, in which A(g) produces B(g) and C(g) with different rates. The initial concentration of A(g) is 0.4 mol L^{-1}.
Answer the following questions on the basis of above write up.

17. How much time is needed for 75% completion of the reaction?
(A) 15s (B) 10s
(C) 20s (D) 18s

17. C

18. Choose the correct statement.

(A) The ratio of concentration of B to C i.e., $\frac{[B]}{[C]} = 6.45$

(B) If the reverse reaction(s) are negligible then 'C' can be called a kinetic controlled product and 'B' thermodynamic controlled product

(C) The rate of formation of B and C are equal to each other

(D) The half-life of the reaction increases by increasing temperature

18. B

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Tangents are drawn from the point P (3, 4) to the ellipse $\frac{x^2}{9}+\frac{y^2}{4}=1$ touching the ellipse at points A and B, then the orthocenter of the triangle PAB is

(A) $\left(5,\frac{8}{7}\right)$ (B) $\left(\frac{7}{2},\frac{25}{8}\right)$

(C) $\left(\frac{11}{5},\frac{8}{5}\right)$ (D) $\left(\frac{8}{25},\frac{7}{5}\right)$

1. C

2. Number of real solutions of the equation $\sum_{k=1}^{2019} k^2\left|x^2+(k+3)x-k-4\right|=0$ is

(A) 0 (B) 1

(C) 2 (D) infinite

2. B

3. Let a, b and λ be positive real numbers. Suppose P is an end point of the latus rectum of the parabola $y^2=4\lambda x$, and suppose the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ passes through the point P. If the tangents to the parabola and the ellipse at the point P are perpendicular to each other, then the eccentricity of the ellipse is

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2}$

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

3. A

4. Consider a branch of the hyperbola $x^2-2y^2-2\sqrt{2}x-4\sqrt{2}y-6=0$ with vertex at the point A. Let B be one of the end points of its latus rectum. If C is the focus of the hyperbola nearest to the point A, then the area of the triangle ABC is

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

(C) $1+\sqrt{\frac{2}{3}}$ (D) $\sqrt{\frac{3}{2}}+1$

4. B

5. The number of elements in the set $\left\{x\in R:(|x|-3)|x-4|=6\right\}$ is equal to

(A) 3 (B) 4

(C) 2 (D) 1

5. C

6. A hyperbola with equation $\frac{(x-1)^2}{16}-\frac{(y+2)^2}{9}=1$ is given. A triangle is formed with two vertices as the focus of the hyperbola and third vertex lies on hyperbola. The locus of centroid of the triangle is:

(A) $16(x-1)^2-9(y+2)^2=16$ (B) $9(x-1)^2-16(y+2)^2=16$

(C) $9(x-1)^2+16(y+2)^2=169$ (D) $16(x-1)^2+9(y+2)^2=16$

6. B

7. Exact set of values of a for which $x^3(x+1)=2(x+a)(x+2a)$ is having four real solutions is

(A) $[-1, 2]$ (B) $[-3, 7]$

(C) $[-2, 4]$ (D) $\left[-\frac{1}{8}, \frac{1}{2}\right]$

7. D

(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.**

8. Let α and β be the roots of $x^2-x-1=0$, with $\alpha>\beta$. For all positive integers n, define

$a_n=\frac{\alpha^n-\beta^n}{\alpha-\beta}, n\geq 1$

$b_1=1$ and $b_n=a_{n-1}+a_{n+1}, n\geq 2$

Then which of the following options is/are correct?

(A) $\sum_{n=1}^{\infty}\frac{a_n}{10^n}=\frac{10}{89}$

(B) $b_n=\alpha^n+\beta^n$ for all $n\geq 1$

(C) $a_1+a_2+a_3+.....a_n=a_{n+2}-1$ for all $n\geq 1$

(D) $\sum_{n=1}^{\infty}\frac{b_n}{10^n}=\frac{8}{89}$

8. ABC

9. Consider two straight lines, each of which is tangent to both the circle $x^2 + y^2 = \frac{1}{2}$ and the parabola $y^2 = 4x$. Let these lines intersect at the point Q. Consider the ellipse whose center is at the origin O (0, 0) and whose semi – major axis is OQ. If the length of the minor axis of this ellipse is $\sqrt{2}$, then which of the following statement(s) is (are) TRUE?

(A) For the ellipse, the eccentricity is $\frac{1}{\sqrt{2}}$ and the length of the latus rectum is 1

(B) For the ellipse, the eccentricity is $\frac{1}{2}$ and the length of the latus rectum is $\frac{1}{2}$

(C) The area of the region bounded by the ellipse between the lines $x = \frac{1}{\sqrt{2}}$ and $x = 1$ is $\frac{1}{4\sqrt{2}}(\pi - 2)$

(D) The area of the region bounded by the ellipse between the lines $x = \frac{1}{\sqrt{2}}$ and $x = 1$ is $\frac{1}{16}(\pi - 2)$

9. AC

10. Let a and b be positive real numbers such that $a > 1$ and $b < a$. Let P be a point in the first quadrant that lies on the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$. Suppose the tangent to the hyperbola at P passes through the point (1, 0), and suppose the normal to the hyperbola at P cuts off equal intercepts on the coordinate axes. Let Δ denote the area of the triangle formed by the tangent at P, the normal at P and the x – axis. If e denotes the eccentricity of the hyperbola, then which of the following statement is/are TRUE?

(A) $1 < e < \sqrt{2}$ (B) $\sqrt{2} < e < 2$

(C) $\Delta = a^4$ (D) $\Delta = b^4$

10. AD

11. Let $-\frac{\pi}{6} < \theta < -\frac{\pi}{12}$. Suppose α_1 and β_1 are the roots of the equation $x^2 - 2x\sec\theta + 1 = 0$ and α_2 and β_2 are the roots of the equation $x^2 + 2x\tan\theta - 1 = 0$. If $\alpha_1 > \beta_1$ and $\alpha_2 > \beta_2$, then $\alpha_1 + \beta_2$ equals

(A) $2(\sec\theta - \tan\theta)$ (B) $2\sec\theta$

(C) $-2\tan\theta$ (D) $-2\sin\theta\sec\theta$

11. CD

12. Let $\alpha(a)$ and $\beta(a)$ be the roots of the equation $\left(\sqrt[3]{1+a}-1\right)x^2+\left(\sqrt{1+a}-1\right)x+\left(\sqrt[6]{1+a}-1\right)=0$ where $a>-1$. Then $\lim\limits_{a\to 0^+}\alpha(a)=l_1$ and $\lim\limits_{a\to 0^+}\beta(a)=l_2$ gives

(A) $l_1+l_2=-\frac{3}{2}$ (B) $l_1-l_2=\frac{1}{2}$

(C) $l_1l_2=\frac{1}{2}$ (D) $\frac{l_1}{l_2}=\frac{1}{2}$

12. ABCD

13. If roots of the equation $x^2-10ax-11b=0$ are c, d and those of $x^2-10cx-11d=0$ are a, b then (a, b, c, d are distinct numbers).

(A) $ac=121$ (B) $a+c=121$

(C) $b+d=1089$ (D) $a+b+c+d=1110$

13. ABC

14. Tangents are drawn from the point P (3, 4) to the ellipse $\frac{x^2}{9}+\frac{y^2}{4}=1$ touching the ellipse at points A and B, then the equation of the locus of the point whose distances from the point P and the line AB are equal is

(A) $9x^2+y^2-6xy-54x-62y+241=0$

(B) $x^2+9y^2+6xy-54x+62y-241=0$

(C) $9x^2+9y^2-6xy-54x-62y-241=0$

(D) $x^2+y^2-2xy+27x+31y-120=0$

14. A

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **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. 15 to 16

Let $F_1(x_1,0)$ and $F_2(x_2,0)$, for $x_1<0$ and $x_2>0$, be the foci of the ellipse $\frac{x^2}{9}+\frac{y^2}{8}=1$. Suppose a parabola having vertex at the origin and focus at F_2 intersects the ellipse at point M in the first quadrant and at point N in the fourth quadrant.

15. The orthocentre of the triangle F_1MN is

(A) $\left(-\frac{9}{10},0\right)$ (B) $\left(\frac{2}{3},0\right)$

(C) $\left(\frac{9}{10},0\right)$ (D) $\left(\frac{2}{3},\sqrt{6}\right)$

15. A

16. If the tangents to the ellipse at M and N meet at R and the normal to the parabola at M meets the x – axis at Q, then the ratio of area of the triangle MQR to area of the quadrilateral MF_1NF_2 is

(A) 3 : 4 (B) 4 : 5
(C) 5 : 8 (D) 2 : 3

16. C

Paragraph for Question no. 17 to 18

Let a, r, s, t be non – zero real numbers. Let $P\left(at^2, 2at\right), Q, R\left(ar^2, 2ar\right)$ and $S\left(as^2, 2as\right)$ be distinct points on the parabola $y^2 = 4ax$. Suppose that PQ is the focal chord and lines QR and PK are parallel, where K is the point (2a, 0).

17. The value of r is

(A) $-\frac{1}{t}$ (B) $\frac{t^2+1}{t}$
(C) $\frac{1}{t}$ (D) $\frac{t^2-1}{t}$

17. D

18. If $st = 1$, then the tangent at P and the normal at S to the parabola meet at a point whose ordinate is

(A) $\frac{\left(t^2+1\right)^2}{2t^3}$ (B) $\frac{a\left(t^2+1\right)^2}{2t^3}$
(C) $\frac{a\left(t^2+1\right)^2}{t^3}$ (D) $\frac{a\left(t^2+2\right)^2}{t^3}$

18. B

ANSWERS

SECTION-1 : PHYSICS

PART – A

Paper – 2 : CHEMISTRY

PART – A

SECTION – 3 : MATHEMATICS

PART – A