FIITJEE (JEE-Advanced)

BATCHES – NWCMSR122A1, NWSW122A1, NWCMSR122B1, NWCMSW122B1, CSO (ONLINE) BATCHES

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - 1 | **QP Code:** | **TEST - 3**

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

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

INSTRUCTIONS

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

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts**: **Part-A & B** in the 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 HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Two Parts.

(i) **Part-A (01-06) –** Contains six (06) 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 (07-12) –** Contains seven (06) 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.

(ii) **Part-B (01-06)** contains Six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+4 marks** for correct answer and **there will be no negative marking.**

Name of the Candidate :_____

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

Enrolment Number :_____

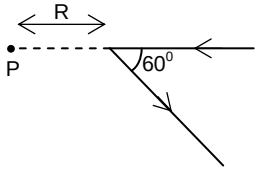
SECTION-1 : PHYSICS

PART – A

(Single Correct Choice Type)

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

1. A long straight wire, carrying a current I is bent at its mid point to form an angle of 60^0. AT a point P, distance R from the point of bending the magnetic field is

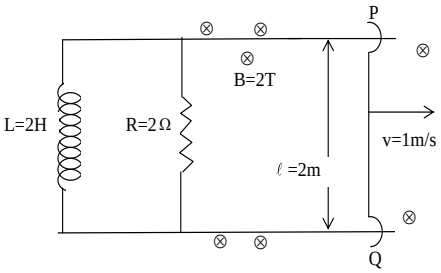


(A) $\frac{\left(\sqrt{2}-1\right)\mu_0 i}{4\pi R}$ (B) $\frac{\left(\sqrt{2}+1\right)\mu_0 i}{4\pi R}$

(C) $\frac{\mu_0 i}{4\sqrt{3}\pi R}$ (D) $\frac{\mu_0 i}{8R}$

1. **C**

2. The given figure shows an inductor and resistance fixed on a conducting wire. A movable wire PQ starts moving on the fixed rails from t = 0 with constant velocity 1 m/s. A constant magnetic field (B = 2T) exist perpendicular to the plane of paper. The work done by the external force on the wire PQ in 2 second is

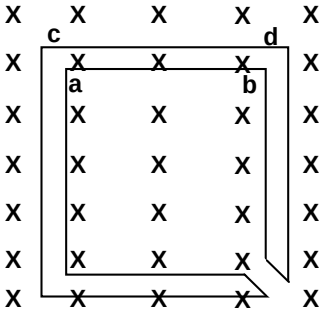


(A) 16 J (B) 32 J

(C) 48 J (D) 64 J

2. **B**

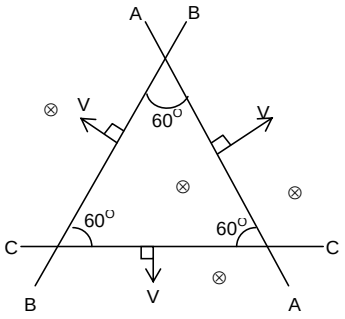
3. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of the figure. The magnitude of the field increase with time. If I_1 and I_2 are the currents in the segments ab and cd. Then



(A) $I_1 > I_2$
(B) $I_1 < I_2$
(C) I_1 is in the direction ba I_2 is in the direction cd
(D) I_1 is in the direction ab I_2 is in the direction dc

3. **D**

4. Three long rods AA, BB, CC are moving with a speed v in a uniform magnetic field B_o perpendicular to the plane of paper as shown in the figure. The triangle formed between the three wires is always an equilateral triangle. The induced the three wires is always an equilateral triangle. The induced current in the triangle is (resistance per unit length of wire is λ)

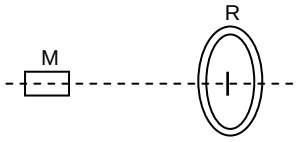


(A) $B_o v/3\lambda$ (B) $2B_o v/3\lambda$

(C) $B_o v/\sqrt{3\lambda}$ (D) vB_o/λ

4. **D**

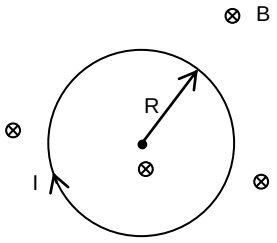
5. A conducting ring R is placed on the axis of a bar magnet M. The plane of R is perpendicular to this axis. M can move along this axis.



(A) M will repel R when it is moving towards R
(B) M will attract R when it is moving towards R
(C) M will repel R when moving towards as well as away from R
(D) M will attract R when moving towards as well as away

5. **A**

6. A conducting loop is placed in a magnetic field (uniform) as shown in figure.



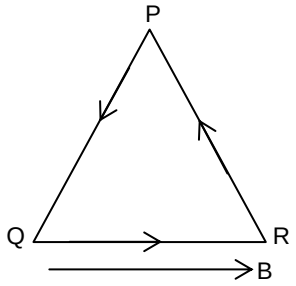
For this situation, markout the correct statement
(A) The force of compression experienced by loop is IRB
(B) The force of compression experienced by loop is 2IRB
(C) The force of expansion experienced by loop is 2IRB
(D) The force of expansion experienced by loop is IRB

6. **D**

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

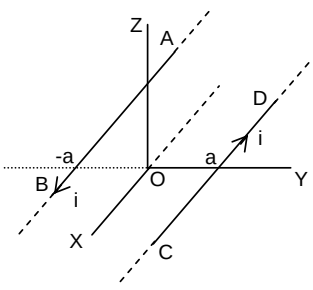
7. An equilateral triangular loop PQR of side l carries a currents i in the direction shown. The loop is kept in uniform magnetic field B, directed parallel to the base of triangle QR as shown. Net force F and torque τ acting on loop is



(A) F = 0
(B) F = $\sqrt{3}$ ilB
(C) τ = 0
(D) $\tau = \frac{\sqrt{3}l^2iB}{4}$

7. **AD**

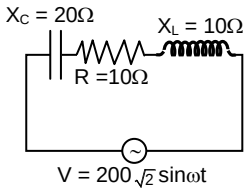
8. Two long parallel wires, AB and CD, carry equal currents in opposite directions. They lie in the xy plane, parallel to the x-axis, and pass through the points (0, -1, 0) and (0, 1, 0) respectively. The resultant magnetic field is



(A) zero on the x-axis
(B) maximum on the x-axis
(C) directed along the z-axis at the origin, but not at other points on the z-axis
(D) directed along the z-axis at all points on the z-axis

8. **BD**

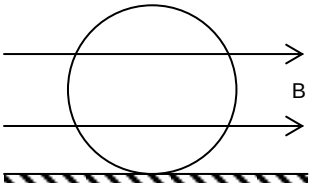
9. In the LCR circuit shown in figure:



(A) current will lead the voltage
(B) rms value of current is 20 A
(C) power factor of the circuit is $\frac{1}{\sqrt{2}}$
(D) voltage drop across resistance is 100 V

9. **AC**

10. A conducting ring of mass 2 kg and radius 0.5 m is placed on a smooth horizontal plane. The ring carries a current of I = 4A. A horizontal magnetic field B = 10T, coplanar with ring, is switched on at time t = 0 as shown in figure. Then at t=0



(A) angular acceleration of the ring is $40\,\pi$rad s^{-2}
(B) torque on the ring is $20\ \pi$Nm
(C) angular acceleration of the ring is $20\,\pi$rad s^{-2}
(D) torque on the ring is $10\ \pi$Nm

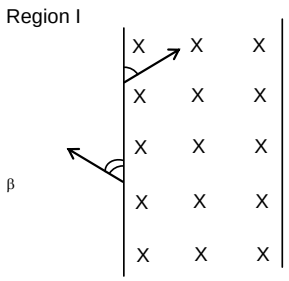
10. **CD**

11. An L-C-R series circuit with 100 Ω resistance is connected to an *ac* source. When only the capacitance is removed, the current lags behind voltage by $\frac{\pi}{4}$. When only the inductance is removed, the current leads voltage by $\frac{\pi}{4}$. Then

(A) Inductive reactance is 100 Ω
(B) Capacitive reactance is 100 Ω
(C) Impedance of L-C-R circuit is 100 Ω
(D) maximum potential difference across inductor is equal to maximum potential difference across capacitor when all are connected in circuit.

11. **ABCD**

12. A particle of charge –q and mass m enters a uniform magnetic field B (perpendicular to paper inward) at P with a velocity v_0 at an angle α and leaves the field at Q with velocity v at angle β as shown in given figure.

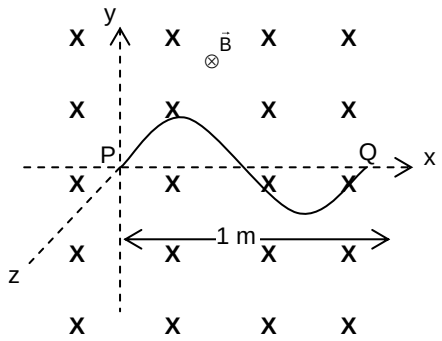


(A) $\alpha = \beta$
(B) $v = v_0$
(C) PQ = $\frac{2mv_0 \sin\alpha}{Bq}$
(D) The particle remains in field for time t = $\frac{2m(\pi-\alpha)}{Bq}$

12. **ABCD**

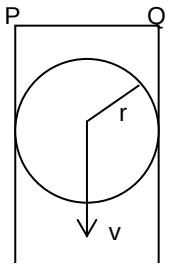
PART – B
(Numerical based)

1. A wire forming one cycle of sine curve is moved in x – y plane with velocity $\vec{V} = 3\hat{i} + 1.5\hat{j}$. There exit a magnetic field $\vec{B} = -3\hat{k}$. Find the magnitude of motional emf develop across the ends PQ of wire.



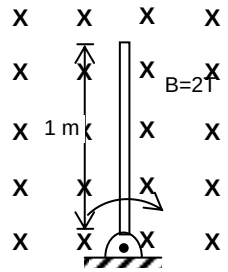
1. **4.50**

2. A vertical ring of radius 'r' and resistance 'R' slips vertically between two frictionless and resistance less vertical rails. The rails which are joined at top there is uniform magnetic field B perpendicular to plane of ring and the rails. When speed of ring is v, current induced in section PQ is $\frac{2Brv}{nR}$ find the value of 'n'.



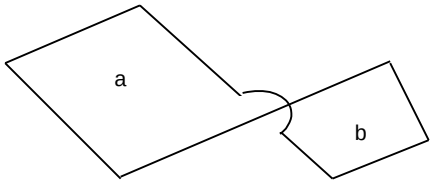
2. **0.25**

3. A rod of length 1 m rotates about one of its end point with an angular velocity 2 rad/ sec in a plane perpendicular to the magnetic field B = 2T as shown in the figure. Then find magnitude of electric field(In SI unit) at the mid point of the rod



3. **2**

4. A plane loop, shaped as two squares of sides a = 1m and b = 0.4 m is introduced into a uniform magnetic field perpendicular to the plane of loop. The magnetic field varies as B = 10^{-3} sin 100 t. Find the amplitude of current induced(In A) in the loop if resistance per unit length is r = 5 mΩ m^{-1}. The inductance is negligible.

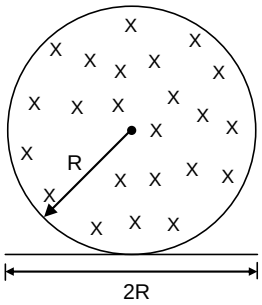


4. **3**

5. A charged particle is projected in a magnetic field $\vec{B} = \left(x\hat{i} + 4\hat{j}\right)10^{-2}\,T$. The acceleration of the particle is found to be a, where $\vec{a} = \left(5\hat{i} - 2\hat{j}\right)m/s^2$. Find the value of 'x'.

5. **1.60**

6. A uniform but time varying magnetic field is present in a circular region of radius R = 4 m. The magnetic field is perpendicular and into the plane of the paper and the magnitude of the field is increasing at a constant rate $\alpha = \frac{1}{\pi}$ T sec^{-1}. There is a straight conducing rod of length 2R placed as shown in the figure. Find the magnitude of induced emf (in volt) across the rod.



6. **4**

SECTION-2 : CHEMISTRY

PART – A

(Single Correct Choice Type)

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

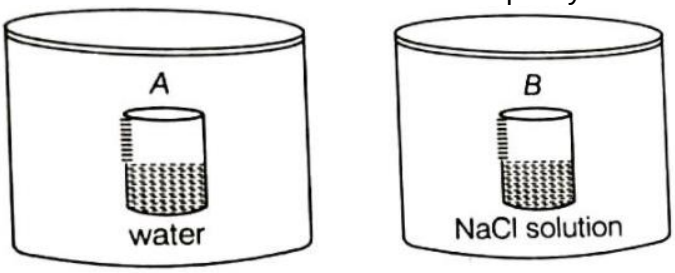
1. For H_3PO_3 and H_3PO_4 the correct choice is
   (A) H_3PO_3 is dibasic and reducing
   (B) H_3PO_3 is dibasic and non-reducing
   (C) H_3PO_4 is tribasic and reducing
   (D) H_3PO_3 is tribasic and non-reducing

1. A

2. The gases produced in the reaction, $Pb(NO_3)_2 \xrightarrow{\Delta}$ and $NH_4NO_3 \xrightarrow{\Delta}$ are respectively
   (A) N_2O, NO
   (B) N_2O, NO_2
   (C) NO, NO_2
   (D) NO_2, N_2O

2. D

3. Two beakers of capacity 500 mL were taken. One of these beakers, labelled as "A", was filled with 400 mL water whereas the beaker labelled "B" was filled with 400 mL of 2 M solution of NaCl. At the same temperature both the beakers were placed in closed containers of same material and same capacity as shown in figure.

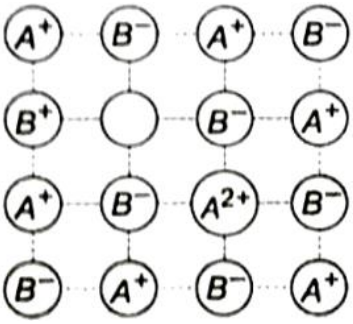


   At a given temperature, which of the following statement(s) is/are correct about the vapour pressure of pure water and that of NaCl solution.
   (A) vapour pressure in container A is more than that in container B
   (B) vapour pressure in container A is less than that in container B
   (C) vapour pressure is equal in both the containers
   (D) vapour pressure in container A is twice the vapour pressure in container B

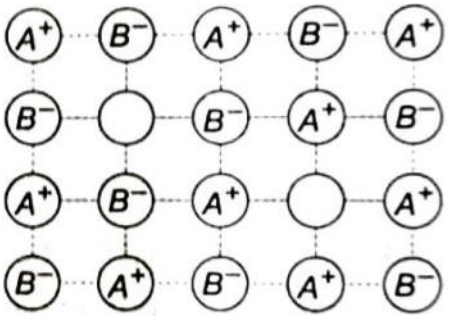
3. A

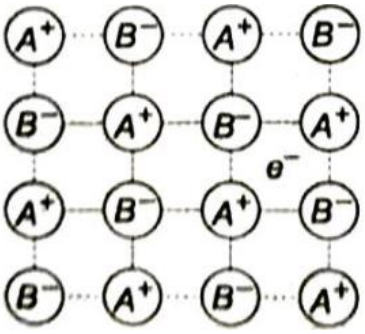
4. Which of the following represents incorrect defect in crystals?

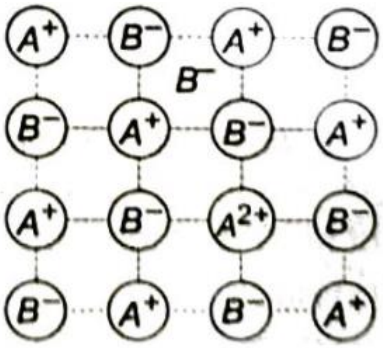
(A)



(B)



(C) 

(D) 

4. D

5. For the non-equilibrium process,

$A + B \longrightarrow$ products

The rate is first order with respect to A and second order wrt B.
When [A] = 1.0 M, [B] = 1.0 M, rate = 1.0×10^{-2} Ms^{-1}
When 50% of each of reactant has been converted into products, rate is
(A) 1.25×10^{-3} Ms^{-1} (B) 1.0×10^{-2} Ms^{-1}
(C) 2.50×10^{-3} Ms^{-1} (D) 2.0×10^{-2} Ms^{-1}

5. A

6. For a reaction of the type $X_1 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} Y$

$[X]_0$ is the concentration of X at time t = 0 and [X] is the concentration of [X] at time t = t. Thus, correct rate expression is

(A) $\frac{-d[X]}{dt} = k_1[X]_0 - (k_1 + k_2)[X]$ (B) $\frac{-d[X]}{dt} = (k_1 + k_2)[X] - k_2[X]_0$

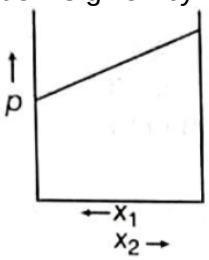
(C) $\frac{-d[X]}{dt} = (k_1 + k_2)[X]_0 - k_2[X]$ (D) $\frac{-d[X]}{dt} = (k_1 - k_2)[X] - k_2[X]_0$

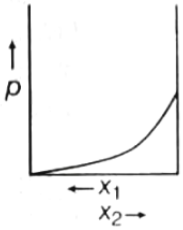
6. B

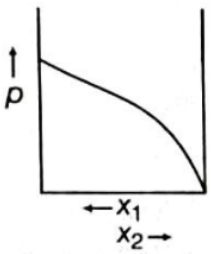
(Multi Correct Choice Type)

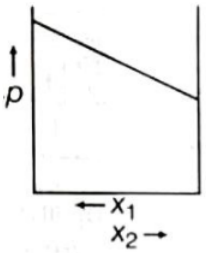
This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. For a binary ideal liquid solution, the variation in total vapour pressure versus composition of solution is given by which of the curves?

(A) 

(B) 

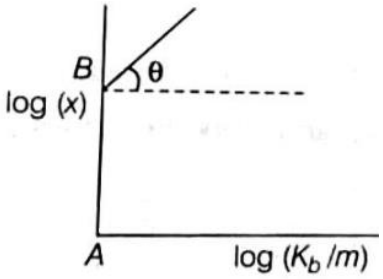
(C) 

(D) 

7. AD

8. 10% aqueous solution of a non-electrolyte solute of molar mass(m) has elevation in boiling point x^o, then

(A) graphically



(B) AB = 2 and $\tan\theta = 1$

(C) x is dependent on $\left(\frac{K_b}{m}\right)$

(D) $\log\left(\frac{K_b}{m}\right) \to 0$, when boiling point of the solution is twice the boiling point of water (in ^oC)

8. ABCD

9. Which of the following statement(s) is/are correct?
(A) The CN of each type of ion in CsCl crystal is 8
(B) A metal that crystallizes in bcc structure has a CN of 12
(C) A unit cell of an ionic crystal shares some of its ions with other unit cells
(D) the length of the unit cell is NaCl is 552 pm
$\left(r_{Na^+} = 95\text{ pm}; r_{Cl^-} = 181\text{ pm}\right)$

9. ACD

10. In the following reaction,
$CH_3COOC_2H_5 + H_2O \longrightarrow CH_3COOH + C_2H_5OH$
At a given time
$-\frac{d[CH_3COOCH_5]}{dt} = 1.0 \times 10^{-5} Ms^{-1}$ at 0.1 M
Thus
(A) k = 1.0 × 10^{-4} M^{-1} s^{-1} for pseudo unimolecular reaction
(B) k = 1.8 × $10^{-6}M^{-1}$ s^{-1} for bimolecular reaction
(C) k = 1. × $10^{-4}M^{-1}$ s^{-1} for bimolecular reaction
(D) k = 1.8 × $10^{-6}M^{-1}$ s^{-1} for pseudo unimolecular reaction

10. AB

11. Which one of the following reactions of xenon compounds are not feasible?
(A) $3XeF_4 + 6H_2O \longrightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$
(B) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$
(C) $XeF_6 + RbF \longrightarrow Rb[XeF_7]$
(D) $XeO_3 + 6HF \longrightarrow XeF_6 + 3H_2O$

11. D

12. Radii of A^+ and that of X^- and Y^- have been given as
$A^+ = 1.00$ pm
$X^- = 1.00$ pm
Y = 2.00 pm
Thus, ratio of volume of AX and AY unit cell is
(A) 0.057 (B) 1.0
(C) 0.217 (D) 17.54

12. A

PART – B
(Numerical based)

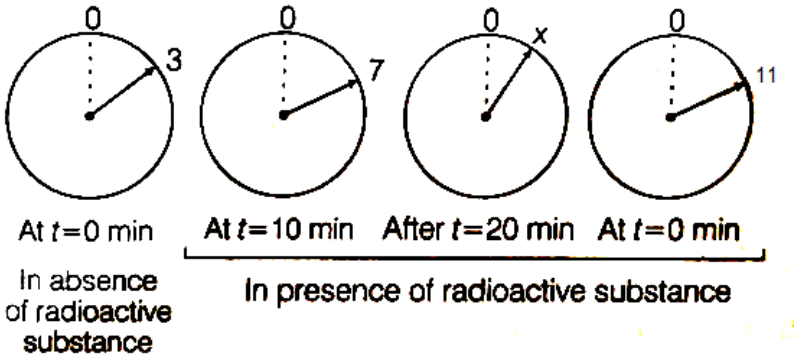
13. 75.2 g of C_6H_5OH(phenol) is dissolved in 800 g solvent of $K_f = 14$. If the depression in freezing point is 7 K, then find the percentage of phenol that dimerises.

13. 100

14. The vapour pressure of pure benzene C_6H_6 at 50°C is 260 Torr. How many moles of non-volatile solute per mole of benzene are required to prepare a solution of benzene having a vapour pressure of 167.0 Torr at 50°C?

14. 0.60

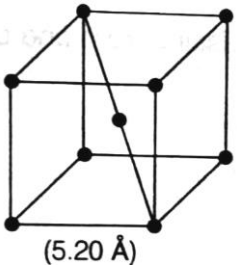
15. Radioactive decay is studies by G.M. counter which records it in CPS(Counts per second)



If radioactive decay follows first-order kinetics, what is the value of x?

15. 5

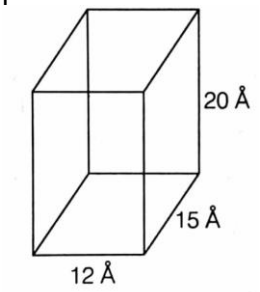
16. Potassium crystallizes in a bcc lattice as shown.



Ratio of distances between nearest neighbours and next nearest neighbour is

16. 0.87 (Range 0.86 – 0.87)

17. A newly synthesized copper complex with molecular formula $C_{11}H_{29}N_5B_2Cu$(molar mass = 316.5 g mol^{-1}) is found to crystallizes in the orthorhombic system with following parameters.

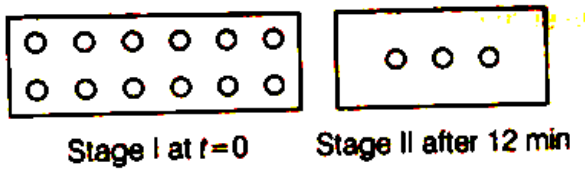


Density = 1.17 g cm^{-3}

Thus, the number of molecules of the complex per unit cell is

17. 8.01(Range 8.00 to 8.01)

18. Two stages of a reaction following rate law $\frac{-d[A]}{dt} = k[A]$ are shown as



What is the half-life period (in minutes)?

18. 4

SECTION-3 : MATHEMATICS

PART – A

(Single Correct Choice Type)

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

1. If the line x + y = 1 touches the parabola $y^2 - y + x = 0$, then the co-ordinates of the point of contact are

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

   (C) (0, 1) (D) (1, 0)

1. C

2. The common tangent to the circles $x^2 + y^2 = 4$ and $x^2 + y^2 + 6x + 8y - 24 = 0$ also passes through the point

   (A) (–4, 6) (B) (6. –2)

   (C) (–6, 4) (D) (4, –2)

2. B

3. The line x = y touches a circle at the point (1, 1). If the circle also passes through the point (1, –3), then its radius is

   (A) $3\sqrt{2}$ (B) 3

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

3. D

4. The locus of the point such that the tangents drawn from it to the circle $x^2 + y^2 - 6x - 8y = 0$ are perpendicular to each other, is

   (A) $x^2 + y^2 - 6x - 8y - 25 = 0$ (B) $x^2 + y^2 + 6x - 8y - 5 = 0$

   (C) $x^2 + y^2 - 6x + 8y - 5 = 0$ (D) $x^2 + y^2 - 6x - 8y + 25 = 0$

4. A

5. The locus of mid points of the chords of the circle $x^2 - 2x + y^2 - 2y + 1 = 0$ which are of unit length is

   (A) $(x - 1)^2 + (y - 1)^2 = \frac{3}{4}$ (B) $(x - 1)^2 + (y - 1)^2 = 2$

   (C) $(x - 1)^2 + (y - 1)^2 = 4$ (D) none of these

5. A

6. The sum of coordinate of point on curve $x^2 = 4y$ which is at minimum distance from the line $y = x - 4$ is equal to

   (A) 9 (B) 3

   (C) 7 (D) 8

6. B

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. The equation of straight line equally inclined to the axes and equidistant from the point (1, -2) and (3, 4) is
(A) x + y = 3 (B) x – y + 1 = 0
(C) y – x = 2 (D) y – x + 1 = 0

7. AD

8. If the vertex of the parabola $y = x^2 – 8x + c$ lies on x-axis then the value of 'c' **CANNOT** be
(A) 13 (B) 16
(C) 19 (D) 17

8. ACD

9. Two sides of a rhombus OABC (lying entirely in first quadrant or third quadrant) of area equal to 2 sq. units, are $y = \frac{x}{\sqrt{3}}$, $y = \sqrt{3}x$. Then possible coordinates of B is / are ('O' being the origin)
(A) $\left(1+\sqrt{3},\ 1+\sqrt{3}\right)$ (B) $\left(-1-\sqrt{3},\ -1-\sqrt{3}\right)$
(C) $\left(\sqrt{3}-1,\ \sqrt{3}-1\right)$ (D) none of these

9. AB

10. The tangent to the parabola $y^2 = 4x$ at the point where it intersects the circle $x^2 + y^2 = 5$ in the first quadrant, **NOT** passes through the point:
(A) $\left(-\frac{1}{3},\frac{4}{3}\right)$ (B) $\left(\frac{3}{4},\frac{7}{4}\right)$
(C) $\left(-\frac{1}{4},\frac{1}{2}\right)$ (D) $\left(\frac{1}{4},\frac{3}{4}\right)$

10. ACD

11. If $ax^2 - 6xy + y^2 + bx + cy + d = 0$ is pair of lines whose slopes are m and m^2 then a is /are
(A) a = -8 (B) a = 8
(C) a = 27 (D) a = - 27

11. BD

12. If the circles $x^2 + y^2 = 25$ and $x^2 + y^2 + 2ax + 2y + 1 = 0$ touch each other, then a may be
(A) $\frac{14}{5}$ (B) $\frac{12}{5}$
(C) $\frac{-14}{5}$ (D) $\frac{-12}{5}$

12. BD

PART – B
(Numerical based)

1. The sum of values of λ for which the equation $x^2 - \lambda xy + 2y^2 + 3x - 5y + 2 = 0$ may represent a pair of straight lines, is

1. 7.5

2. Given the two ends of the latus rectum, the maximum number of parabolas that can be drawn is

2. 2

3. Angle between two focal chords of a parabola $(y-5)^2 = 8(x-1)$ which are tangents to the circle $x^2 + y^2 = 9$ is $\tan^{-1}\left(\frac{a}{b}\right)$, where a and b relatively prime number, then (a – b) is

3. 7

4. The equation of directrix of the parabola $y^2 + 4y + 4x + 2 = 0$ is $x = k$ then k is

4. 1.5

5. Let ABCD be a trapezium in which AB is parallel to CD, AB = 11, BC = 4, CD = 6 and DA = 3. The distance between AB and CD is

5. 2.4

6. The radius of circle which passes through the focus of the parabola $x^2 = 4y$ and touches it at point (6, 9) is $k\sqrt{10}$, then k is equal to?

6. 5

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B