FIITJEE (JEE-Advanced)

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-2 | **QP CODE:** | **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 186**

- 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.

BATCH –

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 & B** 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 All Two Parts.

(i) **Part-A (01-04) –** Contains Six (04) 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** (**05–12)** contains (8) Multiple Choice Questions which have **One or More Than One 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-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 **+3 marks** for correct answer. **There is no negative marking.**

Name of the Candidate :_____

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

Enrolment Number :_____

SECTION-1 : PHYSICS

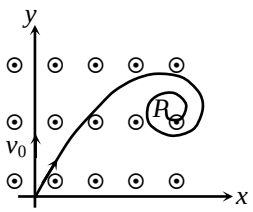
PART – A

(Single Correct Choice Type)

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

1. A radioactive sample has decay constant λ. The rate of production of nuclei in the given sample is $\frac{9\lambda N_0^2}{N}$, where N_0 is the number of radioactive nuclei in the sample at t = 0 and N is the number of radioactive nuclei in the sample at time t sec. If the number of nuclei present in the radioactive sample at $t \to \infty$ is m x 10^6 nuclei then find the value of m (Given $N_0 = 10^6$ nuclei)
(A) 1 (B) 2 (C) 3 (D) 4

2. A particle having mass *m*, charge *q* is projected with velocity v_0 along *y*-axis in a region of uniform magnetic field B_0 which is outward and perpendicular to the plane of the paper as shown in the figure. The particle is continuously subjected to a frictional force which varies with velocity as $\vec{F}_r = -\alpha\vec{v}$, where α is a constant. Consequently the particle moves on a spiral path till it comes to rest at point *P*. The *x*- co-ordinate of point *P* is



(Take $\alpha = 10^{-3}$ kg/s, $q = 10^{-3}$ C, $B_0 = 1$T, $v_0 = 1$m/s, m = 20 gm)
(A) 10 m (B) 4 m (C) 6 m (D) 8 m

3. A certain sample of monoatomic ideal gas is subject to a thermodynamic process in which V and T are related as $V^2 = kT$ (k is constant). The molar specific heat of the gas in this process is
(A) $\frac{3R}{2}$ (B) 2R (C) $\frac{5R}{2}$ (D) $\frac{7R}{2}$

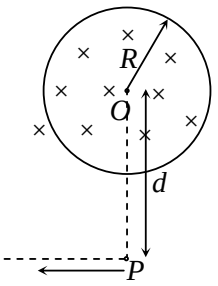
4. In young's double slit experiment, the separation between two coherent sources S_1 and S_2 is d and the distance between the source and screen is D. In the interference pattern, it is found that exactly in front of one slit, there occurs a minimum. The possible wavelengths used in the experiment are
(A) $\lambda = \frac{d^2}{D}, \frac{d^2}{3D}, \frac{d^2}{5D}$ (B) $\lambda = \frac{d^2}{D}, \frac{d^2}{5D}, \frac{d^2}{9D}$
(C) $\lambda = \frac{d^2}{D}, \frac{d^2}{5D}, \frac{d^2}{3D}$ (D) $\lambda = \frac{d^2}{3D}, \frac{d^2}{7D}, \frac{d^2}{11D}$

(Multi Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

5. A vibrating string produces 2 beats per seconds when sounded with a turning fork of frequency 256 Hz. increasing the tension in the string produces 3 beats per second. The initial frequency of the string may have been
(A) 253 Hz (B) 254 Hz
(C) 258 Hz (D) 259 Hz

6. In a cylindrical region of radius R, there exists a time varying magnetic field B such that $\frac{dB}{dt} = k(>0)$. A charged particle having charge q is placed at the point P at a distance d (> R) from its centre O. Now, the particle is moved in the direction perpendicular to OP (see figure) by an external agent upto infinity so that there is no gain in kinetic energy of the charged particle. Choose the correct statement/s.



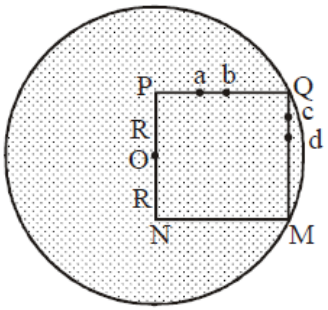
(A) Work done by external agent is $\frac{q\pi R^2}{4}k$ if d = 2R

(B) Work done by external agent is $\frac{q\pi R^2}{8}k$ if d = 4R

(C) Work done by external agent is $\frac{q\pi R^2}{4}k$ if d = 4R

(D) Work done by external agent is $\frac{q\pi R^2}{4}k$ if d = 6R

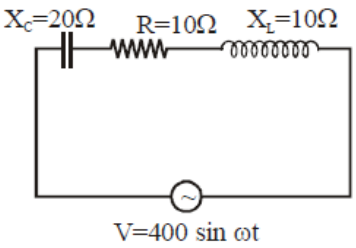
7. Magnetic field is varying in a cylindrical region of radius 3R. A square frame of wire (side 2R) is present n the field such that magnetic lines are perpendicular to its plane, one of its side is along a diameter of the circular region in which the rectangular plate is present and mid point of this side is at the centre of the field. The magnitude of component of induced electric field along the length of the wire at point a, b, c and d are E_a, E_b, E_c and E_d respectively then choose correct option(s).



(A) $E_a = E_b$ (B) $E_c = E_d$

(C) $E_a > E_c$ (D) $E_b < E_d$

8. 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) rms voltage drop across resistance is 200 V

9. Choose from following the correct alternatives.

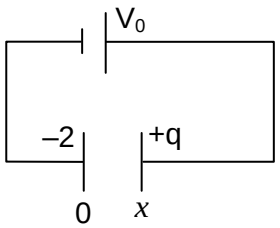
(A) Random error is minimized by taking the arithmetic mean of a large number of observations.

(B) The source of random error is known and hence it can be corrected completely.

(C) The source of random error is not known and analysis is done by statistical methods

(D) Zero error of an apparatus can be corrected completely.

10. Two plates of a parallel plate capacitors carry changes q and –q and are separated by a distance x from each other. The capacitor is connected to a constant voltage source V_o. The distance between the plates is changed to $x + dx$. Then in steady state.



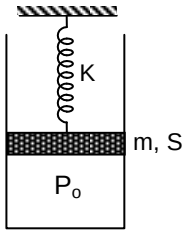
(A) change in electrostatic energy stored in the capacitor is $\frac{-Udx}{x}$, where U is initial potential energy.

(B) force on right plate = $\frac{U}{x}$

(C) force on right plate = $-\frac{U}{x}$

(D) none of these

11. In the arrangement shown in figure, gas is thermally insulated. An ideal gas is filled in the cylinder having pressure P_0 (> atmospheric pressure P_a). The spring of force constant K is initially unstretched. The piston of mass m and area S is frictionless. In equilibrium the piston rises up by distance x_0, then



(A) final pressure of the gas is $P_a + \frac{Kx_0}{S} + \frac{mg}{S}$

(B) work done by the gas is $\frac{1}{2}Kx_0^2 + mgx_0$

(C) decrease in internal energy of the gas is $\frac{1}{2}Kx_0^2 + mgx_0 + P_aSx_0$

(D) all of the above

12. The bodies *A* and *B* have thermal emissivities of 0.01 and 0.81 respectively. The outer surface areas of the two bodies are equal. The two bodies emit total radiant power at the same rate. The wavelength λ_B corresponding to maximum spectral radiancy in the radiation from *B* is shifted from the wavelength corresponding to maximum spectral radiancy in the radiation from *A*, by 1.00 μm. If the temperature of *A* is 5802 K:

(A) the temperature of *B* is 1934 K (B) λ_B = 1.5 μm

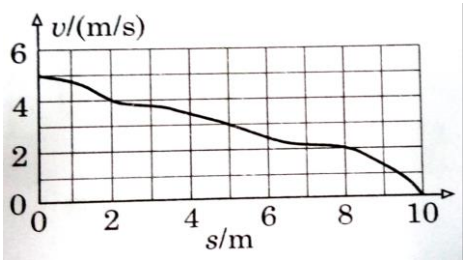
(C) the temperature of *B* is 1160 K (D) the temperature of *B* is 2901 K

PART – B

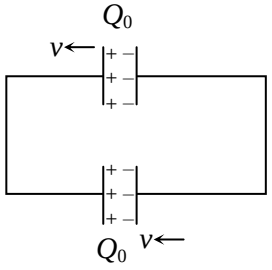
(Numerical based)

This section contains 6 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)

1. On a horizontal surface of non-uniform texture, friction varies from point to point. On this surface a small disc projected with speed 5 m/s covers 10 m along a straight path before it stops. Variation in speed v of the disc with distance s covered is shown in the figure. If the disc is projected with speed 4 m/s from the same initial point in the same direction, how much total distance will it cover in cm?

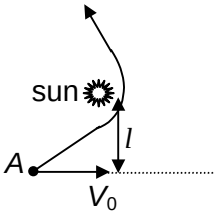


2. Two identical capacitor connected as shown and having initial charge Q_0. Separation between plates of capacitor is d_0. Suddenly the left plate of upper capacitor and right plate of lower capacitor start moving with speed *v* towards left while other plate of capacitor remains fixed. (given $\frac{Q_0 v}{2d}$ =1 amp). Find the value of current (in mili-amp) in the circuit.

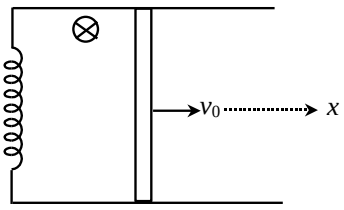


3. A uniform disc of radius R having charge Q distributed uniformly all over its surface is placed on a smooth horizontal surface. A magnetic field, $B = kxt^2$, where k is a constant, x is the distance (in metre) from the centre of the disc and t is the time (in second), is switched on perpendicular to the plane of the disc. Find the torque (in N-m) acting on the disc after 15 sec. (Take 4kQ = 1 S.I. unit and R = 1 m)

4. A cosmic body A moves towards sun with velocity v_0 (when far from the sun) and aiming parameter l and arm of velocity vector v_0 relative to the centre of the sun as shown in figure. If the minimum distance by which this body will get to the sun $\frac{GM}{nv_0^2}\left[\sqrt{1+\left(\frac{lv_0^2}{GM}\right)^2}-1\right]$. Then the find value of n (Mass of the sun is M).



5. A loop is formed by two parallel conductors connected by a solenoid with inductance L = 2H and a conducting rod of mass m = 8kg which can freely (without friction) slide over the conductors. The conductors are located in a horizontal plane and in a uniform vertical magnetic field B= πT. The distance between the conductors is l = 2m. At the moment t = 0, the rod is imparted on initial velocity v0 = 2m/s directed to the right. Find the time period of oscillation of rod in sec if the resistance of loop is negligible.



6. An imaginary particle has a charge equal to that of an electron and mass 100 times the mass of the electron. It moves in a circular orbit around a nucleus of charge (+4e). Take the mass of nucleus to be infinite. Assuming that the Bohr's model is applicable to this system. Find the wavelength of the radiation emitted, when the particle jumps from fourth orbit to the second orbit.(In nm)

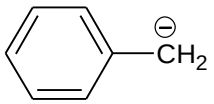
SECTION-2 : CHEMISTRY

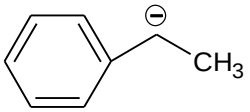
PART – A

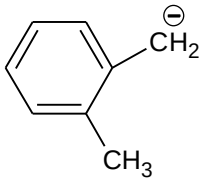
(Single Correct Choice Type)

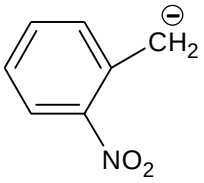
This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Which of the following carbanion is most stable?

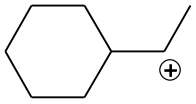
(A) 

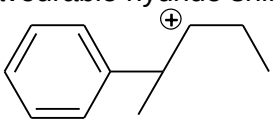
(B) 

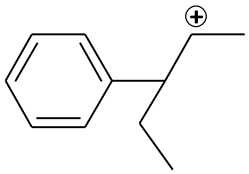
(C) 

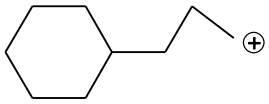
(D) 

2. Which of the following is most likely to undergo a favourable hydride shift?

(A) 

(B) 

(C) 

(D) 

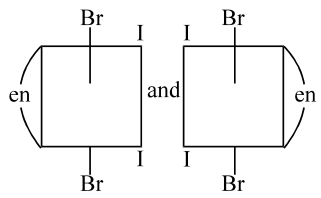
3. $Y \xleftarrow[\text{Liquid } NH_3]{Na} H_3C-C\equiv C-CH_3 \xrightarrow{H_2/Ni} X$

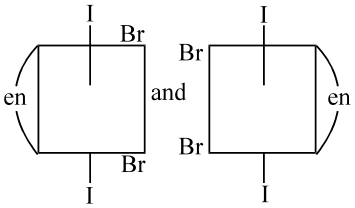
Products (X) and (Y) in the above reaction are respectively.

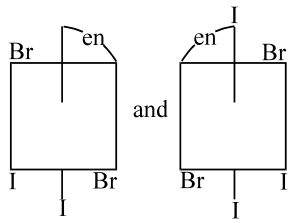
(A) cis – 2 – butene and trans – 2 – butene (B) trans – 2 – butene and cis – 2 – butene

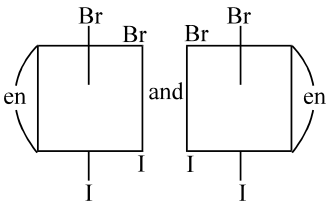
(C) trans – 2 – butene and n – butane (D) cis – 2 – butene and n – butane

4. The complex ion has two optical isomers. Their correct configurations are:

(A) 

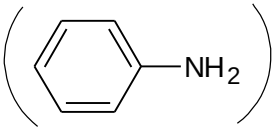
(B) 

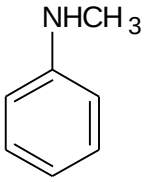
(C) 

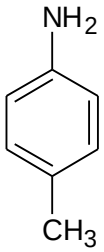
(D) 

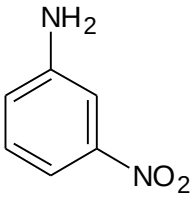
(Multi Correct Choice Type)

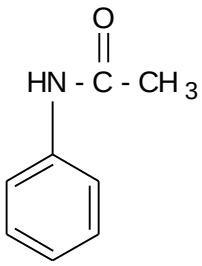
This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

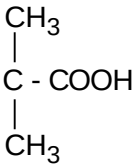
5. Which of the following compound(s) is/are more basic than aniline  ?

(A) 

(B) 

(C) 

(D) 

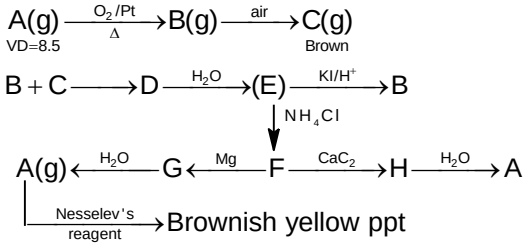
6. The molecular formula of a monocarboxylic acid is $C_5H_{10}O_2$. Choose correct statement regarding the isomers of the acid.
(A) The isomer having highest acidic strength is $CH_3CH_2CH_2CH_2COOH$.
(B) The isomer with least acidic strength is 
(C) The IUPAC name of the isomer with highest value of K_a is n-pentanoic acid.
(D) The isomer having the highest value of p^{K_a} contains a 4^o – carbon atom

7. The rate of a first order chemical reaction can be increased by
(A) increasing temperature
(B) increasing the concentration of reactant
(C) decreasing the activation energy
(D) adding a positive catalyst

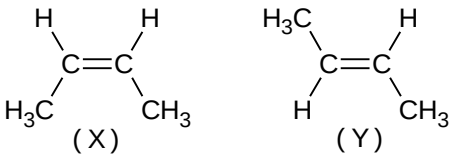
8. $MgCO_3(s) \rightleftharpoons MgO(s) + CO_2(g);\ \Delta H = +ve$
The yield of CO_2 in the above system can be increased by
(A) adding more $MgCO_3$ into the system
(B) removing MgO from the system
(C) increasing the volume of reaction vessel
(D) increasing temperature

9. The standard electrode potentials of two metals M and N are given below:
$E^0_{M^{2+}/M} = -0.5\,volt$ and $E^0_{N^{2+}/N} = -0.2\,volt$
Choose correct statement(s) from the following.
(A) The reaction, $M + N^{2+} \longrightarrow M^{2+} + N$ is feasible
(B) The reaction $N + M^{2+} \longrightarrow N^{2+} + M$ is feasible
(C) The standard potential of the cell $M|M^{2+}||N^{2+}|N$ is 0.3 volt
(D) The standard potential of the cell $M|M^{2+}||N^{2+}|N$ is -0.3 volt

10. The boiling point of the aqueous solutions of which of the following compound(s) is/are higher than 100°C?
(A) $C_6H_{12}O_6$ (B) $CaCl_2$
(C) NaCl (D) $AlCl_3$

11. 

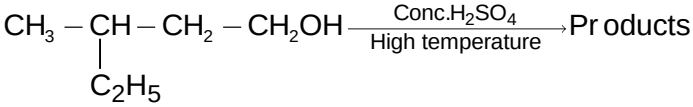
Which of the following is/are correct?
(A) B is NO (B) F is N_2
(C) H is $Ca(CN)_2$ (D) A is NH_3

12. 

Choose the correct property/properties of (X) and (Y)
(A) Boiling point: X > Y (B) Melting point: X < Y
(C) Heat of hydrogenation: X > Y (D) Dipole moment: X > Y

PART – B
(Numerical based)

This section contains 6 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)

1. 

How many product(s) of above reaction exhibit(s) geometrical isomerism?

2. An optical active amino acid(A) can exist in three forms depending upon the pH of the medium. The molecular formula of (A) is $C_3H_7NO_2$. How many hydrogen atom(s) is/are present in (A) in basic medium?

3. The molecular mass of a polyhydric alcohol increases by 252 unit if it reacts with CH_3COCl in presence of pyridine. How many OH group(s) is/are present in the alcohol?

4. How many carbon atom(s) is/are present in the simplest optical active amino acid?

5. What is the value of $\left(\frac{\Lambda_m}{\Lambda_e}\right)$ for the solution of $Ca_3(PO_4)_2$?

6. A sample of 10 cm^3 of 0.10 mol dm^{-3} iron (II) sulphate is titrated against 0.025 mol dm^{-3} patassium permaganate (VII) in the presence of an excess of fluoride ions. It is found that 10.0 cm^3 of the manganate (VII) solution is required to reach the end point. What is the oxidation number of the manganese at the end point ?

SECTION-3 : 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. $\lim\limits_{x\to\infty}\left\{\cos 2\left(\ln\left(x-1\right)-\ln\left(x+1\right)\right)\right\}^{(x+1)^2}$ is equal to

   (A) e^{-8} (B) 0

   (C) ∞ (D) $-e^{-1}$

2. If $x=111....1(20\text{ digits}), y=333....3(10\text{ digits})$ and $z=222.....2(10\text{ digits})$, then $\frac{x-y^2}{z}=$

   (A) 1 (B) 2

   (C) 1/2 (D) 3

3. If $f:R\to R$ defined as $f(x)=x^3+2x+3$ and $g(x)$ be the inverse, then $g''(3)=$

   (A) 3 (B) 0

   (C) 6 (D) –1

4. $\sum\limits_{r=1}^{50}\left(\frac{1}{49+r}-\frac{1}{2r(2r-1)}\right)=$

   (A) $\frac{1}{50}$ (B) $\frac{1}{99}$

   (C) $\frac{1}{100}$ (D) $\frac{1}{101}$

(Multi Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

5. If $\lim\limits_{x\to\infty}4x\left(\frac{\pi}{4}-\tan^{-1}\frac{x+1}{x+2}\right)=y^2+4y+5$, then y can be equal to

   (A) 1 (B) -1

   (C) -4 (D) -3

6. A curve $g(x)=\int x^{27}\cdot(1+x+x^2)^6\cdot(6x^2+5x+4)dx$ is passing through origin, then

   (A) $g(1)=\frac{3^7}{7}$ (B) $g(1)=\frac{2^7}{7}$

   (C) $g(-1)=\frac{1}{7}$ (D) $g(-1)=\frac{3^7}{14}$

7. The domain of $f(x)=\cos^{-1}\left(\frac{2\left[|\sin x|+|\cos x|\right]}{\sin^2 x+\sin x+\frac{11}{4}}\right)$ contains

   (A) $[0,\pi]$ (B) $\left[\frac{\pi}{6},\frac{7\pi}{6}\right]$

(C) $\left[\frac{5\pi}{3}, 2\pi\right]$ (D) $\left[\frac{11\pi}{6}, 2\pi\right]$

8. Let $\alpha_1 = \int_0^1 \frac{e^x dx}{1+x}$ or $\alpha_2 = \int_0^1 \frac{x^2}{e^{x^3}(2-x^3)} dx$ then

(A) $0 < \alpha_1 < \alpha_2$ (B) $\alpha_1 > \alpha_2 > 0$
(C) $\alpha_1 = 3e\alpha_2$ (D) $\alpha_2 = 3e\alpha_1$

9. Let $A = \{1^2, 3^2, 5^2, ...\}$, 9 elements are selected from set A to make a matrix B of order 3×3, then $\det(B)$ will divisible by

(A) 9 (B) 36
(C) 8 (D) 64

10. If a,b,c,d are complex numbers, then the determinant

$$\begin{vmatrix} 2 & a+b+c+d & ab+cd \\ a+b+c+d & 2(a+b)(c+d) & ab(c+d)+cd(a+b) \\ ab+cd & ab(c+d)+cd(a+b) & 2abcd \end{vmatrix}$$ is independent of

(A) a (B) b
(C) c (D) d

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

(A) $f(2) + f\left(\frac{1}{2}\right) = 1$

(B) $f(2) + f(1) = f\left(\frac{1}{2}\right)$

(C) $f(2) + f(1) = 0$
(D) $f(1) = -1$, but $f(2)$ and $f(1/2)$ can not be obtained

12. The contents of 3 urns 1st, 2nd , 3rd respectively are as follows:
1 white, 2 black, 3 red balls;
2 white, 1 black, 1 red balls;
4 white, 5 black, 3 red balls
one urn is selected at random and two balls drawn and these happen to be white and red. Then the probability that they come from

(A) 1st urn is $\frac{36}{118}$ (B) 2nd urn is $\frac{55}{118}$
(C) 3rd urn is $\frac{33}{118}$ (D) 3rd urn is $\frac{30}{118}$

PART – B

(Numerical based)

This section contains 6 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)

1. If $\int_{-\pi/4}^{3\pi/4} \frac{e^{\pi/4}dx}{\left(e^x + e^{\frac{\pi}{4}}\right)(\sin x + \cos x)} = \frac{\sqrt{2}}{k}\int_{-\pi/2}^{\pi/2} \sec x\,dx$ then k is

2. If $f(n) = \sum_{r=1}^{n}\left[r^2\left({}^nC_r - {}^nC_{r-1}\right) + (2r+1)\left({}^nC_r\right)\right]$, and f(30) is equal to $30(k+30)$ then k =

3. A bag contains a white balls and b black balls. Two players A and B alternately draw a ball from the bag, replacing the ball each time after the draw till one of them draws a white ball and wins the game. A begins the game. If the probability of A winning the game is three times that of B, then $\frac{a}{b}$ =_____.

4 Let $A(\alpha,0), B(\beta,0), C(\gamma,0), D(\delta,0)$ and α,β are the roots of equation $ax^2 + 2hx + b = 0$ while γ,δ are the those of $a_1x^2 + 2h_1x + b_1 = 0$ if C and D divides AB in the ratio $\lambda:1$ and $\mu:1$ respectively also ab_1, hh_1, a_1b are in A.P., then $\lambda + \mu$ is equal to _____

5. Consider the function $f(x) = x^2 - 3x + 2, \forall x \in \mathbb{R}$. .If the area bounded by the curve $y = |f(|x|)|$ between $1 \le |x| \le 2$ and x-axis is A then (12A) equals

6. If the lines $\lambda x + (k-4)y + 2 = 0$ and $x + y - 1 = 0$ where $\lambda, k \in R^+$ are perpendicular lines, then max. value of $\lambda^2k^2 + 2\lambda k + 3$ is:

ANSWERS

PHYSICS

PART – A

1.	**C**	2.	**A**	3.	**B**	4.	**A**
5.	**BC**	6.	**ACD**	7.	**ABD**	8.	**ABCD**
9.	**ACD**	10.	**AC**	11.	**AC**	12.	**AB**

PART – B

1.	**500**	**2**.	**2000**	**3**.	**1**	**4**.	**1**
5.	**4**	**6**.	**0.30**				

CHEMISTRY

PART – A

1.	**D**	2.	**B**	3.	**C**	4.	**D**
5.	**AB**	6.	**ABCD**	7.	**ABCD**	8.	**CD**
9.	**AC**	10.	**ABCD**	11.	**ABCD**	12.	**ABCD**

PART – B

1.	**1**	**2**.	**6**	**3**.	**6**	**4**.	**3**
5.	**6**	**6**.	**3**				

MATHEMATICS

PART – A

1.	**A**	2.	**A**	3.	**B**	4.	**C**
5.	**BD**	6.	**AC**	7.	**ABCD**	8.	**BC**
9.	**CD**	10.	**ABCD**	11.	**ABC**	12.	**BD**

PART – B

1.	**4.00**	**2**.	**2.00**	**3**.	**2.00**	**4**.	**0.00**
5.	**4.00**	**6**.	**27.00**				