FIITJEE (JEE-Advanced)

BATCHES – All Two Yr CRP224 Batches

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - 2 | **QP Code: 100186** | **Common TEST - 6**

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 Six (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 **to Two decimal places** (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

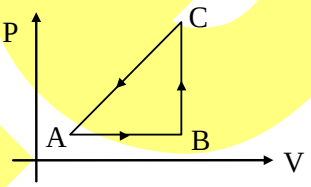
PART – A

(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. When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is:
   (A) 2/5 (B) 3/5
   (C) 3/7 (D) 5/7

2. An enclosed gas is taken through a cycle as shown in the figure:
   (A) along AB, the temperature increases, while along BC the temperature decreases
   (B) along AB, the temperature decreases, while along BC, temperature increases
   (C) along CA, work is done on the gas, and the internal energy of the gas decreases.
   (D) along CA, work is done by the gas and the internal energy remains constant.



3 Two mole of argon are mixed with one mole of hydrogen, then C_p/C_v for the mixture is nearly
   (A) 1.2 (B) 1.3
   (C) 1.4 (D) 1.5

4. 840 J of heat is required to raise the temperature of 2g moles of an ideal gas from 20°C to 40°C at constant pressure. The amount of heat required to raise the temperature of the same gas from 40°C to 60°C at constant volume is (take R = 8.4 J g.mole^{-1} k^{-1})
   (A) 504 J (B) 420 J
   (C) 840 J (D) 630 J

5. Three closed vessels A, B and C are at temperature T and contain gases which obey the Maxwellian distribution of velocities. Vessel A contains only O_2, B only N_2 and C a mixture of equal quantities of O_2 and N_2. If the average speed of the O_2 molecules in vessel A is V_1, that of the N_2 molecules in vessel B is V_2, the average speed of the O_2 molecules in vessel C is (where M is the mass of an oxygen molecule).
   (A) $(V_1 + V_2)/2$ (B) V_1
   (C) $(V_1V_2)^{1/2}$ (D) $\sqrt{\frac{3kT}{M}}$

Space For Rough Work

6. An ideal gas is taken from the state A (pressure P, volume V) to the state B (pressure P/2, volume 2V) along a straight line path in the P - V diagram. Select the correct statement(s) from the following:
   (A) The work done by the gas in the process A to B exceeds the work that would be done by it if the system were taken from A to B along an isotherm
   (B) In the T - V diagram, the path AB becomes a part of a parabola
   (C) In the P - T diagram, the path AB becomes a part of a hyperbola
   (D) In going from A to B, the temperature T of the gas first increases to a maximum value and then decreases.

(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. In the isothermal expansion of an ideal gas:
   (A) there is no change in the temperature of the gas
   (B) there is no change in the internal energy of the gas
   (C) the work done by the gas is equal to the heat supplied to the gas
   (D) the work done by the gas is equal to the change in its internal energy.

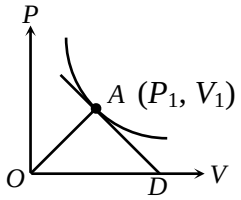
8. When an enclosed perfect gas is subjected to an adiabatic process:
   (A) its total internal energy does not change
   (B) its total internal energy changes
   (C) its temperature does not change
   (D) its pressure varies inversely as a certain power of its volume

9. For an ideal gas:
   (A) the change in internal energy in a constant pressure process from temperature T_1 to T_2 is equal to nC_v $(T_2 - T_1)$, where C_v is the molar specific heat at constant volume and n the number of moles of the gas.
   (B) the change in internal energy of the gas and the work done by the gas are equal in magnitude in an adiabatic process.
   (C) the internal energy does not change in an isothermal process.
   (D) no heat is added or removed in an adiabatic process.

10. A mixture of two diatomic gases X and Y is enclosed in a container at constant temperature.
    The molecular weight of X is 16 times that of Y and mass of the gas X is 2 times that of Y. Then
    (A) The average molecular kinetic energy of X equals that of Y
    (B) The r.m.s. molecular speed of translation of X is 1/4th that of Y.
    (C) The pressure exerted by X is 1/8th that by Y.
    (D) The pressure exerted by X is 8 times that by Y.

Space For Rough Work

11. n moles of an ideal gas undergo an isothermal process at temperature T. P-V graph of the process is as shown in the figure. A point A (V_1, P_1) is located on the P-V curve. Tangent at point A, cuts the V-axis at point D. AO is the line joining the point A to the origin O of PV diagram. Then,



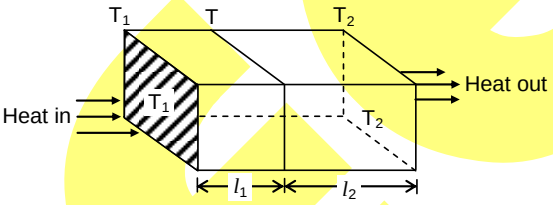
(A) coordinates of points D is $\left(\frac{3V_1}{2}, 0\right)$

(B) coordinates of points D is $(2V_1, 0)$

(C) area of the triangle AOD is nRT

(D) area of the triangle AOD is $\frac{3}{4}$nRT

12. Two plates thickness l_1 and l_2 with thermal conductivities K_1 and K_2 respectively are kept in thermal contact as shown in the figure. If A is area of each face, then mark the correct options.



(A) Thermal resistance of combination is $R = \frac{l_1}{AK_1} + \frac{l_2}{AK_2}$

(B) Heat flow rate through the combination is $H = \frac{A(T_1 - T_2)}{\left(\frac{l_1}{K_1} + \frac{l_2}{K_2}\right)}$

(C) Temperature of joint of slabs is $T = \frac{T_1\frac{l_2}{K_2} + T_2\frac{l_1}{K_1}}{\left(\frac{l_1}{K_1} + \frac{l_2}{K_2}\right)}$

(D) Equivalent thermal conductivity; of combination will be $K_{eq} = \frac{l_1 + l_2}{\left(\frac{l_1}{K_1} + \frac{l_2}{K_2}\right)}$

Space For Rough Work

PART – B
(Numerical based)

1. The specific heat capacity of mono-atomic ideal gas for thermodynamic process $P = \alpha v^2$, is equal to KR. Where α and K are positive constant and R is gas constant. Find the value of K.

2. An amount Q of heat is added to a monatomic ideal gas in a process in which the gas performs a work Q/2 on its surrounding. The molar heat capacity for the process = 2nR. Find 'n'.

3. A steel rod with a cross-sectional area of 150 mm2 is stretched between two fixed points. The tensile load at 20°C is 5000 N. If stress at –20° is $k127\times10^6 N/m^2$ find the value of k. (assume α = 11.7μm/m°C and Y = 200 GN/m^2)

4. A vertical cylinder with a massless piston filled with one mole of an ideal gas. The piston can move freely without friction. The piston is slowly raised so that the gas expands isothermally at temperature 300 K. If the amount of work done in increasing the volume two times is W then find the value of $\frac{W}{250}$ $\left(R = \frac{25}{3} J/mol/K, \log_e 2 = 0.7\right)$

5. If P-V diagram of a diatomic gas is plotted, it is a straight line passing through origin. The molar heat capacity of the gas in the process is nR where n is an integer. Find the value of n.

6. 2 kg of ice at –20°C is mixed with 5 kg of water at 20°C in an insulating vessel having negligible heat capacity. Calculate the final mass of water (in kg) remaining in the container. It is given that the specific heats of water and ice are 1 kcal/kg/°C and 0.5 kcal/kg/°C respectively, while the latent heat of fusion of ice is 80 kcal/kg.

Space For Rough Work

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. $CH_4 + Cl_2 \xrightarrow{h\nu} P + Q + R + S + HCl$

Out of the four products
'P' contains maximum percentage of hydrogen
'Q' is most acidic compound out of the four unknown products
'R' is the product in which the oxidation state of carbon is zero. It contains equal number of hydrogen and chlorine atoms.
What is the molar mass of (S) in g mol^{-1} unit?

(A) 162 (B) 119.5
(C) 154 (D) 85

2. Which sodium salt will form a hydrocarbon having the lowest boiling point, upon Kolbes electrolysis?

(A) $CH_3CH_2\underset{\displaystyle COONa}{\underset{|}{C}}HCH_3$ (B) $CH_3CH_2CH_2CH_2COONa$

(C) $(CH_3)_3CCOONa$ (D) $H_3C\diagdown \quad \diagup CH - CH_2COONa$, $H_3C\diagup$

3. Which forms optical isomers as products when treated with HCl?

(A) Ethylene (B) 2-Butene
(C) Isobutene (D) Propene

4. $CH_3COONa \xrightarrow[\text{Heat}]{\text{Sodalime}} (P) + Na_2CO_3$

The organic product(P) is

(A) the simplest alkane (B) more reactive towards HCl than C_2H_4
(C) contains two carbon atoms (D) the simplest alcohol

5. $CH_3 - CH = CH - C \equiv CH \xrightarrow{H_2/Ni(2eq)} Product$

The major product of above reaction is

(A) $CH_3CH_2CH_2CH = CH_2$ (B) $CH_3CH = CHCH_2CH_3$
(C) $CH_3CH_2CH = CHCH_2CH_3$ (D) $CH_3CH = CHCH = CH_2$

Space For Rough Work

6. $CH_3CH_2C \equiv CCH_3 \xrightarrow{NaNH_2(excess)}$ Product

The product of above reaction is

(A) $CH_3CH_2CH_2C \equiv CH$ (B) $CH_3CH_2CH_2C \equiv C^-Na^+$

(C) Cis-2-pentene (D) Trans-2-pentene

(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. Which of the following reaction(s) produce(s) propene $CH_3CH = CH_2$?

(A) $CH_3CH_2CH_2Cl \xrightarrow{Alc.KOH}$ (B) $CH_3\underset{\displaystyle Cl}{\underset{|}{C}}HCH_2Cl \xrightarrow[\Delta]{Zn\ dust}$

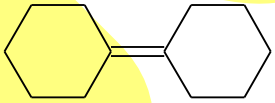
(C) $CH_3CH_2CH_2OH \xrightarrow{Conc.H_2SO_4}$ (D) $CH_3\underset{\displaystyle Cl}{\underset{|}{C}}HCH_3 \xrightarrow{Alc.KOH}$

8. Which reaction(s) form(s) ethyne($HC \equiv CH$)?

(A) $CHCl_3 \xrightarrow[Heat]{Ag}$ (B) $CH_3CHCl_2 \xrightarrow[Heat]{Alcoholic\ KOH}$

(C) $ClCH_2CH_2Cl \xrightarrow{NaNH_2}$ (D) $CH_3CH_2OH \xrightarrow{Conc.H_2SO_4}$

9. Which of the following compound(s) produces at least one ketone(s) upon ozonolysis?

(A) $(CH_3)_2C = CHCH_2CH_3$ (B) 

(C) $(C_2H_5)_2C = C(CH_3)_2$ (D) $CH_3CH_2CH = CHCH_3$

10. Nitration of propane with HNO_3 at high temperature, produce(s)

(A) $CH_3CH_2CH_2NO_2$ (B) $CH_3CH_2NO_2$

(C) CH_3NO_2 (D) $CH_3\underset{\displaystyle NO_2}{\underset{|}{C}}HCH_3$

11. Which of the following form a precipitate with the simplest alkyne?

(A) Na (B) $AgNO_3/NH_4OH$

(C) $CuCl/NH_4OH$ (D) $CuCl/NH_4Cl$

Space For Rough Work

12. Which of the following is/are more reactive than $CH_3CH_2CH = CH_2$ towards hydrogenation reaction?
(A) $CH_2 = CH_2$ (B) $CH_3CH = CH_2$
(C) $CH_3CH = CHCH_3$ (D) $(CH_3)_2C = C(CH_3)_2$

PART – B
(Numerical based)

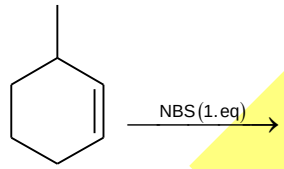
1. Reaction of 2-butene with hot acidified $KMnO_4$ solution produces two moles of compound(P). if the molar mass of (P) is expressed as (20x + 8), what is the value of x?

2. The highest melting isomer with formula C_4H_8 reacts with Cl_2/CCl_4 form to a product(P).
If x = the value of dipole moment of C_4H_8
y = number of chlorine atoms in(P)
Then the value of $\frac{x+y}{10}$ is

3. $(X) \xrightarrow[\Delta]{KMnO_4/H^+} 2CH_3COOH + \begin{matrix}COOH\\|\\COOH\end{matrix}$

If the number of geometrical isomers possible for (X) is a, what is the value of $\frac{a}{2}$?

4. If the maximum number of disubstituted products formed by chlorination of $CH_3CH_2CH_3$ is (2x - 2), what is x?

5. 

(X)
X is a pure stereoisomers. If the total number of products that can be formed is expressed as 2.5X, what is X?

6. If the number of moles of H_2 required to complete hydrogenate one mole of 1, 6-octadiyne is equal to 10x + 2, the value of x is

Space For Rough Work

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. The complete solution of the equation $7\cos^2 x + \sin x \cos x - 3 = 0$ is given by

   (A) $n\pi + \frac{\pi}{2}(n \in I)$ (B) $n\pi - \frac{\pi}{4}(n \in I)$

   (C) $n\pi + \tan^{-1}\left(\frac{4}{3}\right)(n \in I)$ (D) $n\pi + \frac{3\pi}{4}, k\pi + \tan^{-1}\left(\frac{4}{3}\right)(n,k \in I)$

2. If $(1 - x + x^2)^n = a_0 + a_1x + a_2x^2 + \ldots + a_{2n}x^{2n}$, then $a_0 + a_2 + a_4 + \ldots + a_{2n}$ equals

   (A) $\frac{1}{2}(3^n + 1)$ (B) $\frac{1}{2}(3^n - 1)$

   (C) $\frac{1}{2}(1 - 3^n)$ (D) $\frac{1}{2} + 3^n$

3. The coefficient of x^6 in $(1 + x)^6 + (1 + x)^7 + \ldots + (1 + x)^{15}$ is

   (A) ${}^{16}C_9$ (B) ${}^{16}C_5 - {}^6C_5$

   (C) ${}^{16}C_6 - 1$ (D) none of these

4. If $\sin\theta + \sin 3\theta + \sin 5\theta = 0$, then the general value of θ is

   (A) $\frac{n\pi}{6}, \frac{m\pi}{12}; m,n \in I$ (B) $\frac{n\pi}{3}, m\pi \pm \frac{\pi}{3}, m,n \in I$

   (C) $\frac{n\pi}{3}, m\pi \pm \frac{\pi}{6}, m,n \in I$ (D) $n\pi, 2m\pi, m,n \in I$

5. If $0 \le x \le 2\pi, 0 \le y \le 2\pi$ and $\sin x + \sin y = 2$ then, the value of $x + y$ is:

   (A) π (B) $\frac{\pi}{2}$

   (C) 3π (D) none of these

6. An isosceles triangle of wood is placed in a vertical plane, vertex upwards and faces the sun. If 2a be the base of the triangle, h its height and 30^o the altitude of the sun, then the tangent of the angle at the apex of the shadow is

   (A) $\frac{2ah\sqrt{3}}{3h^2 - a^2}$ (B) $\frac{2ah\sqrt{3}}{3h^2 + a^2}$ (C) $\frac{ah\sqrt{3}}{h^2 - a^2}$ (D) None of these

Space For Rough Work

(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. A tower subtends an angle of 30^o at a point on the same level as the foot of the tower. At a second point, h meter above the first, the depression of the foot of the tower is 60^o, horizontal distance of the tower from the point is

(A) $h\cot 60^o$ (B) $\frac{1}{3}h\cot 30^o$

(C) $\frac{1}{3}h\cot 60^o$ (D) $h\cot 30^o$

8. In the expansion of $\left(7^{1/3}+11^{1/9}\right)^{6561}$,

(A) the term which involves greatest binomial coefficients is rational
(B) there are exactly 730 rational terms
(C) there are exactly 5831 irrational terms
(D) the terms which involves greatest binomial coefficients is irrational

9. If $\sin(x-y)=\cos(x+y)=\frac{1}{2}$ then the value of x and y lying between 0 and π are given by:

(A) $x=\frac{\pi}{4}, y=\frac{3\pi}{4}$ (B) $x=\frac{\pi}{4}, y=\frac{\pi}{12}$

(C) $x=\frac{5\pi}{4}, y=\frac{5\pi}{12}$ (D) $x=\frac{11\pi}{12}, y=\frac{3\pi}{4}$

10. The coefficient of x^{33} in the expansion of $\sum_{r=0}^{50} {}^{50}C_r\left(x-4\right)^{50-r}3^r$ is

(A) ${}^{50}C_{33}$ (B) $-{}^{50}C_{33}$

(C) $-{}^{50}C_{17}$ (D) ${}^{50}C_{17}$

11. If $\left(\cos^2 x+\frac{1}{\cos^2 x}\right)(1+\tan^2 2y)(3+\sin 3z)=4$, then

(A) x may be a multiple of π (B) x can not be an even multiple of π
(C) z can be a multiple of π (D) y can be a multiple of $\pi/2$.

Space For Rough Work

12. If second , third and fourth term of the expansion $(a+b)^n$ are 135 , 30 and $\frac{10}{3}$ respectively then

(A) a = 3 (B) $b=\frac{1}{3}$

(C) n = 5 (D) n = 7

PART – B
(Numerical based)

1. The number of irrational terms in the expansion of $\left(5^{\frac{1}{8}}+2^{\frac{1}{6}}\right)^{100}$ is a two digit number AB then $\frac{A-B}{5}$ is

2. The sum of coefficients of all terms in the expansion $(x-y+z)^{100}$ is k then $\frac{k+7}{5}$ is

3. The remainder when 3^{2003} is divided by 28 is

4. Four times the sum of the roots of the equation $\sin 2x+5\sin x+5\cos x+1=0$ in the interval $[0,50\pi]$ is $p\pi$, then $\frac{p}{2020}$ is

5. The number of integral values of k, for which the equation 2cosx + 3sinx = k+1 has a solution.

6. The remainder when 8^{501} is divided by 49 is

Space For Rough Work

QP Code: 100186
ANSWERS

SECTION-1 : PHYSICS

PART – A

1.	D	2.	C	3.	D	4.	A
5.	D	6.	A	7.	ABC	8.	BD
9.	ABCD	10.	ABC	11.	BC	12.	ABCD

PART – B

1.	1.83	2.	1.5	3.	1	4.	3
5.	3	6.	6				

SECTION – 2 : CHEMISTRY

PART – A

1.	C	2.	C	3.	B	4.	A
5.	B	6.	B	7.	ABCD	8.	ABC
9.	ABC	10.	ABCD	11.	BC	12.	AB

PART – B

1.	2.6 (Range 2.2 to 3.2)	2.	0.2 (Range 0.1to 0.8)
3.	1.5 (Range 1.2 to 2)	4.	3.5 (Range 3 to 4)
5.	3.2 (Range 3 to 4)	6.	0.2 (Range 0 to 1)

SECTION – 3 : MATHEMATICS

PART – A

1.	D	2.	A	3.	A	4.	B
5.	A	6.	A	7.	AB	8.	BCD
9.	BD	10.	BC	11.	AD	12.	BCD

PART – B

1.	1.20	2.	1.60	3.	19	4.	2.50
5.	7	6.	29				