FIITJEE (JEE-Advanced)

BATCHES – NWCM721O1S, NWCM921X1W, NWCM921A1W & PANINI921-XIIG1

PHYSICS, CHEMISTRY & MATHEMATICS

QP Code: **Test- 8**

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 **Three Parts**: **Part-A, B & Part-C** 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 Three Parts.

(i) **Part-A (01-06) –** 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*: –2 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 **–2** marks, as a wrong option is also darkened.

(ii) **Part-B (07-12)** contains Six (06) Numerical based questions with single digit integer as answer, ranging from 0 to 9 (both inclusive) and each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(iii) **Part-C (13-18)** 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

(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.

1. 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.

1. **ABC**

2. 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.

2. **BD**

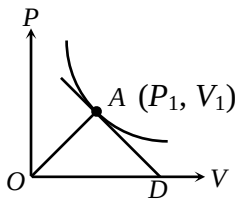
3. A mixture of two diatomic gases X and Y is enclosed in a container at constant temperature.
   The molecular weight of X is 16 times that of Y and mass of the gas X is 2 times that of Y. Then
   (A) The average molecular kinetic energy of X equals that of Y
   (B) The r.m.s. molecular speed of translation 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.

3. **ABC**

4. 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.

4. **ABCD**

5. 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

5. **BC**

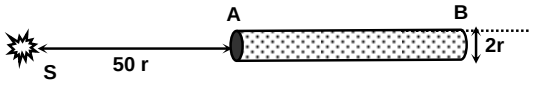
6. A bimetallic strip is formed by two identical strips, one of copper and the other of brass. The coefficients of linear expansion of the two metals are α_C and α_B. On heating, the temperature of the strip goes up by ΔT and the strip bends to from an arc of radius of curvature R. Then R is
(A) proportional to ΔT (B) inversely proportional to ΔT
(C) proportional to $|\alpha_B - \alpha_C|$ (D) inversely proportional to $|\alpha_B - \alpha_C|$

6. **BD**

PART – B
Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

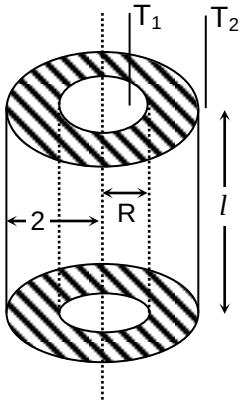
7. A cylindrical rod of length l = 674 cm and cross sectional radius r = (2/π) cm is placed at a distance 50 r from a infrared point source S of power 1.25 kW as shown in the figure.



The lateral surface of the rod is perfectly insulated from the surroundings.
The cross section A absorbs 80% of incident energy, has temperature T_A in steady state. The surface B is radiating energy into space and the wavelength emitted by it with maximum energy density is 100,000A°. Determine the values of k if temperature of end B is 250k

7. **2**

8. Inner surface of a cylindrical shell of length *l* and of material of thermal conductivity *k* is kept at constant temperature T_1 and outer surface of the cylinder is kept at constant temperature T_2 such that $(T_1 > T_2)$ as shown in figure. Heat flows from inner surface to outer surface radially outward. Inner and outer radii of the shell are *R* and 2*R* respectively. Due to lack of space this cylinder has to be replaced by a smaller cylinder of length $\frac{l}{2}$, inner and outer radii $\frac{R}{4}$ and *R* respectively and thermal conductivity of material *nk*. If rate of radial outward heat flow remains same for same temperatures of inner and outer surface i.e. T_1 and T_2, then find the value of *n*.



8. **4**

9. A hollow sphere of inner radius R_0 and outer radius $2r_0$ is made of a uniform material of constant thermal conductivity K. The temperature with in the ball is maintained at $2T_0$ and outside the ball is T_0. If temperature at distance $\frac{3r_0}{2}$ from centre is $\frac{pT_0}{3}$, then find the value of p.

9. **4**

10. Air is initially at 260°C and 700 pa and occupied 0.028 m^3. The air is expanded at constant pressure to 0.084 m^3. A polytropic process (PV^n = constant) with n = 1.5 is then carried out followed by a constant temperature process which complete the cycle. If efficiency of the cycle is 38.6k, find the value of k.

10. **1**

11. A double-pane window consists of two glass sheets of area 1 m^2 and thickness 0.01 m separated by a 0.05 m thick stagnant air space. In the steady state, the room glass interface and the glass outdoor interface are at constant temperature of 27°C and 0°C, respectively.
If rate of heat flow through the window pane is 0.13k find the value of k

11. **5**

12. A solid copper sphere of diameter 10 mm is cooled to a temperature of 150 K and is then placed in an enclosure at 290 K. Assuming that all interchange of heat is by radiation, calculate the value of x if initial rate of rise of temperature of the sphere is 0.022x.. The sphere may be treated as a black body.

12. **3**

PART – C
(Numerical based)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. An electrically heated coil was placed in calorimeter containing 360 gm of water at 10°C. The coil consumes energy at the rate of 90 watts. The water-equivalent of the calorimeter and the coil is 40 gm. Calculate the temperature of the water (in °C) after 10 minutes (J = 4.2 Joules/cal).

13. **42.14**

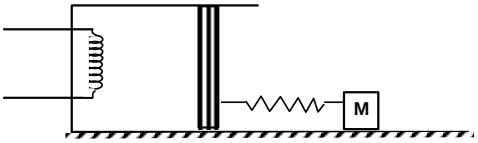
14. A vertical cylinder closed from both ends is equipped with an easily moving piston dividing the volume into two parts, each containing 1 mole of air. In equilibrium at T_0 = 87°C, the volume of the upper part is η = 4 times greater than that of the lower part. At what temperature (in °C) will the ratio of these volumes be equal to η' = 5?

14. **8.25**

15. A thin tube of uniform cross-section is sealed at both ends. It lies horizontally, the middle 5 cm containing mercury and the two equal ends containing air at the same pressure P_0. When the tube is held at an angle 60° with the vertical the lengths of the air column above and below the mercury are 46 cm and 44.5 cm respectively. Calculate the pressure P_0 in cm of Hg. (The temperature of the system is kept at 30 K).

15. **75.4**

16. An adiabatic cylinder has 8 gm of helium. A light smooth adiabatic piston is connected to a light spring of force constant 30 N/m. The other end of the spring is connected with a block of mass 1 kg kept on a rough horizontal surface of coefficient of friction μ = 0.3. Area of cross section of cylinder is a = 25 cm^2.



Initially the spring is in a relax position and the temperature of the gas is 400 K. The gas is heated slowly from some time by means of an electric heater so as the block M just starts moving. If work done by the gas is W (in J), then the value of 10W is

16. **11.3**

17. 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.

17. **1.83**

18. A steel rod with a cross-sectional area of 150 mm2 is stretched between two fixed points. The tensile load at 20°C is 500 N. If stress at –20° is $k\times10^6 N/m^2$ find the value of k. (assume α = 1.17 μm/m°C and Y = 200 GN/m^2)

18. **12.69**

SECTION-2 : CHEMISTRY

PART – A

(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.

1. Nitrogen may be obtained by
   (A) heating ammonium nitrite.
   (B) by heating ammonium dichromate.
   (C) by passing vapours of ammonia over heater CrO_3(s).
   (D) by strong heating of naturally occurring zeolite.

1. ABCD

2. Which of the following statement(s) is/are correct for phosphorus?
   (A) Black phosphorus is most thermodynamically stable allotrope of phosphorus.
   (B) The standard state of phosphorus is white phosphorus.
   (C) In the Hittorf's phosphorus which is also known as violet phosphorus has complicated structure having interlocking chain.
   (D) The electrical conductivity of black phosphorus resembles graphite.

2. ABCD

3. $NaHPO_3$ and Na_2HPO_4 can be distinguished by
   (A) $AgNO_3$ solution
   (B) MnO_4^- / H^+
   (C) Conc.H_2SO_4
   (D) $HgCl_2$ solution

3. ABCD

4. Select the pyramidal molecule/species
   (A) $(CH_3)_2\ddot{N}$
   (B) $(SiH_3)_3\ddot{N}$
   (C) $(SiH_3)_3\ddot{P}$
   (D) $[O(HgCl)_3]^+$

4. AC

5. Which of the following statement(s) is/are correct for the reduction of HNO_2 by HSO_3^- under weakly acidic conditions?
   (A) Hydroxylamine is formed under weakly acidic medium
   (B) An intermediate hydroxylaminedisulphonate acid HO – $N(SO_3H)_2$ can be isolated
   (C) If excess of bisulphate is used then H_2NOH oxidize bisulphide into HSO_4^- and itself reduce into NH_3
   (D) If excess of bisulphate is used, a mixture of hydrazine and HSO_4^- are formed

5. ABC

6. NO_2^- and NO_3^- can be distinguished by
   (A) Fe^{2+} + dil.acid
   (B) Acidic MnO_4^-
   (C) $BaCl_2$ solution
   (D) $AgNO_3$

6. ABD

PART – B

Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. How many water of crystallization is/are present in actual structure of borax?

7. 8

8. The alkali metal forms phosphide, which contains group of P atoms funning cage $[P_7]^{3-}$. How many P – P bond are present in cage?

8. 9

9. How many of these liberates H_2 gas from very dilute nitric acid?
Pb, Fe, Cu, Zn, Mn, Mg, Sn, Ag, Hg

9. 3

10. P_4O_6 reacts with O_3 in CH_2Cl_2 solvent to give P_4O_{18}. How many P – O – P bonds are present in P_4O_{10}?

10. 6

11. How many of these are insoluble in water.
$Pb(OH)_2$, $PbSO_4$, $PbCO_3$, PbI_2, $Pb(OOCCH_3)_2$, $Pb_3(PO_4)_2$, PbO_2, $PbSO_3$, PbS

11. 8

12. The reaction of SnI_4 with KNH_2 in liquid NH_3 at 243 K followed by annealing gives the solid product having composition Sn_xN_y. What is the value of (x + y)?

12. 7

PART – C

(Numerical based)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. The borax may be formulated as $Na_2[B_4O_5(OH)_4].xH_2O$ and sodium peroxoborate may be formulated as $Na_2[B_2(O_2)_2(OH)_4].yH_2O$. What is the ratio of $\frac{x}{y}$?

13. 1.33

14. First all metal aromatic species is Al_4^{2-}. What is Al – Al bond order?

14. 1.25

15. In the nitrosyl azide, the N – O bond order is x. What is the value of x?

15. 1.67

16. If water freezes in the presence of N_2O gas, a crystalline hydrate is formed having composition $N_2O.xH_2O$. What is the value of x?

16. 5.75

17. P_4O_6 and P_4S_6 are not isostructural. What is ratio of P – O – P bond and P – S – P bond in above compounds?

17. 1.20

18. Carbon suboxide is a foul smelling gas having formula C_xO_y. What is the value of x/y?

18. 1.50

SECTION-3 : MATHEMATICS

PART – A

(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.

1. A person buys twelve packets of VANISH detergent. Each packet contains one coupon, which bears one of the letters of the word VANISH. If he shows all the letters of the word VANISH, he gets one free packet. If he gets exactly one free packet, then the number of different possible combinations of the coupons is

(A) $^{18}C_6 - {}^{17}C_6$ (B) $^{11}C_5 - 1$

(C) $^{17}C_5$ (D) 461

1. BD

2. Total number of words formed by 2 vowels and 3 consonants taken from 4 different vowels and 5 different consonants such that
(A) vowels are together is 3600
(B) consonants are together is 1200
(C) vowels are together and consonants are together is 1000
(D) No restriction is 5000

2. AB

3. The number of ways in which letters of word 'ARRANGE' be arranged so that
(A) No two R's are together is 900 (B) Two A's are together is 360
(C) Two A' are together is 200 (D) All consonants are together is 160

3. AB

4. The number of ways of arranging the letters AAAAA, BBB, CCC, D, EE and F in a row if the letters C are separated from one another is:

(A) $^{13}C_3.\dfrac{12!}{5!3!2!}$ (B) $\dfrac{13!}{5!3!3!2!}$

(C) $\dfrac{14!}{3!3!2!}$ (D) $\dfrac{15!}{5!(3!)^2 2!} - \dfrac{13!}{5!3!2!} - \dfrac{12!}{5!3!}\,{}^{13}C_2$

4. AD

5. The number of different seven digit numbers that can be written using only three digits 1, 2 and 3 under the condition that the digit 2 occurs exactly twice in each number is
(A) 672 (B) 640
(C) 512 (D) None of these

5. A

6. There are three coplanar parallel lines. If any p points are taken on each the lines, the maximum number of triangles with vertices at these points is

(A) $3p^2(p-1)+1$ (B) $3p^2(p-1)$

(C) $p^2(4p-3)$ (D) None of these

6. C

PART – B

Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. Number greater than 7000 and divisible by 5 that can be formed using only the digits 3, 5, 7, 8 and 9, no digit being repeated, is 7λ then λ is

7. 6

8. A shopkeeper has 10 copies of each of nine different books, then number of ways in which atleast one book can be selected $11^{\lambda}-\mu$ the find $\lambda-\mu$

8. 8

9. Number of different words that can be formed using all the letters of the word "DEEPMALA", if the vowels are together and the other two are also together but separated from the first two is $1440+\lambda$ then λ is

9. 0

10. The number of different ways in which five 'alike dashes' and eight 'alike dots' can be arranged, using only seven of these 'dashes' and 'dots' is λ then find $\frac{\lambda}{24}$

10. 5

11. The number of times the digit 5 will be written while listing the integers from 1 to 1000 is μ then find $\frac{\mu}{50}$

11. 6

12. Number of ways in which 6 different toys can be distributed among two brothers in ratio 1 : 2, is 6λ then λ

12. 5

PART – C

(Numerical based)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. 10 IIT and 2 PET students sit in a row. The total number of ways in which exactly 3 IIT students sit between 2 PET students is $\lambda 10!$, then find λ.

13. 16.00

14. The number of integral solution of this equation $x+y+z+w<25$ such that $x>-2, y>1, z\geq 0, w>3$ are ${}^{23}C_{\lambda}$, then find λ.

14. 19.00

15. 17 persons can depart from railway station in 2 cars and 3 autos, given that 2 particular person depart by same car are $\frac{15!}{\lambda!(3!)^3}$. (4 persons can sit in a car and 3 persons can sit in an auto), then find the value of λ

15. 4.00

16. Number of way in which 3 numbers in AP can be selected from $\{1,2,3,.....50\}$ is

16. 600.00

17. Number of ways of selecting 3 persons out of 12 sitting in a row, if no two selected persons were sitting together, is

17. 120.00

18. Number of solutions of the equation $x+y+z=20$, where $1\le x<y<z$ and $x,y,z\in I$ is

18. 24.00

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B