FIITJEE Internal test

PINNACLE 1ST YEAR (2021-2023)

P H A S E – 4 (JEEA-13)

Time : 3 hours   **Maximum Marks: 240**

INSTRUCTIONS

A. **Questions paper format :**

i) This question paper consists of 3 sections (Section 1 – Maths, Section 2 – Physics & Section 3 - Chemistry) Each Section has 2 parts: PART – A, PART – C

ii) **PART – A** contains 10 multiple choice questions. Each question has 4 choices a, b, c and d, out of which **one or more than one choice is correct** answer.

iii) **PART – C** contains 10 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9. (The answer will have to be appropriately bubbled in the ORS).

B. **Marking scheme :**

i) For each question in **PART- A,** you will be awarded **4 Marks** if you darken all but only the bubble(s) corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus two (-2) mark** will be awarded.

ii) For each question in **PART- C**, you will be **awarded 4 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.

IMPORTANT DATA

Mass of an electron (m) = 9.1×10^{-31} kg   Charge of an electron (e) = 1.6×10^{-19} coulombs

Avogadro's Number (N_a) = 6.023×10^{23} Planck's constant (h) = 6.626×10^{-34} Js

1 Faraday = 96500 Coulomb   1 Calorie = 4.2 joule

Atomic Masses: Cr = 52, Mn = 55, Fe = 56, Co = 59, Ni = 58.7, Cu = 63.5, Zn = 65.4, As = 75, Br = 80, Kr = 83.8, Ag = 108, Sn=118.6,I = 127,Xe = 131, Ba = 137,Au= 197, Pb = 207, U=238

Enrollment No. : ☐☐☐☐ ☐☐ ☐☐☐ ☐☐☐☐

Batch : _____

Name : _____

SECTION – 1

Mathematics

PART - A

ONE OR MORE THAN ONE CORRECT:

1. Let $[x]$ denote the greatest integer less than or equal to x. If $f(x) = [x \sin \pi x]$, then $f(x)$ is

   a) Continuous at $x = 0$
   b) Continuous in $(-1, 0)$

   c) Differentiable at $x = 1$
   d) Differentiable in $(-1, 1)$

2. If $f(x) = \begin{cases} x^2 \sin \dfrac{1}{x} & \text{for } x \neq 0 \\ 0 & \text{for } x = 0 \end{cases}$, then

   a) f and f' are continuous at $x = 0$
   b) f is derivable at $x = 0$
   c) f is derivable at $x = 0$ and f' is not continuous at $x = 0$
   d) f is derivable at $x = 0$ and f' is continuous at $x = 0$

3. The function $f(x) = 1 + |\sin x|$ is

   a) Continuous nowhere
   b) Continuous everywhere
   c) Differentiable nowhere
   d) Not differentiable at an infinite number of points

4. Let $h(x) = \min\{x, x^2\} \ \forall \ x$. Then,

   a) h is continuous for all x
   b) h is differentiable for all x

   c) $h'(x) = 1$, for all $x > 1$
   d) h is not differentiable at two values of x

-- ROUGH WORK --

FIITJEE VIZAG Centre, #49-52-5, Santhipuram, Sankaramatam Road, Visakhapatnam-530016 Ph:0891-2555501,02,03
FIITJEE VIZAG Centre # 1-9-4, 1-9-4/2 to 1-9-4/5, Sector-1, MVP Colony, Visakhapatnam – 530 017. Ph:0891-2555501,02,03

2

5. The equations of the tangents to the curve $y = x^4$ from the point $(2,0)$ not on the curve, are given by

    a) $y = 0$ b) $y - 1 = 5(x - 1)$

    c) $y - \dfrac{4098}{81} = \dfrac{2048}{27}\left(x - \dfrac{8}{3}\right)$ d) $y - \dfrac{32}{243} = \dfrac{80}{81}\left(x - \dfrac{2}{3}\right)$

6. Let the function $f(x) = \sin x + \cos x$ be defined in $[0, 2\pi]$ then $f(x)$

    a) increases in $\left(\dfrac{\pi}{4}, \dfrac{\pi}{2}\right)$ b) decreases in $\left(\dfrac{\pi}{4}, \dfrac{\pi}{2}\right)$

    c) increases in $\left[0, \dfrac{\pi}{4}\right] \cup \left[\dfrac{5\pi}{4}, 2\pi\right]$ d) decreases in $\left[0, \dfrac{\pi}{4}\right] \cup \left[\dfrac{\pi}{2}, 2\pi\right]$

7. If $f'(x) = g(x)(x - a)^2$, where $g(a) \neq 0$ and g is continuous at $x = a$ then

    a) f is increasing near a if $g(a) > 0$ b) f is increasing near a if $g(a) < 0$

    c) f is decreasing near a if $g(a) > 0$ d) f is decreasing near a if $g(a) < 0$

8. In a triangle ABC, let $AB = \sqrt{23}$, $BC = 3$ and $CA = 4$. Then the value of $\dfrac{\cot A + \cot C}{\cot B} =$

    a) 2   b) 4   c) 3   d) 5

9. In a triangle ABC

    a) $b = 3c$, $C - B = 90^0$ then $\tan B = 3$

    b) $A = 60^0$, $b : c = (\sqrt{3} + 1) : 2$ then $B - C = 60^0$

    c) $a\cos^2\dfrac{C}{2} + c\cos^2\dfrac{A}{2} = \dfrac{3b}{2}$ then $a + c = 2b$

    d) $(a + b + c)(a - b + c) = 3ac$ then $B = 60^0$

10. Let $\dfrac{\sin A}{\sin B} = \dfrac{\sin(A - C)}{\sin(C - B)}$, where A, B, C are angles of a triangle ABC. If the lengths of the sides opposite these angles are a, b, c respectively, then

    a) b^2, c^2, a^2 are in A.P   b) c^2, a^2, b^2 are in A.P

    c) $b^2 - a^2 = a^2 + c^2$ d) a^2, b^2, c^2 are in A.P

-- ROUGH WORK --

PART - C

INTEGER ANSWER TYPE:

1. The number of points of discontinuity for $f(x) = \text{sgn}(\sin x), x \in [0, 4\pi]$ is

2. Let $F(x) = f(x)g(x)h(x)$ for all real x, where $f(x), g(x)$ and $h(x)$ are differentiable functions. At some point x_0, $F'(x_0) = 3F(x_0)$, $f'(x_0) = 4f(x_0)$, $g'(x_0) = -7g(x_0)$ and $h'(x_0) = k\,h(x_0)$ where $k \in R$. Then k is equal to

3. A function f, defined for all positive real numbers, satisfies the equation $f(x^2) = x^3$ for every $x > 0$. Then the value of $f'(4)$ is

4. The volume of a cube is increasing at a rate of 9 cubic centimeters per second, and the rate at which surface area is increasing when the length of the edge is 10cm is $k \ cm^2/\sec$ then $\dfrac{10k}{4} =$

5. The maximum value of the function $f(x) = 2x^3 - 15x^2 + 36x - 48$ on the set $A = \left\{ x \big| x^2 + 20 \le 9x \right\}$ is

--- ROUGH WORK ---

6. If the function $f(x) = x^3 + e^{x/2}$ and $g(x) = f^{-1}(x)$, then the value of $g'(1)$ is

7. With the usual notation, in ΔABC, if $\lfloor A + \lfloor B = 120^0$, $a = \sqrt{3} + 1$ and $b = \sqrt{3} - 1$, then the ratio $\lfloor A : \lfloor B$ is $k:1$ then $k =$

8. If a, b and c (all distinct) are the sides of a triangle ABC opposite to the angles A, B and C respectively, then $\dfrac{c\sin(A-B)}{a^2 - b^2} - \dfrac{b\sin(C-A)}{c^2 - a^2}$ is equal to

9. Suppose a differential function $f(x)$ satisfies the identity

$f(x+y) = f(x) + f(y) + xy^2 + x^2 y$, for all real x and y. If $\lim\limits_{x \to 0} \dfrac{f(x)}{x} = 1$, then $f'(3) - 2$ is equal to

10. In ΔABC, if $\dfrac{1}{a+c} + \dfrac{1}{b+c} = \dfrac{3}{a+b+c}$ then $\dfrac{\lfloor C}{10^0} =$

-- ROUGH WORK --

FIITJEE VIZAG Centre, #49-52-5, Santhipuram, Sankaramatam Road, Visakhapatnam-530016 Ph:0891-2555501,02,03
FIITJEE VIZAG Centre # 1-9-4, 1-9-4/2 to 1-9-4/5, Sector-1, MVP Colony, Visakhapatnam – 530 017. Ph:0891-2555501,02,03

5

SECTION – 2

Physics

PART - A

ONE OR MORE THAN ONE CORRECT:

1.   If two satellites of different masses are revolving in the same orbit, they have the same
a) angular momentum   b) energy
c) time period   d) speed

2.   From a solid sphere of mass M and radius R, a spherical portion of radius $\dfrac{R}{2}$ is removed, as shown in the figure. Taking gravitational potential $V = 0$ at $r = \infty$, the potential at the centre of the cavity thus formed is (G = gravitational constant)

a) $\dfrac{-GM}{2R}$ b) $\dfrac{-GM}{R}$ c) $\dfrac{-2GM}{3R}$ d) $\dfrac{-2GM}{R}$

3.   An iceberg is floating partially immersed in sea water. The density of sea water is 1.03 $g\,cm^{-3}$ and that of ice is 0.92 $g\,cm^{-3}$. The approximate percentage of total volume of iceberg above the level of sea water is
a) 8   b) 11   c) 34   d) 89

4.   Two solid spheres A and B of equal volumes but of different densities d_A and d_B are connected by a string. They are fully immersed in a fluid of density d_F. They get arranged into an equilibrium state as shown in the figure with a tension in the string. The arrangement is possible only if

a) $d_A < d_F$ b) $d_B > d_F$ c) $d_A > d_F$ d) $d_A + d_B = 2d_F$

5.   A log of wood of mass 120 kg floats in water. The weight that can be put on the raft to make it just sink, should be (density of wood = $600\ kg/m^3$)
a) 80 kg   b) 50 kg   c) 60 kg   d) 30 kg

-- ROUGH WORK --

6.   A concrete sphere of radius R has a cavity of radius r which is packed with sawdust. The specific gravities of concrete and sawdust are respectively 2.4 and 0.3 for this sphere to float with its entire volume submerged under water. Ratio of mass of concrete to mass of sawdust will be

a) 8 : 1   b) 4 : 1   c) 3 : 1   d) 2 : 1

7.   A sample of metal weighs 210 gm in air, 180 gm in water and 120 gm in liquid. Then specific gravity of

a) Metal is 3   b) Metal is 7

c) Liquid is 3   d) Liquid is $\dfrac{1}{3}$

8.   A solid sphere of specific gravity $\eta < 1$, is suspended in a water tank by a string tied to its base as shown in figure. If the mass of the sphere is m then the tension in the string is given by
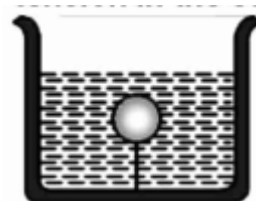
a) $\left(\dfrac{\eta-1}{\eta}\right)mg$ b) ηmg c) $\dfrac{mg}{\eta-1}$ d) $\left(\dfrac{1-\eta}{\eta}\right)mg$

9.   A particle is dropped from a height equal to the radius of the earth above the tunnel dug through the earth as shown in the figure. (Radius of earth = R; mass of earth = M)
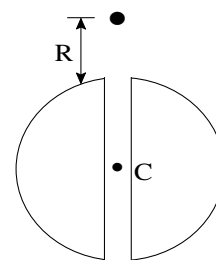
a) Particle will oscillate through the earth to a height R on both sides
b) Particle will execute simple harmonic motion
c) Motion of the particle is periodic

d) Particle passes the centre of earth with a speed $= \sqrt{\dfrac{2GM}{R}}$

-- ROUGH WORK ---

FIITJEE VIZAG Centre, #49-52-5, Santhipuram, Sankaramatam Road, Visakhapatnam-530016 Ph:0891-2555501,02,03
FIITJEE VIZAG Centre # 1-9-4, 1-9-4/2 to 1-9-4/5, Sector-1, MVP Colony, Visakhapatnam – 530 017. Ph:0891-2555501,02,03
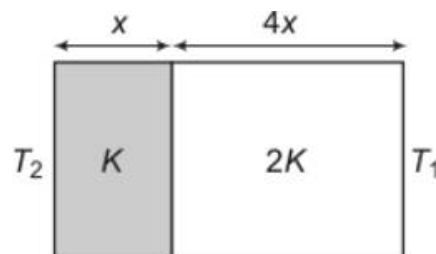
7

10. A tunnel is dug along a chord of the earth at a perpendicular distance $\dfrac{R}{2}$ from the earth's centre. The wall of the funnel may be assumed to be frictionless. A particle is released from one end of the tunnel. The passing force by the particle on the wall and the acceleration of the particle varies with × (distance of the particle from the centre) according to :

a)

b)

c)

d)
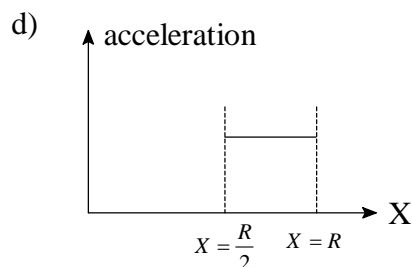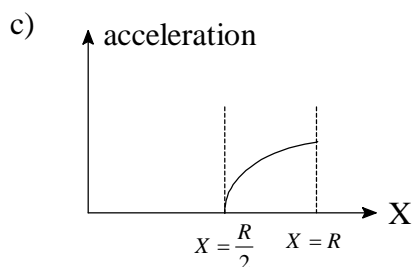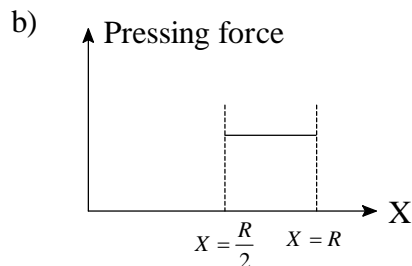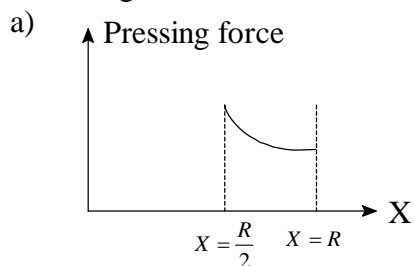
PART - C

INTEGER ANSWER TYPE:

1. The temperature of the two outer surfaces of a composite slab consisting of two materials having coefficients of thermal conductivity K and 2K and thickness x and $4x$ respectively are T_2 and T_1 ($T_2 > T_1$). The rate of heat transfer through the slab in steady state is $\dfrac{AK(T_2 - T_1)}{nx}$. The value of n is

-- ROUGH WORK --

FIITJEE VIZAG Centre, #49-52-5, Santhipuram, Sankaramatam Road, Visakhapatnam-530016 Ph:0891-2555501,02,03
FIITJEE VIZAG Centre # 1-9-4, 1-9-4/2 to 1-9-4/5, Sector-1, MVP Colony, Visakhapatnam – 530 017. Ph:0891-2555501,02,03

8

2. A cylindrical rod with one end in a steam chamber and the other end in ice results in melting of 2 g of ice per second. If the rod is replaced by another with half the length and double the radius of the first and if the thermal conductivity of material of second rod is $\frac{1}{4}$ that of first, the rate at which ice melts in $\frac{g}{s}$ will be

3. The earth is assumed to be a sphere of radius R. A platform is arranged at a height 3R from the surface of the earth. The escape velocity of a body from this platform is $\frac{v_e}{f}$, where v_e is its escape velocity from the surface of the earth. Find the value of f.

4. A bullet is fired vertically upwards with velocity v from the surface of a spherical planet. When it reaches its maximum height, its acceleration due to the planet's gravity is $\frac{1}{4}$ th of its value at the surface of the planet. If the escape velocity from the planet is $v_{esc} = v\sqrt{N}$, then the value of N is _____ . (lgnore energy loss due to atmosphere)

5. Two satellites A and B have masses m and $2m$ respectively. A is in a circular orbit of radius R and B is in a circular orbit of radius 2R around the earth. The ratio of their kinetic energies, $\frac{T_A}{T_B}$ is

6. A container filled with water is accelerated horizontally at an acceleration $a = \frac{g}{2}$. (g is magnitude of acceleration due to gravity. If $h_1 = 1\,\text{m}$ then the value of h_2 is meters is


$\ell = 3\,\text{m}$
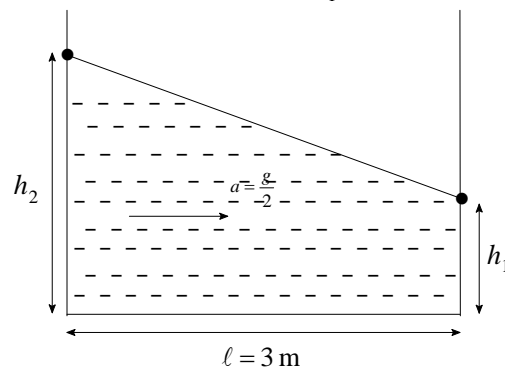
--- ROUGH WORK ---

7. A cubical block is floating in a liquid with half of its volume immersed in the liquid. When the whole system accelerates upwards with a net acceleration of $\dfrac{g}{3}$. The fraction of volume immersed in the liquid is $\dfrac{1}{n}$, the value of n is
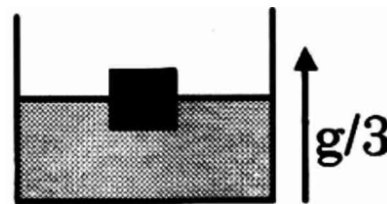
8. A ball whose density is $0.4 \times 10^3 \, \text{kg/m}^3$ falls into water from a height of 9 cm. To what depth does the ball sink. (in cm)

9. A U-tube contains water and methylated spirit separated by mercury. The mercury columns in the two arms are in the same level with 10 cm of water in one arm and 12.5 cm of spirit in the other. The specific gravity of spirit is $\dfrac{x}{5}$, the value of x is
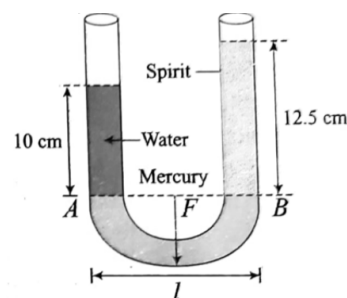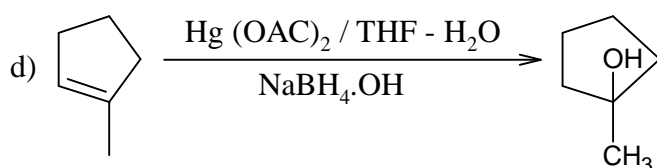

10. Two solids A and B float in water. It is observed that A floats with $\dfrac{1}{2}$ of its body immersed in water and B floats with $\dfrac{1}{4}$ of its volume above the water level. The ratio of the density of A to that of B is $2:n$, the value of n is

-- ROUGH WORK --

SECTION – 3

Chemistry

PART - A

ONE OR MORE THAN ONE CORRECT:

1. Which of the following is/are correct statement ?
   a) Cis – alkenes have higher boiling points than the corresponding trans – isomer
   b) Addition of HCl and HI in presence of peroxide follows Markonikov's rule
   c) Isobutene react with water in presence of H_2SO_4 follows antimarkonikov's addition

   d)
   $$\text{cyclopentene} \xrightarrow[\text{NaBH}_4.\text{OH}]{\text{Hg (OAC)}_2 / \text{THF - H}_2\text{O}} \text{product with OH and CH}_3$$

   In the above reaction final product OH comes from H_2O and H comes from $NaBH_4 / OH^-$.

2. Which of the following statements is/are correct ?
   a) the ease of dehydration of alcohols is $1° > 2° > 3°$
   b) the dehydrogenation of alkyl halides is an example of 1, 2 elimination and is brought about by action of a base
   c) 1, 2 – elimination reaction involving E_2 mechanism does not involve any rearrangement of carbon skeleton
   d) 1, 2 – elimination reaction involving E_1 mechanism may involve the rearrangement of carbon skeleton

3. Methylacetylene contains
   a) Six sigma bonds and two *pi* bonds   b) three sigma and two *pi* bonds
   c) one methyl group and one triple bond   d) one sigma and two *pi* bonds

4. Which of the following statements are correct ?
   a) vinyl alcohol on isomerization produces ethanal
   b) acetylene is produced by the action of water on aluminium carbide
   c) acetylene on reacting with $HOCl$ produces 1, 2 – dichloro – 1, 2 – ethanediol
   d) 1 – pentyne can be distinguished from 2 – pentyne with the help of ammonical $AgNO_3$ solution

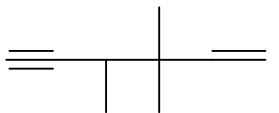-- ROUGH WORK ---

5.   Which of the following statements are not correct ?
      a) The addition of H_2 to 2 – butyne using Na in liquid NH_3 gives cis 1, 2 – dimethyl ethene
      b) The addition of H_2 to 2 – butyne using H_2 and lindalar catalyst gives Cis 1, 2 – dimethylethene
      c) The Cis 1 , 2 – dimethylethene is more stable than its trans isomer
      d) Cis – trans mixture of 2 – pentene cannot be converted to either cis or trans form

6.   Which of the following statements are incorrect ?
      a) potassium superoxide is diamagnetic in nature
      b) the thermal stability of hydroxides of group – I decrease on moving down the group
      c) Be, Mg do not respond to flame test
      d) the compound Na_2O_2 is sodium dioxide

7.   Which of the following statements are correct ?
      a) amongst group – I elements, Li^+ ion has the highest enthalpy of hydration
      b) BeH_2, MgH_2 are covalent and polymeric while other hydrides are ionic
      c) the metallic oxides of group – I elements become more basic on going down the group
      d) the ionic size of Li^+ in water is minimum in comparision to other alkali metal ions

8.   Which of the following is/are correct for lithium ?
      a) Lithium is least reactive but the strongest reducing agent among all the alkali metals
      b) $LiCl$ is deliquescent and crystallizes as a hydrate $LiCl.2H_2O$
      c) Lithium hydrogen carbonates being unstable is not obtained in the solid form
      d) Lithium is much heavily hydrated than those of the rest of the group

9.   Which of the following is/are incorrect ?
      a) $LiH > NaH > KH > RbH > CsH$ (Stability of hydrides)
      b) $H_2O < MgH_2 < NaH$ (Reducing property)
      c) Percentage strength of $28V$ H_2O_2 is 2.8
      d) Zeolites can be regenerated by Conc. HCl solution

-- ROUGH WORK ---

10. Which of the following statements is/are correct ?

a) A dilute solution of H_2O_2 can be concentrated by heating it under reduced pressure

b) Heavy water is usually prepared by prolonged electrolysis of ordinary water. In fact a dil. solution (0.5 M) of $NaOH$ is taken to improve its electrolytic properties

c) In clark's process water softening is done by calculated amount of slaked lime, $Ca(OH)_2$

d) H^+, D^+ and T^+ differ in all number of neutrons and ionic mass

PART - C

INTEGER ANSWER TYPE:

1. In the given compound $\equiv\!\!\!\!-\!\!\!-\!\!\!\!|\!\!\!-\!\!\!\!\equiv$, the locant for 'yne' in IUPAC name is _____

2. How many carbon – hydrogen bond orbitals are available for overlap with the vacant p-orbital in ethyl carbocation ?

3. x no. of moles of BH_3 are needed to react completely with 7 mole of 1 – pentene in hydroboration oxidation reaction what is $x \times 3$ is _____

4.
$$Na_2O_2 \quad \xrightarrow{\text{water / 25°C}} \quad A + B\uparrow + C$$
$$\xrightarrow{\text{water / 0°C}} \quad A + D$$
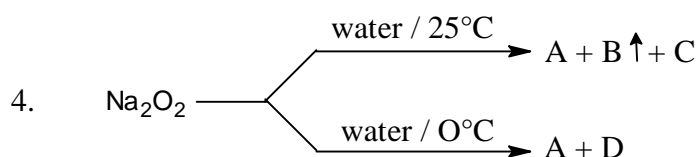
Calculate sum of bond order between same bonded atoms in B and D compounds.

--- ROUGH WORK ---

5. An acidified solution of titanium salt when treated with H_2O_2, a yellow or orange colour compound (X) developed and H_2O_2 on shaking with acidified $K_2Cr_2O_7$ with little ether blue colour compound (Y) is produced. In compound (X) the oxidation state of Titanium is P and in compound Y oxidation state of chromium is Q. What is $Q - P =$

6. How many elements in group 2 will show paramagnetic solution in liquid ammonia. (except radioactive element)

7. To prepare 1 mole of acetylene we need x mole of $CaCO_3$ and y moles of Coke / carbon are required and 'Z' moles of silver is heated with iodoform to produce 1 mole of acetylene. What is $xy + z =$ _____.

8.

   What is $\dfrac{X}{26} =$

9.
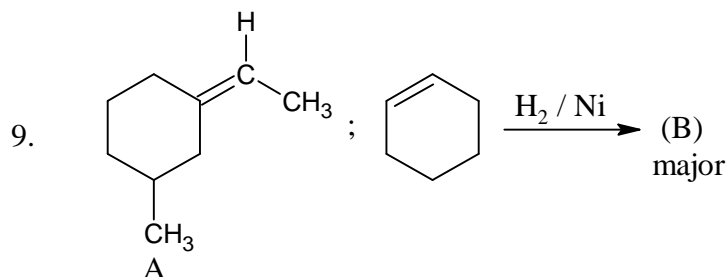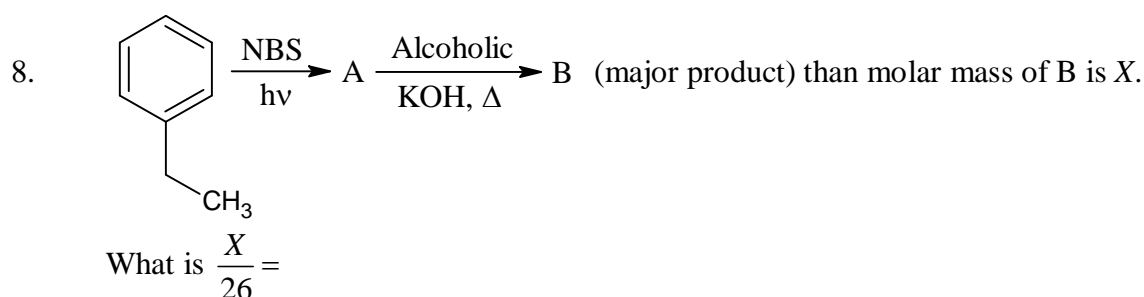
   'X' number of stereoisomers possible for (A) and 'Y' is the degree of unsaturation in (B), what is $X + Y$?

10. The summation of water molecules in microcosmic salt, sodium thiosulphate (Hypo), and glauber's salt is X. What is $X - 10 =$ _____.

-- ROUGH WORK --