FIITJEE (JEE-Advanced)

BATCHES – NWCM721O1S, NWCM921X1W, NWCM921A1W & PANINI921-XIIG1

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-1 | **QP Code:** | **TEST - 19**

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*: –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 (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 :_____

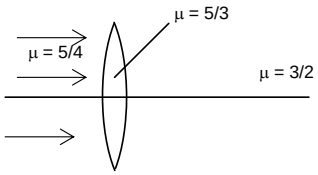
SECTION-1 : PHYSICS

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 thin equi – convex lens having radius of curvature R = 10 cm, where the parallel rays will converge if the parallel rays are incident as shown

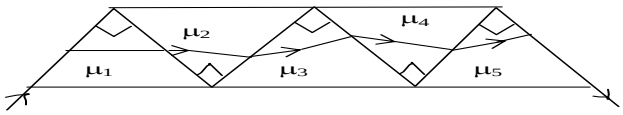


(A) $\frac{90}{7}$cm (B) $\frac{180}{7}$ cm

(C) $\frac{90}{14}$ cm (D) 90 cm

1. **B**

2. A ray of light at grazing angle of incidence an assembly of five isosceles right-angled prisms havings refractive indices μ_1,μ_2,μ_3,μ_4 and μ_5 respectively.The ray also emerges out at a grazing angle .Then

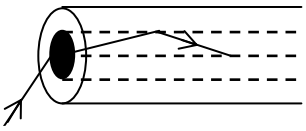


(A) $\mu_1^2+\mu_3^2+\mu_5^2+=1+\mu_2^2+\mu_4^2$ (B) $\mu_1^2+\mu_3^2+\mu_5^2+=2+\mu_2^2+\mu_4^2$

(C) $\mu_1^2+\mu_3^2+\mu_5^2+=\mu_2^2+\mu_4^2$ (D) none of the above

2. **B**

3. An optical fibre consists of core of μ_1 surrounded by a cladding of $\mu_2 < \mu_1$. A beam of light enters from air at an angle α with axis of fibre. The highest α for which a ray can be travelled through fibre is

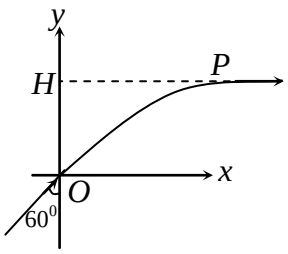


(A) $\cos^{-1}\sqrt{\mu_2^2-\mu_1^2}$ (B) $\sin^{-1}\sqrt{\mu_1^2-\mu_2^2}$

(C) $\tan^{-1}\sqrt{\mu_1^2-\mu_2^2}$ (D) $\sec^{-1}\sqrt{\mu_1^2-\mu_2^2}$

3. **B**

4. A system of coordinates is drawn in a medium whose refractive index varies as $\mu=\frac{2}{1+y^2}$, where 0<y<1. A ray of light is incident at origin at an angle 60^0 with *y* –axis as shown in the figure. At point P ray becomes parallel to x-axis. The value of *H* is

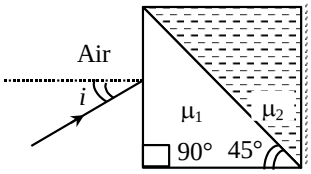


(A) $\left\{\frac{2}{\sqrt{3}}-1\right\}^{1/2}$ (B) $\frac{2}{\sqrt{3}}^{1/2}$

(C) $\sqrt{3}\ -1\ ^{1/2}$ (D) $\sqrt{3}+1\ ^{1/2}$

4. **A**

5. In the given situation, for what value of *i,* the incidence ray will retrace its initial path



(A) $\sin^{-1}\left\{\mu_1 \sin\left(\frac{\pi}{4}-\sin^{-1}\left(\frac{\mu_2}{\sqrt{2}\mu_1}\right)\right)\right\}$

(B) $\cos^{-1}\left\{\mu_1 \sin\left(\frac{\pi}{4}-\sin^{-1}\left(\frac{\mu_2}{\sqrt{2}\mu_1}\right)\right)\right\}$

(C) $\sin^{-1}\left\{\mu_2 \sin\left(\frac{\pi}{4}-\sin^{-1}\left(\frac{\mu_1}{\sqrt{2}\mu_2}\right)\right)\right\}$

(D) $\cos^{-1}\left\{\mu_2 \sin\left(\frac{\pi}{4}-\sin^{-1}\left(\frac{\mu_1}{\sqrt{2}\mu_2}\right)\right)\right\}$

5. **A**

6. An object is placed at a distance of 3f from a convex lens of focal length f. A slab of refractive index μ is placed in between lens and object. The image of the object will be formed nearest to the object if thickness of the slab is

(A) f (B) 2f (C) $\frac{f}{\mu-1}$ (D) $\frac{\mu f}{\mu-1}$

6. **D**

(Multi Correct Choice Type)

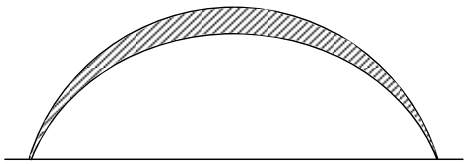
This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. A ray of light travelling in a transparent medium falls on a surface separating the medium from air at an angle of incidence 45^0. The ray undergoes total internal reflection. If *n* is the refractive index of the medium with respect to air, select the possible value(s) of *n* from the following

(A) 1.3 (B) 1.4
(C) 1.5 (D) 1.6

7. **CD**

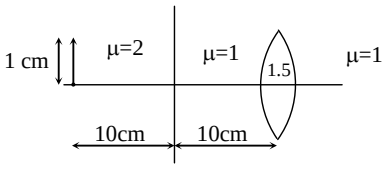
8. The concave and convex surfaces of a thin concavo – convex lens of index 1.5 has radius of curvature 50 and 10 cm respectively. The concave side is silvered and placed on a horizontal surface as shown



(A) Focal length of lens is 25 cm(before silvering)
(B) Focal length of the combination (after silvering) in 25cm
(C) Image of the object at 150cm will coincide with itself (after silvering)
(D) Image will not coincide in this type of silvered lenses

8. **ABC**

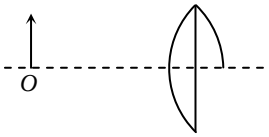
9. An object of length 1m is placed on a principle axis of biconvex lens of radius 5 cm. Distance between the lens and object is 20 cm. Space between the lens and object is filled with medium of two different refractive index 2 and 1 as shown in the figure. Refractive index is 1 on the left of the object and on the right side of the lens. Boundary of both medium is mid-way between the object and lens as shown in figure.



(A) The image will be formed at distance of 7.5 cm from the optical centre.
(B) The image will be formed at distance of 10 cm from the optical centre.
(C) The size of the image is 0.5 cm.
(D) The size of the image is 0.4 cm.

9. **AC**

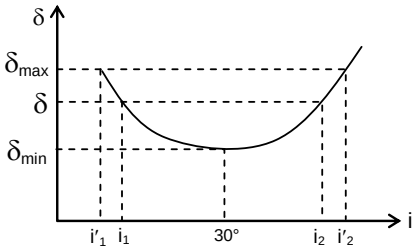
10. One fourth part of an equiconvex lens of focal length 100 cm is removed as shown in the figure. An object of height 1 cm is placed in front of the lens. It is observed that all the images are of equal height. Then



(A) Object is at a distance of $\frac{400}{3}$ cm from the lens.
(B) The magnitude of magnification produced by upper and lower part is equal.
(C) The no. of images formed is two.
(D) The product of magnification of both the lenses is negative.

10. **ABCD**

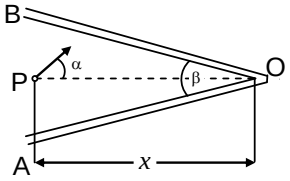
11. The deviation δ_{min} of a prism versus the angle of incidence i is given. Then



(A) $\delta = i_1 + i_2 - A$
(B) if $\delta_{min} = 30°$, $A = 30°$
(C) for $\delta_{max} = i_2' + 90° - A$ and $\sin i_1' = n \sin(A - \theta_C)$ where $\theta_C = \sin^{-1}(1/n)$
(D) $\delta_{max} = 90° + i_1' - A$, where $i_1' = \sin^{-1}[n \sin(A - \theta_c)]$ where $\theta_C = \sin^{-1}(1/n)$

11. **ABD**

12. In free space, a particle is projected from a point P on axis of a fixed rigid cone AOB, at an angle $\alpha = 37°$ with the axis (see figure). Distance of point P from the apex O is x = 10 cm and the apex angle of cone is $\beta = 20°$. All the collisions of the ball with the cone are perfectly elastic

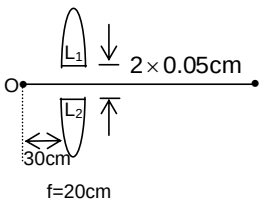


(A) the distance of closest approach of the ball from the apex is 6 cm.
(B) the distance of closest approach of the ball from the apex is 8 cm.
(C) the number of collisions of the ball with the cone is 7.
(D) the number of collisions of the ball with the cone is 8.

12. **AC**

PART – B
(Numerical based)

1. A point object O is placed at a distance of 0.3 m from a convex lens (focal length 0.2 m) cut into two halves each of which is displaced by 0.0005 m as shown in figure. Find the distance between the two images formed by the two parts of the lens (In mm).

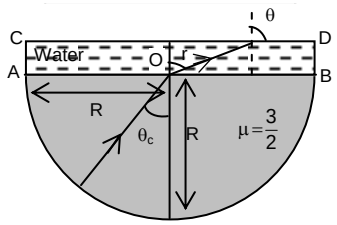


1. **3**

2. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The line PQ cuts the surface at a point O, and PO = OQ. Find the value of $\frac{PO}{R}$.

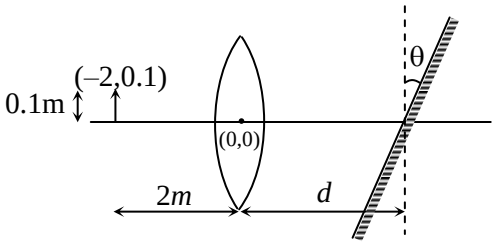
2. **5**

3. A ray of light traveling in glass (μ = 3/2) is incident on a horizontal glass air surface at the critical angle θ_C. If a thin layer of water (μ = 4/3) is now poured on the glass air surface, the ray of light emerge into air at the water air surface at an angle of k radians find the value of k.



3. **1.57**

4. A convex lens of focal length 1.5m is placed in a system of coordinate axis such that its optical centre is at origin and principal axis coinciding with the *x*-axis. An object and a plane mirror are arranged on the principal axis as shown in figure. Find the value of *d* (in m) so that *y*-coordinate of final image (after refraction and reflection) is 0.3m. (Take tan θ = 0.3)



4. **5**

5. A mirror (μ = 3/2) is 10 cm thick. An object is placed 15 cm in front of it. Find the position of image from the front surface in cms.

5. **28.34**

6. A concave mirror of focal length 15 cm is placed in water of refractive index μ = 4/3. Water is filled upto 30 cm. An object of height 1 cm is placed at a distance of 20 cm in front of the mirror. If the size of image is n times size of object, then n =

6. **3**

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.**

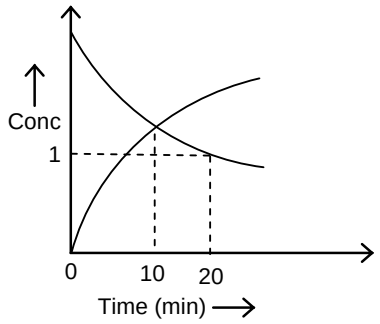
1. For the given equilibrium $L(g) \rightleftharpoons M(g)$

   The $K_f = 5 \times 10^{-4}$ mole/lt/sec and $K_b = 3 \times 10^{-2}$ lt/mol/sec, the equilibrium concentration of M is

   (A) 0.129 M
   (B) 0.3 M
   (C) 0.8 M
   (D) not possible to calculate

1. A

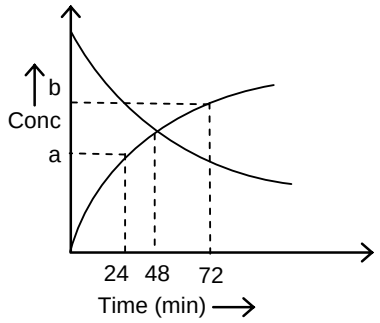
2. For a first order reaction, $A \rightleftharpoons B$ whose conc. vs time curve is as shown. The rate constant is equal to



   (A) 41.58 hr^{-1}
   (B) 1.155×10^{-3} sec^{-1}
   (C) 4.158 sec^{-1}
   (D) none(can't be calculated)

2. B

3. For a first order reaction, $nA \longrightarrow B$. Whose conc. vs time curve is as shown in the figure. If half-life for the reaction is 24 minutes. Find out the value of n.



   (A) 1
   (B) 2
   (C) 3
   (D) data insufficient

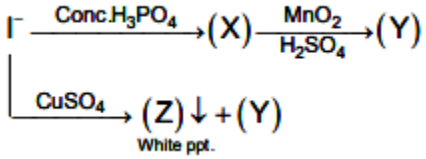
3. C

4. The ratio of the rate constant of a reaction at any temperature T to the rate constant $T \longrightarrow \infty$ is equal to

   (A) energy of activation of the reaction
   (B) fraction of molecules in activated state
   (C) average life of the reaction
   (D) pre exponential factor in the Arrhenius equ^n

4. B

5.



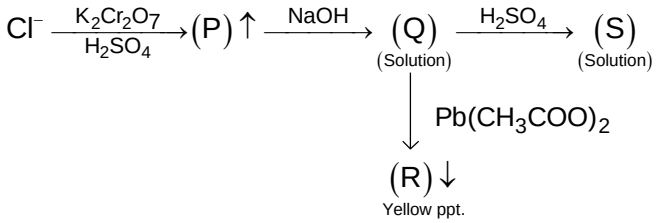
The unknown compound (Y) in the above reaction is:

(A) I_2 (B) HI

(C) I_3^- (D) Both A and C are correct

5. **D**

6.



Which of the following statement is NOT correct about the above unknown compounds?

(A) (P)↑ is a reddish-brown gas

(B) The colour of solution(Q) is different from that of (S)

(C) (S) and (R) contain the same anion CrO_4^{2-}

(D) $(Q) \longrightarrow (S)$ is a dehydration reaction

6. **C**

(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 statement(s) is/are correct for NO_3^- radical?

(A) It forms brown fumes when treated with dil. HCl or dil.H_2SO_4.

(B) Addition of conc. H_2SO_4 and Cu turning to its aqueous solution results in the formation of a blue solution.

(C) It forms brown ring with $FeSO_4$ and Conc.H_2SO_4.

(D) It is oxidised by acidified permanganate solution to HNO_3.

7. **BC**

8. Which of the following precipitate(s) is/are soluble in hot water?

(A) $PbCrO_4$ (B) $PbCl_2$

(C) $PbSO_4$ (D) $PbBr_2$

8. **BD**

9. Which of the following reagent(s) can be used to distinguish between SO_2 and CO_2?

(A) Lime water (B) $BaCl_2$

(C) Acidified dichromate paper (D) $Cl_2/H_2O + BaCl_2$

9. **CD**

10. $FeCl_3$ forms red colour solution with

(A) SCN^- (B) CH_3COO^-

(C) $HCOO^-$ (D) CN^-

10. **ABC**

11. Which of the following radical(s) do/does NOT evolve any gas when react(s) with acidified permanganate solution?

(A) NO_2^- (B) SO_3^{2-}

(C) CO_3^{2-} (D) $C_2O_4^{2-}$

11. **ABC**

12. The conversion of CrO_4^{2-} to $Cr_2O_7^{2-}$ in acidic medium is an example of

(A) redox reaction (B) dehydration reaction

(C) condensation reaction (D) precipitation reaction

12. **BC**

PART – B
(Numerical based)

1. How many of the following given white ppt. will dil. HCl

Pb^{2+}, Ba^{2+}, Mn^{2+}, Zn^{2+}, Ag^+, Hg_2^{2+}

1. 3

2. $\underset{\text{Black}}{X(s)} \xrightarrow{\text{dil.HCl}} Y\uparrow \xrightarrow[\text{NaOH}]{Na_2[Fe(CN)_5(NO)]}$

Purple solution gas Y has been allowed to react with following species in neutral/acidic medium.

(a) $FeCl_3$, (b) $CuSO_4$, (c) $BaCl_2$, (d) SO_2, (e) $Cr_2O_7^{2-}$, (f) CH_3COONa, (g) Hg_2^{2+}

Then calculate the value of (P + Q – R)

P: Number of species which undergoes redox reaction with gas Y.

Q: Number of species with which gas Y undergoes precipitation.

R: Number of species with which gas Y produce no observable change.

2. 6

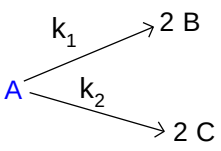
3. An aqueous solution contains Hg^{2+}, Hg_2^{2+}, Pb^{2+} and Cd^{2+}. Out of these, how many ions will produce white precipitate with dilute HCl?

3. 2

4. $SO_3(g)$ is entering the environment at a constant rate of 6.93×10^{-6} gm/L/day. Due to emission of pollution gases from thermal power plant but at same time it is decomposing and following first order kinetics with half life of 10 days. Find out 'X' if $x \times 10^{-5}$ is concentration of SO_3 in Delhi assuming SO_3 in air reaches steady state

4. 1.25

5. For a hypothetical reaction



Where $k_1/k_2 = ½$

With initial moles of 'A' = 2

Find number of moles of 'B' at the end of 50% reaction

5. 0.67

6. Substance ‘A’ undergoes sequential decay as shown

$A \xrightarrow{\lambda_1} B \xrightarrow{\lambda_2} C$

If $\lambda_1 = 4 \times 10^{-2}$ min^{-1} and $\lambda_2 = 16 \times 10^5$ min^{-1}

Find value of ‘X’ if molar ratio of B to A after a very long time will be “$X \times 10^{-8}$”.

6. 2.5

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 curve $f(x)=\int x^{11}\left(2x^3+3x+4\right)^3\left(1+x+x^3\right)dx$ passes through origin and $f(1)=\frac{p}{q}$ where p and q are relatively prime, then p – q is

(A) 1161 (B) 1773
(C) 2017 (D) 2171

1. D

2. $\int xe^{\tan x}\left(2+x\sec^2 x\right)dx$ is equal to:

(A) $2e^{\tan x}+C$ (B) $x^2e^{\tan x}+C$
(C) $\tan x+xe^{\tan x}+C$ (D) $x^2+xe^{\tan x}+C$

2. B

3. $\lim\limits_{t\to 0}\int_0^{2\pi}\frac{|\sin(x+t)-\sin x|}{|t|}dx$ equals:

(A) 0 (B) 1
(C) 2 (D) 4

3. D

4. For $\theta\in\left(0,\frac{\pi}{2}\right)$, the value of definite integral $\int_0^{\theta}\ln(1+\tan\theta\tan x)dx$ is equal to:

(A) $\theta\ln(\sec\theta)$ (B) $\theta\ln(\operatorname{cosec}\theta)$
(C) $\frac{\theta\ln 2}{2}$ (D) $2\theta\ln\sec\theta$

4. A

5. If $\int_0^{f(x)}t^2\,dt=x\cos\pi x$, then $f'(9)$:

(A) is equal to $-\frac{1}{9}$ (B) is equal to $-\frac{1}{3}$
(C) is equal to $\frac{1}{3}$ (D) is non existent

5. A

6. $\lim\limits_{n\to\infty}\frac{1}{\sqrt{n}\sqrt{n+1}}+\frac{1}{\sqrt{n}\sqrt{n+2}}+.....+\frac{1}{\sqrt{n}\sqrt{4n}}$ is equal to:

(A) 2 (B) 4
(C) $2\left(\sqrt{2}-1\right)$ (D) $2\left(\sqrt{2}-1\right)$

6. 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.

7. If $\int f(x)dx = \frac{3}{55}\sqrt[3]{\tan^5}\left(5\tan^2 x + 11\right) + c$, then $f(x)$ is equal to:

(A) $\sqrt[3]{\sin^2 x \cos^{-14} x}$ (B) $\sqrt[3]{\tan^2 x\left(1+\tan^2 x\right)^6}$

(C) $\sqrt[3]{\cos^2 x \sin^{-14} x}$ (D) $\frac{7}{3}\sqrt[3]{\sin^2 x \cos^{-14} x}$

7. AB

8. If $\int \frac{3x+4}{x^3-2x-4}dx = \log|x-2| + k\log f(x) + c$, then:

(A) $K = \frac{-1}{2}$ (B) $f(x) = x^2 + 2x + 2$

(C) $f(x) = |x^2 + 2x + 2|$ (D) $K = \frac{1}{4}$

8. ABC

9. Let $A = \int_{e^{-1}}^{\tan x} \frac{t\,dt}{t^2+1}$ and $B = \int_{e^{-1}}^{\cot x} \frac{dt}{t\left(1+t^2\right)}$ then:

(A) At $x = \frac{\pi}{4}$, $A + B = 1$

(B) $A + B = 1$ for all x in $\left(0, \frac{\pi}{2}\right)$

(C) $A + B = 1$ for all x in $\left(0, \frac{\pi}{4}\right)$ and 2 for all x in $\left(\frac{\pi}{4}, \pi\right)$

(D) $A = B$ for all x

9. AB

10. The integral $\int_0^{\pi} x f(\sin x)dx$ is equal to:

(A) $\frac{\pi}{2}\int_0^{\pi} f(\sin x)dx$ (B) $\frac{\pi}{4}\int_0^{\pi} f(\sin x)dx$

(C) $\pi\int_0^{\pi/2} f(\sin x)dx$ (D) $\pi\int_0^{\pi/2} f(\cos x)dx$

10. ACD

11. Which of the following function (s) is/are even?

(A) $f(x) = \int_0^x \ln\left(t + \sqrt{1+t^2}\right)dt$ (B) $g(x) = \int_0^x \frac{\left(2^t+1\right)t}{2^t-1}dt$

(C) $h(x) = \int_0^x \left(\sqrt{1+t+t^2} - \sqrt{1-t+t^2}\right)dt$ (D) $I(x) = \int_0^x \ln\left(\frac{1-t}{1+t}\right)dt$

11. ACD

12. Let $f: R \to R$ be defined as $f(x) = \int_{-1}^{e^x} \frac{dt}{1+t^2} + \int_{-1}^{e^{-x}} \frac{dt}{1+t^2}$, then:

(A) $f(x)$ is a periodic

(B) $f(f(x)) = f(x) \forall x \in R$

(C) $f(1) + f'(1) = \frac{\pi}{2}$

(D) $f(x)$ is unbounded

12. BC

PART – B
(Numerical based)

1. If $\int \left(x^6 + 7x^5 + 6x^4 + 5x^3 + 4x^2 + 3x + 1\right)e^x dx$ is equal to $\sum_{k=1}^{\alpha} \beta x^k . e^x + C$ (were C is constant of integration), then $(\alpha + \beta)$ is:

1. 7

2. If $\int \frac{\ln\left(ex^{x+1}\right) + \left(\ln\left(x^{\sqrt{x}}\right)\right)^2}{1 + (x \ln x)\left(\ln\left(e^x x^x\right)\right)} dx = f(x) + C$, where $f(1) = 0$, then $e^{\left(e^{f(2)} - 1\right)}$ is equal to

2. 4

3. If $\lim_{x \to \infty} x^{-\left(\frac{3}{2} + n\right)} \int_0^x t^n \sqrt{t+1} dt$ has the value equal $\frac{2}{11}$ then find the value of $n \in N$.

3. 4

4. If $f_1(x)$ and $f_2(x)$ are two antiderivatives of $f(x) = ax + b + \sin x$ such that $\int_2^4 \left(f_1(x) - f_2(x)\right) dx = 8$ then find the area of the triangle formed by joining the points $\left(3, f_1(3)\right), \left(3, f_2(3)\right)$ and the origin.

4. 6

5. Suppose $V = \int_0^{\pi/2} x \left|\sin^2 x - \frac{1}{2}\right| dx$, find the value of $\frac{96V}{\pi}$.

5. 12

6. Let $I_n = \int_0^{\frac{\pi}{4}} \tan^n x \, dx \left(n = 0, 1, 2, 3, 4, ...\right)$ and $S_n = \sum_{n=0}^{n} \left(I_n I_{n+1} + I_n I_{n+3} + I_{n+1} I_{n+2} I_{n+3}\right)$. Find the value of $\lim_{n \to \infty} 100\left(S_n\right)$.

6. 100

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B