

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - 1

QP Code:

TEST - III

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 option(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 (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**.

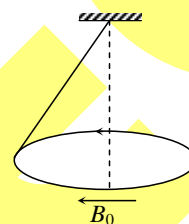
1. A particle of charge q and mass m starts moving from the origin under the action of an electric field $\vec{E} = E_0 \hat{i}$ and $\vec{B} = B_0 \hat{i}$ with a velocity $\vec{v} = v_0 \hat{j}$. The speed of the particle will become $2v_0$ after a time

(A) $t = \frac{2mv_0}{qE}$ (B) $t = \frac{2Bq}{mv_0}$ (C) $t = \frac{\sqrt{3} Bq}{mv_0}$ (D) $t = \frac{\sqrt{3} mv_0}{qE}$

1. **D**

2. A uniform current carrying ring of mass m and radius R is connected by a massless string as shown. A uniform magnetic field B_0 exist in the region to keep the ring in horizontal position, then the current in the ring is ($l =$ length of string)

(A) $\frac{mg}{\pi R B_0}$ (B) $\frac{mg}{R B_0}$ (C) $\frac{mg}{3\pi R B_0}$ (D) $\frac{mgl}{\pi R^2 B_0}$



2. **A**

3. A metallic wire is folded to form a square loop of side a . It carries a current i and is kept perpendicular to a uniform magnetic field B . If the shape of the loop is changed from square to an equilateral triangle without changing the length of the wire and current, the amount of work done in doing so is

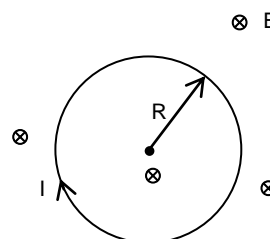
(A) $Bia^2 \left(1 - \frac{4\sqrt{3}}{9}\right)$ (B) $Bia^2 \left(1 - \frac{\sqrt{3}}{9}\right)$ (C) $\frac{2}{3} Bia^2$ (D) zero

3. **A**

4. A conducting loop is placed in a magnetic field (uniform) as shown in figure.

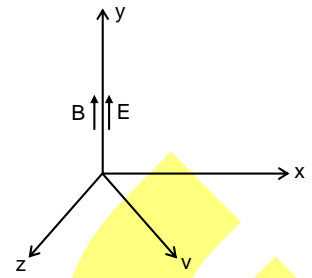
For this situation, mark out the correct statement

- (A) The force of compression experienced by loop is IRB
 (B) The force of compression experienced by loop is $2IRB$
 (C) The force of expansion experienced by loop is $2IRB$
 (D) The force of expansion experienced by loop is IRB

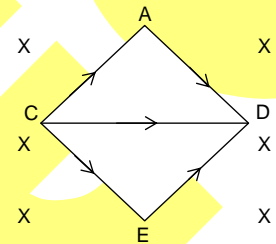


4. **D**

5. A charge particle of mass 'm', charge 'q' has velocity $\vec{v} = v(\hat{i} + \hat{k})$ in the magnetic field at the origin. Its speed as the function of y is:
- (A) $\sqrt{v^2 + \frac{qE}{2m}y}$
- (B) $\sqrt{\left(\frac{B}{E}\right)^2 + v^2 + \frac{qE}{2m}y}$
- (C) $\sqrt{v^2 + \frac{2qE}{m}y}$
- (D) None of the above



5. **D**
6. Constant current of 1A flows along all the three branches of wire frame as shown. The frame is a combination of two equilateral triangles ACD and CDE of side 1m. It is placed in uniform magnetic field $B = 4T$ acting perpendicular to the plane of paper. The magnitude of magnetic force acting on the frame is
- (A) 12 N
- (B) 24 N
- (C) 36 N
- (D) Zero

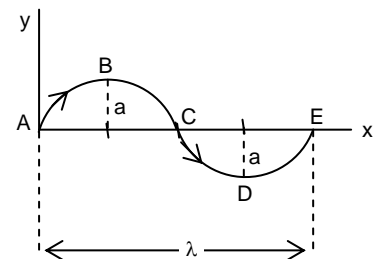


6. **A**

(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. A conductor ABCDE, shaped as shown, carries current I. It is placed in the xy-plane with the ends A and E on the x-axis. A uniform magnetic field of magnitude B exists in the region. The force acting on it will be
- (A) zero, if B is in the x-direction
- (B) λBI in the z-direction, if B is in the +y- direction
- (C) λBI in the negative y-direction, if B is in the +z-direction
- (D) λaBI , if B is in the x-direction

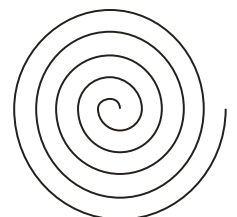


7. **ABC**

8. A proton is fired from origin with velocity $\vec{v} = v_0\hat{j} + v_0\hat{k}$ in a uniform magnetic field $\vec{B} = B_0\hat{j}$. In the subsequent motion of the proton
- (A) its z coordinate can never be negative
- (B) its x coordinate can never be positive
- (C) its x and z coordinates cannot be zero at the same time
- (D) its y coordinate will be proportional to its time of flight.

8. **BD**

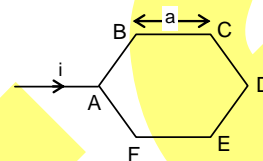
9. A charged particle enters a region which offers some resistance against its motion and a uniform magnetic field exists in the region. The particle traces a spiral path as shown. Then:
- (A) angular velocity of particle remains constant
- (B) speed of particle decreases continuously
- (C) total mechanical energy of the particle remains conserved
- (D) net force on the particle is always perpendicular to its direction of motion



9. **AB**
10. A charged particle moves in a gravity-free space without change in velocity. Which of the following is/are possible?
 (A) $E = 0, B = 0$ (B) $E = 0, B \neq 0$ (C) $E \neq 0, B = 0$ (D) $E \neq 0, B \neq 0$

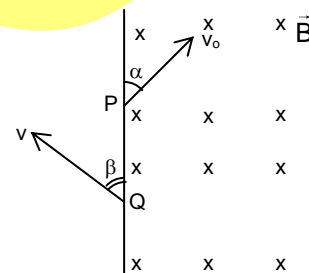
10. **ABD**

11. As situation shown in figure the magnitude of magnetic field at the centre will be
 (A) Zero, if the current exit in the long wire from the B and along EB
 (B) $\frac{\mu_0 i}{8\pi a}$, if the current exit in the long wire from the D and along CD
 (C) $\frac{\mu_0 i}{4\sqrt{3}\pi a}$, if the current exit in the long wire from the E and along DE
 (D) None of these



11. **AC**

12. A particle of charge $-q$ and mass m enters a uniform magnetic field \vec{B} (perpendicular to paper inwards) at P with a velocity v_0 at an angle α and leaves the field at Q with velocity v at angle β as shown in figure. Then
 (A) $\alpha = \beta$
 (B) $v = v_0$
 (C) $PQ = \frac{2mv_0 \sin \alpha}{Bq}$
 (D) particle remains in the field for time $t = \frac{2m(\pi - \alpha)}{Bq}$



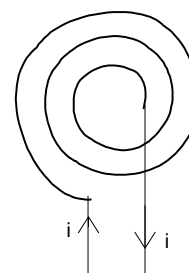
12. **ABCD**

PART – B (Numerical based)

1. A charged particle is projected in a magnetic field $\vec{B} = (10x\hat{i} + 4\hat{j})10^{-2} \text{ T}$. The acceleration of the particle is found to be $\vec{a} = \left(\frac{8}{3}\hat{i} - 2\hat{j}\right) \text{ m/s}^2$. Find the value of 'x'.

1. **0.30**

2. A thin insulate wire forms a plane spiral of $N = 100$ turns carrying a current $I = 2.3 \text{ A}$. The inner and outer radii are equal to $a = 5 \text{ cm}$ and $b = 10 \text{ cm}$. Find the magnetic field ($\text{In } 10^{-3} \text{ T}$) at the centre of spiral [$\ln 2 = 0.69$]

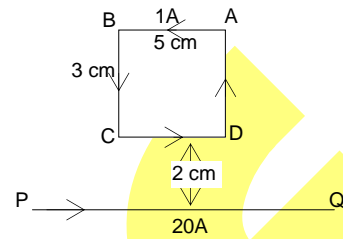


2. **2**

3. A steady current I goes through a wire loop PQR having shape of a right angle triangle with $PQ = 3x$, $PR = 4x$ and $QR = 5x$. If the magnitude of the magnetic moment is $10k(Ix^2)$. Find the value of 'k'.

3. **0.60**

4. A small rectangular loop of sides 5.0 cm and 3.0 cm carries a current of 1A. It is placed with its longer side parallel to a long straight conductor of length 5 cm at a distance of 2 cm from it. If current in the long conductor is 20 A, find the net force (In micro N) on the loop.

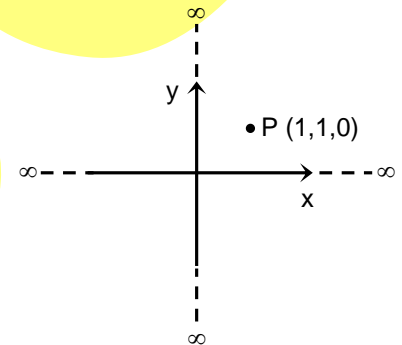


4. **6**

5. A particle having a mass of 0.5 g carries a charge $2.5 \times 10^{-8} \text{C}$. The particle is given an initial horizontal velocity of $4 \times 10^4 \text{ms}^{-1}$. To keep the particle moving in a horizontal direction, the minimum value of magnetic field (in Tesla) should be (take acceleration due to gravity = 10m/s^2)

5. **5**

6. There are two infinitely long & broad sheets, one is lying on xz plane and another one is lying on yz plane. In both the sheets, current is moving in positive z direction having linear density (current per unit perpendicular length) equal to $\frac{\sqrt{2}}{\pi} \times 10^7$ Ampere/meter. Find the magnitude of magnetic field (in Tesla) at point P shown in the figure.

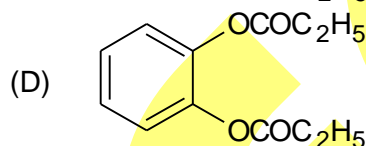
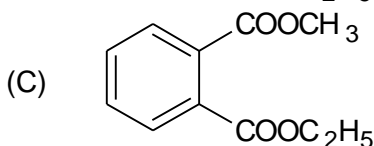
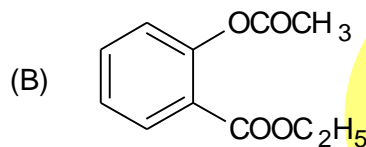
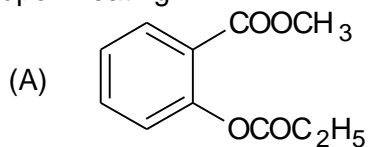


6. **4**

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. Which of the following, upon hydrolysis produces a product that forms cyclic anhydride upon heating?



1. C

2. The structure of an amine(X) is



Which isomer of (X) is more basic as well as less soluble in water than it?

(A) Chain isomer

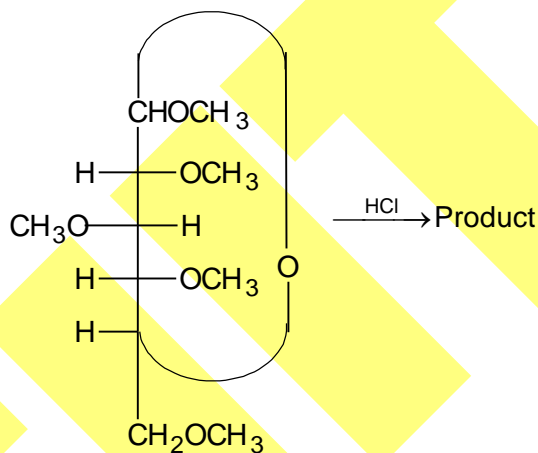
(B) Position isomer

(C) Functional isomer

(D) Optical isomer

2. C

- 3.



Demethylation reaction in above molecule takes place easily at

(A) C – 1

(B) C – 2

(C) C – 3

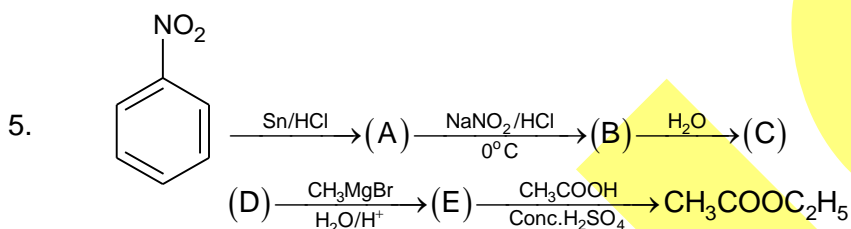
(D) C – 4

3. A

4. Which of the following, form of amino acid is correct at pH = 5?

- (A) $\text{H}_2\text{N} - \underset{\text{R}}{\text{CH}} - \text{COO}^-$ (pH at isoelectric point = 6.2)
- (B) $\text{H}_2\text{N} - \text{CH}_2 - \text{CH}_2 - \underset{\text{R}}{\overset{\text{COOH}}{\text{C}}} - \text{NH}_3^+$ (pH at isoelectric point = 4.6)
- (C) $\text{H}_3\text{N}^+ - \text{CH}_2 - \underset{\text{R}}{\text{CH}} - \text{COO}^-$ (pH at isoelectric point = 6)
- (D) $\text{H}_3\text{N}^+ - \text{CH}_2 - \underset{\text{R}}{\text{CH}} - \text{COOH}$ (pH at isoelectric point = 7.1)

4. D

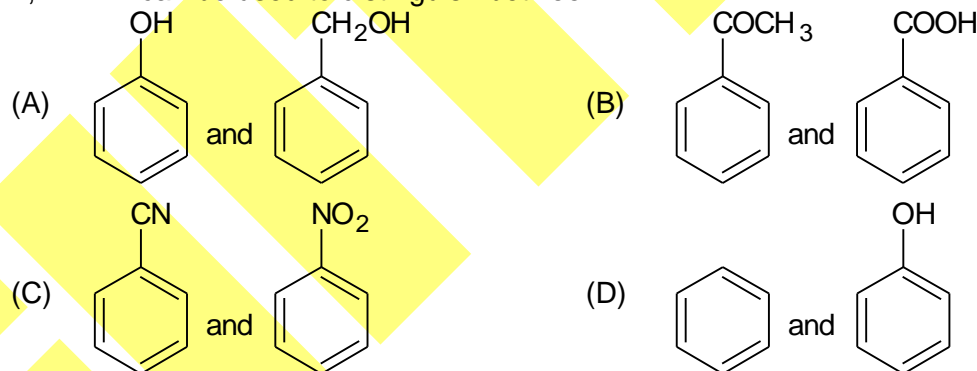


Which of the following two compounds are monomers of a polymer?

- (A) C and D (B) A and B
(C) E and C (D) B and C

5. A

6. 2, 4-DNP can be used to distinguish between



6. B

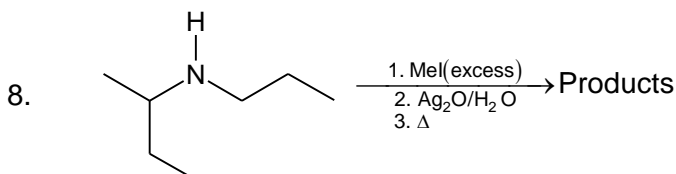
(Multi Correct Choice Type)

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.

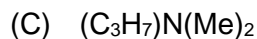
7. Which of the following produce(s) CO_2 gas upon heating?

- (A) $\begin{array}{c} \text{COOH} \\ | \\ \text{COOH} \end{array}$ (B) $\begin{array}{c} \text{CH}_2\text{COOH} \\ | \\ \text{CH}_2\text{COOH} \end{array}$
- (C) $\begin{array}{c} \text{COOH} \\ / \\ \text{H}_2\text{C} \\ \backslash \\ \text{COOH} \end{array}$ (D) $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \text{COOH}$

7. ACD

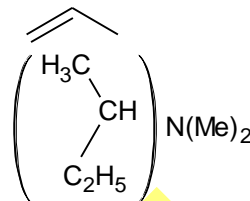


The product(s) of above reaction is/are



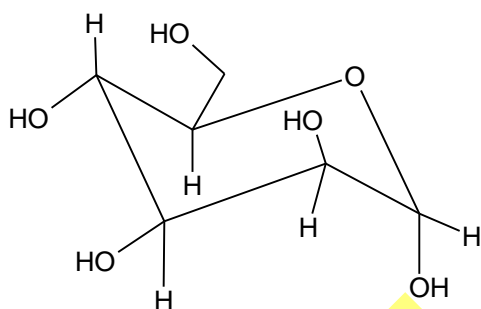
(B)

(D)

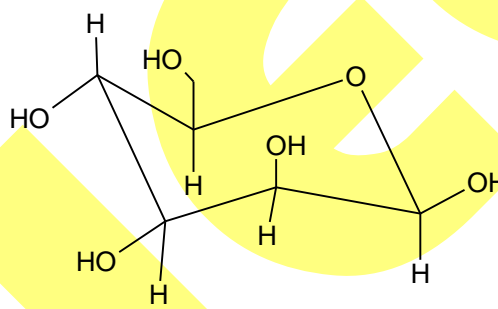


8. ABCD

9.



(I)

 α -D-mannose

(II)

 β -D-mannose

Choose correct statements regarding the above two molecules

(A) (II) is more stable than (I)

(B) (I) is more stable than (II)

(C) Axial OH groups makes the molecule unstable than equatorial OH groups

(D) Axial OH groups makes the molecules stable than equatorial OH group

9. BC

10. Which of the following bond(s) is/are found in the repeating unit of polymer Nylon 6, 6?

(A) C - N

(B) N - N

(C) N - H

(D) O - H

10. AC

11. An organic compound gives the following tests

(i) When CuO is added to the ignited organic compound, water drops are found on the cooler part of test tube.

(ii) The soda extract gives a red solution with Fe(III) ions

The presence of which element(s) in the organic compound is/are ascertained by above two tests

(A) Hydrogen

(B) Oxygen

(C) Sulphur

(D) Nitrogen

11. ACD

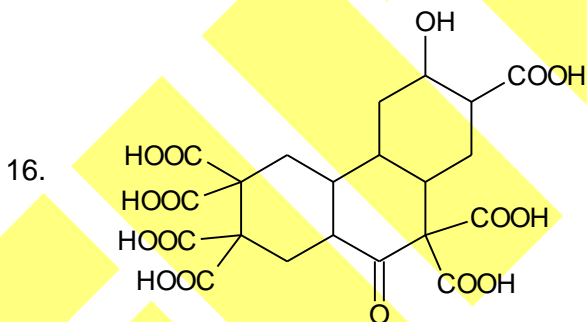
12. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CONH}_2 \xrightarrow{\text{Br}_2/\text{KOH}}$ Product
 Correct statement(s) regarding above reaction is/are
 (A) the product contains four carbon atoms
 (B) four moles of OH^- ions are needed to get one mole of product
 (C) carbocation intermediate is formed in the reaction
 (D) in the product, the lone pair on nitrogen atom is delocalized
12. AB

PART – B
(Numerical based)

13. $\text{H}_3\text{N}^+ - \text{CH}_2 - \underset{\text{NH}_3^+}{\text{CH}} - \text{COO}^-$ $\text{pK}_{\text{a}_3} = 2$
 $\text{pK}_{\text{a}_1} = 8$ $\text{pK}_{\text{a}_2} = ?$

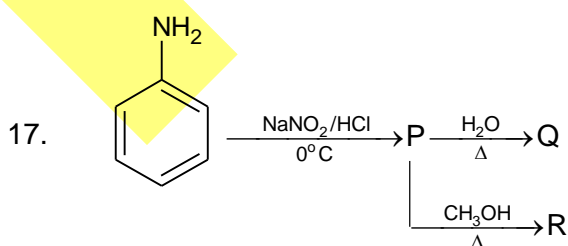
If the isoelectric point of above amino acid is 7. What is $\text{pK}_{\text{a}_2} = ?$

13. 6
14. A hexapeptide of molar mass 392 g mol^{-1} , on complete hydrolysis produces glycine and other amino acids. Glycine contributes 60% to the total weight of the hydrolysis products. How many glycine units are present in the hexapeptide?
14. 4
15. How many maximum number of primary structure(s) is/are possible for the peptide containing four α -amino acids?
15. 24



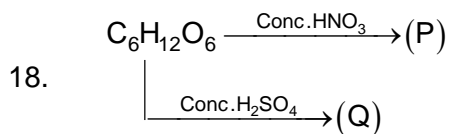
If $x =$ Number of CO_2 molecules evolved on heating the above compound and
 $y =$ Number of H_2O molecules formed on heating the above compound, then $x - y = ?$

16. 2



$x =$ number of hydrogen atoms present in Q and if
 $y =$ number of hydrogen atoms present in R
 What is the value of $(x + y)$?

17. 14



If x = molar mass of carbon containing product (P) in g mol^{-1} unit and y = molar mass of carbon containing product (Q) in g mol^{-1} unit. What is $(x - y)$?

18. 198

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. $\int \frac{3x^2 dx}{1+x^6} =$

(A) $\log|1+x^6| + c$

(B) $\tan^{-1}(x^3) + c$

(C) $\cot^{-1}(x^3) + c$

(D) $3\tan^{-1}(x^3) + c$

1. **B**

2. $\int \frac{dx}{\sqrt{4-9x^2}} =$

(A) $\frac{1}{3} \sin^{-1} \frac{3x}{2} + c$

(B) $\frac{1}{2} \sin^{-1} \frac{3x}{2} + c$

(C) $\sin^{-1} \frac{3x}{2} + c$

(D) none of these

2. **A**

3. The value of $\int 2^{mx} \cdot 3^{nx} dx$ (when $m, n \in \mathbb{N}$) is equal to :

(A) $\frac{2^{mx} + 3^{nx}}{m \ln 2 + n \ln 3} + C$

(B) $\frac{2^{nx} \cdot 3^{nx}}{\ln(2^m \cdot 3^n)}$

(C) $\frac{2^{mx} \cdot 3^{nx}}{\ln(2^m \cdot 3^n)} + C$

(D) $\frac{(mn) \cdot 2^x \cdot 3^x}{m \ln 2 + n \ln 3} + C$

3. **C**

4. $\int (e^x \sin x + e^x \cos x) dx =$

(A) $e^x \sin x + c$

(B) $e^x \cos x + c$

(C) $-e^x \sin x + c$

(D) $-e^x \cos x + c$

4. **A**

5. If $\int \frac{x}{x^2 - 4x + 8} dx = K \log(x^2 - 4x + 8) + \tan^{-1} \left(\frac{x-2}{2} \right) + C$ then the value of K is

(A) $\frac{1}{2}$

(B) 1

(C) 2

(D) none of these

5. **A**

6. If $f(x) = \int_{2x}^{\sin x} \cos(t^3) dt$, then $f'(x)$ is equal to
- (A) $\cos(\sin^3 x)\cos x - 2\cos(8x^3)$ (B) $\sin(\sin^3 x)\sin x - 2\sin(8x^3)$
 (C) $\cos(\cos^3 x)\cos x - 2\cos(x^3)$ (D) $\cos(\sin^3 x) - \cos(8x^3)$

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. $\int \frac{1 - \sin x}{\cos x} dx$ equals
- (A) $\ln(1 + \sin x) + c$ (B) $2\ln\left(\cos\left(\frac{\pi}{4} - \frac{x}{2}\right)\right) + c$
 (C) $2\ln\left(\sin\left(\frac{\pi}{4} + \frac{x}{2}\right)\right) + c$ (D) $2\ln\left(\cos\frac{x}{2} + \sin\frac{x}{2}\right) + c$

7. **ABCD**

8. The value of $\int \frac{\ln\left(\frac{x-1}{x+1}\right)}{x^2-1} dx$ is equal to
- (A) $\frac{1}{2}\ln^2\frac{x-1}{x+1} + C$ (B) $\frac{1}{4}\ln^2\frac{x-1}{x+1} + C$
 (C) $\frac{1}{2}\ln^2\frac{x+1}{x-1} + C$ (D) $\frac{1}{4}\ln^2\frac{x+1}{x-1} + C$

8. **BD**

9. The value of integral $\int_0^{\frac{\pi}{2}} \ln \sin x dx$ is equal to
- (A) $\int_0^{\frac{\pi}{2}} \ln \cos x dx$ (B) $\int_0^{\frac{\pi}{2}} \ln \sin 2x dx$
 (C) $-\frac{\pi}{2} \ln 2$ (D) $\frac{\pi}{2} \ln \frac{1}{2}$

9. **ABCD**

10. Which of the following is/are correct?

$$(A) \int_0^{\frac{\pi}{2}} \frac{\cos x}{\cos x + \sin x} dx = \frac{\pi}{4}$$

$$(B) \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{dx}{1 + \sqrt{\tan x}} = \frac{\pi}{6}$$

$$(C) \int_0^{\frac{\pi}{2}} \cos(\pi \sin^2 x) dx = 0$$

$$(D) \int_0^a \frac{f(x)}{f(x) + f(a-x)} dx = \frac{a}{2}$$

10. **ACD**

11. Let $I_n = \int_0^{\frac{\pi}{2}} \sin^n x dx$.

$$(A) I_n = \int_0^{\frac{\pi}{2}} \cos^n x dx$$

$$(B) I_n = \left(\frac{n-1}{n}\right) I_{n-2}$$

$$(C) I_n = \left(\frac{n}{n-1}\right) I_{n-2}$$

$$(D) I_4 = \frac{3\pi}{16}$$

11. **ABD**

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

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

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

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

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

12. **ACD**

PART – B (Numerical based)

1. If $\int \frac{2^x}{\sqrt{1-4^x}} dx = K \sin^{-1}(2^x) + C$, then the value of $K \ln 2$ is equal to

1. **1**

2. If $\int \frac{dx}{25+16x^2} = \frac{1}{a} \tan^{-1} \frac{px}{q} + c$, then the value of $(a-p+q)$ is

2. **21**

3. $\frac{1}{4} \int_{-3}^3 \sqrt{5^2 - x^2} dx = k + \frac{25}{4} \sin^{-1} \frac{3}{5}$, then k equals

3. **3**

4. $\int_0^{\pi/8} \tan^2(2x) dx = \frac{4-\pi}{\lambda}$ then λ equal to

4. **8**

5. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a differentiable function such that $f(3) = 3$, $f'(3) = \frac{1}{2}$ and the value of

$$\lim_{x \rightarrow 3} \left(\frac{\int_3^{f(x)} 2t^3 dt}{x-3} \right) \text{ is } k \text{ then } \frac{k}{9}$$

5. **3**

6. Let $p(x)$ be a function defined on \mathbb{R} such that $p'(x) = p'(1-x)$, for all $x \in [0, 1]$, $p(0) = 1$ and $p(1) = 41$ and $\int_0^1 p(x) dx$ equals p then $\frac{p}{3}$ is ____

6. **7**

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B