

PHYSICS, CHEMISTRY & MATHEMATICS

QP Code:

Common
Test- 2

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: -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 (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. Two objects of masses m and $4m$ are at rest at an infinite separation. They move towards each other under mutual gravitational force of attraction. If G is the universal gravitational constant. Then at separation r

(A) the total energy of the two objects is zero.

(B) their relative velocity of approach is $\left(\frac{10Gm}{r}\right)^{\frac{1}{2}}$ in magnitude.

(C) the total kinetic energy of the objects is $\frac{4Gm^2}{r}$.

(D) net angular momentum of both the particles is zero about any point.

1. **ACD**

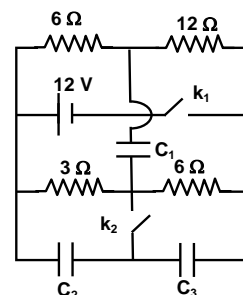
2. Given $C_1 = 2\mu\text{F}$; $C_2 = 4\mu\text{F}$, $C_3 = 8\mu\text{F}$. C_1 , C_2 , C_3 are initially uncharged. Initially all the keys are open. Then

(A) In steady state, after closing k_1 alone the charge in capacitor C_1 is zero.

(B) In steady state, after closing k_1 alone the charge in capacitor C_2 and C_3 are $8\mu\text{C}$ and $4\mu\text{C}$.

(C) In steady state, after closing k_1 alone the current drawn from the cell is 2A.

(D) In steady state, after closing k_1 and k_2 the current drawn from the cell is 1A.



2. **AC**

3. The potential of point A is 16V higher than potential of point B. Both the batteries have internal resistance 1Ω as shown in the circuit. Which is/are the correct statement out of the following :



(A) the current through the 2Ω resistance is 3.5 amp.

(B) the current through the 4Ω resistance is 2.5 amp.

(C) the current through the 3Ω resistance is 1.5 amp.

(D) the potential difference between the terminals of the 9 V battery is 7 V.

3. **ACD**

4. The magnitude of gravitational field at distance r_1 and r_2 from the centre of a uniform sphere of radius R and mass M are I_1 and I_2 respectively. Then

(A) $\frac{I_1}{I_2} = \frac{r_1}{r_2}$ if $r_1 < R$ and $r_2 < R$

(B) $\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$ if $r_1 > R$ and $r_2 > R$

(C) $\frac{I_1}{I_2} = \frac{r_1}{r_2}$ if $r_1 > R$ and $r_2 > R$

(D) $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$ if $r_1 < R$ and $r_2 < R$

4. **AB**

5. The capacitance of a parallel-plate capacitor is C_0 when the region between the plates has air. This region is now filled with a dielectric slab of dielectric constant K . The capacitor is connected to a cell of emf ε and the slab is taken out.
- (A) Charge $\varepsilon C_0(K - 1)$ flows through the cell.
 (B) Energy $\varepsilon^2 C_0(K - 1)$ is absorbed by the cell.
 (C) The energy stored in the capacitor is reduced by $\varepsilon^2 C_0(K - 1)$.
 (D) The external agent has to do $\frac{1}{2} \varepsilon^2 C_0(K - 1)$ amount of work to take the slab out.

5. **ABD**

6. A non-conducting solid sphere of radius R is uniformly charged. The magnitude of the electric field due to the sphere at a distance r from its centre
- (A) Increases as r increases for $r < R$
 (B) decreases as r increases for $0 < r < \infty$
 (C) is maximum at $r = R$
 (D) is discontinuous at $r = R$

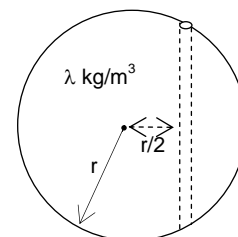
6. **AC**

PART – B

Integer Answer Type

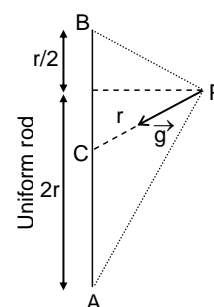
This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. Consider a planet of radius r having density λ . A tunnel is dug inside it at a distance $r/2$ from its centre as shown in figure. An object of mass m is left in the tunnel at the surface at $t = 0$, if the magnitude of velocity of object at the centre of the tunnel is $\sqrt{n\pi G\lambda r^2}$, then find the value of n .



7. **1**

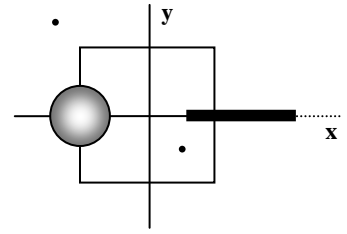
8. As situation shown in figure, the value of $\frac{\angle APB}{\angle CPB}$. Net gravitational field at point P is along the PC .



\vec{g} = gravitational field at point P due to rod

8. **2**

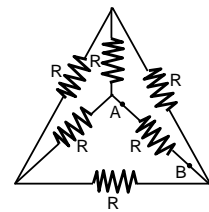
9. A disk of radius $a/4$ having a uniformly distributed charge $-(6\epsilon_0)$ Coulombs is placed in the x - y plane with its centre at $(-a/2, 0, 0)$. A rod of length a carrying a uniformly distributed charge $-(8\epsilon_0)$ Coulombs is placed on the x -axis from $x = a/4$ to $x = 5a/4$. Two point charges $+(12\epsilon_0)$ Coulombs and $+(3\epsilon_0)$ Coulombs are placed at $(a/4, -a/4, 0)$ and $(-3a/4, 3a/4, 0)$, respectively. Consider a cubical surface formed by six surfaces $x = \pm a/2, y = \pm a/2, z = \pm a/2$. The electric flux through this cubical surface in SI unit is



9. 7
10. A 100 pF capacitor is charged to a potential difference of 24 V. It is connected to an uncharged capacitor of 20 pF. The new potential difference across the 100 pF capacitor is 10 K volt. Find the value of K.

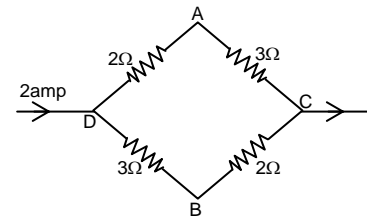
10. 2

11. Six equal resistances each of $R = 6$ ohm, are connected to form the network show in the figure. The resistance between AB is



11. 3

12. A current of 2 ampere flows in a system of conductors as shown in the following figure. The potential difference $V_A - V_B$ will be (in Volt):

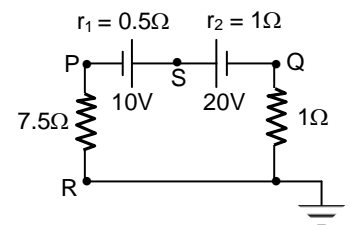


12. 1

PART – C (Numerical based)

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

13. Consider the following statements regarding the circuit shown. Find the potential at point P (in volts).



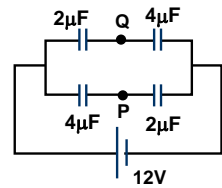
13. 7.5

14. If a particle of small mass is dropped for a height $h = R$, above the earth's surface and its speed with which strikes the earth's surface is $\sqrt{\frac{xGM}{R}}$, then find the value of x.
(Assume M – mass of earth, R – radius of earth & neglect air resistance)

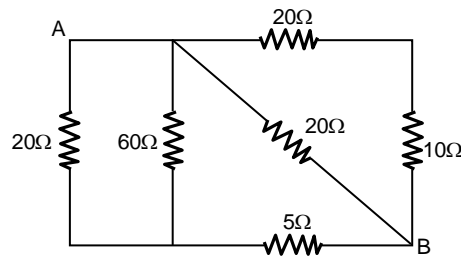
14. 1

15. A spacecraft is moving in a circular orbit around the Earth (Radius 6400 Km), at a height of 300 km from the surface. To place the spacecraft in an elliptical orbit, the mechanical energy of the spacecraft– Earth system is increased by 10.0%. If the spacecraft-earth system had initial energy ($-E_0$) and the total mechanical energy of the system after firing the rocket will be $x E_0/10$, then find the value of x .
15. **-9**
16. An infinite charged sheet has $8.85 \times 10^{-9} \text{ C/m}^2$ surface charge density. Find the potential difference (in volts) between two equipotential surfaces separated by 7 mm.
16. **3.5**

17. In the figure, the potential difference between V_Q and V_P is (in Volt)



17. **-4**
18. Equivalent resistance (in Ω) of the given circuit between points A and B is



18. **7.5**

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. A new carbon-carbon bond formation is possible in
 (A) Cannizzaro's reaction (B) Friedel-Craft's alkylation
 (C) Clemmensen reduction (D) Friedel-Craft's acylation

1. BD

2. An organic $C_5H_{10}O$ (A) reacts with phenylhydrazine and does not react with Tollen's reagent, but gives iodoform test. Compound A should not be
 A) $CH_3 - \overset{O}{\parallel} C - CH_2 - CH_2 - CH_3$ B) $CH_3 - CH_2 - \overset{O}{\parallel} C - CH_2 - CH_3$
 C) $CH_3 - CH_2 - CH_2 - CH_2 - CHO$ D) $CH_3 - \overset{CH_3}{|} CH - CH_2 - CHO$

2. BCD

3. A positive carbylamine test is given by
 (A) N, N-dimethyl aniline (B) 2, 4-dimethyl aniline
 (C) N-methyl-o-methyl aniline (D) p-methyl benzyl amine

3. BD

4. Which of the following vitamin(s) is/are insoluble in fat?
 (A) Vitamin – C (B) Vitamin – B
 (C) Vitamin – H (D) Vitamin – A

4. ABC

5. Which of the following has a glycosidic linkage?
 (A) Sucrose (B) Amylose
 (C) Galactose (D) Maltose

5. ABD

6. Which one of the following contain(s) cobalt?
 (A) Chlorophyll (B) Haemoglobin
 (C) Vitamin C (D) Vitamin B_{12}

6. D

PART – B

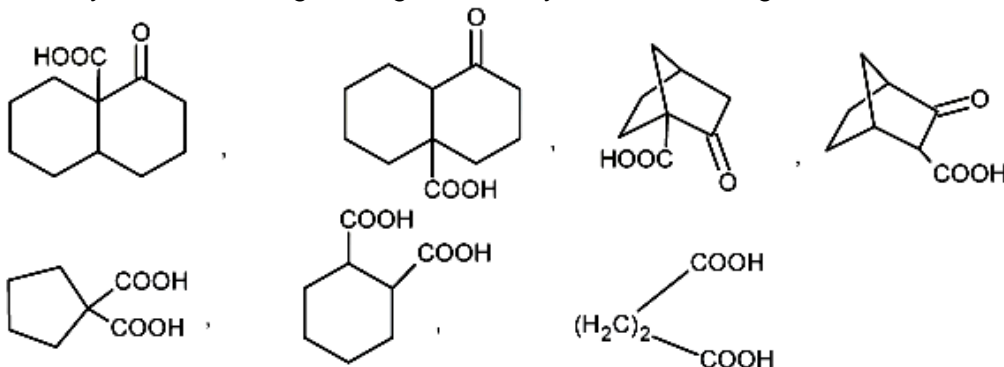
Integer Answer Type

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

7. Total number of DBE present in the product obtained when cyclohexanone reacts with 2, 4-DNP is

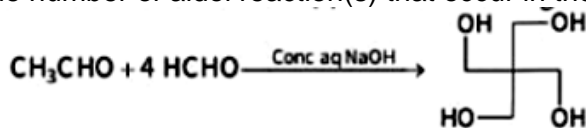
7. 8

8. How many of the following undergo decarboxylation on heating



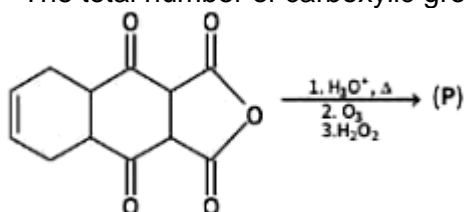
8. 3

9. The number of aldol reaction(s) that occur in the given transformation is



9. 3

10. The total number of carboxylic groups in the product P is



10. 2

11. Find the maximum number of moles of CH_3I which can react with 1 mole of methyl amine

11. 3

12. Find the number of moles of phenylhydrazine required to convert one mole of glucose into osazone.

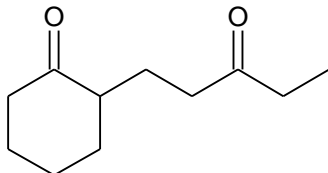
12. 3

PART – C

(Numerical based)

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

13. Find the ratio of number of α -hydrogen atom by number of $\text{—}\overset{\text{O}}{\parallel}{\text{C}}\text{—}$ group in given structure



13. 3.5
14. The PI (pH at isoelectric point) of following amino acid
- $$\begin{array}{ccccccc} & \text{O} & & \text{O} & & & \\ & \parallel & & \parallel & & & \\ \text{H} & - \text{O} - \text{C} - & \text{CH}_2\text{CH}_2 - & \text{CH} - & \text{C} - \text{O} - \text{H} & \leftarrow & \text{PKa} = 2.19 \\ & \uparrow & & | & & & \\ & \text{PKa} = 4.25 & & \text{NH}_3^+ & & & \\ & & & \uparrow & & & \\ & & & \text{PKa} = 9.67 & & & \end{array}$$

14. 3.22
15. Consider the reaction
- $$\text{CH}_3\text{CH}=\text{CH}-\text{CHO} \xrightarrow{\text{OH}^-} \underset{\text{(A)}}{\text{C}_8\text{H}_{12}\text{O}_2} \xrightarrow[\Delta]{\text{H}^+} \text{B}$$

The number of stereoisomers for compound B is x then $\frac{x}{3}$

15. 2.66
16. Formaldehyde reacts with NH_3 to form product 'P'. The number of 3° amine group be 'P', then $\frac{P}{3}$ is
16. 1.33
17. If x is the number of pi bonds in croton aldehyde, then value of $x/4$ is
17. 0.5
18. In an amino acid, the carboxylic acid group has $K_a = 10^{-4}$ and amino group has $K_b = 10^{-5}$. The isoelectric point of that amino acid is

18. 6.5

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. $\int \frac{\cos 2x}{(\sin x + \cos x)^2} dx =$

(A) $\frac{-1}{\sin x + \cos x} + c$

(B) $\log|\sin x + \cos x| + c$

(C) $\log(\sin x - \cos x) + c$

(D) $\frac{1}{2} \log|1 + \sin 2x| + c$

1. **BD**

2. $\int |x|^3 dx =$

(A) $\frac{x^4}{4} + c, x > 0$

(B) $-\frac{x^4}{4} + c, x < 0$

(C) $\frac{|x|^4}{4} + c$

(D) none of these

2. **AB**

3. The value of $\int x^3 \log x dx$ is

(A) $\frac{1}{8} \{x^4 \log x - 4x^4 + c\}$

(B) $\frac{1}{16} \{4x^4 \log x - x^4 + c\}$

(C) $\frac{x^4 \log x}{4} + c$

(D) $\frac{1}{16} \{4x^4 \log x - x^4 - c\}$

3. **BD**

4. $\int e^{\cos^{-1}x} \left\{ 1 + \frac{x}{\sqrt{1-x^2}} \right\} dx =$

(A) $\sqrt{1-x^2} e^{\cos^{-1}x} + c$

(B) $xe^{\cos^{-1}x} + c$

(C) $-\sqrt{1-x^2} e^{\cos^{-1}x} + c$

(D) $-\sqrt{1-x^2} e^{\frac{\pi}{2} - \sin^{-1}x} + c$

4. **CD**

5. $\int \frac{dx}{x + \sqrt{x}}$ is equal to

(A) $2 \log(\sqrt{x} + 1) + c$

(B) $2 \log(x + \sqrt{x}) + c$

(C) $\log(1+x)^{3/2} + c$

(D) $\log(x + 1 + 2\sqrt{x}) + c$

5. **AD**

6. $\int_0^{\frac{\pi}{2}} |\cos x - \sin x| dx =$

(A) $2(\sqrt{2} - 1)$ (B) $2(\sqrt{2} + 1)$

(C) $2\sqrt{2}$ (D) $\frac{2}{(\sqrt{2} + 1)}$

6. AD

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. The order of the differential equation whose general solution is given by $y = (c_1 + c_2)\sin(3x + c_3) - c_4 e^{2x + c_5}$ is

7. **3**

8. $y = ae^{-1/x} + b$ is a solution of $\frac{dy}{dx} = \frac{y}{x^2}$ then $3b + 3 =$

8. **3**

9. $\int_0^{\pi} \sin x \cos 3x dx = k$, where $2k + 3$ equals to

9. **3**

10. $\int_{\frac{\pi}{2}}^{\pi} \sqrt{\sin x - \sin^3 x} dx$ is equal to k where value of $3k$ is

10. **2**

11. $\int_0^{\infty} \frac{dx}{(x^2 + 4)(x^2 + 9)}$ is equal to $\frac{\pi}{120} k$, where k is

11. **2**

12. $\int_0^{\infty} \frac{x^3}{(1+x^2)^{\frac{9}{2}}} dx$ equal to k where $\frac{35k}{2}$ equals

12. **1**

PART – C

(Numerical based)

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

13. Area bounded by the parabola $x = -2y^2$ and $x = 1 - 3y^2$ is $\frac{16}{3}k$ where k is

13. **0.25**

14. Area bounded by the curve $y = (x-1)(x-2)(x-3)$ and x -axis lying between the ordinates $x = 0$ and $x = 3$ is equal to (in sq. units) A , where $\frac{A}{11}$ equals

14. **0.25**

15. If a curve $y = a\sqrt{x} + bx$ passes through the point $(1, 2)$ and the area bounded by the curve, line $x = 4$ and x -axis is 8 sq. unit, then $a + b$ equals to k where $2 - 3k$ equals

15. **-4**

16. If $y = y(x)$ and $\left(\frac{2 + \sin x}{y+1}\right) \frac{dy}{dx} = -\cos x$, $y(0) = 1$, then $y\left(\frac{\pi}{2}\right)$ equals k where $3k - 2$ equals

16. **-1**

17. The area of the region bounded by the curve $y = x|x|$, x -axis and the ordinate $x = 1$, $x = -1$ is given by A , where $\frac{3A}{4}$ equals to

17. **0.5**

18. The integral $\int_{-\frac{1}{2}}^{\frac{1}{2}} \left([x] + \ln\left(\frac{1+x}{1-x}\right) \right) dx$ equals, where $[x]$ represent greatest integer function.

18. **-0.5**

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B