

FIITJEE INTERNAL TEST

Batches: 1921

RANK IMPROVEMENT TEST – VII

IIT- JEE

QP CODE:

Time: 3 hours

Maximum Marks: 186

- Please read the instructions carefully. You are allotted 5 minutes specially for this purpose.
- You are not allowed to leave the examination hall before end of the test.
- Use Blue/Black Ball Point Pen only for writing particulars on Side-1 and Side-2 of the Answer Sheet. Use to Pencil is strictly prohibited.

Instructions

Note:

1. The question paper contains 3 sections (Sec-1, Chemistry, Sec-II, Physics & Sec-III, Mathematics.)
2. Each section is divided into one part, **Part-A**.
3. **Part – A** contains 18 questions which are further divided as follows:
 - i) **PART – A (01 – 06)** contains 6 Multiple Choice Questions which have **Only One Correct answer**. Each question carries **+3 marks** for correct answer and **–1 mark** for wrong answer.
 - ii) **PART – A (07 – 14)** contains 8 Multiple Choice Questions which have **One or More Correct** answer.

For each question in the group **Q. 7 – 14** of **PART – A** you will be awarded

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.

- iii) **PART – A (15 – 18)** contains 2 Paragraphs. Based upon each paragraph, 2 Multiple Choice Questions. Each question has four choices (A), (B), (C) and (D), out of which **only one is correct**. Each question carries **+3 marks** for correct answer. There is no negative marking.

Name of the Candidate :

Enrolment Number :

Section – I (Chemistry)

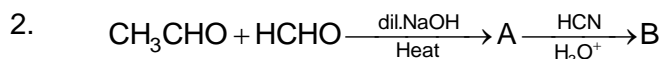
PART – A

(Single Correct Choice Type)

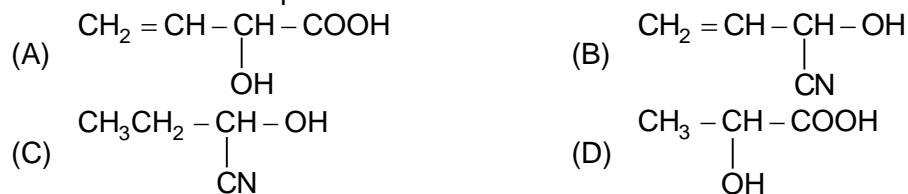
This section contains 6 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which only ONE option is be correct.

1. A compound 'X' neither reacts with sodium displacing hydrogen nor with phosphorus pentachloride to give hydrogen chloride. 'X' reduces an alkaline solution of Cu(II) salt on gentle warming. The structure 'X' is
 (A) primary alcohol (B) secondary alcohol
 (C) a ketone (D) an aldehyde

1. D

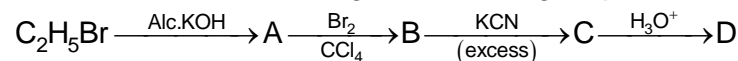


The structure of compound B is



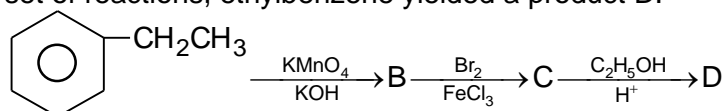
2. A

3. The acid D obtained through the following sequence of reactions is

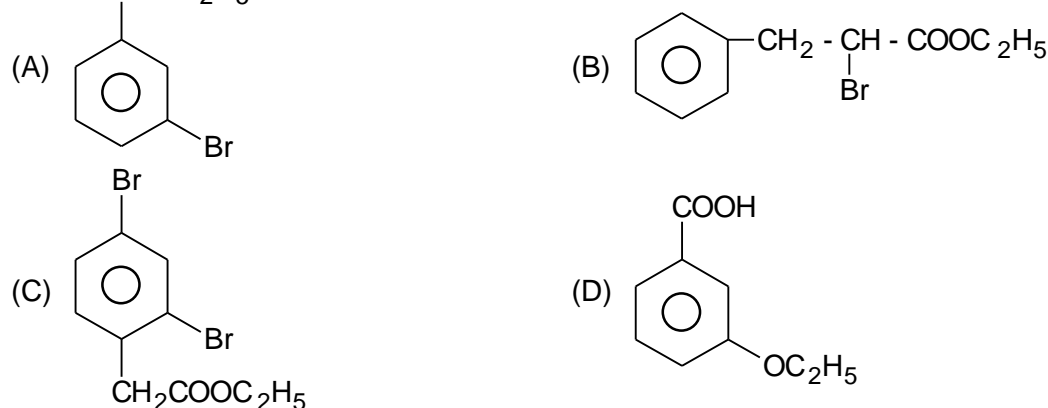


3. A

4. In a set of reactions, ethylbenzene yielded a product D.

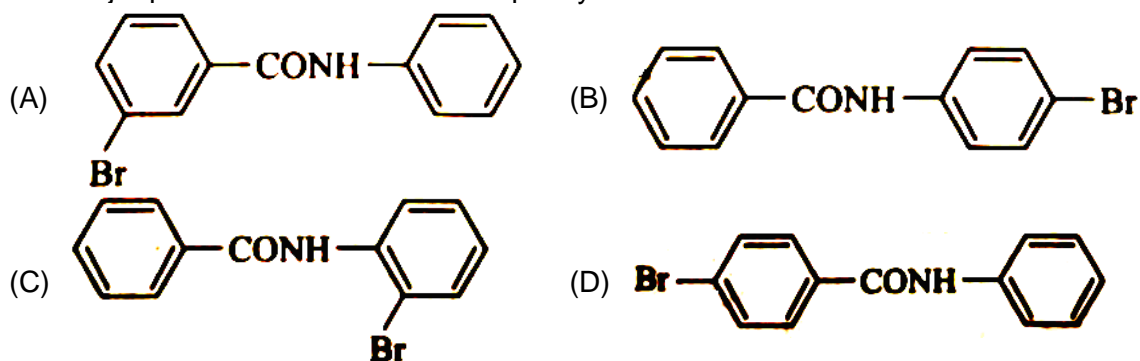


'D' should be
 COOC_2H_5

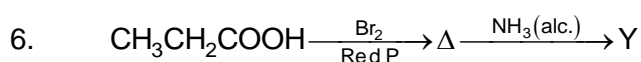


4. A

5. The major product in the reaction of N-phenylbenzamide with Br_2/Fe is



5. B



Y in the above reaction is

- (A) Lactic acid (B) Ethylamine
(C) Propylamine (D) Alanine

6. D

(Multiple Correct Choice Type)

This section contains 8 **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 statements are correct about HCOOH ?

- (A) It is a stronger acid than CH_3COOH
(B) It forms formyl chloride with PCl_5
(C) It gives CO and H_2O on heating with conc. H_2SO_4
(D) It reduces Tollen's reagent

7. ACD

8. Which of the following reagents are used for detecting the presence of carbonyl group?

- (A) NH_2OH (B) NH_2NH_2
(C) $\text{H}_2\text{NCONHNH}_2 \cdot \text{HCl}$ (D) $\text{C}_6\text{H}_5\text{NHNH}_2 \cdot \text{HCl}$

8. ABCD

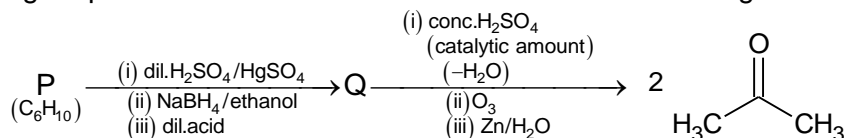
9. The reaction of esters with Grignard reagents gives rise to

- (A) primary alcohols (B) secondary alcohols
(C) tertiary alcohols (D) ketones alcohols

9. BC

Comprehension Type
Paragraph for question nos. 15 – 16

An acyclic hydrocarbon P, having molecular formula C_6H_{10} gave acetone as the only organic product through the following sequence of reaction in which Q is an intermediate organic compound.



15. The structure of compound P is

- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2 - \text{C} \equiv \text{C} - \text{H}$ (B) $\text{H}_3\text{CH}_2\text{C} - \text{C} \equiv \text{C} - \text{CH}_2\text{CH}_3$
 (C) $\begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{H}-\text{C}-\text{C} \equiv \text{C}-\text{CH}_3 \\ | \\ \text{H}_3\text{C} \end{array}$ (D) $\begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{H}_3\text{C}-\text{C}-\text{C} \equiv \text{C}-\text{H} \\ | \\ \text{H}_3\text{C} \end{array}$

15. D

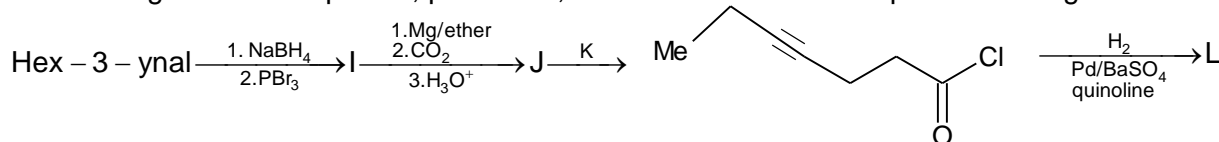
16. The structure of the compound Q is

- (A) $\begin{array}{c} \text{H}_3\text{C} \quad \text{OH} \\ | \quad | \\ \text{H}_3\text{C}-\text{C}-\text{C}-\text{CH}_2\text{CH}_3 \\ | \quad | \\ \text{H}_3\text{C} \quad \text{H} \end{array}$ (B) $\begin{array}{c} \text{H}_3\text{C} \quad \text{OH} \\ | \quad | \\ \text{H}_3\text{C}-\text{C}-\text{C}-\text{CH}_3 \\ | \quad | \\ \text{H}_3\text{C} \quad \text{H} \end{array}$
 (C) $\begin{array}{c} \text{H}_3\text{C} \quad \text{OH} \\ | \quad | \\ \text{H}-\text{C}-\text{CH}_2\text{CHCH}_3 \\ | \\ \text{H}_3\text{C} \end{array}$ (D) $\begin{array}{c} \text{OH} \\ | \\ \text{CH}_3\text{CH}_2\text{CH}_2\text{CHCH}_2\text{CH}_3 \end{array}$

16. B

Paragraph for question nos. 17 – 18

In the following reaction sequence, products I, J and L are formed. K represent a reagent



17. The structure of the product I is

- (A) $\text{Me}-\text{CH}_2-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{Br}$ (B) $\text{Me}-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_2-\text{Br}$
 (C) $\text{Me}-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$ (D) $\text{Me}-\text{CH}_2-\text{C} \equiv \text{C}-\text{CH}_2-\text{CH}_2-\text{Br}$

17. D

18. The structures of compounds J and K respectively are

- (A) $\text{Me}-\text{CH}_2-\text{C} \equiv \text{C}-\text{CH}_2-\text{COOH}$ and SOCl_2
 (B) $\text{Me}-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ and SO_2Cl_2
 (C) $\text{Me}-\text{CH}_2-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{COOH}$ and SOCl_2
 (D) $\text{Me}-\text{CH}_2-\text{C} \equiv \text{C}-\text{CH}_2-\text{COOH}$ and $\text{CH}_3\text{SO}_2\text{Cl}_2$

18. A

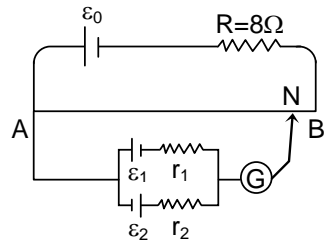
Section – II (Physics)

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 option is be correct.

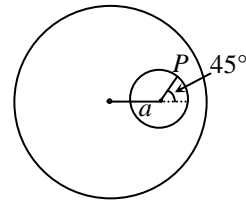
1. A battery of emf $\epsilon_0 = 12V$ is connected across a 4m long uniform wire having resistance $4\Omega/m$. The cells of small emfs $\epsilon_1 = 2V$ and $\epsilon_2 = 4V$ having internal resistance 2Ω and 6Ω respectively, are connected as shown in the figure. If galvanometer shows no deflection at the point N, the distance of point N from the point A is equal to :



- (A) $\frac{1}{6}$ m (B) $\frac{1}{3}$ m
 (C) 25 cm (D) 50 cm

1. **C**

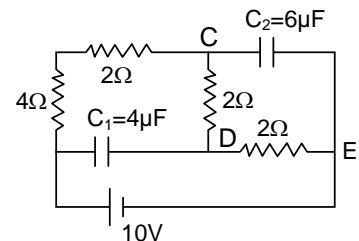
2. A cavity of radius r is made inside a solid sphere. The volume charge density of the remaining sphere is ρ . An electron (charge e , mass m) is released inside the cavity from point P as shown in figure. The centre of sphere and centre of cavity are separated by a distance a . The minimum time after which the electron will be reach again the initial position



- (A) $4\sqrt{\frac{6\sqrt{2}r\epsilon_0 m}{e\rho a}}$ (B) $5\sqrt{\frac{6\sqrt{2}r\epsilon_0 m}{e\rho a}}$ (C) $6\sqrt{\frac{6\sqrt{2}r\epsilon_0 m}{e\rho a}}$ (D) none of these

2. **A**

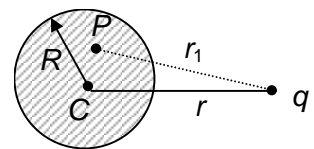
3. Find the potential difference across C_2 : When steady state reached.



- (A) 6 V
 (B) 4 V
 (C) Zero
 (D) 2 V

3. **B**

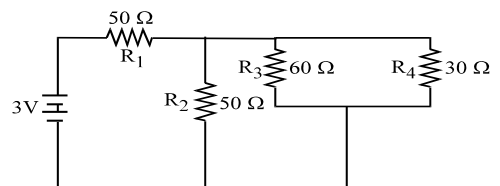
4. A point charge is placed at a distance r from center of a conducting neutral sphere of radius R ($r > R$). The potential at any point P inside the sphere at a distance r_1 from point charge due to induced charge of the sphere is given by $[k = \frac{1}{4\pi\epsilon_0}]$



- (A) kq/r_1 (B) kq/r
 (C) $kq/r - kq/r_1$ (D) $-kq/R$

4. **C**

5. In the circuit shown, the resistances are given in ohms and the battery is assumed ideal with emf equal to 3.0 volts. The resistor that dissipates the most power is



- (A) R_1 (B) R_2
 (C) R_3 (D) R_4

5. **A**

6. The electric field at a point inside a long cylinder charged throughout its volume is given by the relation

$$E = \frac{1}{3\epsilon_0} kr^2$$

where k is a positive constant and r is the distance from the axis of the cylinder. The charge density ρ inside the cylinder depends on r as

- (A) $\rho = k$ (B) $\rho = kr$ (C) $\rho = kr^2$ (D) $\rho = k\sqrt{r}$

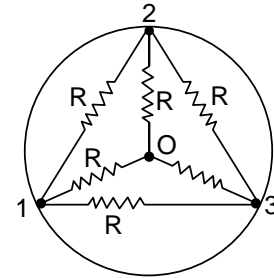
6. **B**

(Multiple Correct Choice Type)

This section contains 8 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. As shown in the figure, equivalent resistance.

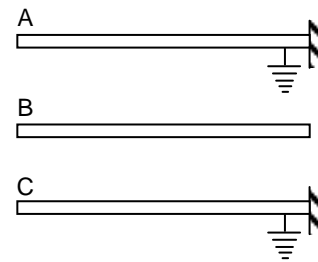
- (A) Between 1 and 3 is zero
 (B) Between O and 1 is $\frac{R}{3}$
 (C) Between O and 1, O and 2, O and 3 are equal.
 (D) Between 1 and 2, 2 and 3 and 3 and 1 are equal



7. **ABCD**

8. A, B and C are three large, parallel conducting plates, placed horizontally. A and C are rigidly fixed and earthed. B is given some charge. Under electrostatic and gravitational forces, B may be

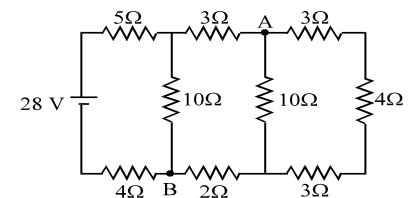
- (A) in equilibrium midway between A and C
 (B) in equilibrium if it is closer to A than to C
 (C) in equilibrium if it is closer to C than to A.
 (D) B can never be in stable equilibrium.



8. **BD**

9. Consider the circuit shown in the figure

- (A) the current in the $5\ \Omega$ resistor is 2 A
 (B) the current in the $5\ \Omega$ resistor is 1 A
 (C) the potential difference $V_A - V_B$ is 10 V
 (D) the potential difference $V_A - V_B$ is 5 V



9. **ABD**

10. 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_1 and the slab is taken out.

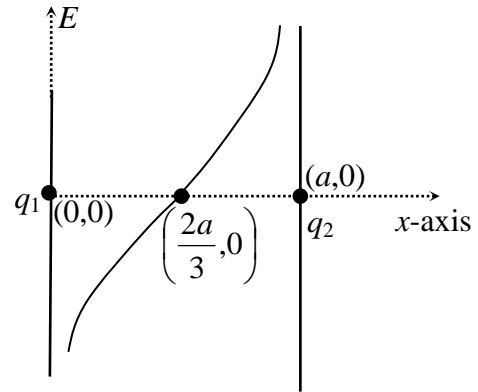
- (A) Charge $\epsilon C_0(K - 1)$ flows through the cell.
 (B) Energy $\epsilon^2 C_0(K - 1)$ is absorbed by the cell.
 (C) The energy stored in the capacitor is reduced by $\epsilon^2 C_0(K - 1)$.
 (D) The external agent has to do $\frac{1}{2} \epsilon^2 C_0(K - 1)$ amount of work to take the slab out.

10. **ABD**

11. A microammeter has a resistance of 100Ω and a full scale range of $50\mu\text{A}$. It can be used as a voltmeter or as a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combinations
- (A) 50 V range with $10\text{ k}\Omega$ resistance in series
 - (B) 10 V range with $200\text{ k}\Omega$ resistance in series
 - (C) 5 mA range with 1Ω resistance in parallel
 - (D) 10 mA range with 1Ω resistance in parallel

11. **ACD**

12. If the electric field E is plotted, with distance from q_1 along the line joining of two, then (E is positive along +ve x-axis) it looks as shown in figure. From the plot we can say that

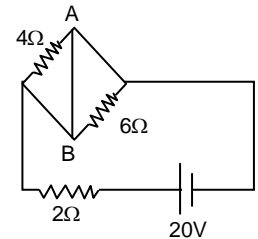


- (A) q_1 and q_2 both are negative
- (B) $\left| \frac{q_1}{q_2} \right| = 4$
- (C) q_1 is positive and q_2 is negative
- (D) $\left| \frac{q_1}{q_2} \right| = \frac{1}{4}$

12. **AB**

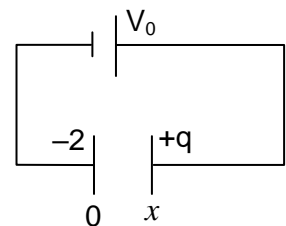
13. In the circuit shown in figure:

- (A) power supplied by the battery is 200 W.
- (B) current flowing in the circuit is 5 A.
- (C) potential difference across 4Ω resistance is equal to the potential difference across 6Ω resistance.
- (D) current in wire AB is zero.



13. **AC**

14. Two plates of a parallel plate capacitors carry charges q and $-q$ and are separated by a distance x from each other. The capacitor is connected to a constant voltage source V_0 . The distance between the plates is changed to $x + dx$. Then in steady state.



- (A) change in electrostatic energy stored in the capacitor is $\frac{-Udx}{x}$, where U is initial potential energy.

(B) force on right plate = $\frac{U}{x}$

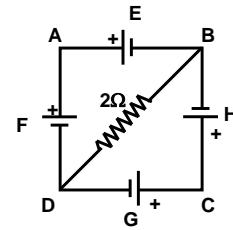
(C) force on right plate = $-\frac{U}{x}$

- (D) none of these

14. **AC**

Comprehension Type
Paragraph for question nos. 15 – 16

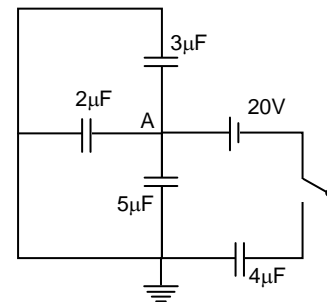
In the circuit shown in fig. E, F, G and H are cells of emf 2, 1, 3 and 1 Volts respectively and their internal resistance are 2, 1, 3 and 1Ω respectively. Calculate



15. The potential difference between B and D and
 (A) $\frac{2}{13}V$ (B) $\frac{4}{13}V$ (C) $\frac{6}{13}V$ (D) $\frac{8}{13}V$
15. **A**
16. The potential difference across the terminals of the cell H.
 (A) $\frac{19}{13}V$ (B) $\frac{17}{13}V$ (C) $\frac{21}{13}V$ (D) $\frac{23}{13}V$
16. **A**

Paragraph for question nos. 17 – 18

Three capacitors of $2\mu F$, $3\mu F$ and $5\mu F$ are independently charged with batteries of emf's 5V, 20V and 10V respectively. After disconnecting from the voltage sources, these capacitors are connected as shown in figure with their positive polarity plates connected to A and negative polarity plates are earthed. Now a battery of 20V and an unchanged capacitor of $4\mu F$ capacitance are connected to the junction. A as shown with a switch S. When switch is closed, find:



17. Potential of junction A
 (A) $\frac{40V}{7}$ (B) $\frac{100V}{7}$ (C) $\frac{60V}{7}$ (D) $\frac{140V}{7}$
17. **B**
18. Charge on $4\mu F$ capacitor
 (A) $\frac{40}{7}\mu C$ (B) $\frac{100}{7}\mu C$ (C) $\frac{160}{7}\mu C$ (D) $\frac{140}{7}\mu C$
18. **C**

space for rough work

Section – III (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 option is be correct.

1. If $2b^2 = a^2 + c^2$, then the value of $\frac{\sin 3B}{\sin B}$ is equal to
- (A) $\left(\frac{a^2 - c^2}{2ac}\right)^2$ (B) $\left(\frac{a^2 + c^2}{2ac}\right)^2$
 (C) $\frac{a^2 + b^2}{c^2}$ (D) $\frac{a^2 - b^2}{2ab}$
1. A
2. In a ΔABC , the value of $\frac{a \cos A + b \cos B + c \cos C}{a + b + c}$ is equal to
- (A) $\frac{R}{r}$ (B) $\frac{R}{2r}$
 (C) $\frac{r}{R}$ (D) $\frac{2r}{R}$
2. C
3. Let altitude AD of acute angled triangle (ΔABC) be produced which meets its circumcircle at P such that $AP = 4$. If circumradius of the triangle is $2\sqrt{2}$ then the value of $\sec^2(B - C)$
- (A) 1 (B) 2
 (C) 3 (D) 4
3. B
4. Find the number of values of x satisfying simultaneously $\sin^{-1} x = 2 \tan^{-1} x$ and $\tan^{-1} \sqrt{x(x-1)} + \operatorname{cosec}^{-1} \sqrt{1+x-x^2} = \frac{\pi}{2}$.
- (A) 0 (B) 1
 (C) 2 (D) 3
4. C
5. The number of solution in $(0 \text{ and } 2\pi)$, satisfying $\cos 3x + \cos 2x = \sin \frac{3x}{2} + \sin \frac{x}{2}$ is
- (A) 4 (B) 5
 (C) 6 (D) 7
5. B
6. If range of the function $f(x) = \sin^{-1} x + 2 \tan^{-1} x + x^2 + 4x + 1$ is $[p, q]$, then the value of $(p + q)$ is
- (A) 4 (B) 5
 (C) 6 (D) 7
6. A

(Multiple Correct Choice Type)

This section contains 8 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. Let $\alpha, \beta (\alpha > \beta)$ are roots of the equation $\sin^{-1} x - \frac{1}{\sin^{-1} x} = \cos^{-1} x - \frac{1}{\cos^{-1} x}$ then
- (A) $\alpha = \frac{1}{\sqrt{2}}$ (B) $\beta = -\frac{1}{\sqrt{2}}$
- (C) $\sin^{-1} \alpha = \frac{\pi}{3}$ (D) $\sin^{-1} \beta = \frac{\pi}{4} - \sqrt{\left(1 + \frac{\pi^2}{16}\right)}$
7. AD
8. If α, β and γ are the roots of $\tan^{-1}(x-1) + \tan^{-1} x + \tan^{-1}(x+1) = \tan^{-1} 3x$, then
- (A) $\alpha + \beta + \gamma = 0$ (B) $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{-1}{4}$
- (C) $\alpha\beta\gamma = 1$ (D) $|\alpha - \beta|_{\max} = 1$
8. ABD
9. If $f(x) = (\sin^{-1} x)^2 + (\cos^{-1} x)^2$, then
- (A) $f(x)$ has the least value of $\frac{\pi^2}{8}$ (B) $f(x)$ has the greatest value of $\frac{5\pi^2}{8}$
- (C) $f(x)$ has the least value of $\frac{\pi^2}{16}$ (D) $f(x)$ has the greatest value of $\frac{5\pi^2}{4}$
9. AD
10. If in a triangle, $\sin^4 A + \sin^4 B + \sin^4 C = \sin^2 B \sin^2 C + 2\sin^2 C \sin^2 A + 2\sin^2 A \sin^2 B$, then its angle A is equal to
- (A) 30° (B) 120°
- (C) 150° (D) 60°
10. AC
11. If N is the number of terms of the series $\cot^{-1} 3, \cot^{-1} 7, \cot^{-1} 13, \cot^{-1} 21, \dots$, whose sum is $\frac{1}{2} \cos^{-1} \left(\frac{24}{145} \right)$, then
- (A) N is prime (B) N has 3 factors
- (C) Sum of digits of N is 2 (D) Sum of digits of N is 3
11. AC
12. In $\triangle ABC$, if $r = 1, R = 3$ and $s = 5$, then value of $a^2 + b^2 + c^2$ is divisible by
- (A) 4 (B) 6
- (C) 8 (D) 12
12. ABCD
13. Let $\alpha = 3 \cos^{-1} \left(\frac{5}{\sqrt{28}} \right) + 3 \tan^{-1} \left(\frac{\sqrt{3}}{2} \right)$ and $\beta = 4 \sin^{-1} \left(\frac{7\sqrt{2}}{10} \right) - 4 \tan^{-1} \left(\frac{3}{4} \right)$ then which of the following does not hold(s) good?
- (A) $\alpha < \pi$ but $\beta > \pi$ (B) $\alpha > \pi$ but $\beta < \pi$
- (C) both α and β are equal (D) $\cos(\alpha + \beta) = 0$
13. ABD

14. Identify the correct options:

(A) $\frac{\sin 3\alpha}{\cos 2\alpha} > 0$ for $\alpha \in \left(\frac{3\pi}{8}, \frac{23\pi}{48}\right)$

(B) $\frac{\sin 3\alpha}{\cos 2\alpha} < 0$ for $\alpha \in \left(\frac{13\pi}{48}, \frac{14\pi}{48}\right)$

(C) $\frac{\sin 2\alpha}{\cos \alpha} < 0$ for $\alpha \in \left(-\frac{\pi}{2}, 0\right)$

(D) $\frac{\sin 2\alpha}{\cos \alpha} > 0$ for $\alpha \in \left(\frac{13\pi}{48}, \frac{14\pi}{48}\right)$

14. ABCD

Comprehension Type

Paragraph for question nos. 15 – 16

In a triangle ABC, if line joining the circum center and orthocentre is parallel to the side AC, then answer the following:

15. $\tan A \cdot \tan C$ is equals to,

(A) $\frac{2 \sin A \sin C}{\cos B}$

(B) $\frac{2 \sin A \sin B}{\cos C}$

(C) $\frac{2 \sin B \sin C}{\cos A}$

(D) none of these

15. A

16. $\sqrt{2} \cos A$, $\sqrt{\cos B}$ and $\sqrt{2} \cos C$ are in

(A) AP

(B) GP

(C) HP

(D) none of these

16. B

Paragraph for question nos. 17 – 18

Consider a real-valued function $f(x) = \sqrt{\sin^{-1} x + 2} + \sqrt{1 - \sin^{-1} x}$

17. The domain of definition of $f(x)$ is

(A) $[-1, 1]$

(B) $[\sin 1, 1]$

(C) $[-1, \sin 1]$

(D) $[1, 0]$

17. C

18. The range of $f(x)$ is

(A) $[0, \sqrt{3}]$

(B) $[1, \sqrt{3}]$

(C) $[1, \sqrt{6}]$

(D) $[\sqrt{3}, \sqrt{6}]$

18. D

space for rough work

FIITJEE INTERNAL TEST

Batches: 1921

RANK IMPROVEMENT TEST – VII

IIT- JEE 2021

QP CODE:

ANSWERS

SECTION – I (Chemistry)

Part – A

SECTION – II (Physics)

Part – A

SECTION – III (Mathematics)

Part – A