FIITJEE - JEE (Main)

PHYSICS, CHEMISTRY & MATHEMATICS
BATCHES: 2 Yr CRP(2022) B-lot
PHASE TEST – IV
Q.P. CODE:

Time Allotted: 3 Hours **Maximum Marks: 300**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important 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 & C** in the OMR. Part-B of OMR to be left unused
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. No candidate is allowed to carry any textual material, printed or written, bits of papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices ext. except the Admit Card inside the examination hall / room.

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 ***Blue/Black Ball Point Pen*** 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.
4. **Do not fold or make any stray marks on the Answer Sheet.**

C. Marking Scheme for All Two Parts:

(i) Part-A (01-20) – Contains Twenty (20) multiple choice objective questions which have four (4) options each and only one correct option. Each question carries **+4 marks** which will be awarded for every correct answer and **-1 mark** will be deducted for every incorrect answer.

(ii) Part-B (01-05) contains five (05) 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 :_____

Physics

PART – A

Straight Objective Type

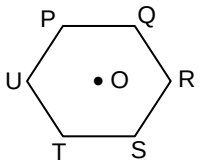
This part contains **20 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. An electron of mass m_e, initially at rest, moves through a certain distance in a uniform electric field in time t_1. A proton of mass m_p, also, initially at rest, takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio t_2/t_1 is nearly equal to

(A) 1 (B) $\left(m_p / m_e\right)^{1/2}$ (C) $\left(m_e / m_p\right)^{1/2}$ (D) 1936

1. **B**

2. Six charges, three positive and three negative of equal magnitude are to be placed at the vertices of a regular hexagon such that the electric field at O is double the electric field when only one positive charge of same magnitude is placed at R. Which of the following arrangements of charge is possible for P, Q, R, S, T and U respectively?



(A) +, –, +, –, –, + (B) +, –, +, –, +, –
(C) +, +, –, +, –, – (D) –, +, +, –, +, –

2. **D**

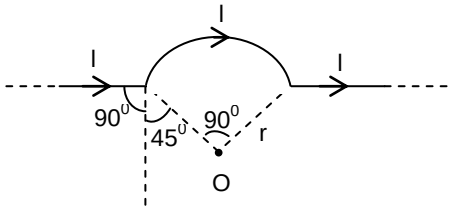
3. The magnetic field at the centre O of the arc in figure is (r is the radius of circular arc)

(A) $\frac{\mu_0 I}{4\pi \times r}\left[\sqrt{2}+\pi\right]$

(B) $\frac{\mu_0 I}{2\pi r}\left[\frac{\pi}{4}+1\left(\sqrt{2}-1\right)\right]$

(C) $\frac{\mu_0}{4\pi}\times\frac{I}{r}\left[\sqrt{2}+r\right]$

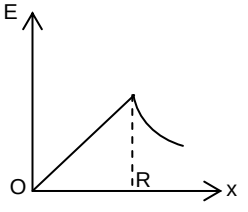
(D) $\frac{\mu_0}{4\pi}\times\frac{I}{r}\left[\sqrt{2}+\frac{\pi}{4}\right]$



3. **B**

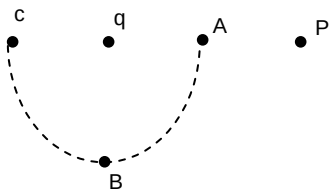
4. A sphere has a positive charge. Figure shows variation of electric field (E) with distance x from its centre. Which of the following statements is incorrect?

(A) Sphere is made of a non conducting materials
(B) Diameter of sphere is equal to R/2
(C) Electric potential, due to sphere, is maximum at its centre
(D) Density of charge is uniform throughout the volume of sphere



4. **B**

5. The net work done in carrying a point charge form P to A is W_A from P to B is W_B and from P to C is W_C then

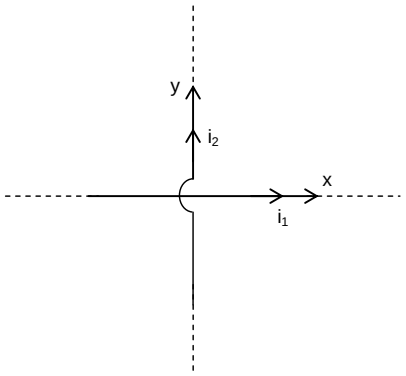


(A) $W_A < W_B < W_C$ (B) $W_A > W_B > W_C$

(C) $W_A = W_B = W_C$ (D) $W_A = W_B + W_C$

5. **C**

6. Two infinite wires carrying current i_1 and i_2 are lying along x and y axes, as shown in the x – y plane. Then



(A) Locus of points where magnetic field B is zero is a circle

(B) Locus of points where magnetic field B is zero is a straight line

(C) Magnetic field B decays hyperbolically along any line parallel x axis

(D) Magnetic field B decays hyperbolically along any line parallel to y axis

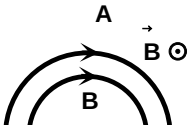
6. **B**

7. A proton, a deuteron and an α - particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles, then

(A) $r_\alpha = r_p < r_d$ (B) $r_\alpha > r_d > r_p$ (C) $r_\alpha = r_p > r_d$ (D) $r_\alpha = r_d = r_\alpha$

7. **A**

8. Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively and the trajectories are as shown in the figure. Then



(A) $m_A v_A < m_B v_B$ (B) $m_A v_A > m_B v_B$

(C) $m_A < m_B$ and $v_A < v_B$ (D) $m_A = m_B$ and $v_A = v_B$

8. **B**

9. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium if q is equal to:

(A) $-\frac{Q}{2}$ (B) $-\frac{Q}{4}$ (C) $+\frac{Q}{4}$ (D) $+\frac{Q}{2}$

9. **B**

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

(A) $t = \frac{2mv_0}{qE_0}$ (B) $t = \frac{2Bq}{mv_0}$ (C) $t = \frac{\sqrt{3}\,Bq}{mv_0}$ (D) $t = \frac{\sqrt{3}\,mv_0}{qE_0}$

10. **D**

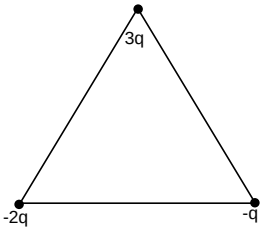
11. The electric flux from a cube of edge l is ϕ. What will be its value if edge of cube is made 2l and charge enclosed is halved?
(A) 4ϕ (B) 2ϕ (C) $\phi/2$ (D) ϕ

11. **C**

12. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that of Y is
(A) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (B) $\frac{R_2}{R_1}$ (C) $\left(\frac{R_1}{R_2}\right)^{2}$ (D) $\frac{R_1}{R_2}$

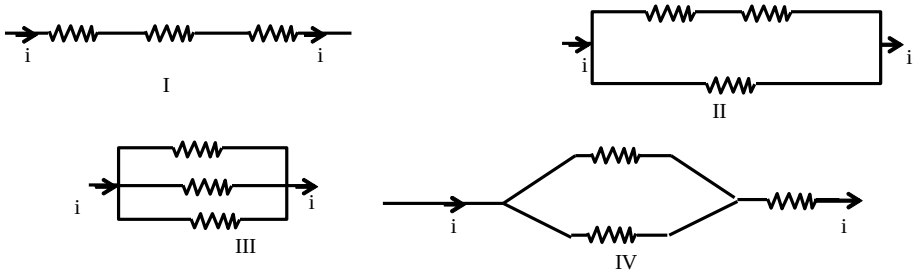
12. **C**

13. 3 points charges are kept on the vertices of an equilateral triangle of side l as shown in figure find out equivalent dipole moment of this charge system.
(A) $\sqrt{5}$ql (B) $\sqrt{7}$ql
(C) 3ql (D) $\sqrt{19}$ql



13. **B**

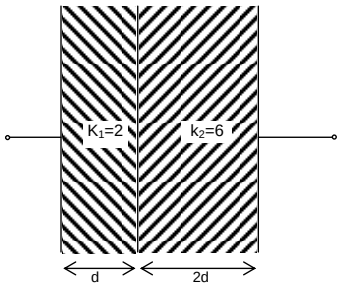
14. Three resistances of equal values are arranged in the different combinations as shown below. Arrange them in increasing order of total power dissipation.



(A) III< II < IV < I (B) III< I < IV < II
(C) II< III < IV < I (D) I< III < II < IV

14. **A**

15. A parallel plate capacitor has two layers of dielectrics as shown in figure. This capacitor is connected across a battery, then the ratio of potential difference across the dielectric layers is
(A) 4/3 (B) 1/2
(C) 1/3 (D) 3/2



15. **D**

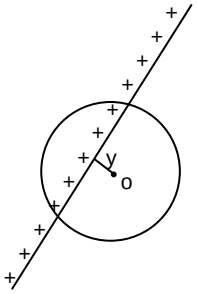
16. A wire of length ℓ metres carrying a current I amperes is bent in the form of a circle. The magnitude of the magnetic moment is
(A) $\frac{\ell I^2}{2\pi}$ (B) $\frac{\ell I^2}{4\pi}$ (C) $\frac{\ell^2 I}{2\pi}$ (D) $\frac{\ell^2 I}{4\pi}$

16. **D**

17. A capacitor is charged and then made to discharge through a resistance. The time constant is τ. In what time will the potential difference across the capacitor decrease by 10%?
(A) τ In (0.1) (B) τ In (0.9)
(C) τ In (10/9) (D) τ In (11/10)

17. **C**

18. A uniformly charged and infinitely long line having a linear charge density 'λ' is paced at a normal distance y from a point O. Consider a sphere of radius R with O as centre and R > y. Electric flux through the surface of the sphere is

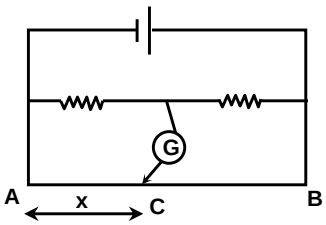


(A) zero (B) $\frac{2\lambda R}{\varepsilon_0}$

(C) $\frac{2\lambda\sqrt{R^2 - y^2}}{\varepsilon_0}$ (D) $\frac{\lambda\sqrt{R^2 + y^2}}{\varepsilon_0}$

18. **C**

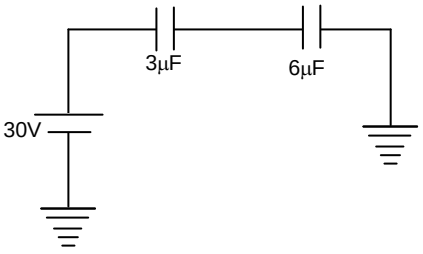
19. In the meter bridge circuit shown, the null point is obtained at C (AC = x) on the wire AB. If the diameter of the wire AB is doubled, the position of the new null point C′ will correspond to



(A) AC′ = x/2 (B) AC′ = x/4
(C) AC′ = 4x (D) AC′ = x

19. **D**

20. In the circuit shown, charge stored in capacitor of capacitance 3μF is:



(A) zero (B) 40 μC
(C) 60 μC (D) 90 μC

20. **C**

PART-B
Numerical Type

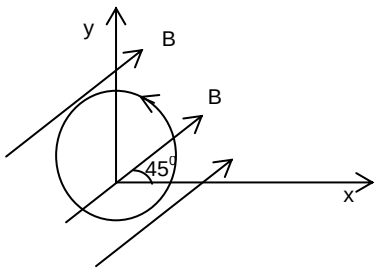
21. Two identical rings P and Q of radius 0.1 m are mounted coaxially at a distance 0.5m apart. The charge on the two rings are 2 and 4 μC respectively. The work done in transferring a charge of 5 μC from the center of P to that of Q is

21. **0.72**

22. A cell of emf E and internal resistance 'r' is connected in series with an external resistance 5r. Then the ratio of the terminal potential difference to emf is

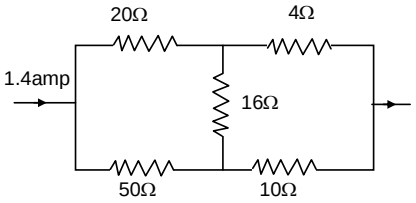
22. **0.83**
Range: 0.80 to 0.90

23. A circular loop of radius R = 20 cm is placed in a uniform magnetic field $\vec{B}$ = 2T in x-y plane as shown in figure. The loop carries a current i = 1.0 A in the direction shown in figure. Find the magnitude of the torque acting on the loop.



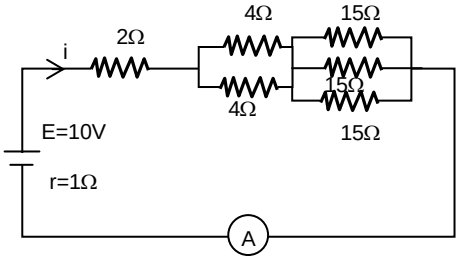
23. **0.25**

24. In the following figure the current through 4 ohm resistor is



24. **1.00**

25. In the circuit shown in the figure, the current I has a value equal to



25. **1.00**

Space For Rough Work

Chemistry

PART – A

Straight Objective Type

This part contains **20 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. $(C_2H_5)_3COH$ does not react with
   (A) Na (B) NaCl
   (C) HCl (D) Conc.H_2SO_4

1. **B**

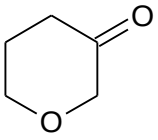
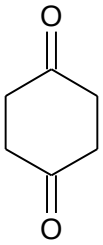
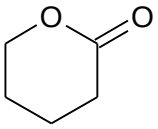
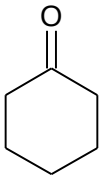
2. Formaldehyde(HCHO) forms two different organic products when reacts with
   (A) $LiAlH_4$ (B) Conc.NaOH
   (C) NH_3 (D) HCN

2. **B**

3. CH_3COCH_3 can form a tertiary alcohol when reacts with
   (A) CH_3Cl (B) CH_3MgBr/H_3O^+
   (C) $Cu/300^oC$ (D) (i)PCl_5/(ii)H_2O

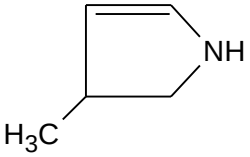
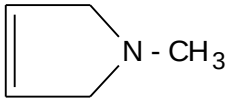
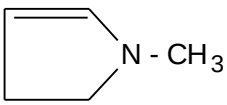
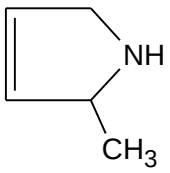
3. **B**

4. Which of the following compound does not react with $NaBH_4$?

   (A) 
   (B) 
   (C) 
   (D) 

4. **C**

5. Which is most basic in gaseous state?

   (A) 
   (B) 
   (C) 
   (D) 

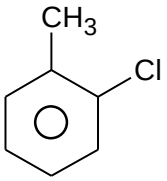
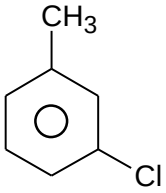
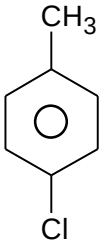
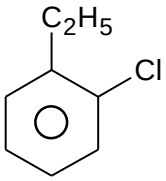
5. **B**

6. Which will convert $CH_3CH_2CH_2COOH$ to a chiral compound?
(A) $CH_3CH_2NH_2$ (B) $LiAlH_4/HCl$
(C) Cl_2/ red P (D) $CH_3CH_2OH/Conc.H_2SO_4$

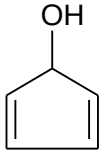
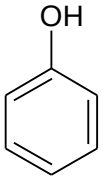
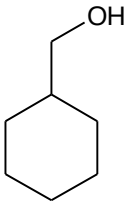
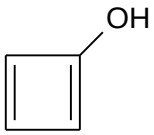
6. **C**

7. Which reaction of glucose confirms the presence of a straight chain of six carbon atoms in it?
(A) $LiAlH_4$ (B) CH_3COCl/Py
(C) Conc.HI/red P (D) Br_2/H_2O

7. **C**

8. $(X) \xrightarrow[Liq.NH_3]{KNH_2} Products$
Which will form maximum number of monosubstituted products in the above reaction?
(A) 
(B) 
(C) 
(D) 

8. **B**

9. Which of the following alcohol will form ether easily upon treatment with conc. H_2SO_4?
(A) 
(B) 
(C) 
(D) 

9. **C**

10. $CH_3 - \underset{\diagdown O \diagup}{CH} - CH_2 \xrightarrow{HCl(excess)} Products$
Which product is not formed in above reaction?
(A) $CH_3 - \underset{OH}{\underset{|}{CH}} - CH_2 - Cl$ (B) $CH_3 - \underset{Cl}{\underset{|}{CH}} - CH_2 - OH$
(C) $CH_3 - \underset{Cl}{\underset{|}{CH}} - CH_2 - Cl$ (D) $CH_3 - \underset{OH}{\underset{|}{CH}} - CH_2 - OCl$

10. **D**

11. With which of the following reagent phenol forms the lightest product?
(A) Br_2/CS_2 (B) Zn dust/Δ
(C) $CHCl_3/KOH$ (D) CH_2N_2

11. **B**

12. Which of the following cannot form a yellow precipitate with I_2/NaOH?
(A) CH_3COCH_3 (B) CH_3CHO
(C) CH_3CH_2OH (D) $CH_3CH_2\underset{\underset{OH}{|}}{C}HCH_2CH_3$

12. **D**

13. Which of the following compounds does not exist in the aqueous solution of acetone?
(A) $CH_3-\overset{\overset{OH}{|}}{C}=CH_2$ (B) $CH_3\overset{\overset{OH}{|}}{C}CH_3$
(C) $CH_3\underset{\diagdown\ \diagup}{\underset{O}{CH}}CH_2$ (D) $CH_3\overset{\overset{O}{||}}{C}CH_3$

13. **C**

14. Aqueous solution of which compound has the lowest pH value?
(A) CH_3COOH (B) CH_3COOCH_3
(C) CH_3COCl (D) CH_3CONH_2

14. **C**

15. Which of the following reaction cannot form pure $CH_3CH_2CH_2NH_2$?
(A) $CH_3CH_2Cl \xrightarrow[(ii)LiAlH_4]{(i)KCN}$ (B) $CH_3CH_2CH_2Cl \xrightarrow{NH_3}$
(C) $CH_3CH_2CH_2NO_2 \xrightarrow{LiAlH_4}$ (D) $CH_3CH_2CH_2CONH_2 \xrightarrow{Br_2/KOH}$

15. **B**

16. Glucose is converted to a black colour product when treated with?
(A) Conc.HNO_3 (B) Conc.H_2SO_4
(C) Conc.HCl (D) Conc.HI

16. **B**

17. Which of the following reagent can convert $CH_3CH_2CONH_2$ to CH_3CH_2CN?
(A) $LiAlH_4$ (B) P_4O_{10}
(C) Zn-Hg/conc.HCl (D) NaOH

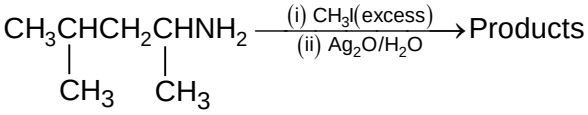
17. **B**

18. For the amino acid $H_2N-\underset{\underset{R}{|}}{CH}-COOH$, the K_a of –COOH group is 10^{-6} and the K_b of $-NH_2$ group is 10^{-5}. What is the pH of the amino acid at isoelectric point?
(A) 6 (B) 5.5
(C) 7.5 (D) 5

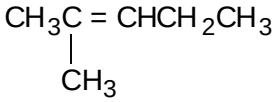
18. C

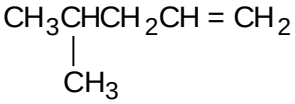
19. What type of amino acid does not form α-helix structure?
(A) Containing one NH_2 and two COOH group
(B) Containing one NH and one COOH group
(C) Containing two NH_2 and one COOH group
(D) Containing one NH_2 and one COOH group

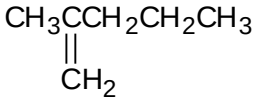
19. B

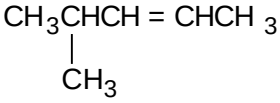
20. 

The major product of above reaction is

(A) 

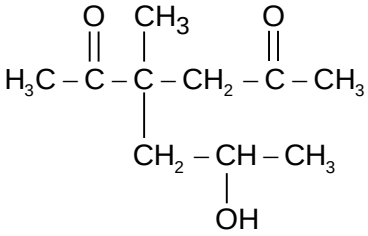
(B) 

(C) 

(D) 

20. B

PART-B
Numerical Type

1. 

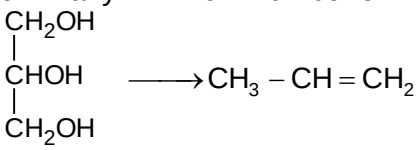
How many maximum number of moles of iodoform is formed when one mole of the above compound reacts with I_2 in presence of hot NaOH solution?

1. **3**

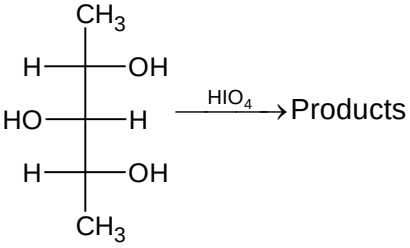
2. How many structural isomer(s) containing four membered ring(s) is/are possible with formula C_4H_5F?

2. 4

3. How many minimum number of moles of HI is needed for the following change?



3. 4

4. 

What is the molar mass of the carboxylic acid formed in above reaction in g mol^{-1} unit?

4. 46

5. $Ph-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow{HBr/SN^2} Products$

How many oxygen atom(s) is/are present in the product which contains the phenyl group?

5. 2

Space For Rough Work

Mathematics

PART – A

Straight Objective Type

This part contains **20 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. The domain of function $f(x) = \sqrt{2^x - 3^x}$ is

   (A) $(-\infty, 0]$ (B) R

   (C) $[0, \infty)$ (D) No value of x

1. A

2. Range of $y = \frac{2\sin x}{1+\sin^2 x}$ is

   (A) R (B) $\{-1, 1\}$

   (C) $\left[\frac{-1}{2}, \frac{1}{2}\right]$ (D) None

2. B

3. The domain of the function $y = \frac{1}{\log_{\sqrt{x}} x}$ is

   (A) R^+ (B) $R^+ - \{1\}$

   (C) $R - \{1\}$ (D) none of these

3 B

4. If the function f : R $\to$ A given by f (x) = $\frac{x^2}{x^2+1}$ is a surjective function, then A =

   (A) R (B) [0, 1]

   (C) (0, 1] (D) [0, 1)

4. D

5. If $f: A \to B$, where $A = \{a,b,c,d\}$ and $B = \{x,y,z\}$ and $f(a) = x$ then number of such INTO functions is

   (A) 27 (B) 15

   (C) 21 (D) none of these

5. B

6. If f : (2, 4) $\to$ (1, 3) is a function defined by $f(x) = x - \left[\frac{x}{2}\right]$ (where [·] denotes the greatest integer function), then $f^{-1}(x)$ is

   (A) x – 1 (B) x + 1

   (C) x (D) none of these

6. B

7. If $f(x)=|x-2|+|x-5|$ then $f'(4)$ is equal to

(A) –1 (B) 0
(C) 1 (D) 2

7. B

8. If $\lim\limits_{x\to 1}\dfrac{x^2-ax+b}{x-1}=3$, then a + b is equal to

(A) 5 (B) 1
(C) -4 (D) -7

8. D

9. $$f(x)=\begin{cases}\lim\limits_{n\to\infty}\dfrac{x^n\cos x+\cos\left(x+4x^n\right)}{x^n+1}, & x\neq 1\\ k, & x=1\end{cases}$$

If $f(x)$ is continuous at x = 1, then

(A) $k=2\cos 1$ (B) $k=\cos 1$
(C) $k=\cos 1+\cos 4$ (D) No real value of 'k' exists

9. B

10. $\lim\limits_{x\to 0}\left(e^x+2x\right)^{\frac{3}{x}}$ equal to

(A) 9 (B) e^3
(C) e^9 (D) 3

10. C

11. The values of k for which the function $f(x)=kx^3+9x^2+9x+3$ is an increasing function will be

(A) k > 3 (B) k > 1
(C) $k\geq 2$ (D) $k\geq 1$

11. A

12. The points on the curve $y=\left(x^3-3x\right)$ at which the normals are parallel to the line $2x+18y=9$ are

(A) (2, 2), $(2,\ -2)$ (B) $(2,\ -2)$, $(-2,\ -2)$
(C) $(2,\ -2)$, $(-2,\ 2)$ (D) (2, 2), $(-2,\ -2)$

12. D

13. If $0<a<b<\dfrac{\pi}{2}$ and $f(a,b)=\dfrac{\tan b-\tan a}{b-a}$, then

(A) $f(a,b)\geq 2$ (B) $f(a,b)>1$
(C) $f(a,b)\leq 1$ (D) none of these

13. B

14. Let $f(x+y)=f(x)f(y)$ for all x and y. If $f(5)=2$ and $f'(0)=3$ then $f'(5)$ is equal to

(A) 5 (B) 8
(C) 0 (D) none of these

14. D

15. Let $x^k+y^k=a^k,(a,k>0)$ and $\frac{dy}{dx}+\left(\frac{y}{x}\right)^{\frac{1}{3}}=0$, then k is:

(A) $\frac{3}{2}$ (B) $\frac{4}{3}$
(C) $\frac{1}{3}$ (D) $\frac{2}{3}$

15. D

16. $\int\frac{x^2+\sin^2 x}{1+x^2}\sec^2 x\,dx$ is equal to

(A) tan x + c (B) $\tan x-\tan^{-1}x+c$
(C) $\tan x+\tan^{-1}x+c$ (D) none of these

16. B

17. If c is a point at which Rolle's theorem holds for the function, $f(x)=\log_e\left(\frac{x^2+\alpha}{7x}\right)$ in the interval $[3,4]$, where $\alpha\in R$, then $f''(c)$ is equal to:

(A) $-\frac{1}{12}$ (B) $-\frac{1}{24}$
(C) $\frac{\sqrt{3}}{7}$ (D) $\frac{1}{12}$

17. D

18. ∫ sinx . cosx . cos2x . cos 4x . cos 8x dx is equal to

(A) $\frac{1}{96}\cos 16x+C$ (B) $-\frac{1}{256}\cos 16x+C$
(C) $-\frac{1}{16}\cos 16x+C$ (D) None of these

18. B

19. $\int\frac{\left(x^4-x\right)^{\frac{1}{4}}}{x^5}dx$ is equal to

(A) $\frac{4}{15}\left(1-\frac{1}{x^3}\right)^{\frac{5}{4}}+c$ (B) $\frac{4}{5}\left(1-\frac{1}{x^3}\right)^{\frac{5}{4}}+c$
(C) $\frac{4}{15}\left(1+\frac{1}{x^3}\right)^{\frac{5}{4}}+c$ (D) none of these

19. A

20. $\int \frac{\log(x+1)-\log x}{x(x+1)}\,dx$ equals

(A) $-\log\left(\frac{x+1}{x}\right)+c$

(B) $-\log\left[\log\left(\frac{x+1}{x}\right)\right]+c$

(C) $-\frac{1}{2}\left[\log\left(\frac{x+1}{x}\right)\right]^2+c$

(D) $c-\frac{1}{2}\left[\log(x+1)^2-(\log)^2\right]$

20. C

PART-B
Numerical Type

1. If the thrice repeated roots of equation $x^4+ax^3+bx^2+cx-1=0$ is 1 then $a+b+2c$ is equal to

1. 2

2. If $\sqrt{x+y}+\sqrt{y-x}=5$, then $\frac{d^2y}{dx^2}=$

2. 0.08

3. If the tangent to the curve $y=\frac{x}{x^2-3}, x\in R, \left(x\neq\pm\sqrt{3}\right)$ at a point $(\alpha, \beta)\neq(0, 0)$ on it is parallel to the line $2x + 6y - 11 = 0$ then $|6\alpha + 2\beta| =$

3. 19.00

4. A line through origin is tangent to $y=x^3+x+16$. Then slope of the line is

4. 13

5. Maximum value of $\left(\sqrt{-3+4x-x^2}+4\right)^2+(x-5)^2, 1\le x\le 3$ is

5. 36

Space For Rough Work

FIITJEE INTERNAL TEST

BATCHES:

PHYSICS, CHEMISTRY & MATHEMATICS

JEE MAIN-PHASE-IV

Paper Code

ANSWER KEY

SECTION – I

(PHYSICS)

PART – A

PART – B

SECTION – II

(CHEMISTRY)

PART – A

PART – B

SECTION – III
(MATHEMATICS)

PART – A

PART – B