FIITJEE - JEE (Main)

PHYSICS, CHEMISTRY & MATHEMATICS

BATCHES: NWCMPA122A1_PT1

PHASE TEST – I

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

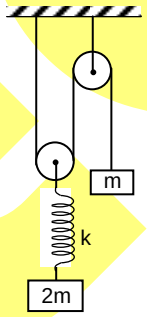
This part contains **20 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. A boat which has a speed of 6 km/h in still water crosses a river of width 1 km along the shortest possible path in 20 min. The velocity of the river water in km/h is

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

1. **D**

2. For a system in equilibrium as shown in figure elongation in spring will be



(A) $\frac{mg}{k}$ (B) $\frac{2mg}{k}$

(C) $\frac{4mg}{k}$ (D) $\frac{3mg}{k}$

2. **B**

3. A projectile is projected from horizontal plane with velocity u at an angle θ with horizontal. Find out radius of curvature of particle motion when its velocity makes angle $\frac{\theta}{2}$ with horizontal, (u = 15 m/s, $\theta = 60^0$)

(A) $5\sqrt{3}$ m (B) $\frac{5}{\sqrt{3}}$m (C) $\frac{45}{8}$ m (D) none of these

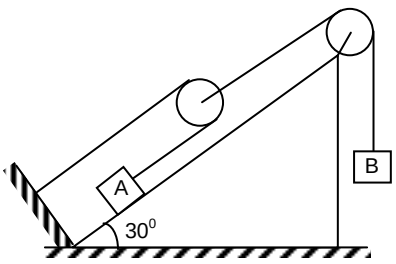
3. **A**

4. Velocity time equation of a particle moving in a straight line is $V = t^2 - 5t + 6$. The distance travelled by the particle in the time interval from t = 0 to t = 4 sec

(A) 0 (B) $\frac{17}{3}$ (C) 6 (D) $\frac{16}{3}$

4. **B**

5. In system shown in figure $m_B = 4kg$ and $m_A = 2kg$. The pulleys are massless and friction is absent everywhere. The acceleration of block A is $g = 10 m/s^2$



(A) $\frac{10}{3}$ m/s^2 (B) $\frac{20}{3}$m/s^2

(C) 2 m/s^2 (D) 4 m/s^2

5. **A**

6. Two forces, each of magnitude. F have a resultant of the same magnitude F. The angle between the two forces is

(A) 45^0 (B) 120^0

(C) 150^0 (D) 60^0

6. **B**

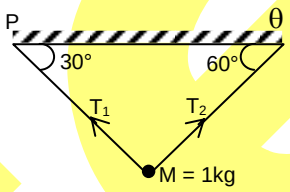
7. If $\vec{A}+\vec{B}$ is a unit vector along x-axis and $\vec{A}=\hat{i}-\hat{j}+\hat{k}$, then what is $\vec{B}$

(A) $\hat{i}-\hat{k}$ (B) $\hat{j}-\hat{k}$

(C) $\hat{i}+\hat{j}+\hat{k}$ (D) $\hat{i}+\hat{j}-\hat{k}$

7. **B**

8. A 1 kg ball hangs in equilibrium from two strings as shown in the figure. Calculate the tension T_1 and T_2 in the strings (take g = 10 m/s^2)

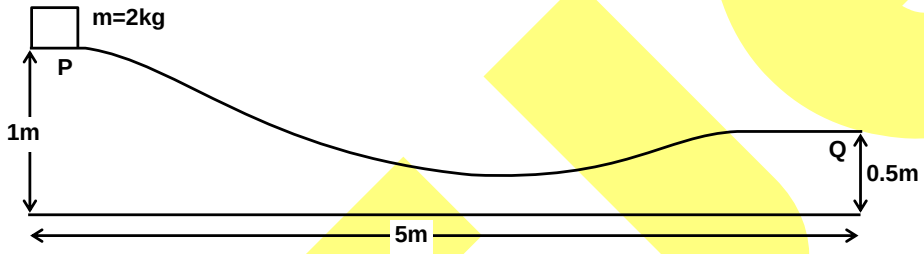


(A) 5N, 5N (B) $5\sqrt{3}$N, $5\sqrt{3}$N

(C) 5N, $5\sqrt{3}$N (D) $5\sqrt{3}$N, 5N

8. **C**

9. Find the horizontal velocity of the particle when it reach the point Q. Assume there is no friction. Take g = 9.8 m/s^2.

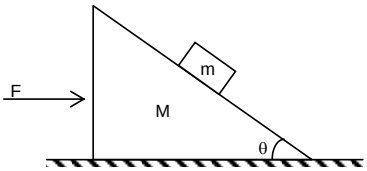


(A) 4 m/s (B) 5 m/s

(C) 3.13 m/s (D) 3.6 m/s

9. **C**

10. All surfaces are smooth, then calculate the value of F for which the block remains stationary w.r.t wedge.



(A) Mg tanθ

(B) $(M+m)\,g\tan\theta$

(C) Mg cotθ

(D) $(M+m)\,g\cot\theta$

10. **B**

11. If a unit vector is represented by $0.5\hat{i}+0.8\hat{j}+c\hat{k}$, then the value of 'c' is

(A) 1 (B) $\sqrt{0.11}$ (C) $\sqrt{0.01}$ (D) $\sqrt{0.39}$

11. **B**

12. For a particle moving in a straight line, the displacement of the particle at time t is given by $S=t^3-6t^2+3t+7$. What is the velocity of the particle when its acceleration is zero?

(A) –9 ms^{-1} (B) –12 ms^{-1} (C) 3 ms^{-1} (D) 42 ms^{-1}

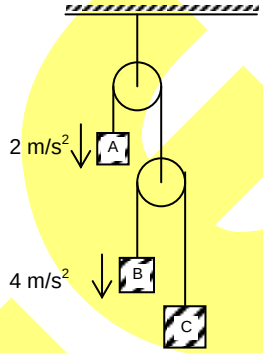
12. **A**

13. The unit vector perpendicular to $\vec{i} - 2\hat{j} + \hat{k}$ and $3\vec{i} + \hat{j} - 2\hat{k}$ is

(A) $\frac{5\vec{i} + 3\hat{j} + 7\hat{k}}{\sqrt{83}}$ (B) $\frac{3\vec{i} + 5\hat{j} + 7\hat{k}}{\sqrt{83}}$ (C) $\frac{5\vec{i} + 3\hat{j} - 7\hat{k}}{\sqrt{83}}$ (D) $\frac{3\vec{i} - 5\hat{j} + 7\hat{k}}{\sqrt{83}}$

13. **B**

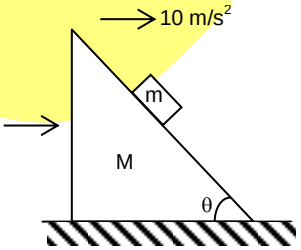
14. In the figure shown acceleration of blocks A and B are as shown. The acceleration of block C is



(A) 8 m/s^2 upward (B) 4 m/s^2 upward
(C) 2 m/s^2 downward (D) zero

14. **A**

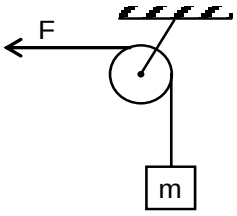
15. In the figure shown all the surfaces are frictionless, and mass of the block, m = 1kg. The block and wedge are held initially at rest. Now wedge is given a horizontal acceleration of 10 m/s^2 by applying a force on the wedge so that the block does not slip on the wedge. Then work done by the normal force in ground frame on the block in $\sqrt{3}$ seconds is



(A) 30J (B) 60J
(C) 150J (D) $100\sqrt{3}$ J

15. **C**

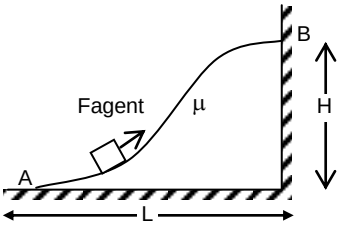
16. A block of mass m is hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force F. The kinetic energy of the block increase by 20 J in 1 seconds.



(A) The work done by the tension on the block is 20 J in 1 second.
(B) The work done by the tension on he block is greater than 20 J in one second.
(C) The work done by the tension on the block is less than 20 J in one second.
(D) None of the above statements are correct.

16. **B**

17. A external agent moves the block m slowly from A to B, along a rough (coefficient of friction between block and will = μ) hill such that every time he applies the force tangentially. Find the work done by agent in this interval.



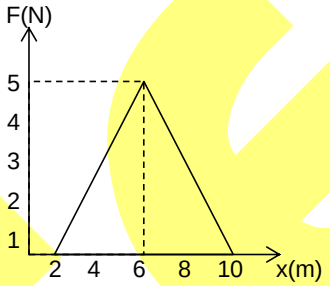
(A) $\frac{m^2g^2H^2}{L}$ (B) $\frac{mgH^2}{L}$
(C) mg(uH + L) (D) mg (H + μL)

17. **D**

18. An object of mass m is hanging by a string from the ceiling of an elevator. The elevator is moving upward but decreasing speed. What is the tension in the sting
(A) less than mg (B) exactly mg
(C) greater than mg (D) none of these

18. **A**

19. A force shown in the F – x graph is applied to a 2kg block horizontally as shown in the figure. The change in kinetic energy is
(A) 15J (B) 20J
(C) 25J (D) 30J



19. **B**

20. Power applied to a particle varies with time as $P = 3t^2 - 2t + 1$ watt, where t is in second. Find the change in its kinetic energy between t = 2sec and t = 4sec
(A) 32 J (B) 46 J
(C) 61 J (D) 100 J

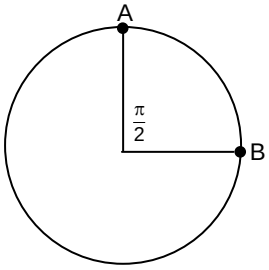
20. **B**

PART-B
Numerical Type

1. An object is displaced from point A(1 m, 2 m, 3 m) to a point B(2 m, 3 m, 4 m) under a constant force $\vec{F} = \left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)$N. Find the work done by this force in this process. (in joule)

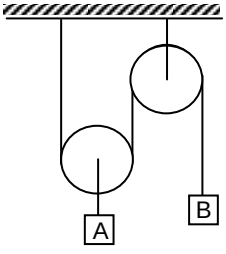
1. **9**

2. A particle is moving in a circular path of radius 1 metre. Under the action of centripetal force. The speed $\frac{\pi}{\sqrt{2}}$ m/s of the particle is constant. Find the average velocity(in m/s) between A and B.

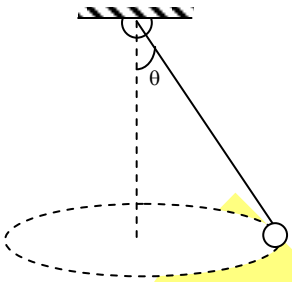


2. **2**

3. As shown in figure two blocks A and B are connected by pulleys through strings as shown in figure. If block A is moved 2 cm down wards then find the magnitude of the displacement of block B (in cm).



3. **4**



4 In the conical pendulum, half of centripetal force (in N) will be ($\theta = 45^0$, m = 0.1 kg, g = 10 m/s^2)

4. **0.50**

5. If $\vec{A} = 4\hat{i} - 2\hat{j} + 6\hat{k}$ and $\vec{B} = -\hat{i} + 2\hat{j} + 3\hat{k}$, find the $\frac{\vec{A}.\vec{B}}{4}$.

5. **2.50**

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. A one litre vessel initially contains 2.0, 0.5 and 0.0 moles of N_2, H_2 and NH_3 respectively. The system after attaining equilibrium has 0.2 mole of NH_3. The number of moles of H_2 in the vessel at equilibrium is
(A) 0.3 (B) 0.4
(C) 0.2 (D) 1.8

1. **C**

2. A reaction takes place in three steps with the rate constants k_1, k_2 and k_3. The overall rate constant $k = \frac{k_1(k_2)^{1/2}}{k_3}$. If activation energies are 40, 30 and 20 kJ for step I, II and III respectively, the overall activation energy of reaction will be
(A) 10 (B) 15
(C) 30 (D) 35

2. **D**

3. If a reaction A + B $\longrightarrow$ C is exothermic to the extent of 30 kJ/ mol and the forward reaction has an activation energy of 70 kJ/mol. The activation energy of reverse reaction is
(A) 30 kJ/mol (B) 40 kJ/mol
(C) 70 kJ/mol (D) 100 kJ/mol

3. **D**

4. The angular momentum L of an electron in a Bohr's orbit is given as
(A) $L = \frac{nh}{2\pi}$ (B) $L = \sqrt{\ell(\ell+1)}\,\frac{h}{2\pi}$
(C) $L = \sqrt{\ell(\ell+2)}\,\frac{h}{2\pi}$ (D) $L = \frac{h}{4\pi}$

4. **A**

5. The electronic configuration of four elements are given in brackets
L ($1s^2$, $2s^2 2p^1$); M ($1s^2$, $2s^2 2p^5$); Q ($1s^2$, $2s^2 2p^6$, $3s^1$); R ($1s^2$, $2s^2 2p^2$)
The element that would most readily form a diatomic molecule is
(A) Q (B) M
(C) R (D) L

5. **B**

6. Which of the following is most soluble?
(A) Bi_2S_3 ($K_{sp} = 1 \times 10^{-17}$) (B) MnS ($K_{sp} = 7 \times 10^{-16}$)
(C) CuS ($K_{sp} = 8 \times 10^{-37}$) (D) Ag_2S ($K_{sp} = 6 \times 10^{-51}$)

6. **B**

7. If doubling the concentration of a reactant 'A' increases the rate 4 times and tripling the concentration of 'A' increases the rate 9 times, the rate is proportional to
(A) concentration of 'A'
(B) square of concentration of 'A'
(C) under root of the concentration of 'A'
(D) cube of concentration of 'A'

7. **B**

8. The hydrogen ion concentration of 0.2 N CH_3COOH which is 40% dissociated is
(A) 0.08N (B) 0.12N
(C) 0.80N (D) 1.2N

8. **A**

9. The rate of a gaseous reaction is given by the expression k[A][B]. If the volume of the reaction vessel is suddenly reduced to $1/4^{th}$ of the initial volume, the reaction rate relating to original rate will be
(A) 1/10 (B) 1/8
(C) 8 (D) 16

9. **D**

10. An atom has 2K, 8L and 5M electrons. The number of occupied sub-shells in the atom in ground state is
(A) 3 (B) 5
(C) 7 (D) 9

10. **B**

11. The solubility (in water) order of the following is $MgCO_3$, $CaCO_3$, $BaCO_3$, $SrCO_3$
(A) $MgCO_3 > CaCO_3 > BaCO_3 > SrCO_3$ (B) $CaCO_3 > MgCO_3 > BaCO_3 > SrCO_3$
(C) $SrCO_3 > CaCO_3 > BaCO_3 > MgCO_3$ (D) $MgCO_3 > CaCO_3 > SrCO_3 > BaCO_3$

11. **D**

12. The atomic number of an atom is 14. Choose correct statement about the atom?
(A) It contains four electrons with $\ell = 0$.
(B) It attains a half-filled electronic configuration by gaining one electron.
(C) It can lose two electrons in order to attain the electronic configuration of its nearest inert gas.
(D) The principal quantum number of its valence electron is 4.

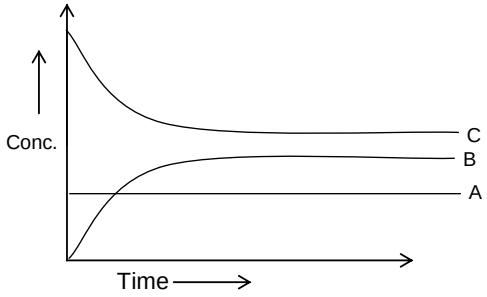
12. **B**

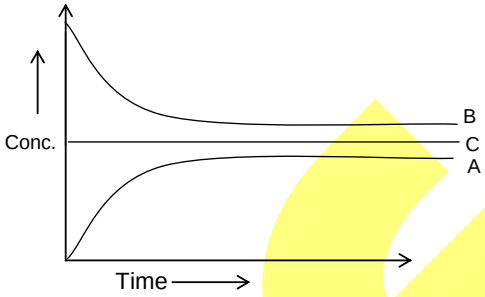
13. Which of the following molecule has non-zero dipole moment?
(A) SF_4 (B) CF_4
(C) XeF_4 (D) SiF_4

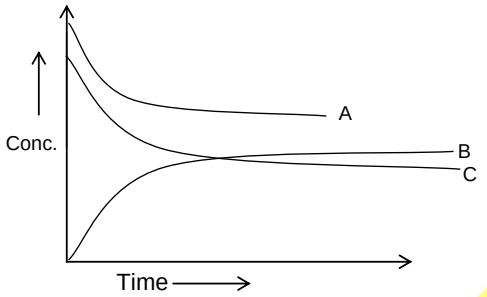
13. **A**

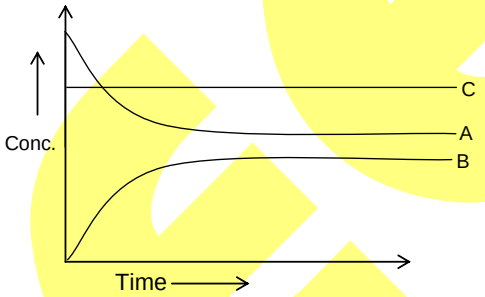
14. $A(g) + C(s) \rightleftharpoons B(g)$

Which of the following graph represents the above reversible reaction?

(A) 

(B) 

(C) 

(D) 

14. **D**

15. The values of K_{a_1} and K_{a_2} of H_2CO_3 are respectively 10^{-8} and 10^{-11}. What will be the p^{K_b} of CO_3^{2-} ion?

(A) 11 (B) 3
(C) 6 (D) 8

15. **B**

16. Which of the following compound can absorb moisture and carbon dioxide from the atmosphere?

(A) $NaNO_3$ (B) NaOH
(C) Na_2CO_3 (D) NaCl

16. **B**

17. Which of the following contains maximum number of unpaired electrons?

(A) Fe (B) Fe^{+}
(C) Fe^{2+} (D) Fe^{4+}

17. **B**

18. Which of the following orbital has maximum number of radial nodes?

(A) 4s (B) 4p
(C) 4d (D) 4f

18. **A**

19. The radius of first orbit of hydrogen atom is a_0. What will be the ratio of the radii of first, second and third orbits of hydrogen atom respectively?

(A) 1 : 2 : 3 (B) $1:\frac{1}{2}:\frac{1}{3}$
(C) 1 : 4 : 9 (D) $1:\frac{1}{4}:\frac{1}{9}$

19. **C**

20. Which of the following boils at the highest temperature?
(A) H_2O (B) D_2O
(C) D_2 (D) H_2

20. **B**

PART-B
Numerical Type

1. What is the sum of principal quantum number and azimuthal quantum number for the unpaired electron of aluminium?

1. **4**

2. The rate of an elementary reaction $2X(g) + Y(g) \longrightarrow X_2Y(g)$ is 8×10^{-3} mol $L^{-1}s^{-1}$ if the reaction starts with 0.1 M of X and 0.2 M of Y. What is the rate constant (k) of the reaction in $mol^{-2}\ L^2s^{-1}$ unit?

2. **4**

3. $XY(g) \rightleftharpoons X(g) + Y(s)$
The degree of dissociation of XY according to above equilibrium is 0.8. Therefore the equilibrium constant K_C is

3. **4**

4. 100 mL of 0.0055 M CH_3COOH was added to 100 mL of 0.0005 M NaOH. What is the pH of the resulting solution after complete reaction?
[K_a of $CH_3COOH = 10^{-5}$]

4. **4**

5. Potassium superoxide (KO_2) + Sulphur $(S) \xrightarrow{\text{Heat}}$ Product .
How many oxygen atoms are present in the product of above reaction?

5. **4**

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. Period of $f(x)=\tan(3x+2)$ is:

   (A) π (B) $\frac{2\pi}{3}$

   (C) $\frac{\pi}{3}$ (D) None of these

1. C

2. The value of k which makes $f(x)=\begin{cases}\sin\left(\frac{1}{x}\right) & : \ x\neq 0\\ k & : \ x=0\end{cases}$ continuous at x = 0 is:

   (A) 8 (B) 1

   (C) –1 (D) None

2. D

3. Let $f(x):\begin{cases}x^3 & : \ x^2<1\\ x & : \ x^2\geq 1\end{cases}$. Then points of non – differentiability are:

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

   (C) $\{-1,1\}$ (D) None of these

3. C

4. If $x=3\cos\theta-2\cos^3\theta$ and $y=3\sin\theta-2\sin^3\theta$, then $\frac{dy}{dx}=$

   (A) $\sin\theta$ (B) $\cos\theta$

   (C) $\tan\theta$ (D) $\cot\theta$

4. D

5. Equation of normal to the curve $y=x(2-x)$ at the point (2, 0) is:

   (A) $x-2y=2$ (B) $2x+y=4$

   (C) $x-2y+2=0$ (D) None of these

5. A

6. Which of the following functions is even function?

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

   (C) $f(x)=\frac{a^x-a^{-x}}{a^x+a^{-x}}$ (D) $f(x)=\sin x$

6. B

7. The value of $\lim_{x\to 0}\left(\frac{1+5x^2}{1+3x^2}\right)^{1/x^2}$ is:

(A) e
(B) e^2
(C) –1
(D) 0

7. B

8. The length of the sub – normal to the curve $y = x^3$ at (2, 8) is:

(A) $\frac{2}{3}$
(B) $\frac{3}{2}$
(C) 96
(D) None

8. C

9. If $y = a\log|x| + bx^2 + x$ has its extremum values at $x = -1$ and $x = 2$, then:

(A) $a = 2, b = -1$
(B) $a = 2, b = \frac{-1}{2}$
(C) $a = -2, b = \frac{1}{2}$
(D) None of these

9. B

10. The function $f(x) = x^3 - 6x^2 + 9x + 1$ is monotonically decreasing for:

(A) $1 < x < 3$
(B) $x < 3$
(C) $x > 1$
(D) $x > 3$ or $x < 1$

10. A

11. Range of $f(x) = \sin x + \cos x$ is

(A) $[-2, 2]$
(B) $[-1, 1]$
(C) $\left[-\sqrt{2}, \sqrt{2}\right]$
(D) None of these

11. C

12. If $f : R \to R$ satisfies $f(x+y) = f(x) + f(y)$, for all $x, y \in R$ and $f(1) = 7$, then $\sum_{r=1}^{n} f(r)$ is:

(A) $\frac{7(n+1)}{2}$
(B) $7n(n+1)$
(C) $\frac{7n(n+1)}{2}$
(D) $\frac{7n}{2}$

12. C

13. The range of the function $f(x)=\frac{2+x}{2-x}, x\neq 2$ is:

(A) R
(B) $R-\{-1\}$
(C) $R-\{1\}$
(D) $R-\{2\}$

13. B

14. If $\frac{dy}{dx}=(x-1)^3(x-2)^4$, then y is –

(A) Local maximum at x = 1
(B) Local maximum at x = 2
(C) Local minimum at x = 1
(D) Local minimum at x = 2

14. C

15. $\int \tan x \sec^2 x\, dx =$

(A) $\tan^2 x + C$
(B) $\frac{\tan^2 x}{2}+C$
(C) $\frac{\tan^2 x}{3}+C$
(D) None of these

15. B

16. $\int \frac{\cos 4x+1}{\cot x-\tan x}dx = p\cos 4x + c$ is possible for:

(A) $p=\frac{-1}{2}$
(B) $p=\frac{-1}{4}$
(C) $p=\frac{-1}{8}$
(D) No real p

16. C

17. The value of $\int \frac{dx}{2+\cos x}$

(A) $\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{\tan\frac{x}{2}}{\sqrt{3}}\right)+C$
(B) $\frac{1}{\sqrt{3}}\tan^{-1}\left(\frac{\tan\frac{x}{2}}{\sqrt{3}}\right)+C$
(C) $\frac{1}{\sqrt{3}}\tan^{-1}\left(\tan\frac{x}{2}\right)+C$
(D) None of these

17. A

18. The value of $\int_0^{\pi/2} \cos^3 x\,dx =$

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

(C) $\frac{4}{3}$ (D) $\frac{5}{3}$

18. B

19. The value of $\int \frac{(\sin x + \cos x)dx}{\sqrt{\sin 2x}}$

(A) $\sin^{-1}(\sin x + \cos x) + C$ (B) $\sin^{-1}(\sin x - \cos x) + C$

(C) $\sin^{-1}(\cos x - \sin x) + C$ (D) None of these

19. B

20. If $f(x) = \int_0^x \frac{1}{\log t}dt$ then $f'(x) =$

(A) $\frac{1}{\log x}$ (B) $\log x$

(C) $\frac{1}{x}$ (D) None

20. A

PART-B
Numerical Type

1. Number of critical points of $f(x) = \frac{x}{1+x^2}$ is .....

1. 2

2. If $f(x) = 2x^3 - 3x^2 - 12x + 5$ on [–2, 4] then absolute maximum occurs at x =

2. 4

3. The value of c of the mean value theorem, if $f(x) = 2x^2 + 3x + 4$ in [1, 2] is:

3. 1.5

4. If $\int \frac{\sin x}{\sin(x-\alpha)}dx = Ax + B\log\sin(x-\alpha) + c$, then value of $A^2 + B^2$ is

4. 1

5. If $f(x)=\begin{cases} x+\lambda & : \ -1<x<3 \\ 4 & : \ x=3 \\ 3x-5 & : \ x>3 \end{cases}$ is continuous at x = 3, then λ is equal to

5. 1

Space For Rough Work

FIITJEE INTERNAL TEST

BATCHES:

PHYSICS, CHEMISTRY & MATHEMATICS

JEE MAIN-PHASE-I

Paper Code

ANSWER KEY

SECTION – I

(PHYSICS)

PART – A

PART – B

JEEM

(CHEMISTRY)

PART – A

PART – B

SECTION – III
(MATHEMATICS)

PART – A

PART – B