JEE (Main)
Sample Question Paper

Subjects	Physics, Chemistry and Mathematics
Total Number of Questions	75
Maximum Marks	300
Time Allowed	3 Hours

Marking Scheme (As per JEE Main Pattern)

Each question carries **4 (four) marks**.
1 (one) mark will be deducted for each incorrect answer.
No marks will be deducted for unattempted questions.
Only one option is correct for each question.

Important Instructions

1. This Question Paper consists of **75 Multiple Choice Questions**.
2. The paper contains **25 questions each from Physics, Chemistry and Mathematics**.
3. All questions are compulsory.
4. Rough work should be done only in the space provided in the Question Paper.
5. Calculators, mobile phones, smart watches, or any electronic devices are strictly prohibited.

Name of the Candidate (Capital Letters)	
Roll Number	
Examination Centre Name	
Candidate's Signature	Date

Invigilator's Signature

PHYSICS

1. Sound travels in a mixture of two moles of helium and n moles of hydrogen If rms speed of gas molecules in the mixture is $\sqrt{2}$ times the speed of sound, then the value of n will be

A) 1 **B)** 2

C) 3 **D)** 4

2. The rms value of conduction current in a parallel plate capacitor is $69\,\mu A$ The capacity of this capacitor, if it is connected to $230\,V$ ac supply with an angular frequency of $600\,rad/s$, will be :

A) $5\,pF$ **B)** $50\,pF$

C) $100\,pF$ **D)** $200\,pF$

3. A hypothetical gas expands adiabatically such that its volume changes from 08 litres to 27 litres. If the ratio of final pressure of the gas to initial pressure of the gas is $\frac{16}{B1}$. Then the ratio of $\frac{Cp}{Cv}$ will be

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

C) $\frac{1}{2}$ **D)** $\frac{4}{3}$

4. A planet has double the mass of the earth. Its average density is equal to that of the earth. An object weighing W on earth will weigh on that planet:

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

C) $(2)^{-\frac{1}{3}}$ **D)** 2

5. Which of the following expressions give the value of acceleration due to gravity (g') at the altitude h above the surface of Earth.
(R = radius of Earth, g = acceleration due to gravity at surface of Earth)

A) $g' = g\left(1 - \frac{h^2}{2R^2}\right)$ **B)** $g' = g\left(1 - \frac{2h}{R}\right)$

C) $g' = g\left(1 - \frac{h}{2R}\right)$ **D)** $g' = g\left(1 - \frac{2h^2}{R^2}\right)$

6. Match List I with List II

LIST I		LIST II	
A	Isothermal Process	I	Work done by the gas decreases internal energy
B	Adiabatic Process	II	No change in internal energy
C	Isochoric Process	III	The heat absorbed goes partly to increase internal energy and partly to do work
D	Isobaric Process	IV	No work is done on or by the gas

Choose the correct answer from the options given below:

A) A-I, B-II, C-IV, D-III **B)** A-II, B-I, C-IV, D-III

C) A-I, B-II, C-III, D-IV **D)** A-II, B-I, C-III, D-IV

7. Choose the incorrect statement from the given statements.

A) Planets revolve around the Sun with constant linear speed.

B) Energy of the planet in elliptical orbit is constant.

C) Satellites in circular motion have constant energy.

D) Body falling towards the Earth results in negligible displacement of the Earth.

8. An ice cube has a bubble inside. When viewed from one side the apparent distance of the bubble is 12 cm. When viewed from the opposite side, the apparent distance of the bubble is observed as 4 cm. If the side of the ice cube is 24 cm, the refractive index of the ice cube is

A) $\frac{4}{3}$

B) $\frac{3}{2}$

C) $\frac{2}{3}$

D) $\frac{6}{5}$

9. Match the list-I with list-II and choose the correct option.

List-I	List-II
(A). Microwave	(P). 1 nm - 400nm
(B). Ultraviolet	(Q). 1 nm - 1nm
(C). X-rays	(R). 2.5 μm - 750nm
(D). Infrared	(S). 1 μm - 1nm

A) A-(s), B-(q), C-(r), D-(p)

B) A-(s), B-(p), C-(q), D-(r)

C) A-(p), B-(s), C-(q), D-(r)

D) A-(r), B-(q), C-(s), D-(p)

10. A Carnot engine with efficiency 50% takes heat from a source at $600\,K$ In order to increase the efficiency to 70%, keeping the temperature of sink same, the new temperature of the source will be :

A) $900K$

B) $300K$

C) $1000K$

D) $360K$

11. An electron of a hydrogen like atom, having $Z = 4$, jumps from 4^{th} energy state to 2^{nd} energy state. The energy released in this process, will be :
(Given Rch $= 136eV$)
Where $R =$ Rydberg constant
$c =$ Speed of light in vacuum
$h =$ Planck's constant

A) $40.8\,eV$

B) $3.4veV$

C) $10.5\,eV$

D) $13.6\,eV$

12. In which of the following process, the internal energy of gas remains constant

A) Isothermal

B) Isochoric

C) Isobaric

D) Adiabatic

13. Which of the following physical quantities have the same dimensions?

A) Electric displacement $(\vec{D})$ and surface charge density

B) Displacement current and electric field

C) Current density and surface charge density

D) Electric potential and energy

14. Kinetic energy of electron, proton and a particle is given as K, 2K and 4K respectively, then which of the following gives the correct order of De-Broglie wavelengths of electron, proton and a particle

A) $\lambda p > \lambda\alpha > \lambda e$ **B)** $\lambda\alpha > \lambda p > \lambda e$

C) $\lambda e > \lambda p > \lambda\alpha$ **D)** $\lambda e > \lambda\alpha > \lambda p$

15. The half-life of a radioactive nucleus is 5 years. The fraction of the original sample that would decay in 15 years is:

A) $\frac{1}{8}$ of initial value **B)** $\frac{7}{8}$ of initial value

C) $\frac{1}{4}$ of initial value **D)** $\frac{3}{4}$ of initial value

16. Match List I with List II

LIST I	LIST II
A Gauss's Law in Electrostatics	I $\oint \vec{E} \cdot d\vec{l} = -\frac{d\phi_B}{dt}$
B Faraday's Law	II $\oint \vec{B} \cdot d\vec{A} = 0$
C Gauss's Law in Magnetism	III $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \in_0 \frac{d\phi_E}{dt}$
D Ampere-Maxwell Law	IV $\oint \vec{E} \cdot d\vec{s} = \frac{q}{\epsilon_0}$

Choose the correct answer from the options given below:

A) A-I, B-II, C-III, D-IV **B)** A-IV, B-I, C-II, D-III

C) A-III, B-IV, C-I, D-II **D)** A-II, B-III, C-IV, D-I

17. A body of mass 200 g is tied to a spring of spring constant 12.5 N/m, while the other end of the spring is fixed at point *O*. If the body moves about *O* in a circular path on a smooth horizontal surface with constant angular speed 5 rad/s, then the ratio of extension in the spring to its natural length will be:

A) 1 : 1 **B)** 2 : 3

C) 2 : 5 **D)** 1 : 2

18. A point charge of 10 μC is placed at the origin At what location on the X-axis should a point charge of 40 μC be placed so that the net electric field is zero at $x = 2\,cm$ on the X-axis?

A) $x = -4\,cm$ **B)** $x = 4\,cm$

C) $x = 8\,cm$ **D)** $x = 6\,cm$

19. Wire A and B have their Young's moduli in the ratio 1:3, area of cross section in the ratio of 1:2 and lengths in ratio of 3:4. If same force is applied on the two wires to elongate then ratio of elongation is equal to

A) 8:1 **B)** 1:12

C) 1:8 **D)** 9:2

20. If mass, radius of cross-section and height of a cylinder are (0.4+0.01) g, (6+0.03) m and height (8+0.04) m. The maximum percentage error in the measurement of density of cylinder is?

A) 1% **B)** 4%

C) 8% **D)** 7%

21. Light wave travelling in air along x-direction is given by $E_y = 540 \sin \pi \times 10^4 (x - ct) V m^{-1}$ Then, the peak value of magnetic field of wave will be (Given $c = 3 \times 10^8 m s^{-1}$)

A) $18 \times 10^{-7} T$ **B)** $54 \times 10^{-7} T$

C) $54 \times 10^{-8} T$ **D)** $18 \times 10^{-8} T$

22. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion (A): The nuclear density of nuclides ${}^{10}_{5}B, {}^{6}_{3}Li, {}^{56}_{26}Fe, {}^{20}_{10}Ne$ and ${}^{209}_{83}Bi$ can be arranged as $\rho^N_{Bi} > \rho^N_{Fe} > \rho^N_{Ne} > \rho^N_B > \rho^N_{Li}$.
Reason R: The radius R of nucleus is related to its mass number A as $R = R_0 A^{1/3}$, where R_0 is a constant.
In the light of the above statements, choose the correct answer from the options given below

A) Both A and R are true and R is the correct explanation of A

B) A is false but R is true

C) Both A and R are true but R is NOT the correct explanation of A

D) A is true but R is false

23. T is the time period of simple pendulum on the earth's surface Its time period becomes xT when taken to a height R (equal to earth's radius) above the earth's surface Then, the value of x will be:

A) $\frac{1}{4}$

B) 4

C) $\frac{1}{2}$

D) 2

24. An electron is moving along positive x direction in xy plane, magnetic field points in negative z direction, then the force due to magnetic field on electron points in the direction

A) j

B) -j

C) k

D) -k

25. In a thermodynamic process work done by gas is 1000 J & heat supplied is 200 J. Find change in internal energy of gas?

A) 800 J

B) -800 J

C) 1200 J

D) -1200 J

JEE MAIN PHYSICS ANSWER KEY

1. (B)	**2. (B)**	**3. (D)**	**4. (B)**	**5. (B)**
6. (B)	**7. (A)**	**8. (B)**	**9. (A)**	**10. (C)**
11. (A)	**12. (A)**	**13. (A)**	**14. (C)**	**15. (A)**
16. (B)	**17. (B)**	**18. (D)**	**19. (D)**	**20. (B)**
21. (A)	**22. (B)**	**23. (D)**	**24. (B)**	**25. (B)**

CHEMISTRY

1. $Be(OH)_2$ reacts with $Sr(OH)_2$ to yield an ionic salt. Choose the incorrect option related to this reaction from the following:

A) Both Sr and Be elements are present in the ionic salt.

B) The reaction is an example of acid - base neutralization reaction.

C) The element Be is present in the cationic part of the ionic salt.

D) Be is tetrahedrally coordinated in the ionic salt.

2. The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals

A. have the same energy
B. have the minimum overlap
C. have same symmetry about the molecular axis
D. have different symmetry about the molecular axis.

Choose the most appropriate from the options given below:

A) A, B, C only

B) A and C only

C) B and C only

D) B and D only

3. Given below are two statements: One is labelled as "Assertion A" and the other is labelled as "Reason R".

Assertion A: In the complex Ni(CO), and Fe(CO)s, the metals have zero oxidation state.

Reason R: Low oxidation states are found when a complex has ligands capable of π-donor character in addition to the o-bonding.

In the light of the above statements, choose the most appropriate answer from the option given below.

A) Both A and R are correct and R is the correct explanation of A.

B) Both A and R are correct but R is NOT the correct explanation of A

C) A is correct but R is not correct

D) A is not correct but R is correct

4. The metals that are employed in the battery industries are

A. Fe
B. Mn
C. Ni
D. Cr
E. Cd

Choose the correct answer from the options given below:

A) B, C, and E only

B) A, B, C, D, and E

C) A, B, C, and D only

D) B, D, and E only

5. 2-Methyl propyl bromide reacts with $C_2H_5O^-$ and gives 'A' whereas on reaction with C_2H_5OH it gives 'B'. The mechanism followed in these reactions and the products 'A' and 'B' respectively are

A) S_N2. A iso-butyl ethyl ether; S_N1, B = tert- butyl ethyl ether

B) S_N1, A tert-butyl ethyl ether; S_N2, B = iso- butyl ethyl ether

C) S_N1, A = tert-butyl ethyl ether; S_N1, B = 2- butyl ethyl ether

D) S_N2, A = 2-butyl ethyl ether; S_N2, B = iso- butyl ethyl ether

6. Match List I with List II

LIST-I		LIST-II
A. Glucose/$NaHCO_3/\Delta$		I. Gluconic acid
B. Glucose/HNO_3		II. No reaction
C. Glucose/HI/Δ		III. n-hexane
D. Glucose/Bromine water		IV. Saccharic acid

Choose the correct answer from the options given below:

A) A-IV, B-I, C-III, D-II

B) A-II, B-IV, C-III, D-I

C) A-III, B-II, C-I, D-IV

D) A-I, B-IV, C-III, D-II

7. Identify correct statements from below:

A. The chromate ion is square planar.

B. Dichromates are generally prepared from chromates.

C. The green manganate ion is diamagnetic.

D. Dark green coloured $K_2\,MnO_4$ disproportionates in a neutral or acidic medium to give permanganate.

E. With increasing oxidation number of transition metal, ionic character of the oxides decreases.

Choose the correct answer from the options given below:

A) B, C, D only

B) A, D, E only

C) A, B, C only

D) B, D, E only

8. The correct IUPAC name of K_2MnO_4 is

A) Potassium tetraoxopermanganate (VI)

B) Potassium tetraoxidomanganate (VI)

C) Dipotassium tetraoxidomanganate (VII)

D) Potassium tetraoxidomanganese (VI)

9. The Lassaigne's extract is boiled with dil HNO_3 before testing for halogens because

A) AgCN is soluble in HNO_3

B) Silver halides are soluble in HNO_3

C) Ag_2S is soluble in HNO_3

D) Na_2S and NaCN are decomposed by HNO_3

10. The bond order and magnetic property of acetylide ion are same as that of

A) O_2^+

B) N_2^+

C) NO^+

D) O_2^-

11. In chromyl chloride, the number of d-electrons present on chromium is same as in (Given at no. of Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26)

A) Mn (VII)

B) Fe (III)

C) V (IV)

D) Ti (III)

12. The compound that is white in color is

A) ammonium sulphide

B) lead sulphate

C) lead iodide

D) ammonium arsinomolybdate

13. The correct sequence of electron gain enthalpy of the elements listed below is

A. Ar

B. Br

C. F

D. S

Choose the most appropriate from the options given below:

A) C > B > D > A

B) A > D > B > C

C) A > B > D > C

D) D > C > B > A

14. In case of isoelectronic species the size of F^- , Ne and Na^+ is affected by:

A) Principal quantum number (n)

B) None of the factors because their size is the same

C) Electron-electron interaction in the outer orbitals

D) Nuclear charge (z)

15. Given below are two statements :
Statement I: Boron is extremely hard indicating its high lattice energy
Statement II: Boron has highest melting and boiling point compared to its other group members.
In the light of the above statements, choose the most appropriate answer from the options given below :

A) Both Statement I and Statement II is correct

B) Both Statement I and Statement II is incorrect

C) Statement I is correct but Statement II is incorrect

D) Statement I is incorrect but Statement II is correct

16. Given below are two statements:
One is labelled as Assertion A and the other is labelled as Reason R:
Assertion A: Alcohols react both as nucleophiles and electrophiles.
Reason R: Alcohols react with active metals such as sodium, potassium and aluminum to yield corresponding alkoxides and liberate hydrogen.
In the light of the above statements, choose the correct answer from the options given below:

A) A is false but R is true.

B) A is true but R is false.

C) Both A and R are true and R is the correct explanation of A.

D) Both A and R are true but R is NOT the correct explanation of A.

17. We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentration 0.1 M, 0.01M & 0.001 M, respectively. The value of vant' Haft factor (i) for these solutions will be in the order.

A) $i_A < i_B < i_C$

B) $i_A < i_C < i_B$

C) $i_A = i_B = i_C$

D) $i_A > i_B > i_C$

18. The density of the alkali metals is in the order:

A) K<Na<Rb<Cs

B) Na<K<Cs<Rb

C) K<Cs<Na<Rb

D) NavRb<K<Cs

19. The correct statement regarding nucleophilic substitution reaction in a chiral alkyl halide is:

A) Retention occurs in SN_1 reaction and inversion occurs in SN_2 reaction.

B) Racemisation occurs in SN_1 reaction and retention occurs in SN_2 reaction.

C) Racemisation occurs in both SN_1 and SN_2 reactions.

D) Racemisation occurs in S_N1 reaction and inversion occurs in S_N2 reaction.

20. On passing a gas, 'X', through Nessler's reagent, a brown precipitate is obtained. The gas 'X' is

A) H_2S

B) CO_2

C) NH_3

D) Cl_2

21. Given below are two statements :
Statement-I: Morphine is a narcotic analgesis. It helps in relieving pain without producing sleep.
Statement-II: Morphine and its derivatives are obtained from opium poppy.
In the light of the above statements, choose the correct answer from the options given below.

A) Both Statement I and Statement II are true

B) Both Statement I and Statement II are false

C) Statement I is true but Statement II is false

D) Statement I is false but Statement II is true

22. ClF5 at room temperature is:

A) Colourless liquid with trigonal bipyramidal geometry.

B) Colourless liquid with square pyramidal geometry

C) Colourless gas with square pyramidal geometry

D) Colourless gas with trigonal bipyramidal geometry.

23. The correct statements from following are:

A. The strength of anionic ligands can be explained by crystal field theory.

B. Valence bond theory does not give a quantitative interpretation of kinetic stability of coordination compounds.

C. The hybridization involved in formation of $[Ni(CN)_4]^{2-}$ complex is dsp^2.

D. The number of possible isomer(s) of $cis-[PtCl_2(en)_2]^{2+}$ is one.

Choose the correct answer from the options given below:

A) A, D only

B) A, C only

C) B, D only

D) B, C only

24. Given below are two statements :

Statement I: SbCI, is more covalent than SbCI3

Statement II: The higher oxides of halogens also tend to be more stable than the lower ones.

In the light of the above statements, choose the most appropriate answer from the options given below :

A) Both statement I and Statement II are correct

B) Both statement I and Statement II are incorrect

C) Statement I is correct but Statement II is incorrect

D) Statement I is incorrect but Statement II is correct

25. The product , which is not obtained during the electrolysis of brine solution is ____ .

A) cl_2

B) H_2

C) HCl

D) N_aOH

JEE MAIN CHEMISTRY ANSWER KEY

1. (C)	**2. (B)**	**3. (C)**	**4. (A)**	**5. (A)**
6. (B)	**7. (D)**	**8. (B)**	**9. (D)**	**10. (C)**
11. (A)	**12. (B)**	**13. (B)**	**14. (D)**	**15. (A)**
16. (D)	**17. (A)**	**18. (A)**	**19. (D)**	**20. (C)**
21. (D)	**22. (B)**	**23. (D)**	**24. (A)**	**25. (B)**

MATHEMATICS

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1. Among the statements :
$(S1)$ $((p \vee q) \Rightarrow r) \Leftrightarrow (p \Rightarrow r)$
$(S2)((p \vee q) \Rightarrow r) \Leftrightarrow ((p \Rightarrow r) \vee (q \Rightarrow r))$

A) only (S2) is a tautology

B) both (S1) and (S2) are tautologies

C) only (S1) is a tautology

D) neither (S1) nor (S2) is a tautology

2. Let $z_1 = 2 + 3i$ and $z_2 = 3 + 4i$. The set $S = \left\{ z \in C : |z - z_1|^2 - |z - z_2|^2 = |z_1 - z_2|^2 \right\}$ represents a

A) straight line with the sum of its intercepts on the coordinate axes equals -18

B) hyperbola with eccentricity 2

C) hyperbola with the length of the transverse axis 7

D) straight line with the sum of its intercepts on the coordinate axes equals 14

3. If a_r is the coefficient of x^{10-r} in the Binomial expansion of $(1 + x)^{10}$, then $\sum_{r=1}^{10} r^3 \left(\frac{a_r}{a_{r-1}} \right)^2$ is equal to

A) 3025

B) 1210

C) 5445

D) 4895

4. The equation $x^2 - 4x + [x] + 3 = x[x]$, where $[x]$ denotes the greatest integer function, has :

A) no solution

B) exactly two solutions in $(-\infty, \infty)$

C) a unique solution in $(-\infty, 1)$

D) a unique solution in $(-\infty, \infty)$

5. If the functions $f(x) = \frac{x^3}{3} + 2bx + \frac{ax^2}{2}$ and $g(x) = \frac{x^3}{3} + ax + bx^2, a \neq 2b$ have a common extreme point, then $a + 2b + 7$ is equal to:

A) $\frac{3}{2}$

B) 3

C) 6

D) 4

6. For three positive integers $p, q, r, x^{pq^2} = y^{yr} = z^{p^2r}$ and $r = pq + 1$ such that $3, 3\log_y x, 3\log_z y\ 7\log_x z$ are in AP with common difference $\frac{1}{2}$ Then $r - p - q$ is equal to

A) 6

B) 2

C) 12

D) -6

7. The value of $\lim\limits_{n \to \infty} \dfrac{1 + 2 - 3 + 4 + 5 - 6 + \ldots + (3n - 2) + (3n - 1) - 3n}{\sqrt{2n^4 + 4n + 3} - \sqrt{n^4 + 5n + 4}}$ is :

A) $3(\sqrt{2} + 1)$

B) $\frac{3}{2}(\sqrt{2} + 1)$

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

D) $\frac{3}{2\sqrt{2}}$

8. Let $f(x) = \begin{vmatrix} 1 + \sin^2 x & \cos^2 x & \sin 2x \\ \sin^2 x & 1 + \cos^2 x & \sin 2x \\ \sin^2 x & \cos^2 x & 1 + \sin 2x \end{vmatrix}, x \in \left[\frac{\pi}{6}, \frac{\pi}{3} \right]$ If α and β respectively are the maximum and the minimum values of f, then

A) $\beta^2 + 2\sqrt{\alpha} = \frac{19}{4}$

B) $\alpha^2 + \beta^2 = \frac{9}{2}$

C) $\alpha^2 - \beta^2 = 4\sqrt{3}$

D) $\beta^2 - 2\sqrt{\alpha} = \frac{19}{4}$

9. The number of real roots of the equation $\sqrt{x^2-4x+3}+\sqrt{x^2-9}=\sqrt{4x^2-14x+6}$, is:

A) 2 **B)** 3

C) 1 **D)** 0

10. Let N be the sum of the numbers appeared when two fair dice are rolled and let the probability that $N-2, \sqrt{3N}, N+2$ are in geometric progression be $\frac{k}{48}$, Then the value of k is

A) 16 **B)** 2

C) 8 **D)** 4

11. Let S be the set of all values of a_1 for which the mean deviation about the mean of 100 consecutive positive integers $a_1, a_2, a_3, \ldots, a_{100}$ is 25 Then S is

A) $\{99\}$ **B)** ϕ

C) N **D)** $\{9\}$

12. Let $y=x+2, 4y=3x+6$ and $3y=4x+1$ be three tangent lines to the circle $(x-h)^2+(y-k)^2=r^2$ Then $h+k$ is equal to :

A) 5 **B)** $5(1+\sqrt{2})$

C) 6 **D)** $5\sqrt{2}$

13. Let $y(x)=(1+x)\left(1+x^2\right)\left(1+x^4\right)\left(1+x^8\right)\left(1+x^{16}\right)$ Then $y'-y''$ at $x=-1$ is equal to :

A) 976 **B)** 944

C) 496 **D)** 464

14. Let $9=x_1<x_2<\ldots<x_7$ be in an A.P. with common difference d. If the standard deviation of $x_1, x_2 \ldots, x_7$ is 4 and the mean is $\bar{x}$, then $\bar{x}+x_6$ is equal to :

A) $18\left(1+\frac{1}{\sqrt{3}}\right)$ **B)** $2\left(9+\frac{8}{\sqrt{7}}\right)$

C) 34 **D)** 25

15. Let the system of linear equations $x+y+kz=2$ $2x+3y-z=1$ $3x+4y+2z=k$ have infinitely many solutions Then the system $(k+1)x+(2k-1)y=7$ $(2k+1)x+(k+5)y=10$ has:

A) infinitely many solutions **B)** unique solution satisfying$x-y=1$

C) no solution **D)** unique solution satisfying$x+y=1$

16. Let α be a root of the equation $(a-c)x^2+(b-a)x+(c-b)=0$where a, b, c are distinct real numbers such that the matrix $\begin{bmatrix}\alpha^2 & \alpha & 1\\ 1 & 1 & 1\\ a & b & c\end{bmatrix}$ is singular Then, the value of $\frac{(a-c)^2}{(b-a)(c-b)}+\frac{(b-a)^2}{(a-c)(c-b)}+\frac{(c-b)^2}{(a-c)(b-a)}$ is

A) 6 **B)** 3

C) 9 **D)** 12

17. A wire of length $20m$ is to be cut into two pieces A piece of length l_1 is bent to make a square of area A_1 and the other piece of length l_2 is made into a circle of area A_2 If $2A_1+3A_2$ is minimum then $(\pi l_1): l_2$ is equal to:

A) $6:1$ **B)** $3:1$

C) $4:1$ **D)** $1:6$

18. Let $\vec{a}$ and $\vec{b}$ be two vectors, Let $|\vec{a}|=1, |\vec{b}|=4$ and $\vec{a}\cdot\vec{b}=2$ If $\vec{c}=(2\vec{a}\times\vec{b})-3\vec{b}$, then the value of $\vec{b}\cdot\vec{c}$ is

A) -60 **B)** -48

C) -84 **D)** -24

19. For $\alpha, \beta \in R$, suppose the system of linear equations $x - y + z = 5$ $2x + 2y + \alpha z = 8$ $3x - y + 4z = \beta$ has infinitely many solutions Then α and β are the roots of

A) $x^2 - 18x + 56 = 0$ **B)** $x^2 + 14x + 24 = 0$

C) $x^2 - 10x + 16 = 0$ **D)** $x^2 + 18x + 56 = 0$

20. Let $f(x) = \int \frac{2x}{(x^2+1)(x^2+3)}dx$ If $f(3) = \frac{1}{2}(\log_e 5 - \log_e 6)$, then $f(4)$ is equal to

A) $\log_e 17 - \log_e 18$ **B)** $\log_e 19 - \log_e 20$

C) $\frac{1}{2}(\log_e 19 - \log_e 17)$ **D)** $\frac{1}{2}(\log_e 17 - \log_e 19)$

21. If $P(h, k)$ be a point on the parabola $x = 4y^2$, which is nearest to the point $Q(0, 33)$, then the distance of P from the directrix of the parabola $y^2 = 4(x + y)$ is equal to :

A) 4 **B)** 2

C) 8 **D)** 6

22. Let $z_1 = 2 + 3i$ and $z_2 = 3 + 4i$ The set $S = \left\{z \in C : |z - z_1|^2 - |z - z_2|^2 = |z_1 - z_2|^2\right\}$ represents a

A) straight line with the sum of its intercepts on the-18 coordinate axes equals **B)** hyperbola with eccentricity 2

C) hyperbola with the length of the transverse axis 7 **D)** straight line with the sum of its intercepts on the coordinate axes equals 14

23. If $y = y(x)$ is the solution curve of the differential equation $\frac{dy}{dx} + y\tan x = x\sec x, 0 \le x \le \frac{\pi}{3}, y(0) = 1$ then $y\left(\frac{\pi}{6}\right)$ is equal to

A) $\frac{\pi}{12} - \frac{\sqrt{3}}{2}\log_e\left(\frac{2}{e\sqrt{3}}\right)$ **B)** $\frac{\pi}{12} + \frac{\sqrt{3}}{2}\log_e\left(\frac{2}{e\sqrt{3}}\right)$

C) $\frac{\pi}{12} + \frac{\sqrt{3}}{2}\log_e\left(\frac{2\sqrt{3}}{e}\right)$ **D)** $\frac{\pi}{12} - \frac{\sqrt{3}}{2}\log_e\left(\frac{2\sqrt{3}}{e}\right)$

24. Let $a, b, c > 1, a^3, b^3$ and c^3 be in A.P., and $log_a\, b, log_c\, a$ and $log_b\, c$ be in G.P. If the sum of first 20 terms of an A.P., whose first term is $\frac{a+4b+c}{3}$ and the common difference is $\frac{a-8b+c}{10}$ is −444, then *abc* is equal to:

A) 343 **B)** 216

C) $\frac{343}{8}$ **D)** $\frac{125}{8}$

25. Let S_1 and S_2 be respectively the sets of all $a \in R - \{0\}$ for which the system of linear equations $ax + 2ay - 3az = 1$ $(2a + 1)x + (2a + 3)y + (a + 1)z = 2$ $(3a + 5)x + (a + 5)y + (a + 2)z = 3$ has unique solution and infinitely many solutions Then

A) $S_1 = \Phi$and$S_2 = R - \{0\}$ **B)** $S_1$is an infinite set and$n\,(S_2) = 2$

C) $S_1 = R - \{0\}$and$S_2 = \Phi$ **D)** $n\,(S_1) = 2$and$S_2$is an infinite set

JEE MAIN MATHEMATICS ANSWER KEY

1. (D)	2. (D)	3. (B)	4. (D)	5. (C)
6. (B)	7. (B)	8. (D)	9. (C)	10. (D)
11. (C)	12. (A)	13. (C)	14. (C)	15. (D)
16. (B)	17. (A)	18. (B)	19. (A)	20. (D)
21. (D)	22. (D)	23. (A)	24. (B)	25. (C)