JEE MAIN- 2024-25 (Part Test-5)

(Physics, Chemistry and Mathematics)

SYLLABUS

Physics :- Modern Physics, Semiconductor
Chemistry :- Amines, Biomolecules
Mathematics :- Vector Algebra, Three Dimensional Geometry

5
PART TEST

CLASS-XIIth

Date :- ..... **Time :- 3:00 Hrs.** **Marks :- 300**

Important Instructions :

1. The test duration is of **3 hours**.
2. The Test Booklet consists of 90 questions. The maximum marks are 300.
3. There are **three** parts in the question paper consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each part (subject) has two sections.

   (i) **Section-A:** This section contains 20 multiple choice questions which have only one correct answer. Each question carries **4 marks** for correct answer and **–1 mark** for wrong answer.
   (ii) **Section-B:** This section contains 10 questions. In Section-B, attempt any **five questions out of 10.** The answer to each of the questions is a numerical value. Each question carries **4 marks** for correct answer and **–1 mark** for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

Student's Name :- .....
School Name :- .....

Student's Signature :- ..... **Invigilator's Signature :- .....**

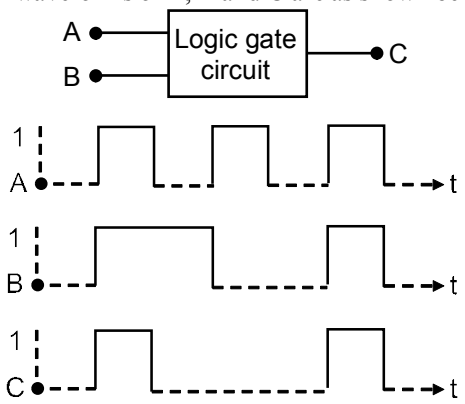
PHYSICS

SECTION-A

1. Hydrogen atom emits blue light when it changes from n = 4 to n = 2 level. Which colour of light would the atom emit when it changes n = 5 to n = 2

(A) Red (B) Yellow
(C) Green (D) Violet

2. The following figure shows a logic gate circuit with two inputs A and B and the output C. The voltage waveforms of A, B and C are as shown below:



The logic circuit gate is:

(A) AND gate (B) NAND gate
(C) NOR gate (D) OR gate

3. The shortest wavelength of the Braqkett series of a hydrogen like atom (atomic number = Z) is the same as the shortest wavelength of the Balmar series of hydrogen atom. The value of Z is –

(A) 2 (B) 3 (C) 4 (D) 6

4. An ac source (sinusoidal source with frequency 50 Hz) is connected in series with a rectifying diode, a 100 Ω resistor, a 1000 μF capacitor and milliammeter. After some time the milliammeter reads zero. The voltage measured across the capacitor with a dc voltmeter is

(A) the peak voltage of the ac source
(B) rms voltage of the ac source
(C) average voltage of the ac source over a half cycle
(D) average voltage of the ac source over a full cycle.

5. A beam of fast moving electrons having cross sectional area A falls normally on a flat surface. The electrons are absorbed by the surface and the average pressure exerted by the electrons on this surface is found to be P. If the electrons are moving with a speed v, then the effective current through any cross section of the electron beam is

(A) APe / (mv) (B) APe / (mv^2)
(C) APv / (me) (D) 2APm / (ev)

6. A particle moving with a velocity 1/10th of that of light will cross a nucleus in about-

(A) 10^{-47} s (B) 10^{-21} s (C) 10^{-12} s (D) 10^{-8} s

7. When 24.8 KeV x-rays strike a material, the photoelectrons emitted from K shell are observed to move in a circle of radius 23 mm in a magnetic field of 2×10^{-2} T. The binding energy of K-shell electrons is-

(A) 6.2 KeV (B) 5.4 KeV
(C) 7.4 KeV (D) 8.6 KeV

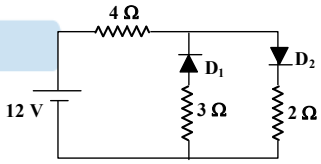
8. If the ratio of the concentration of electrons to that of holes in a semiconductor is $\frac{7}{5}$ and the ratio of currents is $\frac{7}{4}$, then what is the ratio of their drift velocities ?

(A) 5/8 (B) 4/5 (C) 5/4 (D) 4/7

9. When a metal surface is illuminated with light of wavelength λ, the stopping potential is V. When the same surface is illuminated by light of wavelength 2λ, the stopping potential is $\frac{V}{3}$. The threshold wavelength for the surface is:

(A) $\frac{4\lambda}{3}$ (B) 4λ (C) 6λ (D) $\frac{8\lambda}{3}$

10. The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?



(A) 2.31 A (B) 1.33 A
(C) 1.71 A (D) 2.00 A

11. In a photoelectric experiment, with light of wavelength λ, the fastest electron has speed v. If the wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be:

(A) $v\sqrt{\frac{3}{4}}$ (B) $v\sqrt{\frac{4}{3}}$

(C) Less than $v\sqrt{\frac{3}{4}}$ (D) Greater than $v\sqrt{\frac{4}{3}}$

12. The transition from the state $n = 4$ to $n = 3$ in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from –

(A) $2 \rightarrow 1$ (B) $3 \rightarrow 2$
(C) $4 \rightarrow 2$ (D) $5 \rightarrow 4$

13. Match List-I (Fundamental Experiment) with List-II (its conclusion) and select the correct option from the choices given below the list :

List-I

(P) Franck-Hertz experiment

(Q) Photo-electric experiment

(R) Davisson-Germer experiment

(S) Coolidge tube experiment

List-II

(1) Particle nature of light

(2) Discrete energy levels of atom

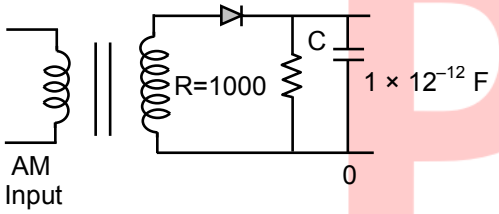
(3) Wave nature of electron

(4) X ray production

Codes :

	P	Q	R	S
(A)	2	2	1	3
(B)	1	3	2	4
(C)	2	1	3	4
(D)	4	3	2	1

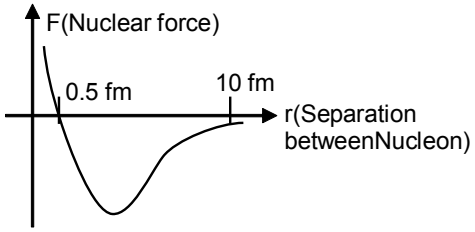
14. In the given detector circuit, the suitable value of carrier frequency is



(A) $<<10^9$ Hz (B) $<<10^5$ Hz

(C) $>> 10^9$ Hz (D) None of these

15. The dependence of nuclear force on distance between nucleons is not known precisely but approximate variation is shown graphically. From graph which of following statements can not be concluded?



(A) Nuclear force is repulsive for separataion less than 0.5 fermi

(B) Nuclear force is attractive for separation less than 0.5 fermi

(C) Nuclear force is attractive for separation more than 0.5 fermi

(D) Nuclear force is negligible when separation between nucleons is more than 10 fermi

16. **Statement - 1 :** In a diode AM detector, R = 1 kΩ and C = 10 pF circuit is good enough to detect a carrier signal of 100 kHz.

Statement - 2 : The condition $\frac{1}{f_c} << RC$.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

17. When photons of energy hν are incident on the surface of photosensitive material of work function $h\nu_0$, then -

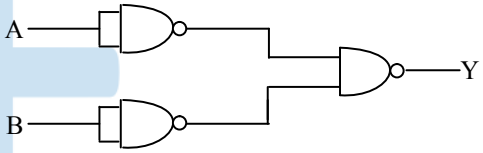
(A) the kinetic energy of all emitted electrons is $h\nu_0$

(B) the kinetic energy of all emitted electrons is h (ν $-\nu_0$)

(C) the kinetic energy of all fastest electrons is h (ν $-\nu_0$)

(D) the kinetic energy of all emitted electrons is hν

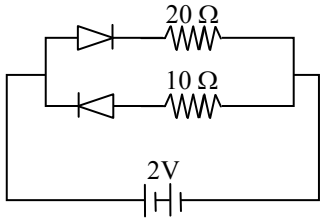
18. Following circuit is equivalent to –



(A) AND gate (B) OR gate

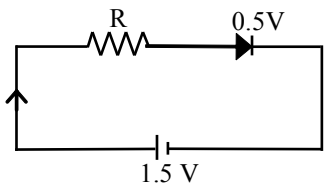
(C) NOT gate (D) X-OR gate

19. In Fig., the current supplied by the battery is -



(A) 0.1 A (B) 0.2 A (C) 0.3A (D) 0.4A

20. The diode used in the circuit shown in the figure has a constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milliwatts. What should be the value of the resistor R, connected in series with the diode for obtaining maximum current –

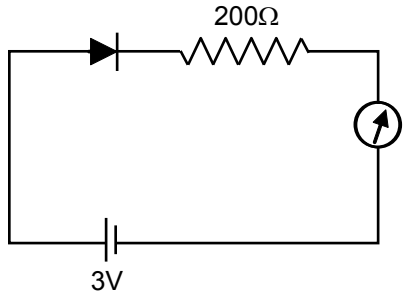


(A) 1.5 Ω (B) 5 Ω

(C) 6.67 Ω (D) 200 Ω

SECTION-B

21. The reading of the ammeter for a silicon diode in the given circuit is :



22. The binding energy of deuteron $\left({}_1^2H\right)$ is 1.15 MeV per nucleon and an alpha particle $\left({}_2^4He\right)$ has binding energy of 7.1 MeV per nucleon. Then in the reaction ${}_1^2H + {}_1^2H \rightarrow {}_2^4H + Q$ the energy Q is (in MeV)

23. A P-type silicon semiconductor is made by adding one atom of indium per 5×10^7 atoms of silicon is 25×10^{28} atom/m.^{3}. Point the number of acceptor atoms in per cubic cm. of silicon is $n \times 10^{15}$ atom/cm^3. Find the value of n

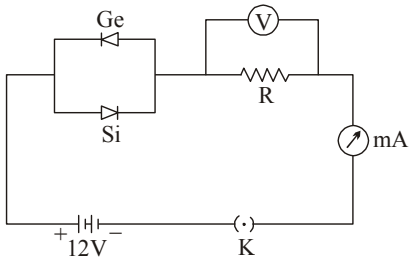
24. The wavelength of light incident on a metal surface is reduced from 300 nm to 200 nm (both are less than threshold wavelength). What is the change in the stopping potential for photoelectrons emitted from the surface.
(Take $h = 6.6 \times 10^{-34}$ J-sec)

25. The maximum efficiency of full wave rectifier is

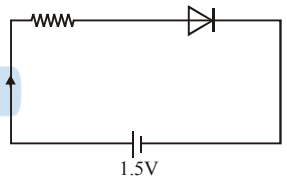
26. A hydrogen atom is in its excited state with energy –1.51 eV. The angular momentum of the electron in this state is $\frac{xh}{2\pi}$ then write the value of 'x'.

27. The fundamental frequency of the output of a bridge rectifier driven by ac mains is

28. Germanium and silicon junction diodes are connected in parallel. These are connected in series with a resistance R, a milliammeter (mA) and a key (K) as shown in fig. When key (K) is closed a current begins to flow in the milliammeter. The potential drop across the germanium diode is. Give your answer by multiplying with 10.



29. A pn junction germanium diode is shown here. The current in excess of 10mA through the diode produces a large Joule-heating which damages (burns) the diode. If we want to use a 1.5V battery to forward bias the diode, what should be the value of resistor used in series with the diode, so that the maximum current does not exceed 6mA ?



30. Nucleus A^{203}(binding energy per nucleon = 6.0 MeV) fissions into nuclei B^{120}(binding energy per nucleon = 6.5 MeV) and C^{80}(binding energy per nucleon = 7.0 MeV) emitting with some neutrons.If the energy released in this nuclear reaction, in MeV, is x, find the value of x –120.

31. Glucose is-
(A) Monosaccharide (B) Disaccharide
(C) Trisaccharide (D) Polysaccharide

32. Secondary structure of proteins refers to-
(A) Mainly denatured proteins and structure of prosthetic group
(B) Three dimensional structure specially the bond between amino acid residues that are distant from each other in polypeptide chain
(C) Linear sequence of amino acid residue in the polypeptide chain
(D) Regular folding patterns of continuous portion of the polypeptide chain

33. The main structural feature of proteins is-
(A) An ester linkage (B) An ether linkage
(C) The peptide linkage (D) All

34. Simplest amino acid is-
(A) Lysine (B) Glycine
(C) Leucine (D) Alanine

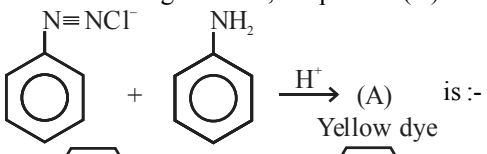
35. The end product of protein digestion is-
(A) Peptides (B) Peptones
(C) Protones (D) α-Amino acids

36. Calorific value is in the order-
(A) Fats > Proteins > Carbohydrates
(B) Carbohydrates > Fats > Protein
(C) Fats > Carbohydrates > Protein
(D) Protein > Fats > Carbohydrates

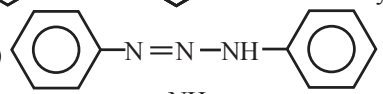
37. Riboflavin deficiency causes-
(A) Scurvy (B) Pellagra
(C) Beri-beri (D) Cheilosis

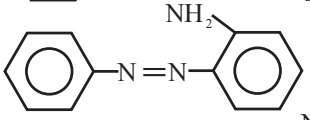
38. A good source of vitamins A and D is:
(A) Whole cereal (B) Cod liver oil
(C) Yeast (D) Water melon

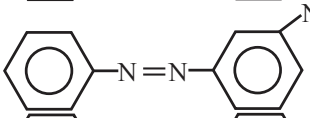
39. In the following reaction, the product(A)

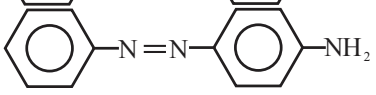


is :-

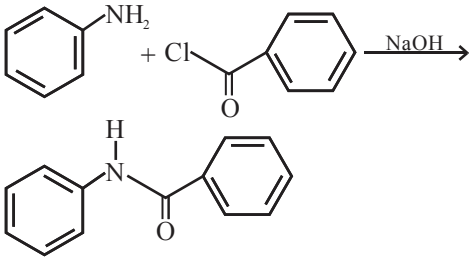
(A) 

(B) 

(C) 

(D) 

40. The following reaction



on is known by the name :
(A) Acetylation reaction
(B) Schotten-Baumann reaction
(C) Friedel-Craft's reaction
(D) Perkin's reaction

41. Method by which Aniline cannot be prepared is : –
(A) Reduction of nitrobenzene with H2/Pd in ethanol
(B) Potassium salt of phthalimide treated with chlorobenzene followed by hydrolysis with aqueous NaOH solution
(C) Hydrolysis of phenylisocyanide with acidic solution
(D) Degradation of benzamide with bromine in alkaline solution

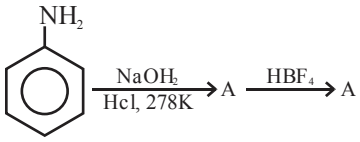
42. Reaction
Primary amine + $CHCl_3$ + KOH ⟶ product, here product will be -
(A) Cyanide (B) Isocyanide
(C) Amine (D) Alcohol

43. Which one of the following methods is neither meant for the synthesis nor for separation of amines ?
(A) Hoffmann method (B) Hinsberg method
(C) Curtius reaction (D) Wurtz reaction

44. Reaction of cyclohexanone with Dimethylamine in the presence of catalytic amount of an acid, forms a compound ifwater during the reaction is continuously removed. The compound formed is generally known as –
(A) An enamine (B) A Schiff's base
(C) An amine (D) An imine

45. In the chemical reaction, $CH_3CH_2NH_2$ + $CHCl_3$ + 3KOH → (A) + (B) + $3H_2O$, the compounds (A) and (B) are respectively -
(A) C_2H_5CN and 3KCl
(B) $CH_3CH_2CONH_2$ and 3KCl
(C) C_2H_5NC and K_2CO_3
(D) C_2H_5NC and 3KCl

46. In the chemical reactions.



The compounds 'A' and 'B' respectively are

(A) nitrobenzene and chlorobenzene

(B) nitrobenzene and fluorobenzene

(C) phenol and benzene

(D) benzene diazonium chloride and flurobenzene

47. The gas leaked from a storage tank of the Union carbide plant in Bhopal gas tragedy was

(A) Methyl isocyanate (B) Methylamine

(C) Ammonia (D) Phosgene

48. On heating an aliphatic primary amine with chloroform and ethanolic potassium hydroxide, the organic compound formed is

(A) An alkanol (B) An alkanediol

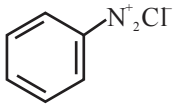
(C) An alkyl cyanide (D) An alkyl isocyanide

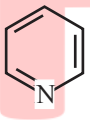
49. Considering the basic strength of amines in aqueous solution, which one has the smallest pKb value ?

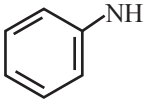
(A) $(CH_3)_2NH$ (B) CH_3NH_2

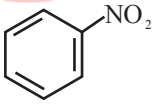
(C) $(CH_3)_3N$ (D) $C_6H_5NH_2$

50. Which of the following compounds is suitable for Kjeldahl's method for nitrogen estimation ?

(A) 

(B) 

(C) 

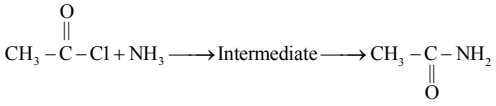
(D) 

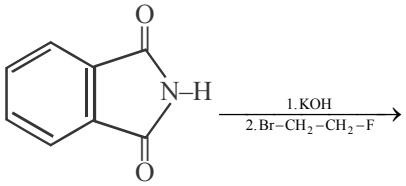
SECTION-B

51. Synthesis of each molecule of glucose in photosynthesis involves.....molecules of ATP

52. The presence or absence of hydroxy group on which carbon atom of sugar differentiates RNA and DNA ?

53. What will be the net charge on intermediate formed in the reaction shown below ?

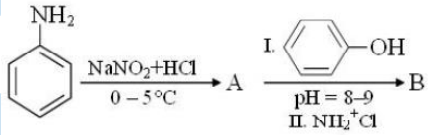


54. 

55. $R-\underset{\underset{O}{\|}}{C}-NH_2 + xNaOH + Br_2 \longrightarrow R-NH_2 + 2NaBr + Na_2CO_3 + H_2O$

Number of moles of NaOH used in above Hoffmann bromamide reaction is :

56. A reaction of 0.1 mole of Benzylamine with bromomethane gave 23 g Benzyl trimethyl ammonium bromide. The number of moles of bromomethane consumed in this reaction are $n \times 10^{-1}$, when n = _____. (Round off to the Nearest Integer).(Given: Atomic masses: C : 12.0 u, H : 1.0 u, N : 14.0 u,Br : 80. 0 u]

57. 

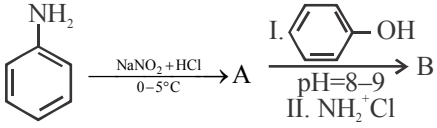
If molar mas of compound B is x then find $\frac{X}{2}$.

58. The total number of reagents from those given below, that can convert nitrobenzene into aniline is _____. (Intergern answer)

I. Sn-HCl II. Sn-NH_4OH

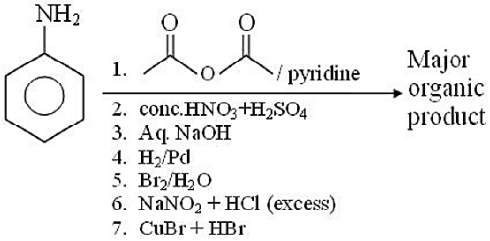
III. Fe-HCl IV. Zn-HC1

V. H_2-Pd VI. H_2-Raney Nickel

59. 

If molar mass of compound B is X then find X.

60. Total number of bromine atom present in major organic product is :



61. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ & $\vec{a} \cdot \vec{b} = 1$ & $\vec{a} \times \vec{b} = \hat{j} - \hat{k}$ then $\vec{b}$ is equal to -

(A) $2\hat{i}$ (B) $\hat{i} - \hat{j} + \hat{k}$

(C) $\hat{i}$ (D) $2\hat{j} - \hat{k}$

62. A vector of magnitude 3, bisecting the angle between the vectors $\bar{a} = 2i + j - k$ and $\bar{b} = i - 2j + k$ and making an obtuse angle with $\bar{b}$ is -

(A) $\frac{3i-j}{\sqrt{6}}$ (B) $\frac{i+3j-2k}{\sqrt{14}}$

(C) $\frac{3(i+3j-2k)}{\sqrt{14}}$ (D) $\frac{3i-j}{\sqrt{10}}$

63. If the vectors $\vec{b}$ $(\tan\alpha, -1, 2\sqrt{\sin\alpha/2})$ and $\vec{c}$ = $(\tan\alpha, \tan\alpha, -\frac{3}{\sqrt{\sin\alpha/2}})$ are orthogonal and a vector $\vec{a}$ = (1, 3, sin 2α) makes an obtuse angle with z-axis, then the value of α is -

(A) $\alpha = (4n+1)\pi - \tan^{-1}2$
(B) $\alpha = (4n+2)\pi - \tan^{-1}2$
(C) $\alpha = (4n+1)\pi + \tan^{-1}2$
(D) $\alpha = (4n+2)\pi + \tan^{-1}2$

64. Foot of perpendicular from (1, 2, 3) to the line joining points (6, 7, 7) and (9, 9, 5) is-

(A) (5, 3, 9) (B) (3, 5, 9)
(C) (9, 9, 5) (D) (3, 9, 9)

65. If $\vec{e_1} = (1, 1, 1)$, $\vec{e_2} = (1, 1, -1)$ and $\vec{a}$ and $\vec{b}$ are two vectors such that $\vec{e}_1 = 2\vec{a} + \vec{b}$ and $\vec{e}_2 = \vec{a} + 2\vec{b}$, then the angle between $\vec{a}$ & $\vec{b}$ is

(A) $\cos^{-1}\left(\frac{7}{9}\right)$ (B) $\cos^{-1}\left(\frac{7}{11}\right)$

(C) $\cos^{-1}\left(-\frac{7}{11}\right)$ (D) $\sin^{-1}\left(\frac{6\sqrt{2}}{11}\right)$

66. If the line x = y = z intersect the line sinA. x + sinB.y + sinC.z = $2d^2$, sin2A.x + sin 2B.y + sin2C.z = d^2, then $\sin\frac{A}{2}.\sin\frac{B}{2}.\sin\frac{C}{2}$ is equal to (where A, B, C are the angles of a triangle) -

(A) $\frac{1}{16}$ (B) $\frac{1}{8}$ (C) $\frac{1}{32}$ (D) $\frac{1}{12}$

67. Let $\vec{u}$, $\vec{v}$ and $\vec{w}$ are vectors such that $\vec{u} + \vec{v} + \vec{w} = \vec{0}$. If $|\vec{u}| = 3$, $|\vec{v}| = 4$ and $|\vec{w}| = 5$, then the value of $\vec{u}.\vec{v} + \vec{v}.\vec{w} + \vec{w}.\vec{u}$ is-

(A) –25 (B) –27 (C) 28 (D) 25

68. Vector equation of the line $6x - 2 = 3y + 1 = 2z - 2$ is :

(A) $\vec{r} = \hat{i} - \hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$

(B) $\vec{r} = \hat{i} + 2\hat{j} + \hat{k} + \lambda\left(\frac{1}{3}\hat{i} - \frac{1}{3}\hat{j} + \hat{k}\right)$

(C) $\vec{r} = \hat{i} - \hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$

(D) $\vec{r} = \frac{1}{3}(\hat{i} - \hat{j} + 3\hat{k}) + \lambda(\hat{i} + 2\hat{j} + 3\hat{k})$

69. Let A, B, C be points with position vectors $r_1 = 2\hat{i} - \hat{j} + \hat{k}$, $r_2 = \hat{i} + 2\hat{j} + 3\hat{k}$ and $r_3 = 3\hat{i} + \hat{j} + 2\hat{k}$ relative to the origin 'O'. The shortest distance between point B and plane OAC is

(A) 10 (B) 5 (C) $\sqrt{\frac{5}{7}}$ (D) $2\sqrt{\frac{5}{7}}$

70. Let $\vec{a}$ and $\vec{b}$ are two perpendicular unit vectors. If $\vec{c}$ is another unit vector equally inclined at angle θ to the vectors $\vec{a}$ and $\vec{b}$, then the set of exhaustive values of θ in $[0, 2\pi]$ is

(A) $\left(0, \frac{\pi}{2}\right)$ (B) $\left[0, \frac{\pi}{4}\right]$

(C) $\left(\frac{\pi}{2}, \frac{3\pi}{4}\right)$ (D) $\left[\frac{\pi}{4}, \frac{3\pi}{4}\right]$

71. If $\vec{a}$, $\vec{b}$, $\vec{c}$ represents adjacent edges of tetrahedron such that $|\vec{a}| = |\vec{b}| = |\vec{c}| = 2$ and angle between $\vec{a}$ and $\vec{b}$ is π/3, and $\vec{a}$ and $\vec{c}$ is π/3 then its volume is

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

72. If the vector $\vec{x}$ satisfying $\vec{x} \times \vec{a} + (\vec{x}.\vec{b})\vec{c} = \vec{d}$ given by $\vec{x} = \lambda\vec{a} + \vec{a} \times \frac{\vec{a} \times (\vec{d} \times \vec{c})}{(\vec{a}.\vec{c})a^2}$, then λ =

(A) $\frac{\vec{a}.\vec{c}}{a^2}$ (B) $\frac{\vec{a}.\vec{b}}{b^2}$ (C) $\frac{\vec{c}.\vec{d}}{c^2}$ (D) $\frac{\vec{a}.\vec{x}}{a^2}$

73. If the vectors $\vec{b} = \left(\tan\alpha, -1, 2\sqrt{\tan\frac{\alpha}{2}}\right)$, $\vec{c} = \left(\tan\alpha, \tan\alpha, \frac{-3}{\sqrt{\sin\frac{\alpha}{2}}}\right)$ are orthogonal and vector $\vec{a} = (1, 3, \sin 2\alpha)$ makes an obtuse angle with z- axis then α equals:

(A) $(2n+1)\pi + \tan^{-1} 2$ (B) $(2n+1)\pi - \tan^{-1}2$

(C) $n\pi - \tan^{-1} 2$ (D) None of these

74. The lines $\vec{r} = i - j + \lambda(2i + k)$ and $\vec{r} = (2i - j) + \mu(i + j - k)$ intersect for

(A) $\lambda = 1, \mu = 1$

(B) $\lambda = 2, \mu = 3$

(C) all values of λ and μ

(D) no value of λ and μ

74. The line $x = ay + b, z = cy + d$ and $x = a\ y + b, z = c\ y + d$ are perpendicular if -

(A) $aa + bb + 1 = 0$ (B) $ab + a\,b + 1 = 0$

(C) $aa + bb + cc = dd$ (D) $aa + cc + 1 = 0$

76. If the shortest distance between the line $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda_1 (2\hat{i} + 3\hat{j} + 4\hat{k})$ and $\vec{r} = (2\hat{i} + 4\hat{j} + 5\hat{k}) + \lambda_2 (3\hat{i} + 4\hat{j} + \hat{k})$ is x, then $\cos^{-1}(\cos\sqrt{6}\, x)$ is equal to -

(A) 1/2 (B) 0 (C) 1 (D) 2

77. If $\vec{a} + \vec{b} + \vec{c} = \alpha\vec{d}$, $\vec{b} + \vec{c} + \vec{d} = \beta\vec{a}$ and $[\vec{a}\ \vec{b}\ \vec{c}] \neq 0$ then $\vec{a} + \vec{b} + \vec{c} + \vec{d}$ equals -

(A) $\alpha\vec{a}$ (B) $\beta\vec{b}$

(C) 0 (D) $(\alpha+\beta)\vec{c}$

78. The coordinates of the vertices of a tetrahedron ABCD are as follows A (2, 3,4); B (1, –1, 2); C (0, 4, 5); D(–2, 3, –4). Then, which of the following is true–

(A) the angle between lines AB and CD is $\cos^{-1}\left(\frac{24}{\sqrt{1860}}\right)$

(B) the angle between AD and the plane ABC is $\sin^{-1}\sqrt{\frac{80}{11}}$

(C) the equation of line BD is $\frac{x-1}{3} = \frac{y-1}{-4} = \frac{z-2}{6}$

(D) the perpendicular distance from D to the plane ABC is $\frac{80}{\sqrt{110}}$

79. If the vector $\vec{a} = (c \log_2 x)\hat{i} - 6\hat{j} + 3\hat{k}$ and $\vec{b} = (\log_2 x)\hat{i} + 2\hat{j} + (2c \log_2 x)\hat{k}$ make an obtuse angle for any $x \in (0, \infty)$ then the interval to which 'c' belongs is -

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

(C) $(-4/3, 0)$ (D) $(-1, 0) \cup (0, 2/3)$

80. The shortest distance between a diagonal of a cube of edge-length one unit and the edge not meeting it, is -

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

(C) $\sqrt{2}$ (D) None of these

81. Let $\bar{P} = a_1(\bar{x} \times \bar{y}) + a_2(\bar{y} \times \bar{z})$ & $4(a_1 + a_2) = \bar{P} \cdot (\bar{z} + \bar{x})$ for $a_1 > 0, a_2 > 0$ then $[\bar{z}\ \bar{y}\ \bar{x}]$ equals

82. Vectors $2\hat{i} - \hat{j} + \hat{k}$ & $2\hat{i} - 4\hat{j} + \lambda\hat{k}$ are perpendicular, if $|\lambda| =$

83. The position vectors of two points A and B are $\hat{i} + \hat{j} - \hat{k}$ and $2\hat{i} - \hat{j} + \hat{k}$ respectively. Then $|\overrightarrow{AB}| =$

84. The volume of the tetrahedron included between the plane $3x + 4y - 5z - 60 = 0$ and the coordinate planes in cubic units is

85. P, Q, R, S are four coplanar points on the sides AB, BC, CD, DA of a skew quadrilateral. The product $\frac{AP}{PB} \cdot \frac{BQ}{QC} \cdot \frac{CR}{RD} \cdot \frac{DS}{SA}$ equals -

86. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are non-coplanar vectors and $\vec{a}$, $\vec{b}$, $\vec{c}$ form reciprocal system of $\vec{a}$, $\vec{b}$, $\vec{c}$ respectively then find the value of $(\vec{a} + \vec{b}) \cdot \vec{a'} + (\vec{b} + \vec{c}) \cdot \vec{b'} + (\vec{c} + \vec{a}) \cdot \vec{c'}$.

87. In a regular tetrahedron let θ be the angle between any edge and a face not containing the edge.

If $\cos 2\theta = \frac{a}{b}$ where $a, b \in I^+$ also a and b are coprime, then find the value of $\frac{5}{13}(10a + b)$

88. Let $\overrightarrow{OA} = \vec{a}$, $\overrightarrow{OB} = 2\vec{a} + 10\vec{b}$, $\overrightarrow{OC} = \vec{b}$ where O, A, C are non collinear points. Let ℓ denote the area of the quadrilateral OABC. Let m denotes the area of parallelogram with $\overrightarrow{OA}$ and $\overrightarrow{OC}$ as adjacent sides. If $\ell = 2\lambda m$ then find the value of λ.

89 If $\hat{i} \times [(\vec{a} - \hat{j}) \times \hat{i}] + \hat{j} \times [(\vec{a} - \hat{k}) \times \hat{j}] + \hat{k} \times [(\vec{a} - \hat{i}) \times \hat{k}] = 0$ and $\vec{a} = x\hat{i} + y\hat{j} + z\hat{k}$ then $8(x^3 - xy + zx)$ is equal to

90. If the planes $x - cy - bz = 0$, $cx - y + az = 0$ and $bx + ay - z = 0$ pass through a straight line, then find the value of $a^2 + b^2 + c^2 + 2abc$.