SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

JR MPC | **JEE MAINS MODEL WT-05** | **Date: 16-08-2020**

Time: 3 Hours | **Max. Marks: 300 M**

MATHEMATICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 01 – 20)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 21 – 25)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

PHYSICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 26 – 45)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 46 – 50)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

CHEMISTRY

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 51 – 70)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 71 – 75)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (B) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

MATHEMATICS

SYLLABUS: Compound Angles, Straight Lines, Rotation of Axes

1. $\dfrac{\left(1+\tan 14^0\right)\left(1+\tan 31^0\right)}{\left(1+\tan 16^0\right)\left(1+\tan 29^0\right)} =$

A) 2 B) 1 C) 3 D) 4

2. $\cos 40^0 + \cos 280^0 + \cos 200^0 =$

A) 0 B) 1 C) 2 D) -1

3. $\cos^2 4^0 + \cos^2 124^0 + \cos^2 116^0 =$

A) $\dfrac{1}{2}$ B) $\dfrac{3}{2}$ C) 1 D) -1

4. $\cos ec 15^0 + \sec 15^0 =$

A) $2\sqrt{2}$ B) $\sqrt{6}$ C) $2\sqrt{6}$ D) $\sqrt{6}+\sqrt{2}$

5. **If** $\cos\left(\alpha+\beta\right)=\dfrac{4}{5}, \sin\left(\alpha-\beta\right)=\dfrac{5}{13}$ **and** α, β **lies between 0 and** $\dfrac{\pi}{4}$ **then** $\tan 2\alpha =$

A) $\dfrac{56}{33}$ B) $\dfrac{33}{56}$ C) $\dfrac{16}{65}$ D) $\dfrac{60}{61}$

6. $\dfrac{\tan 50^0 - \tan 40^0}{\tan 10^0} =$

A) 0 B) 1 C) 2 D) 3

7. **If** $\tan\theta_1 \tan\theta_2 = k$ **then** $\dfrac{\cos\left(\theta_1-\theta_2\right)}{\cos\left(\theta_1+\theta_2\right)} =$

A) $\dfrac{1+k}{1-k}$ B) $\dfrac{1-k}{1+k}$ C) $\dfrac{k+1}{k-1}$ D) $\dfrac{k-1}{k+1}$

8. **If the roots of the quadratic equation** $x^2+px+q=0$ **are** $\cot 60^0$ **and** $\cot 75^0$ **then the value of** $q+2-p$ **is**

A) 1 B) 2 C) 3 D) 0

9. $\cos A = n\cos B, \sin A = m\sin B$ **then** $\left(m+n\right)\sin^2 B =$

A) $\dfrac{1-n^2}{m-n}$ B) $\dfrac{1+n^2}{m-n}$ C) $\dfrac{1-n}{m+n}$ D) $\dfrac{1+n}{m+n}$

10. $x^2+y^2+z^2=r^2$ **and** $zr\sin\alpha = xy\cos\alpha, xr\sin\beta = yz\cos\beta, yr\sin x = zx\cos x$ **then** $\alpha+\beta+x =$

A) $\dfrac{\pi}{4}$ B) π C) $\dfrac{\pi}{2}$ D) $\dfrac{\pi}{3}$

11. **When axes are rotated by an angle** 135^0 **initial coordinates of** $\left(4,-3\right)$ **are**

A) $\left(\dfrac{1}{\sqrt{2}}, \dfrac{7}{\sqrt{2}}\right)$ B) $\left(\dfrac{1}{\sqrt{2}}, \dfrac{-7}{\sqrt{2}}\right)$ C) $\left(\dfrac{-1}{\sqrt{2}}, \dfrac{-7}{\sqrt{2}}\right)$ D) $\left(\dfrac{-1}{\sqrt{2}}, \dfrac{7}{\sqrt{2}}\right)$

12. **The angle of rotation of the axes so that the equation** $ax+by+c=0$ **may be reduced to** $x=p$ **is**

A) $\tan^{-1}\left(\dfrac{b}{a}\right)$ B) $\tan^{-1}\left(\dfrac{a}{b}\right)$ C) $\dfrac{\pi}{2}$ D) $\dfrac{\pi}{3}$

13. **Let L be the line $2x+y-2=0$, the axes rotated by 45^0, in clock wise direction, then the intercepts made by the line L on new axes are respectively**

A) $1,\sqrt{2}$ B) $\sqrt{2},1$ C) $2\sqrt{2},\frac{2\sqrt{2}}{3}$ D) $\frac{2\sqrt{2}}{3},2\sqrt{2}$

14. **The coordinates axes are related through an angle 22^0 about the origin. If the equation $4x^2+12xy+9y^2+6x+9y+2=0$ values of $\frac{g^2-ac}{a^2+h^2}=$**

A) $\frac{1}{52}$ B) $\frac{1}{36}$ C) $\frac{-27}{52}$ D) $\frac{1}{40}$

15. **If the square ABCD where A(0,0), B(2,0), C(2,2), D(0,2) undergoes the following three transformations successively**

(i) $f_1(x,y)\to(y,x)$ **(ii)** $f_2(x,y)\to(x+z,y,y)$

(iii) $f_3(x,y)\to\left(\frac{x-y}{2},\frac{x+y}{2}\right)$

Then the final figure is

A) square B) parallelogram C) rhombus D) rectangle

16. **The area of the triangle formed by the lines $y=m_1x+c_1, y=m_2x+c_2$ and $x=0$ is**

A) $\frac{|c_1-c_2|}{2|m_1-m_2|}$ B) $\frac{(c_1-c_2)^2}{2(m_2-m_1)^2}$ C) $\frac{(c_1-c_2)^2}{2|m_1-m_2|}$ D) $\frac{(c_1-c_2)^2}{|m_2-m_1|}$

17. **If $a+b+c=0, ax+by+c=0, bx+cy+a=0, cx+ay+b=0$ are concurrent then $\frac{a^2+b^2+c^2}{ab+bc+ca}=$**

A) $\frac{1}{2}$ B) 2 C) 1 D) 0

18. **If the slope of the line $\left(\frac{1}{a}+\frac{k}{b}\right)x+\left(\frac{1}{b}+\frac{k}{a}\right)y-(1+k)=0$ is -1, then the value of k is**

A) 2 B) -1 C) 1 D) -2

19. **Two lines cut the x-axis at a distances of 4 and -4 and the y-axis at distances of 2 and 6 respectively, then the coordinates of their point of intersection is**

A) (2, 3) B) (-2, 3) C) (-2, -3) D) (2, -3)

20. **A straight line through the origin 'O' meets the parallel lines $4x+2y=9$ and $2x+y+6=0$ at points P and Q respectively then the point 'O' divides the segment PQ in ratio**

A) 1 : 2 B) 3 : 4 C) 2 : 1 D) 4 : 3

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 in all other cases.

21. **If $\sec\alpha=\sqrt{5}, 0<\alpha<\frac{\pi}{2}$ then the value of $\frac{11\tan^2\alpha}{\sqrt{5}(\sin^3\alpha+3\cos^3\alpha)}=$**

22. **In a ΔPQR, if $3\sin P+4\cos Q=6$, and $4\sin Q+3\cos P=1$ then the $2\sin R=$**

23. **If $A=35^0, B=15^0$ and $C=40^0$, then**

$(\sin A\sin B\cos C+\cos A\sin B\sin C+\sin A\cos B\sin C)(\sec A\sec B\sec C)=$

24. The perpendicular bisector of the line segment joining P(1,4) and Q(k,3) has y intercept -4, then $|k| =$

25. In an isosceles ΔOAB, O is the origin and $OA = OB = 6$, the equation of side AB is $x - y + 1 = 0$ then area of triangle is λ what is the value of $[\lambda]$ where $[.]$ is G.I.F

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

PHYSICS

SYLLABUS: *VECTORS*

26. If $\vec{A} = 3\hat{i} - 4\hat{j}$ and $\vec{B} = -\hat{i} - 4\hat{j}$, calculate the direction of $\vec{A} - \vec{B}$.

A) along positive x- axis B)along negative x-axis
C) along positive y-axis D)along negative y-axis

27. The resultant of the forces $\vec{F}_1 = 4\hat{i} - 3\hat{j}$ and $\vec{F}_1 = 6\hat{i} + 8\hat{j}$ is

A) $5\sqrt{5}$ B) $10\hat{i} - 5\hat{j}$ C) 125 D) $-2\hat{i} - 3\hat{j}$

28. The vector sum of two vector of magnitudes 10 units and 15 unites can never be

A)20 units B)22units C)18 units D)3units

29. A car moves 40m due east and turns towards north and moves 30m then turns 45^0 east of north and moves $20\sqrt{2}m$. The net displacement of car is (east is taken positive x-axis, North as positive y-axis)

A) $50\hat{i} + 60\hat{j}$ B) $60\hat{i} + 50\hat{j}$ C) $30\hat{i} + 40\hat{j}$ D) $40\hat{i} + 30\hat{j}$

30. A bird moves in such a way that it has a displacement of 12m towards east, 5m towards north and 9m vertically upwards. Find the magnitude of its displacement

A) $5\sqrt{2}m$ B) $5\sqrt{10}m$ C) $5\sqrt{5}m$ D) $5m$

31. An aeroplane is heading north east at a speed of $141.4\,ms^{-1}$. The northward component of its velocity is

A) 141.4 ms^{-1} B) 100 ms^{-1} C) zero D) 50 ms^{-1}

32. The unit vector parallel to the resultant of the vectors $\vec{A} = 4\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{B} = -\hat{i} + 3\hat{j} - 8\hat{k}$ is

A) $\frac{1}{7}\left(3\hat{i} + 6\hat{j} - 2\hat{k}\right)$ B) $\frac{1}{7}\left(3\hat{i} + 6\hat{j} + 2\hat{k}\right)$ C) $\frac{1}{49}\left(3\hat{i} + 6\hat{j} - 2\hat{k}\right)$ D) $\frac{1}{49}\left(3\hat{i} - 6\hat{j} + 2\hat{k}\right)$

33. The vector parallel to $4\hat{i} - 3\hat{j} + 5\hat{k}$ and whose length is the arithmetic mean of lengths of two vectors $2\hat{i} - 4\hat{j} + 4\hat{k}$ and $\hat{i} + \sqrt{6}\hat{j} + 3\hat{k}$ is

A) $4\hat{i} - 3\hat{j} + 5\hat{k}$ B) $\left(4\hat{i} - 3\hat{j} + 5\hat{k}\right)/\sqrt{3}$ C) $\left(4\hat{i} - 3\hat{j} + 5\hat{k}\right)/\sqrt{2}$ D) $\left(4\hat{i} - 3\hat{j} + 5\hat{k}\right)/\sqrt{5}$

34. The direction cosines of a vector $\vec{A}$ are $\cos\alpha = \frac{4}{5\sqrt{2}}, \cos\beta = \frac{1}{\sqrt{2}}$ and $\cos\gamma = \frac{3}{5\sqrt{2}}$ then the vector $\vec{A}$ is

A) $4\hat{i} + \hat{j} + 3\hat{k}$ B) $4\hat{i} + 5\hat{j} + 3\hat{k}$ C) $4\hat{i} - 5\hat{j} - 3\hat{k}$ D) $\hat{i} + 5\hat{j} - \hat{k}$

35. Given two vectors $\vec{A}=\hat{i}-2\hat{j}-3\hat{k}$ and $\vec{B}=4\hat{i}-2\hat{j}+6\hat{k}$. The angle made by $\left(\vec{A}+\vec{B}\right)$ with the X-axis is

A) 30^0 B) 45^0 C) 60^0 D) 90^0

36. To go from town A to town B a plane must fly about 1780 km at an angle of 30^0 West of north. How far West of A is B?

A) 1542 km B) 1452 km C) 1254 km D) 890 km

37. A vector $\hat{i}+\sqrt{3}\hat{j}$ rotates about its tail through an angle 60^0 in clockwise direction then the new vector is

A) $\hat{i}+\sqrt{3}\hat{j}$ B) $3\hat{i}-4\hat{j}$ C) $2\hat{j}$ D) $2\hat{i}$

38. Two forces each of 20N act on a body at 120^0. The magnitude and direction of resultant is

A) $20N;\phi=60^0$ B) $20\sqrt{2}N;\phi=60^0$ C) $10\sqrt{2}N;\phi=0^0$ D) $10\sqrt{2}N;\phi=120^0$

39. Two forces whose magnitudes are in the ratio 3:5 give a resultant of 35N. If the angle between them is 60^0, the magnitude of each force is

A) 3N, 5N B) 9N, 25N C) 15N, 25N D) 21N, 35N

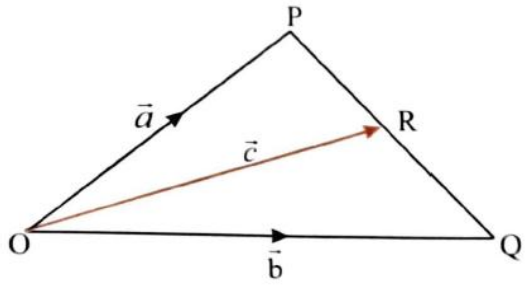
40. The resultant of two forces 2P and $\sqrt{2}P$ is $\sqrt{10}P$. The angle between the forces is

A) 30^0 B) 60^0 C) 45^0 D) 90^0

41. Which one of the following cannot be represented by the three sides of a triangle?

A) 5,9,11 B) 5,7,13 C) 7,10,13 D) 3,8,9

42. Figure shows three vectors a, b and c where R is the mid point of PQ, then which of the following relations is correct.



A) $\vec{a}+\vec{b}=2\vec{c}$ B) $\vec{a}+\vec{b}=\vec{c}$ C) $\vec{a}-\vec{b}=2\vec{c}$ D) $\vec{a}-\vec{b}=\vec{c}$

43. Eleven forces each equal to 5N act on a particle simultaneously. If each force makes an angle 30^0 with the next one, the resultant of all forces is

A) 15N B) 55N C) 5N D) zero

44. A body of mass $\sqrt{3}$ kg is suspended by a string to rigid support. The body is pulled Horizontally by a force F until the string makes an angle of 30^0 with the vertical. The value of F and tension in the string are

A) 9.8 N, 9.8 N B) 9.8 N, 19.6 N C) 19.6 N, 19.6 N D) 19.6 N, 9.8 N

45. Two light strings of length 4m and 3cm are tied to a bob of weight 500 gm. The free ends of the strings are tied to pegs in the same horizontal line and separated by 5 cm. The ratio of tension in the longer string to that in the shorter string is

A) 4 : 3 B) 3 : 4 C) 4 : 5 D) 5 : 4

SECTION-II

(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.
Marking scheme: +4 for correct answer, 0 in all other cases.

46. **A vector $\vec{A}$ makes an angle of 20^0 and $\vec{B}$ makes an angle of 110^0 with the X-axis. The magnitudes of these vectors are 3 m and 4 m respectively. Find the resultant in meter.**

47. **Let $\vec{A}$ and $\vec{B}$ be the two vectors of magnitude 10 unit each. If they are inclined to the X-axis at angles 120^0 and 30^0 respectively, find the resultant (take $\sqrt{2}=1.414$)**

48. **Add vectors A, B and C each having magnitude of 100 unit and inclined to the X-axis at angles 45^0, 135^0 and 315^0 respectively.**

49. **A spy report about a suspected car reads as follows. "The car moved 20 km towards east, made a perpendicular left turn, ran for 30 m, made a perpendicular right turn, ran for 20m and stopped". Find the displacement of the car in km.**

50. **Suppose $\vec{a}$ is a vector of magnitude 4.5 units due north. What is the magnitude of vector $3\vec{a}$?**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.
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CHEMISTRY

***SYLLABUS:* ATOMIC STRUCTURE**

51. **$\Psi^2\,(psi)$ the wave function represents the probability of finding electron. Its value depends**

A) Inside the nucleus B) Far from the nucleus
C) Near the nucleus D) Upon the type of orbital

52. **The electron density of $3d_{xy}$ orbital in YZ plane is**

A) 50% B) 95% C) 33.33% D) Zero

53. **If Pauli's exclusion principle is not known, the electronic arrangement of lithium atom is**

A) $1s^2 2s^1$ B) $1s^1 2s^2$ C) $1s^3$ D) $1s^2 2s^1 2p^1$

54. **Which of the following explains the sequence of filling electrons in different subshells?**

A) Hund's rule B) Aufbau principle
C) Pauli's principle D) All of these

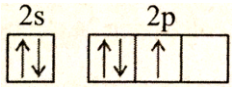
55. **The number of spherical nodes in 3p orbitals is**

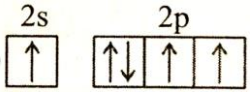
A) one B) three C) two D) zero

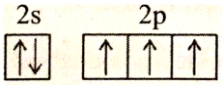
56. **Which of the following quantum numbers is/are not allowed?**

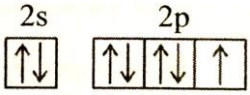
A) $n=3, l=2, m=0$ B) $n=2, l=1, m=-1$
C) $n=3, l=0, m=1$ D) $n=5, l=2, m=-1$

57. **The orbital diagram in which the aufbau principle is violated is**

A) 

B) 

C) 

D) 

58. **The maximum number of electrons in an atom which can have $(n+l)=4$**

A) 2 B) 6 C) 8 D) 18

59. The azimuthal quantum number of a non-directional orbital is
A) 0 B) 1 C) -1 D) +1/2

60. Radial part of the wave function depends on quantum numbers
A) n and s B) 1 and m C) 1 and s D) n and 1

61. The number of radial nodes, nodal planes for an orbital with n = 4; l = 1 is
A) 3, 1 B) 2, 1 C) 2, 0 D) 4, 0

62. The values of quantum numbers n, 1 and m for the fifth electron of boron is
A) n=2,l=1, m=-1 B) n=2, l=0, m=-1 C) n=2, l=2, m=-1 D) n=1, l=2, m=-1

63. Which one of the following atomic orbitals is not directed along the axis?
A) P_x B) $d_{x^2-y^2}$ C) d_{xy} D) d_{z^2}

64. The basis of quantum mechanical model of an atom is
A) Angular momentum of electron B) Quantum numbers
C) Dual nature of electron D) Black body radiation

65. The quantum number which is equal for all the d-electrons in an atom is
A) l B) m C) s D) n

66. How many electrons are present in the M-shell of an atom of the element with atomic number Z = 24?
A) 5 B) 6 C) 12 D) 13

67. Number of unpaired electrons in the electronic configuration $1s^2 2s^2 2p^4$ are
A) 2 B) 3 C) 4 D) 6

68. Number of nodal planes that a p-orbital has
A) 0 B) 1 C) 2 D) 3

69. Which one of the following expressions represented the electron probability function (D)
A) $4\pi r\, dr\, \psi^2$ B) $4\pi r^2\, dr\, \psi$ C) $4\pi r^2\, dr\, \psi^2$ D) $4\pi r\, dr\, \psi$

70. p-orbitals are --- degenerate
A) Two fold B) Three fold C) Four fold D) Five fold

SECTION-II

(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 in all other cases.

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71. Total number of orbitals associated with third shell will be _____.

72. In the plots of radial distribution function for the hydrogen 3s orbital versus 'r', the no. of peaks are ____.

73. The m value not possible for a double dumbell shaped orbital is ____.

74. How many electrons does the last electron have the numbers of n = 4 and $l = 1$____.

75. The orbital angular momentum of an electron in 3s-orbital _____.

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SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

JR MPC | **JEE MAINS MODEL WT-05** | **Date: 16-08-2020**

Time: 3 Hours | **Max. Marks: 300 M**

KEY SHEET

MATHEMATICS

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

PHYSICS

26) **A**	27) **B**	28) **D**	29) **B**	30) **B**	31) **B**	32) **B**	33) **D**	34) **B**	35) **B**
36) **D**	37) **D**	38) **A**	39) **C**	40) **A**	41) **B**	42) **A**	43) **C**	44) **B**	45) **B**
46) **5**	47) **14.14**	48) **100**	49) **0.05**	50) **13.5**					

CHEMISTRY

51) **D**	52) **D**	53) **C**	54) **B**	55) **A**	56) **C**	57) **B**	58) **C**	59) **A**	60) **D**
61) **B**	62) **A**	63) **C**	64) **B**	65) **A**	66) **D**	67) **A**	68) **B**	69) **C**	70) **B**
71) **9**	72) **3**	73) **3**	74) **6**	75) **0**					

Paper Setters:

SNO	Subject	Name of the Paper Setter	Phone No	Branch
1	MATHS	SUDHAKAR SIR	9440260683	CO ICC
2	PHYSICS	MANOHAR SIR	9618550817	CO ICC
3	CHEMISTRY	VASAVI MADAM	8106968077	CO ICC

SOLUTIONS:

MATHEMATICS

1. If $A+B=45^0$ then $(1+\tan A)(1+\tan B)=2$

2. $\cos\theta+\cos(240+\theta)+\cos(240-\theta)=0$

3. $\cos^2\theta+\cos^2(120+\theta)+\cos^2(120-\theta)=\frac{3}{2}$

   $\theta=0$ then $1^2+\frac{1}{4}+\frac{1}{4}=1+\frac{1}{2}=\frac{3}{2}$

4. $\text{cosec}15^0+\sec15^0=\frac{1}{\sin15}+\frac{1}{\cos15}$

   $=\frac{1}{\frac{\sqrt{3}-1}{2\sqrt{2}}}+\frac{1}{\frac{\sqrt{3}+1}{2\sqrt{2}}}$ $=\frac{2\sqrt{2}}{\sqrt{3}-1}+\frac{\sqrt{2}}{\sqrt{3}+1}$

   $=(\sqrt{6}+\sqrt{2})+(\sqrt{6}-\sqrt{2})=2\sqrt{6}$

5. $\cos(\alpha+\beta)=\frac{4}{5}$ $\sin(\alpha-\beta)=\frac{5}{13}$

   $\sin(\alpha+\beta)=\frac{3}{5}$ $\cos(\alpha-\beta)=\frac{12}{13}$

   $\tan(\alpha+\beta)=\frac{3}{4}$ $\tan(\alpha-\beta)=\frac{5}{12}$

   $\tan(2\alpha)=\tan((\alpha+\beta)+(\alpha-\beta))$

   $=\frac{\tan(\alpha+\beta)+\tan(\alpha-\beta)}{1-\tan(\alpha+\beta)\tan(\alpha-\beta)}$

   $=\frac{\frac{3}{4}+\frac{5}{12}}{1-\frac{3}{4}.\frac{5}{12}}=\frac{36+20}{48-15}=\frac{56}{33}$

6. $\frac{\tan50^0-\tan40^0}{\tan10^0}=2$

   $A+B=90^0\Rightarrow\tan A-\tan B=2\tan(A-B)$

7. $\tan\theta_1\tan\theta_2=k$ $\frac{\cos(\theta_1-\theta_2)}{\cos(\theta_1+\theta_2)}$

   $=\frac{\cos\theta_1\cos\theta_2+\sin\theta_1\sin\theta_2}{\cos\theta_1\cos\theta_2-\sin\theta_1\sin\theta_2}$

   $=\frac{1+\tan_1\tan_2}{1-\tan_1\tan_2}=\frac{1+k}{1-k}$

8. $x^2+px+q=0$ are $\cot60^0$, $\cot75^0$

   $\cot60^0=\frac{1}{\sqrt{3}}$, $\cot75^0=2-\sqrt{3}$

   $q=\frac{1}{\sqrt{3}}(2-\sqrt{3})=\frac{2}{\sqrt{3}}-1$

   $q+2-p=\frac{2}{\sqrt{3}}-1+2+\frac{1}{\sqrt{3}}+2-\sqrt{3}=3$

9. $\cos A=n\cos B$ $A=60^0$ $n=\frac{\cos60^0}{\cos45^0}$

   $\sin A=m\sqrt{m}B$ $B=45^0$ $=\frac{\frac{1}{2}}{\frac{1}{\sqrt{2}}}=\frac{\sqrt{2}}{2}$

   $(m+n)\sin^2B$ $=\frac{1}{\sqrt{2}}$

   $=\left(\frac{\sqrt{3}}{\sqrt{2}}+\frac{1}{\sqrt{2}}\right).\frac{1}{2}$ $m=\frac{\sin60^0}{\sin45^0}=\frac{\sqrt{3}/2}{1/\sqrt{2}}$

   $=\frac{\sqrt{3}+1}{2\sqrt{2}}$ $=\sqrt{3}/\sqrt{2}$

   $\frac{1-n^2}{m-n}=\frac{1-\frac{1}{2}}{\frac{\sqrt{3}}{\sqrt{2}}-\frac{1}{\sqrt{2}}}=\frac{\frac{1}{2}}{\frac{\sqrt{3}-1}{\sqrt{2}}}=\frac{1}{2}\times\frac{\sqrt{2}}{\sqrt{3}-1}$

   $=\frac{1}{\sqrt{2}}\times\frac{\sqrt{3}+1}{3-1}$

10. $x^2+y^2+z^2=r^2$

    $zr\sin\alpha=xy\cos\alpha\Rightarrow\tan\alpha=\frac{xy}{rz}$

    $xr\sin\beta=yz\cos\beta\Rightarrow\tan\beta=\frac{yz}{rx}$

    $yr\sin\gamma=zx\cos\gamma$ $\Rightarrow\tan\gamma=\frac{xz}{ry}$

    (1) $\alpha+\beta+r=0(a)\pi(a)2\pi$

    then $\tan\alpha+\tan\beta+\tan\gamma=\tan\alpha.\tan\beta.\tan\gamma$

    $\frac{xy}{rz}+\frac{yz}{rx}+\frac{zx}{ry}=\frac{xy}{rz}.\frac{yz}{rx}.\frac{zx}{ry}$

    $\Rightarrow\frac{x^2y^2+y^2z^2+z^2x^2}{rxyz}=\frac{xyz}{r^3r^2}$

    $\Rightarrow r^2\left[x^2y^2+y^2z^2+z^2x^2\right]=x^2y^2z^2$

    (2) $\alpha+\beta+\gamma=\frac{\pi}{2}$ (a) $\frac{3\pi}{2}$

    then $\tan\alpha.\tan\beta+\tan\beta\tan\gamma+\tan\gamma.\tan\alpha$

    $=\frac{xy}{rz}\times\frac{yz}{rx}+\frac{yz}{rx}\times\frac{zx}{ry}+\frac{zx}{yr}\times\frac{xy}{rz}$

    $=\frac{y^2+z^2+x^2}{r^2}=1$

11.

θ	x	y
x	$\cos\theta$	$-\sin\theta$
y	$-\sin\theta$	$\cos\theta$

135^0	4	-3
x	$\frac{-1}{\sqrt{2}}$	$\frac{-1}{\sqrt{2}}$
y	$\frac{1}{\sqrt{2}}$	$\frac{-1}{\sqrt{2}}$

$$x=\frac{-4+3}{\sqrt{2}}=\frac{-1}{\sqrt{2}},\ y=\frac{4+3}{\sqrt{2}}=\frac{7}{\sqrt{2}}$$

12. $ax+by+c=0$

$\Rightarrow z\left[x\cos\theta-y\sin\theta\right]+b\left[\sin\theta+y\cos\theta\right]+c=0$

$x=p$ from man of $y=0$

$-a\sin\theta+b\cos\theta=0$

$a\sin\theta=b\cos\theta$

$\tan=\frac{b}{a}\Rightarrow\theta=\tan^{-1}\left(\frac{b}{a}\right)$

13. $2x+y-2=0$

$2\left[\frac{-x}{\sqrt{2}}-\frac{y}{\sqrt{2}}\right]+\left[\frac{x}{\sqrt{2}}-\frac{y}{\sqrt{2}}\right]-2=0$

$x\left[\frac{-1}{\sqrt{2}}\right]+y\left[\frac{-3}{\sqrt{2}}\right]=2$

$\frac{-x}{2\sqrt{2}}-\frac{y}{2\sqrt{2}/3}=1$

14. $4x^2+12xy+9y^2+6x+9y+2=0$

$\frac{9^2-ac}{b^2+h^2}=\frac{9-8}{16-136}=\frac{1}{52}$

15. Conceptual

16. Conceptual

17. $\begin{vmatrix}a & b & c\\ b & c & a\\ c & a & b\end{vmatrix}=0\Rightarrow 3abc-a^3-b^3-c^3=0$

$=\left(a+b+c\right)\left(a^2+b^2+c^2-ab-bc-ca\right)=0$

$\therefore a+b+c\neq 0$

$\frac{a^2+b^2+c^2}{ab+bc+ca}=1$

18. Slope = -1

$x_{\text{coeffiient}}=y_{\text{coeffiient}}$

$\frac{1}{a}+\frac{k}{b}=\frac{1}{b}+\frac{k}{a}$

$k\left(\frac{1}{b}-\frac{1}{a}\right)=\frac{1}{b}-\frac{1}{a}$

$k=1$

19. $\frac{x}{9}+\frac{y}{2}=1,\ \frac{x}{-9}+\frac{y}{6}=1$

$\frac{x}{4}-\frac{y}{6}=-1$

$1-\frac{y}{2}-\frac{y}{6}=-1$

$y\left(\frac{1}{2}+\frac{1}{6}\right)=2$

$y\left(\frac{8}{1}\right)=2\Rightarrow y=3$

$\Rightarrow\frac{x}{4}+\frac{z}{2}=1$

$\Rightarrow\frac{x}{4}=\frac{1-3}{2}=\frac{-1}{2}$

$x=\frac{-4}{2}=-2$ ROI (-2, 3)

20. $4x+2y=9\quad 2x+y=-6$

then $4x+2y=-12$

$d_1:d_2=\frac{d_1}{d_2}=\frac{\left|\frac{9}{\sqrt{4^2+2^2}}\right|}{\left|\frac{-12}{\sqrt{4^2+2^2}}\right|}=\frac{9}{12}\quad=\frac{3}{4}=3:4$

21. $\sec\alpha=\sqrt{5}\Rightarrow\cos\alpha=\frac{1}{\sqrt{5}}$

$\sin\alpha=\frac{2}{\sqrt{5}}\ \tan\alpha=\frac{2}{1}$

$\frac{11\tan^2\alpha}{\sqrt{5}\left[\sin^3\alpha+3\cos^2\alpha\right]}=\frac{11(4)}{\sqrt{5}\left[\frac{8}{5\sqrt{5}}+3\left(\frac{1}{5\sqrt{5}}\right)\right]}$

$=\frac{44}{\frac{8}{5}+\frac{3}{5}}=\frac{44}{\frac{11}{5}}=\frac{44\times5}{11}=4\times5=20$

22. $3\sin p+4\cos q=6\rightarrow(1)\quad\sin R=?$

$4\cos q+3\cos p=1\rightarrow(2)$

$(1)+(2)$

$9\sin^2 p+24\sin p\cos q+16\cos^2 q=36$

$16\sin^2 p+24\sin q\cos q+9\cos^2 p=1$

$9+16+24\left[\sin\left(p+q\right)\right]=37$

$25+24\left[\sin\left(p+q\right)\right]=37$

$24\sin(p+q)=12$

$\sin(p+q)=\frac{1}{2}\Rightarrow p+q=30^0 \quad r=150^0$

$\sin R=\sin 150^0=\sin\left(180-30^0\right)=\frac{+1}{2}$

23. $A=35^0 \quad B=15^0 \quad C=40^0$

$(\sin A\sin B\cos C+\cos A+\sin B\sin C+\sin A\cos B\sin C)$

$(\sec A\sec B\sec C) \quad =1$

$A+B+C=90^0\Rightarrow\sin(A+B+C)=1$

$\Rightarrow\sin(A+B)\cos C+\cos(A+B)\sin C=1$

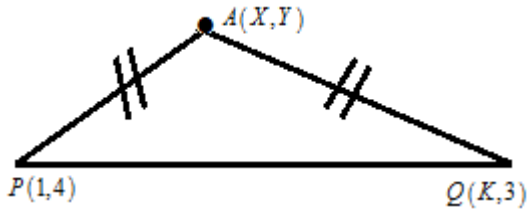
$\Rightarrow(\sin A\cos B+\sin A\cos B)\cos C+(\cos A\cos B-\sin A\sin B)\sin C=1$

$\Rightarrow\sin A\cos B\cos C+\cos A\sin B\cos C$

$+\cos A\cos B.\sin C-\sin A\sin B\sin C=1$

24. AP = AQ

$AP^2=AQ^2$



$\Rightarrow(x-1)^2+(y-4)^2=(x-k^2)+(y-3)^3$

$x^2-2x+1+y^2-8y+16$

$=x^2-2tx+k^2+y^2-6y+9$

$=-2x-8y+17=-2kx+k^2-6y+9\rightarrow(1)$

Given y-intercept is '-4'

So (4) passes through (0, -4)

$\therefore 0+32+17=-0+k^2+24+9$

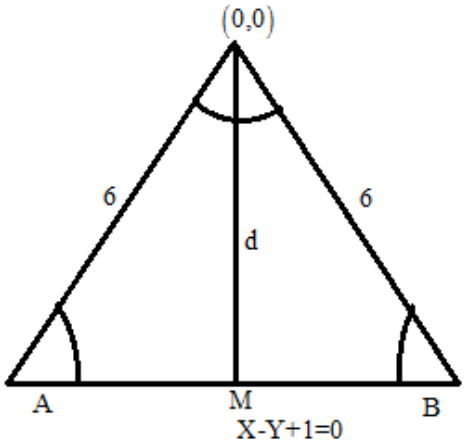
$49=k^2+33$

$k^2=16\Rightarrow k=4$

25. $6^2=d^2+AM^2\Rightarrow 36=\frac{1}{2}+AM^2$

$d=\frac{|0-0+1|}{\sqrt{1^2+1^2}}=\frac{1}{\sqrt{2}}$

$\Rightarrow AM^2=36-\frac{1}{2}=\frac{71}{2}$



$AM=\sqrt{\frac{71}{2}}$

$AB=2AM=2\sqrt{\frac{71}{2}}$

$\lambda=$ Area of triangle

$=\frac{1}{2}\times BASE\times Ht=\frac{1}{2}\times 2\times\sqrt{\frac{71}{2}}\times\frac{1}{\sqrt{2}}$

$=\frac{\sqrt{71}}{2}=\frac{\sqrt{71}}{4}=\sqrt{17}$

$[\lambda]=4$

PHYSICS

26. Conceptual
27. Conceptual
28. Conceptual
29. A car is moving 40m due east =40i, turns towards north moves 30m=30j. Then turns 45east of north moves $20\sqrt{2}m.=20i+20j$ the net displacement of car is $60i+50j$
30. 12 m on x –axis, 5m on y -axis, 9 m on z – axis.

Now since the angle in each case made is 90^0 with other respective

Magnitude of displacement will be

$\Rightarrow|a|=\sqrt{x^2+y^2+z^2}$

$\Rightarrow|a|=\sqrt{12^2+9^2+5^2}$

$\sqrt{144+81+25}=\sqrt{250} \quad =5\sqrt{10}\,m$

31. At first, we should written vector form of velocity of aeroplane. As it is given that, speed of aeroplane is directed to North – East. Means, velocity makes an angle of 45^0 with the east (+x – axis)

so, velocity of aeroplane, $\vec{\upsilon}=141.4\left(\cos 45^0\hat{i}+\sin 45^0\hat{j}\right)$

$=141.4\left(1/\sqrt{2}i+1/\sqrt{2}j\right)$

[as we know, $\sqrt{2}=1.414$]

so, $v=(141.4/1.414)i+(141.4/1.414)j$

$=100i+100j$

32. $\vec{A}=4\hat{i}-3\hat{j}$ and $\vec{B}=8\hat{i}+8\hat{j}$

Resultant of $\vec{A}$ and $\vec{B}$, $\vec{R}=12\hat{i}+5\hat{j}$

Unit vector, $\hat{R}=\dfrac{\vec{R}}{|\vec{R}|}$

$|\vec{R}|=\sqrt{12^2+5^2}=13 \Rightarrow \hat{R}=\dfrac{12\hat{i}+5\hat{j}}{13}$

33. Conceptual

34. $\vec{A}=A_x\hat{i}+A_1\hat{j}+A_2\hat{k}$

35. $\vec{A}+\vec{B}=(4+1)\hat{i}+(-2-2)\hat{j}+(-3+6)\hat{k}$

$=5\hat{i}-4\hat{j}+3\hat{k}$

Unit vector along x-axis $=\hat{i}+O\hat{j}+O\hat{k}$

So, $\cos\theta=\dfrac{(\vec{A}+\vec{B}).\vec{x}}{|\vec{A}+\vec{B}||\vec{x}|}=\dfrac{(5i-4j+3k)(i)}{\sqrt{5^2+4^2+3^2\times1}}$

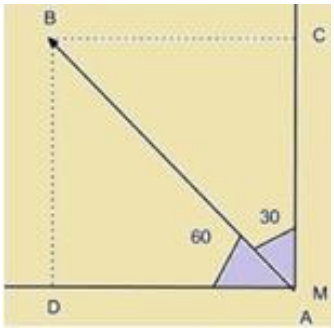
$\cos\theta=\dfrac{5}{\sqrt{50}}=\dfrac{5}{5\sqrt{2}}=\dfrac{1}{\sqrt{2}}$

$\Rightarrow\cos\theta=\cos\left(\dfrac{\pi}{4}\right)$

So, $\theta=\dfrac{\pi}{4}$ or 45^0

36. From the figure, $\cos30^0=(AC/AB)$

Or $AC=AB\cos30^0$



Given, AB = 1780 km

So, $AC=1780\cos30^0$

$=1780\times\left(3\sqrt{2}\right)=1541.48$ km

i.e. B is 1541.48 km north of A.

$\cos60^0=(AD/AB)$

Or $AD=AB\cos60^0=(1780)\times(1/2)=890$ km

i.e. B is 890 km west of A.

37. Conceptual

38. $R=2F\cos60=F,\alpha=\dfrac{\theta}{2}$

Makes equal angle with both vectors

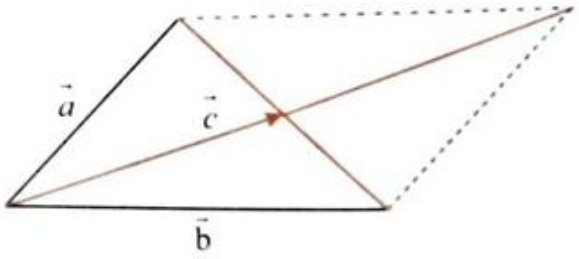
39. $\dfrac{P}{Q}=\dfrac{3}{5}$ (given); Let P =3x and Q =5x

$R=\sqrt{P^2+Q^2+2PQ\cos\theta}$

40. $R^2=P^2+Q^2+2PQ\cos\theta$

41. To get a closed triangle, the sum of any two vectors in magnitude must be either equal or large in magnitude of the third.

42.

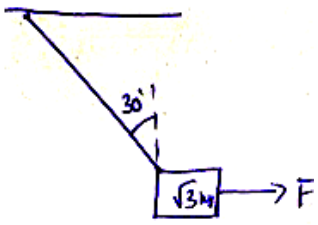


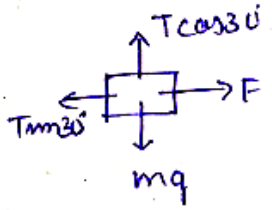
$\therefore\vec{b}+\vec{a}=2\vec{c}$

43. No. of forces =11; $n=\dfrac{360}{0}=12$

Polygon formed with 1 side absent, resultant is closing side.

44. $F=mgTan\theta, T=\sqrt{F^2+(mg)^2}$





$T\cos30^0=mg$

$T\times\dfrac{\sqrt{3}}{2}=\sqrt{3}\times19.8$

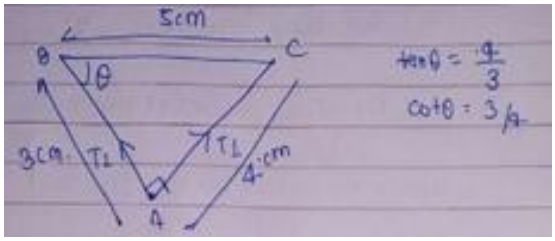
$T=9.8\times2$

$T=19.6\,N$

$T_{mass}30^0=F$

$F=19.6v\,\dfrac{1}{2}\quad=9.8\,N$

45. Let two real be B and C and the bubal 'A'
Let tension in strings be T_2 and T_2



Writing the force equation in horizontal direction

$$T_1\cos\theta = T_2\sin\theta \Rightarrow \frac{T_2}{T_2} = \cot\theta = \frac{3}{4}$$

(From the figure)

$$\cot\theta = \frac{3}{4}$$

46. Magnitude of the resultant

$$= \sqrt{\left(A^2 + B^2 + 2AB\cos\theta\right)} = 5m$$

47. Angle between the vectors

$\theta = 120^0 - 30^0 = 90^0.$

Hence magnitude of the resultant

$$= \sqrt{\left(A^2 + B^2 + 2AB\cos\theta\right)} = \sqrt{\left(10^2 + 10^2 + 2.10.10\cos 90^0\right)}$$

$$= \sqrt{(100+100)} = 10\sqrt{2} = 14.14 \text{ units}$$

48. x component of $\vec{A} = 100\cos 45^0 = 100/\sqrt{2}$ unit.
x component of $\vec{B} = 100\cos 135^0 = 100/\sqrt{2}$ unit.
x component of $\vec{C} = 100\cos 315^0 = 100/\sqrt{2}$ unit.
Resultant x component

$$= 100/\sqrt{2} - 100/\sqrt{2} + 100/\sqrt{2} = 100/\sqrt{2}$$

y component of $\vec{A} = 100\sin 45^0 = 100/\sqrt{2}$ unit
y component of $\vec{B} = 100\sin 135^0 = 100/\sqrt{2}$
y component of $\vec{C} = 100\sin 315^0 = -100/\sqrt{2}$
Resultant y component

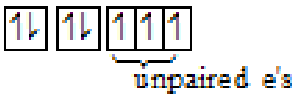
$$= 100/\sqrt{2} + 100/\sqrt{2} - 100/\sqrt{2} = 100/\sqrt{2}$$

Resultant = 100

49. Conceptual
50. Conceptual

CHEMISTRY

51. Conceptual
52. Conceptual
53. Conceptual
54. Conceptual
55. Spherical nodes $= (n-1) - l$
3p orbital
n = 3
$l = 1$
$(n-1) - l = (3-1) - 1 = 1$
56. Conceptual
57. Conceptual
58. $(n+l) = 4$
$3p = (3+1) = 4$
$6e^-$'s
$4s = (4+0) = 4$
$2e^-$'s
Total $= 8e^-$'s
59. Rb = 37
E.C = [Kr] $5s'$
$5s'$
$n = 5, l = 0, m = 0, s = +1/2$
60. Conceptual
61. $n = 4, l = 1$
4P orbital
Radial nodes $= (n-1) - l$
$= (4-1) - 1 = 2$
nodal planes $= l \quad = 1$
62. $B = 1s^2 2s^2 2p^1$
$n = 2, l = 1, m = -1$
63. Conceptual
64. Conceptual
65. Conceptual
66. M-shell (n = 3)
$(Z = 24) 3s^2 3p^6 3d^5$
No. of e^-'s $= 13$
67. $1s^2\ 2s^2\ 2p^4$



=2
68. Nodal planes $= l$
P-orbital $l = 1$
69. Conceptual
70. Conceptual
71. $n^2 = 3^2 = 9$
72. No. of peaks $= n - l$
3s orbital
$n = 3, s = 0; \quad n - l = 3 - 0 = 3$
73. Conceptual
74. 4p orbital
Contains $6e^-$'s
75. Orbital angular momentum of an electron

$$= \frac{h}{2\pi}\sqrt{l(l+1)}$$

3s orbital l values is zero

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