SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR EAMCET | **UNIT TEST-IV** | **Date: 27-04-2020**

Time: 3 Hours

MATHS-A

SYLLABUS: Addition of Vectors, Dot Product, Cross Product, Product of Three & Four Vectors

1. **If the points whose position vectors are** $-2\bar{i}+3\bar{j}+5\bar{k}$, $\bar{i}+2\bar{j}+3\bar{k}, \lambda\bar{i}-\bar{k}$ **are collinear then** $\lambda =$____

1) 1 2) 2 3) 5 4) 7

2. **If** $\bar{a}=2\bar{i}-\bar{j}+3\bar{k}$, $\bar{b}=-\bar{i}+4\bar{j}-2\bar{k}$, $\bar{c}=5\bar{i}+\bar{j}+7\bar{k}$ **and** $x\bar{a}+y\bar{b}=\bar{c}$ **then** $(x,y)=$_____

1) 3, 1 2) $(3,-1)$ 3) $(-3,1)$ 4) $(-3,-1)$

3. **The value of** λ **such that** $(x,y,z)\neq(0,0,0)$ **and** $(\bar{i}+\bar{j}+3\bar{k})x+(3\bar{i}-3\bar{j}+\bar{k})y+(-4\bar{i}+5\bar{j})z=\lambda(x\bar{i}+y\bar{j}+z\bar{k})$ **are**

1) 0, 1 2) 0, –1 3) 1, –1 4) 0, 1, –1

4. **The ratio in which** $\bar{i}+2\bar{j}+3\bar{k}$ **divides the join of** $-2\bar{i}+3\bar{j}+5\bar{k}$ **and** $7\bar{i}-\bar{k}$ **is**

1) – 3:2 2) 1:2 3) 2:3 4) –4:3

5. **The vectors** $\overline{AB}=3\bar{i}+4\bar{k}$ **and** $\overline{AC}=5\bar{i}-2\bar{j}+4\bar{k}$ **are sides of a triangle ABC, the length of the median through A is**

1) $\sqrt{18}$ 2) $\sqrt{72}$ 3) $\sqrt{33}$ 4) $\sqrt{288}$

6. **If c is the mid point of AB and P is any point out side** $\overline{AB}$ then

1) $\overline{PA}+\overline{PB}=2\overline{PC}$ 2) $\overline{PA}+\overline{PB}=\overline{PC}$ 3) $\overline{PA}+\overline{PB}+2\overline{PC}=0$ 4) $\overline{PA}+\overline{PB}+\overline{PC}=0$

7. **If s is the Circumcentre G is the Centroid O the orthocenter of** ΔABC then $\overline{SA}+\overline{SB}+\overline{SC}=$_____

1) $\overline{SG}$ 2) $\overline{OS}$ 3) $\overline{SO}$ 4) $\overline{OG}$

8. **If** $2\bar{i}+3\bar{j}+5\bar{k}, 2\bar{i}+4\bar{j}+5\bar{k}$ **and** $2\bar{i}+4\bar{j}+7\bar{k}$ **are the vertices of a** ΔABC **then its Circumcentre is**

1) $2\bar{i}+\frac{11}{3}\bar{j}+\frac{17}{3}\bar{k}$ 2) $2\bar{i}+\frac{7}{2}\bar{j}+6\bar{k}$ 3) $6\bar{i}+11\bar{j}+17\bar{k}$ 4) $2\bar{i}+4\bar{j}+\frac{5}{2}\bar{k}$

9. **Consider the points A,B, C, D with position vectors** $7\bar{i}-4\bar{j}+7\bar{k}$, $\bar{i}-6\bar{j}+10\bar{k}$, $-\bar{i}-3\bar{j}+4\bar{k}$, $5\bar{i}-\bar{j}+\bar{k}$ **respectively, then ABCD is a**

1) square 2) rhombus

3) rectangular 4) parallelogram not a rhombus

10. **The point of intersection of the line** $\bar{r}=\bar{a}+3(\bar{b}+\bar{c}).\bar{r}=\bar{b}+\bar{c}(\bar{c}+\bar{d})$ **is**

1) $\bar{0}$ 2) $\bar{a}$ 3) $\bar{b}$ 4) $\bar{a}+\bar{b}+\bar{c}$

11. **The vector that is perpendicular to both** $\bar{a}=4\bar{i}+5\bar{j}-\bar{k}$ **and** $\bar{b}=\bar{i}-4\bar{j}+5\bar{k}$ **and satisfying** $\bar{r}.\bar{c}=21$ **where** $\bar{c}=3\bar{i}+\bar{j}-\bar{k}$ **is**

1) $7\bar{i}+7\bar{j}-7\bar{k}$ 2) $7\bar{i}-7\bar{j}+7\bar{k}$ 3) $7\bar{i}+7\bar{j}+7\bar{k}$ 4) $7\bar{i}-7\bar{j}-7\bar{k}$

12. **If** $\bar{a},\bar{b}$ **and** $\bar{c}$ **are unit vectors then** $|\bar{a}-\bar{b}|^2+|\bar{b}-\bar{c}|^2+|\bar{c}-\bar{a}|^2$ **does not exceed.**

1) 4 2) 9 3) 8 4) 6

13. **The value of 'a' for which the points A, B,C with position vectors** $2\bar{i}-\bar{j}+\bar{k}, \bar{i}-3\bar{j}-5\bar{k}$ **and** $a\bar{i}-3\bar{j}+\bar{k}$ **respectively are the vertices of a right angled triangle with** $c=\frac{\pi}{2}$ **are**

1) – 2 and 1 2) 2 and – 1 3) 2 and 1 4) – 2 and – 1

14. If $\bar{a}=2\bar{i}+\bar{j}+2\bar{k}$, $\bar{b}=5\bar{i}-3\bar{j}+\bar{k}$ then the orthogonal projection of $\bar{a}$ on $\bar{b}$ is

1) $5\bar{i}-3\bar{j}+\bar{k}$ 2) $9\left(5\bar{i}+3\bar{j}+\bar{k}\right)$ 3) $\left(\frac{5\bar{i}-3\bar{j}+\bar{k}}{35}\right)$ 4) $\frac{9\left(5\bar{i}-3\bar{j}+\bar{k}\right)}{35}$

15. If θ is the angle between the unit vectors $\bar{a},\bar{b}$ then $\left|\bar{a}-\bar{b}\right|=$

1) $\sin\frac{\theta}{2}$ 2) $2\sin\frac{\theta}{2}$ 3) $\cos\frac{\theta}{2}$ 4) $4\cos\frac{\theta}{2}$

16. If $\bar{a},\bar{b},\bar{c}$ are three vectors such that $\bar{a}+\bar{b}+\bar{c}=0$ $\left|\bar{a}\right|=1$, $\left|\bar{b}\right|=2$, $\left|\bar{c}\right|=3$ then $\bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a}=$____

1) 0 2) – 7 3) 7 4) 1

17. The value of 'c' so that for all real 'x' the vectors $cx\bar{i}-6\bar{j}+3\bar{k}$, $x\bar{i}+2\bar{j}+2cx\bar{k}$ make on obtuse angle are

1) $c<0$ 2) $0<c<\frac{4}{3}$ 3) $-\frac{4}{3}<c<0$ 4) $c>0$

18. The distance between the line $\bar{r}=\left(2\bar{i}-2\bar{j}+3\bar{k}\right)+\lambda\left(\bar{i}-\bar{j}+4\bar{k}\right)$ and the plane $\bar{r}.\left(\bar{i}+5\bar{j}+\bar{k}\right)=5$ is

1) $\frac{10}{9}$ 2) $\frac{10}{3\sqrt{3}}$ 3) $\frac{3}{10}$ 4) $\frac{10}{3}$

19. The angle between the planes $\bar{r}.\left(2\bar{i}-\bar{j}+2\bar{k}\right)$=3 and $\bar{r}.\left(3\bar{i}-6\bar{j}+2\bar{k}\right)=4$

1) $\cos^{-1}\left(\frac{16}{21}\right)$ 2) $\sin^{-1}\left(\frac{4}{21}\right)$ 3) $\cos^{-1}\left(\frac{1}{4}\right)$ 4) $\cos^{-1}\left(\frac{3}{4}\right)$

20. The work done by the force $\bar{F}=2\bar{i}-3\bar{j}+2\bar{k}$ in making a particle from (3, 4, 5) to (1, 2, 3) is

1) 0 2) 3/2 3) – 4 4) – 2

21. If $\bar{a}$ and $\bar{b}$ are vectors satisfying $\left|\bar{a}\right|=\left|\bar{b}\right|=5$ and $\left(\bar{a},\bar{b}\right)=45^0$ then the area of the triangle constructed with the vectors $\bar{a}-2\bar{b}$ and $3\bar{a}+2\bar{b}$ is

1) $50\sqrt{2}$ sq. unit 12) $5\sqrt{5}$ sq. unit 3) $4\sqrt{5}$ sq. unit 4) $3\sqrt{5}$ sq. units

22. If $\bar{u}=\bar{a}-\bar{b}.\bar{v}=\bar{a}+\bar{b}$ and $\left|\bar{a}\right|=\left|\bar{b}\right|=2$ then $\left|\bar{u}\times\bar{v}\right|=$____

1) $2\sqrt{16-\left(\bar{a}.\bar{b}\right)^2}$ 2) $2\sqrt{4-\left(\bar{a}.\bar{b}\right)^2}$ 3) $\sqrt{16-\left(\bar{a}.\bar{b}\right)^2}$ 4) $\sqrt{4-\left(\bar{a}.\bar{b}\right)^2}$

23. The angle between the vectors $\bar{a}\times\bar{b}$ and $\bar{b}\times\bar{a}$ is

1) 0^0 2) 45^0 3) 90^0 4) 180^0

24. If $\left(\bar{a}\times\bar{b}\right)^2+\left(\bar{a}.\bar{b}\right)^2=144$ and $\left|\bar{a}\right|=4$ then $\left|\bar{b}\right|=$_____

1) 16 2) 8 3) 3 4) 12

25. A unit vector perpendicular to the plane of $\bar{a}=2\bar{i}-6\bar{j}-3\bar{k}$, $\bar{b}=4\bar{i}+3\bar{j}-\bar{k}$ is

1) $\frac{4\bar{i}+3\bar{j}-\bar{k}}{\sqrt{26}}$ 2) $\frac{2\bar{i}+6\bar{j}-3\bar{k}}{7}$ 3) $\frac{3\bar{i}-2\bar{j}+6\bar{k}}{7}$ 4) $\frac{2\bar{i}-3\bar{j}-6\bar{k}}{7}$

26. If $\bar{r}=x\bar{i}+y\bar{j}+z\bar{k}$ then $\left(\bar{r}\times\bar{i}\right).\left(\bar{r}\times\bar{j}\right)+xy=$_____

1) 0 2) 1 3) xy 4) $\bar{i}\times\bar{j}$

27. If $\bar{a}$ is any vector then $\left(\bar{a}\times\bar{i}\right)^2+\left(\bar{a}\times\bar{j}\right)^2+\left(\bar{a}+\bar{k}\right)^2=$________

1) $\bar{a}^2$ 2) $2\bar{a}^2$ 3) $3\bar{a}^2$ 4) $4\bar{a}^2$

28. If $\bar{x}.\bar{a}=0,\bar{x}\times\bar{b}=\bar{c}\times\bar{b}$ then $\bar{x}=$_____

1) $\bar{c}-\frac{\bar{c}.\bar{a}}{\bar{b}.\bar{a}}\bar{b}$ 2) $\bar{c}-\frac{\bar{c}.\bar{a}}{\bar{c}.\bar{b}}\bar{a}$ 3) $\bar{a}-\frac{\bar{c}.\bar{a}}{\bar{c}.\bar{b}}\bar{a}$ 4) $\bar{b}-\frac{\bar{c}.\bar{a}}{\bar{c}.\bar{b}}\bar{b}$

29. The perpendicular distance from A(1, 4, -2) to the line BC where B=(2, 1, -2) and C=(0, -5, 1) is

1) $\frac{\sqrt{26}}{7}$ 2) $\sqrt{\frac{26}{7}}$ 3) $\frac{2\sqrt{26}}{7}$ 4) $\frac{3\sqrt{26}}{7}$

30. Let $\bar{a}=\bar{i}-\bar{k}, \bar{b}=x\bar{i}+\bar{j}+(1-x)\bar{k}$ **and** $\bar{c}=y\bar{i}+x\bar{j}+(1+x-y)\bar{k}$ **then** $[\bar{a}\,\bar{b}\,\bar{c}]$ **depends on**

1) only x 2) only y 3) neither x nor y 4) both x and y

31. If $\bar{a}=\bar{i}+\bar{j}, \bar{b}=\bar{j}+\bar{k}, \bar{c}=\alpha\bar{a}+\beta\bar{b}$ **and the vectors** $\bar{i}-2\bar{j}+\bar{k}, 3\bar{i}+2\bar{j}-\bar{k}, \bar{c}$ **are coplanar then** $\frac{\alpha}{\beta}=$_____

1) 0 2) – 2 3) – 3 4) – 1

32. If $\bar{a}=3\bar{i}+4\bar{j}-5\bar{k}$ **then** $\left|\bar{i}\times(\bar{a}\times\bar{i})+\bar{j}\times(\bar{a}\times\bar{j})+\bar{k}\times(\bar{a}\times\bar{k})\right|=$____

1) $2\sqrt{50}$ 2) $50\sqrt{2}$ 3) $10\sqrt{2}$ 4) $100\sqrt{2}$

33. If $\bar{a}$ **is perpendicular to** $\bar{b}$ **and** $\bar{c}$**,** $|\bar{a}|=2, |\bar{b}|=3, |\bar{c}|=4$ **and the angle between** $\bar{b}$ **and** $\bar{c}$ **is** $\frac{2\pi}{3}$ **then** $\left|[\bar{a}\ \bar{b}\ \bar{c}]\right|=$____

1) 24 2) 12 3) $12\sqrt{3}$ 4) $24\sqrt{3}$

34. If the vectors $a\bar{i}+\bar{j}+\bar{k}, \bar{i}+b\bar{j}+\bar{k}, \bar{i}+\bar{j}+c\bar{k}$, $(\bar{a}\neq\bar{b}, \bar{c}\neq 1)$ **are coplanar, then the value of** $\frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}=$____

1) 0 2) 3 3) 2 4) 1

35. If the volume of the tetrahedron with edges $2\bar{i}+\bar{j}-\bar{k}$**,** $\bar{i}+a\bar{j}+\bar{k}$ **and** $\bar{i}+2\bar{j}-\bar{k}$ **is one cubic unit than a=**______

1) 1 2) – 1 3) 2 4) – 2

36. For non zero vectors $\bar{a}, \bar{b}, \bar{c}$; $\left|(\bar{a}\times\bar{b}).\bar{c}\right|=|\bar{a}||\bar{b}||\bar{c}|$ **holds if and only if**

1) $\bar{a}.\bar{b}=\bar{b}.\bar{c}=\bar{c}.\bar{a}$ 2) $\bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a}=0$ 3) $\bar{a}+\bar{b}+\bar{c}=\bar{0}$ 4) $[\bar{a}\ \bar{b}\ \bar{c}]=0$

37. Let $\bar{a}=2\bar{i}+\bar{j}+\bar{k}$**,** $\bar{b}=\bar{i}+2\bar{j}-\bar{k}$ **and a unit vector** $\bar{c}$ **be coplanar. If** $\bar{c}$ **is perpendicular to** $\bar{a}$ **then** $\bar{c}$ **=**________

1) $\frac{1}{\sqrt{2}}(-\bar{j}+\bar{k})$ 2) $\frac{1}{\sqrt{3}}(-\bar{i}-\bar{j}-\bar{k})$ 3) $\frac{1}{\sqrt{5}}(\bar{i}-2\bar{j})$ 4) $\frac{1}{\sqrt{3}}(\bar{i}-\bar{j}+\bar{k})$

38. If $\bar{a}=2\bar{i}+3\bar{j}-4\bar{k}$, $\bar{b}=\bar{i}+\bar{j}+\bar{k}$ and $\bar{c}=4\bar{i}+2\bar{j}+3\bar{k}$ then $\left|\bar{a}\times(\bar{b}\times\bar{c})\right|=$____

1) $\sqrt{10}$ 2) 1 3) 2 4) $\sqrt{5}$

39. Let $\bar{a}, \bar{b}$ **and** $\bar{c}$ **be non zero vectors such that** $(\bar{a}\times\bar{b})\times\bar{c}=\frac{1}{3}|\bar{b}||\bar{c}|\bar{a}$**. If '**$\theta$**' is the acute angle between the vectors** $\bar{b}$ **and** $\bar{c}$ **then** $\sin\theta=$______

1) $\frac{1}{3}$ 2) $\frac{2\sqrt{2}}{3}$ 3) $\frac{2}{3}$ 4) $\frac{\sqrt{2}}{3}$

40. If $\bar{a}, \bar{b}, \bar{c}$ **are non- coplanar unit vectors such that** $\bar{a}\times(\bar{b}\times\bar{c})=\frac{\bar{b}+\bar{c}}{\sqrt{2}}$**. Then the angle between** $\bar{a}$ **and** $\bar{b}$ **is**

1) $\frac{3\pi}{4}$ 2) $\frac{\pi}{4}$ 3) $\frac{\pi}{2}$ 4) π

MATHS-B

SYLLABUS: Tangent and Normals, Errors and approximations, Rate measure, Mean Value Theorem, Increasing, & Decreasing Functions, Maxima and minima

41. The approximate value of $\cos 61^0$ is
1) 0.4848 2) 0.4849 3) 0.4948 4) 0.5059

42. A circular plate expands when heated from a radius of 5 cms to 5.06 cm the percentage increase in its area is
1) 0.6 2) 1.2 3) 2.4 4) 0.12

43. When the radius of a sphere decreases from 3 cm to 2.98 cm then the approximate decrease in volume of sphere is
1) $0.002\pi cm^3$ 2) $0.072\pi cm^3$ 3) $0.72\pi cm^3$ 4) $0.083\pi cm^3$

44. If there is an error of ± 0.04 in the measurement of the diameter of sphere then the percentage error in its volume, when radius is 10 cm
1) ± 1.2 2) ± 0.06 3) ± 0.006 4) ± 0.6

45. If $f(x) = 3x^2 - x$ where x=1 and $\Delta x = 0.02$ then $\Delta f =$
1) 0.1012 2) 1.012 3) 0.101 4) 0.1

46. The approximate value of $\sqrt{50}$ is
1) 7.0704 2) 7.0741 3) 7.0714 4) 7.0785

47. If the length of simple pendulum decreases by 3% then the percentage error in the period T is decreased by
1) 2 2) 2.5 3) 1.8 4) 1.5

48. The value of 'a' for which $x^3 - 3x + a = 0$ has two distinct roots in [0, 1] is given by
1) -1 2) 1 3) 3 4) does not exists

49. The quadratic equation $3ax^2 + 2bx + c = 0$ has at least one root between 0 and 1 if
1) $a+b+c=0$ 2) $c=0$ 3) $3a+2b+c=0$ 4) $a+b=c$

50. The value of 'c' in lagrange's mean value theorem for $f(x) = x(x-2)^2$ in $[0,2]$ is
1) 0 2) 2 3) 2/3 4) 3/2

51. For the function $f(x) = x^3 - 6x^2 + ax + b$, if Rolle's theorem holds in [1, 3] with $c = 2 + \frac{1}{\sqrt{3}}$ then $(a,b) =$
1) $(11,12)$ 2) $(11,11)$ 3) (11, any value) 4) (any value, 0)

52. The chord joining the points where x= p and x= q on the curve $y = ax^2 + bx + c$ is parallel to the tangent at the point on the curve whose abscissa is
1) $\frac{p+q}{2}$ 2) $\frac{p-q}{2}$ 3) $\frac{pq}{2}$ 4) $\frac{p}{q}$

53. Let I be on open interval contained in the domain of a real function f, then $f(x)$ is colled strictly decreasing function in I if
1) $x_1 < x_2 \ in\ I \Rightarrow f(x_1) < f(x_2)$
2) $x_1 < x_2 \ in\ I \Rightarrow f(x_2) > f(x_2)$
3) $x_1 = x_2 \ in\ I \Rightarrow f(x_1) = f(x_2)$
4) $x_1 = x_2 \ in\ I \Rightarrow f(x_1) < f(x_2)$

54. $f(x_1) = x^x$ is decreasing for
1) $x > \frac{1}{c}$ 2) $x > e$ 3) $0 < x < e$ 4) $0 < x < \frac{1}{e}$

55. $f(x)=\frac{10gx}{x}(x>e)$ **is increasing in**

1) $(0,e)$ 2) (e,∞) 3) $(0,\infty)$ 4) $(-\infty,\infty)$

56. The function $a^2\sec^2 x+b^2\cos ec^2 x$ **attains minimum value when x=**

1) $\tan^{-1}(b/a)$ 2) $\tan^{-1}\left(\sqrt{a/b}\right)$ 3) $\tan^{-1}\left(\sqrt{b/a}\right)$ 4) $\tan^{-1}(a/b)$

57. Stationary point of $y=\frac{10gx}{x}(x>0)$ is

1) $(1,0)$ 2) $\left[e,\frac{1}{e}\right]$ 3) $\left[\frac{1}{e},-e\right]$ 4) $\left[\frac{1}{e},\frac{1}{e}\right]$

58. The minimum value of $f(x)=x^2+\frac{250}{x}$ is

1) 15 2) 25 3) 45 4) 75

59. The minimum value of $\frac{7}{4\sin x+3\cos x+2}$ is

1) 1 2) $\frac{7}{9}$ 3) $\frac{7}{5}$ 4) $\frac{7}{3}$

60. The absolute maximum value of $y=x^3-3x+2$ **in** $0\le x\le 2$ **is**

1) 4 2) 6 3) 2 4) 0

61. A straight line segment through the point (3, 4) in the first quadrant meets the coordinate axes in A and B the minimum area of ΔAOB is

1) 42 2) 64 3) 48 4) 24

62. The point on the curve $x^2=2y$ **which is closest to the point (0, 5) is**

1) $\left(2\sqrt{2},4\right)$ 2) $(4,8)$ 3) $\left(\sqrt{2},1\right)$ 4) $(2,2)$

63. The area of the rectangle of maximum area inscribed in the ellipse $\frac{x^2}{25}+\frac{y^2}{16}=1$

1) 48 2) 41 3) 40 4) 50

64. $P(3,4),Q(-7,6)$**. The point A on x-axis for which PA+AQ is least is**

1) $(-2,0)$ 2) $(-1,0)$ 3) $(3,0)$ 4) $(2,0)$

65. The slope of the normal to the curve given by $x=a(\theta-\sin\theta),y=a(1-\cos\theta)$ at $\theta=\frac{\pi}{2}$

1) $\frac{-1}{2}$ 2) $\frac{1}{2}$ 3) -1 4) 2

66. The points on the curve $y=\sin x$**, where the tangent is parallel to the x-axis is**

1) $\left[\frac{n\pi}{2},1\right]$ 2) $\left[(2n+1)\frac{\pi}{2},(-1)^n\right]$ 3) $\left[(2n-1)\frac{\pi}{3},(-2)^n\right]$ 4) $\left[n\pi,(-1)^n\right]$

67. The sum of the squares of intercepts on the axes of the tangent at any point on the curve $x^{2/3}+y^{2/3}=a^{2/3}$ is

1) $\frac{a^2}{2}$ 2) a^2 3) 2a 4) $\frac{3a}{2}$

68. If the straight line $x\cos\alpha+y\sin\alpha=p$ **touches the curve** $\left(\frac{x}{a}\right)^n+\left(\frac{y}{b}\right)^n=2$ **at the point (a, b) on it, then** $\frac{1}{a^2}+\frac{1}{b^2}=$

1) $\frac{1}{p^2}$ 2) $\frac{2}{p^2}$ 3) $\frac{3}{p^2}$ 4) $\frac{4}{p^2}$

69. The area of the triangle formed by the tangent to the curve $xy = a^2$ at (x_1, y_1) on it and the axes is

1) a^2 sq. units 2) $3a^2/125$ sq. units 3) $2a^2$ sq. units 4) $4a^2$ sq. units

70. The length of sub-tangent to the curve $y^n = a^{n-1}.x$ at (x, y) on it is

1) $\left|\frac{n}{x}\right|$ 2) $|nx|$ 3) $n^2|x|$ 4) $\frac{n^2}{|x|}$

71. For the curve $y = a^x (a > 1)$ the L.S.N. at any point on the curve varies as the ……. Of the ordinate

1) square 2) cube 3) twice 4) thrice

72. The angle between the curves y=sinx and y=cosx is

1) $\frac{\pi}{3}$ 2) $\frac{\pi}{2}$ 3) $\tan^{-1}(2)$ 4) $\tan^{-1}(2\sqrt{2})$

73. If the curves $x = y^2$ and $xy = k$ cut each other orthogonally then $k^2 =$

1) $\frac{1}{2}$ 2) $\frac{1}{4}$ 3) $\frac{1}{8}$ 4) $\frac{1}{16}$

74. The equation of the tangent to the curve $y = 2\sin x + \sin 2x$ at $x = \frac{\pi}{3}$ on it is

1) $y - 3 = 0$ 2) $y + \sqrt{3} = 0$ 3) $2y - 3 = 0$ 4) $2y - 3\sqrt{3} = 0$

75. If the distance s travelled by a particle in time t is given by $s = t^2 - 2t + 5$ then its acceleration is

1) 0 2) 1 3) 2 4) 3

76. A stone is thrown vertically upwards and the height reached by it in time t is given by $s = 80t - 16t^2$ then the stone reaches the maximum height in time t=

1) 2 sec 2) 2.5 sec 3) 3 sec 4) 3.5 sec

77. A point on parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa is

1) $(2,2)$ 2) $(9/8, 9/2)$ 3) $(-9/8, 9/2)$ 4) $(2,-8)$

78. The side of an equilateral triangle expands at the rate of 2 cms/sec. The rate of increase of its area when each side is 10 cms is

1) $10\sqrt{2}$ sq. cms/sec 2) $10\sqrt{3}$ sw. cms/sec 3) 10 sq. cms/sec 4) 5 sq. cms/sec

79. The distance moved by the particle in time 't' is given by $s = t^3 - 12t^2 + 6t + 8$. At the instant, when its acceleration is zero the velocity is

1) 42 2) – 42 3) 48 4) – 48

80. If the rate of change in the perimeter of a square is k bines the rate of change in its side then k=

1) 2 2) 3 3) 4 4) 1

PHYSICS

SYLLABUS: Mechanical properties of Fluids (Surface tension) : Theory & Problems, Fluid dynamics Thermal properties of Matter, Thermodynamics, Heat Transfer, Kinetic Theory of Gases

81. The average velocity of molecules of a gas of molecular weight M at temperature T is

1) $\sqrt{\frac{3RT}{M}}$ 2) $\sqrt{\frac{8RT}{M}}$ 3) $\sqrt{\frac{2RT}{M}}$ 4) Zero

82. Four particles have velocities 1, 0, 2, and 3 m/sec. The root mean square velocity of the particles is

1) 3.5 m/sec 2) $\sqrt{3.5}$ m/sec 3) 1.5 m/sec 4) $\sqrt{\frac{14}{3}}$ m/sec

83. The temperature of an ideal gas is increased from 27^0C to 927^0C the rms speed of it's molecules

1) twice 2) half 3) four times 4) one-fourth

84. Incase of hydrogen and oxygen at NTP, which of the following is the same for both?

1) Average linear momentum per molecule
2) Average KE per molecule
3) KE per unit volume
4) KE per unit mass

85. The average kinetic energy of the molecules of an ideal gas at 10^0C has the value E the temperature at which the kinetic energy of the same gas becomes 2E is

1) 5^0C 2) 10^0C 3) 40^0C 4) None of these

86. A polyatomic gas with n degrees of freeform has a mean energy per molecule given by

1) $\frac{n}{2}RT$ 2) $\frac{1}{2}RT$ 3) $\frac{n}{2}KT$ 4) $\frac{1}{2}KT$

87. In a process, the pressure of a gas remains constant. If the temperature is doubled, then the change in the volume will be

1) 100% 2) 200% 3) 50% 4) 25%

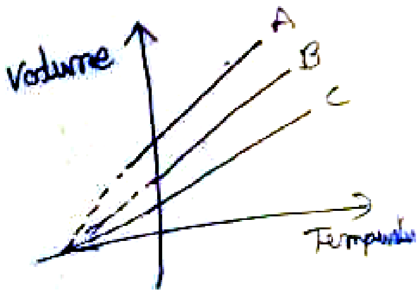
88. A steel rod of length 1m is heated from 25^0C to 75^0C keeping its length constant. The longitudinal strain developed in the rod is $\left(\alpha = 12\times10^{-6}/^0C\right)$

1) 6×10^{-4} 2) -6×10^{-5} 3) -6×10^{-4} 4) Zero

89. The coefficient of linear expansion of steel and brass are $11\times10^{-6}/^0C$ and $19\times10^{-6}/^0C$ respectively. If their difference in length at all temperature has to kept constant at 30cm their length at 0^0C should be

1) 71.25 cm and 41.25 cm
2) 82 cm and 52 cm
3) 92 cm and 62 cm
4) 62.25 cm and 32.25 cm

90. The expansion of an ideal gas of mass m at a constant pressure P is given by the straight line B. Then, the expansion of the same ideal gas of mass 2m at a pressure 2P is given by the straight line



1) C 2) A 3) B 4) Data insufficient

91. In a process, the pressure of an ideal gas is proportional to square of the volume of the gas if the temperature of the gas increases in this process, then work done by this gas

1) Positive
2) Negative
3) Zero
4) May be positive or negative

92. For an adiabatic compression the quantity PV

1) Increases 2) Decreases 3) Remains constant 4) depends on r

93. An ideal gas has initial volume V and pressure P. In doubling its volume the minimum work done will be in the process

1) Isobaric process
2) Isothermal process
3) Adiabatic process
4) same in all given process

94. A cannot engine works between 600K and 300K. The efficiency of the engine is

1) 50 % 2) 70% 3) 20% 4) 80%

95. Air in a cylinder is suddenly compressed by a piston which is then maintained at the same position. As the time passes pressure of the gas

1) Increases 2) Decreases 3) Remains the same
4) may increases of decreases depending on the nature of the gas.

96. A cycle pump becomes hot near the nozzle after a fuel quick strokes even if they are smooth because

1) Volume of air decreases
2) number of air molecules increases
3) The compression is adiabatic
4) collision between air particles increases

97. In an adiabatic change, the pressure P and temperature T of a diatomic gas are related by the relation $P \alpha T^{\alpha}$, where α equals

1) 1.67
2) 0.4
3) 0.6
4) 3.5

98. A diatomic gas obeys the law $PV^x =$ constant for what value of x, it has negative molar specific heat?

1) x > 1.4
2) x < 1.4
3) 1<x < 1.4
4) 0< x < 1

99. The molar specific heat at constant volume of gas mixture is $\frac{13R}{6}$. The gas mixture consis of

1) 2 moles of O_2 and 4 moles of H_2
2) 2 moles of O_2 and 4 moles of Argon
3) 2 moles of Argon and 4 moles of O_2
4) 2 moles of CO_2 and 4 moles of Argon

100. For an enclosure maintained at 2000 K, the maximum radiation occurs at wavelength λ_m. If the temperature is raised to 3000 K, The peak will shift to

1) 0.5 λ_m
2) λ_m
3) $\frac{2}{3}\lambda_m$
4) $\frac{3}{2}\lambda_m$

101. A substance cools from 75^0C to 70^0C in T_1 minute, from 70^0C to 65^0C in T_2 minute and from 65^0C to 60^0C in T_3 minute, then

1) $T_1 = T_2 = T_3$
2) $T_1 < T_2 < T_3$
3) $T_1 > T_2 > T_3$
4) $T_1 < T_2 > T_3$

102. Two liquids are at temperature 20^0C and 40^0C. When same mass of both of them is mixed, the temperature of the mixture is 32^0C. What is the ratio of their specific heats?

1) 1/3
2) 2/5
3) 3/2
4) 2/3

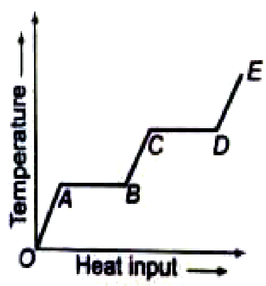
103. The specific heat of a metal at low temperatures varies according to $S = aT^3$, where a is a constant and T is absolute temperature. The heat energy needed to raise unit mass of the metal from temperature T= 1 K to T= 2 K is

1) 3a
2) $\frac{15a}{4}$
3) $\frac{2a}{3}$
4) $\frac{13a}{4}$

104. The intensity of radiation emitted by the sun has its maximum value at a wavelength of 510 nm and that emitted by the North star has the maximum value at 350 nm. If these stars behave like black bodies, then the ratio of the surface temperatures of the sun and the north star is

1) 1.46
2) 0.69
3) 1.21
4) 0.83

105. A solid material is supplied heat at a constant rate. The temperature of material is changing with heat input as shown in the figure. What does the slope of DE represent?



1) Latent heat of liquid
2) Latent heat of vaporization
3) Heat capacity of vapour
4) Inverse of heat capacity of vapour

106. Two ends of rods of length L and radius R of the same material are kept at the same temperature. Which of the following rods conducts the maximum heat?

1) L= 50 cm, R= 1 cm
2) L= 100 cm, R= 2 cm
3) L = 25 cm, R= 0.5 cm
4) L= 75 cm, R= 1.5 cm

107. 1g of ice at 0^0C is mixed with 1g of steam at 100^0C. After thermal equilibrium is achieved, the temperature of the mixture is

1) 100^0C
2) 55^0C
3) 75^0C
4) 0^0C

108. A wall has two layers A and B each made of different materials. The layer A is 10 cm thick and B is 20 cm thick. The thermal conductivity of A is thrice that of B. Under thermal equilibrium temperature difference across the wall is 35^0C. The difference of temperature across the layer A is

1) 30^0C 2) 14^0C 3) 8.75^0C 4) 5^0C

109. A wall has two layers A and B each made of different materials. Both the layers have the same thickness. The thermal conductivity of material A is twice of B. Under thermal equilibrium the temperature difference across the layer B is 36^0C. The temperature difference across layer A is

1) 6^0C 2) 12^0C 3) 18^0C 4) 24^0C

110. The end of two rods of different materials with their thermal conductivities, area of cros-section and lengths all in the ratio 1:2 are maintained at the same temperature difference. If the rate of flow of heat in the first rod is 4 cal/s. Then, in the second rod rate of heat flow in cal/s will be

1) 1 2) 2 3) 8 4) 16

111. A pipe having an internal diameter D is connected to another pipe of same size water flows into the second pipe through 'n' holes, each of diameter d. If the water in the first pipe has speed v, the speed of water leaving the second pipe is

1) $\frac{D^2V}{nd^2}$ 2) $\frac{nD^2V}{d^2}$ 3) $\frac{nd^2V}{D^2}$ 4) $\frac{d^2V}{nD^2}$

112. Eight spherical rain drops of the same mass and radius are falling down with a terminal speed of 6 cm/sec if they coalesce to form one big drop, what will be the terminal speed of bigger drop?

1) 1.5 cm/sec 2) 6 cm/sec 3) 24 cm/sec 4) 32 cm/sec

113. The surface tension of soap solution is 0.03 N/m. The work done in blowing to form a soap bubble of surface area 40 cm^2 is

1) $1.2\times10^{-4}J$ 2) $2.4\times10^{-4}J$ 3) $12\times10^{-4}J$ 4) $24\times10^{-4}J$

114. Two rain drops reach the earth with different terminal velocities having ratio 9:4 then the ratio of their volume is

1) 3:2 2) 4:9 3) 9:4 4) 27:8

115. The excess pressure inside a spherical soap bubble of radius 1 cm is balanced by a column of oil (specific gravity = 0.8), 2 mm high, the surface tension of the bubble is

1) 3.92 N/m 2) 0.0392 N/m 3) 0.392 N/m 4) 0.00392 N/m

116. The excess pressure inside a soap bubble is

1) Inversely proportional to the surface tension 2) Inversely proportional to its radius
3) directly proportional to square of its radius 4) directly proportional to its radius

117. For an ideal fluid, viscosity is

1) Zero 2) Infinity 3) Finite but small 4) Unity

118. At critical temperature surface tension becomes

1) 0 2) 1 3) Infinite 4) negative

119. The surface tension of liquid – with rise of temperature

1) Increases 2) Decreases 3) remains same
4) first decreases and the increases

120. Liquid drops acquire spherical shape due to

1) gravity 2) surface tension
3) viscosity 4) intermolecular separation

CHEMISTRY

SYLLABUS: 14th group elements, Organic Chemistry : Purification, qualitative and quantitative analysis, reaction mechanism. Classification and Nomenclature, Isomerism, Alkanes and Alkenes, Alkynes and Benzene

121. How many atoms are planar in but – 2 – ene?

1) 4 2) 6 3) 8 4) 12

122. The bonds in acetylene are

1) $3\sigma, 2\pi$ 2) $2\sigma, 3\pi$ 3) $6\sigma, 2\pi$ 4) $2\sigma, 2\pi$

123. In kjeldhal method, nitrogen is estimated as

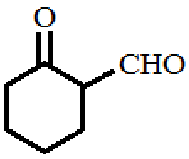
1) NH_3 2) N_2 3) NO_2^- 4) All of these

124. Fractional crystallization is based on

1) Difference in M.P 2) Difference in BP
3) Difference in solubility 4) Crystal structure

125. The reagent used to identify amino acids, separated by paper chromatography is

1) $FeCl_3$ 2) Ninhydrin
3) Sodium nitroprusside 4) $BaCl_2$

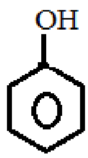
126. The IUPAC name of  **is**

1) 2 – oxo cyclohexane carbaldehyde 2) 2 – oxo cyclo hexyl methanol
3) 1 – Formyl – 2 – keto cyclo hexane 4) 1 – oxo – 2 – formyl cyclohexane

127. The formula of vinyl acetic acid is

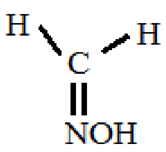
1) $H_2C = CH - COOH$ 2) $H_2C = CH - CH_2 - COOH$
3) $H_2C = CH - CH_2CH_2COOH$ 4) $H_2C = \underset{CH_3}{\underset{|}{C}} - COOH$

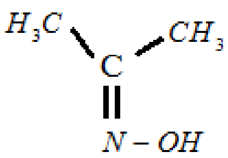
128. Which of the following exhibits tautomerism?

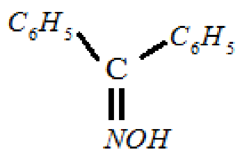
1) H_3CCHO 2) H_3CCOCH_3 3) 

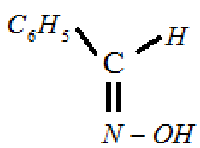
4) All

129. The compound which shows geometrical isomerism is

1) 

2) 

3) 

4) 

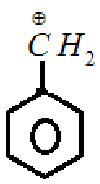
130. Optical isomers differ

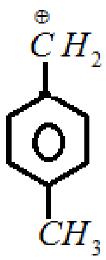
1) Solubility 2) M.P
3) B.P 4) Angle of rotation of plane polarized light

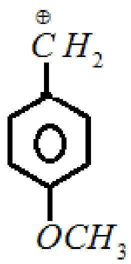
131. Identify the better nucleophile

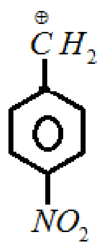
1) F^- 2) Cl^- 3) Br^- 4) I^-

132. Identify the least stable carbocation.

1) 

2) 

3) 

4) 

133. Which of the following is a stronger acid?
1) $\begin{array}{c} COOH \\ | \\ COOH \end{array}$ 2) Cl_3CCOOH 3) $\begin{array}{l} CH_2-COOH \\ | \\ NO_2 \end{array}$ 4) $CHCl_2COOH$

134. C_5H_{12} forms only one monochloro derivative it is
1) Neopentane 2) n- pentane 3) Iso pentane 4) Cyclo pentane

135. Which of the following reaction is not suitable for preparing methane?
1) Wurtz 2) Kolbes electrolysis 3) Sebatier – senderen 4) All

136. Both methane and ethane are obtained from
1) CH_3CH_2MgBr 2) CH_3COOH 3) $CH_2=CH_2$ 4) CH_3OH

137. The reagent required to convert $H_3C-C\equiv C-CH_3$ into trans but – 2 – ene is
1) $H_2/Pd, BaSO_4$, Quinoline 2) $Na, NH_{3(l)}$
3) Na, ethanol 4) Both 2 and 3

138. Which of the following reactions produce a secondary free radical?
1) $H_3C-CH=CH_2 \xrightarrow{HBr}$ 2) $H_3C-CH=CH_2 \xrightarrow[Peroxide]{HBr}$
3) $H_3C-CH=CH_2 \xrightarrow[Sunlight]{Cl_2}$ 4) $H_3C-CH_3 \xrightarrow[hv]{Cl_2}$

139. The reagent required to distinguish alkenes from alkynes is
1) Br_2/H_2O 2) Ammonical $AgNO_3$
3) Ammonical copper chloride 4) Both 2 and 3

140. Addition of hypochlorous acid to an alkene is initiated by
1) $\overset{\oplus}{O}H$ 2) $\overset{\oplus}{C}l$ 3) $\overset{\ominus}{C}l$ 4) $\overset{\ominus}{O}H$

141. Chloroform is heated with Ag. The compound is
1) Ethane 2) Methane 3) Acetylene 4) Propene

142. $HC\equiv CH \xrightarrow{SeO_2} X$. X is
1) Glyoxal 2) Oxalic acid 3) Formic acid 4) Acetic acid

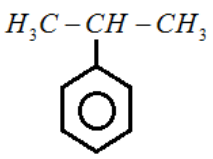
143. $Hex-2-yne \xrightarrow[HgSO_4, H_2SO_4]{H_2O} X+Y$. X and Y are
1) Chain isomers 2) Position isomers 3) Tautomers 4) Metamers

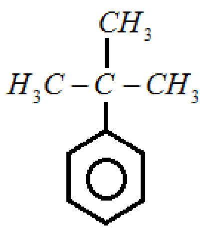
144. $HC\equiv CH \xrightarrow[HgSO_4, H_2SO_4]{H_2O} A \xrightarrow[NaOH]{Cl_2\ excess} B \xrightarrow[\Delta]{Ag} C$. C is
1) Acetylene 2) Chloroform 3) $HC\equiv\bar{C}:Ag^+$ 4) Ethylene

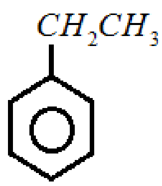
145. Which is more useful for welding?
1) Acetylene 2) Propyne 3) Butyne-1 4) Butyne- 2

146. Benzene is obtained by heating phenol with
1) Na 2) Mg 3) Zn 4) K

147. The C –C bond order in benzene is
1) 1 2) 2 3) 1.5 4) 2.5

148. Which of the following is not oxidized by alkaline KMnO$_4$?
1) Naphthalene 2) 

3) 

4) 

149. The electrophile introduced in the benzene ring during chlorination of benzene is
1) Chloronium ion 2) chloride ion 3) Chlorine atom 4) Chlorine free radical

150. Benzene is present in which of the following fraction of coaltar?
1) Light oil 2) Middle oil 3) Heavy oil 4) Green oil

151. Carboxylic acids and esters
1) Chain Isomers 2) Position isomers 3) Functional isomers 4) Tautomers

152. An organic compound is separated from its aqueous solution by

1) Distillation
2) Solvent extraction
3) Steam distillation
4) Distillation under reduced pressure

153. How many oxygen atoms of SiO_4^{4-} units shared in the continuous 3D frame work silicates

1) 1
2) 2
3) 3
4) 4

154. Asbestos has composition as

1) $CaO.Al_2O_3.SiO_2.H_2O$
2) $CaO.3MgO.4SiO_2$
3) $3MgO.4SiO_2.H_2O$
4) $Al_2O_3.SiO_2.2H_2O$

155. Sn(II) is a strong reducing agent than Pb(II) because

1) Pb(II) is more stable than Sn(II)
2) Pb(II) is less stable than Sn(II)
3) Sn(IV) forms more covalent compounds
4) Pb(II) forms covalent compounds

156. Carborundum on heating with caustic soda in the presence of air produces

1) $Na_2SiO_3 + H_2$
2) $Na_2SiO_3 + Na_2CO_3$
3) $Na_2SiO_2 + H_2$
4) $Na_2SiO_4 + O_2$

157. The correct order of decreasing ionic nature of lead dihalides is

1) $PbF_2 > PbCl_2 > PbBr_2 > PbI_2$
2) $PbF_2 > PbBr_2 > PbCl_2 > PbI_2$
3) $PbF_2 < PbCl_2 > PbBr_2 < PbI_2$
4) $PbI_2 < PbBr_2 < PbF_2 < PbCl_2$

158. $A \xrightarrow{\text{Red hot coke}} CO \xrightarrow{Cl_2} C \xrightarrow{H_2O} 2HCl + A$**. The compounds A and C are**

1) $CO_2, COCl_2$
2) $CO, COCl_2$
3) C, CO_2
4) CO_2, CO

159. Generally diamonds are good conductors of heat. This property of diamonds can be used

1) to estimate the hardness of diamonds
2) to determine the refractive index of diamonds
3) to find out whether the given diamonds is fake or original
4) to determine its chemical reactivity

160. Which of the following minerals classified as an orthosilicate?

1) $CaMg\left[\left(SiO_3\right)_2\right]$
2) $Na_4Si_2O_7$
3) $Ca_3\left[Si_3O_9\right]$
4) $Zn_2\left[SiO_4\right]$

KEY-SHEET

MATHS-A

1) **4**	2) **1**	3) **2**	4) **2**	5) **3**	6) **1**	7) **3**	8) **2**	9) **2**	10) **4**
11) **4**	12) **2**	13) **3**	14) **4**	15) **2**	16) **2**	17) **3**	18) **2**	19) **1**	20) **4**
21) **1**	22) **1**	23) **4**	24) **3**	25) **3**	26) **1**	27) **2**	28) **1**	29) **4**	30) **3**
31) **3**	32) **3**	33) **3**	34) **4**	35) **3**	36) **1**	37) **1**	38) **4**	39) **2**	40) **1**

MATHS-B

41) **2**	42) **3**	43) **3**	44) **4**	45) **1**	46) **3**	47) **4**	48) **4**	49) **1**	50) **3**
51) **3**	52) **1**	53) **2**	54) **4**	55) **1**	56) **3**	57) **2**	58) **4**	59) **1**	60) **1**
61) **4**	62) **1**	63) **3**	64) **2**	65) **3**	66) **2**	67) **2**	68) **4**	69) **3**	70) **2**
71) **1**	72) **4**	73) **3**	74) **4**	75) **3**	76) **2**	77) **2**	78) **2**	79) **2**	80) **3**

PHYSICS

81) **2**	82) **2**	83) **1**	84) **2**	85) **4**	86) **3**	87) **1**	88) **3**	89) **1**	90) **3**
91) **1**	92) **1**	93) **3**	94) **1**	95) **2**	96) **3**	97) **4**	98) **3**	99) **3**	100) **3**
101) **2**	102) **4**	103) **2**	104) **2**	105) **4**	106) **2**	107) **1**	108) **4**	109) **3**	110) **3**
111) **1**	112) **3**	113) **2**	114) **4**	115) **2**	116) **2**	117) **1**	118) **1**	119) **2**	120) **2**

CHEMISTRY

121) **2**	122) **1**	123) **1**	124) **3**	125) **2**	126) **1**	127) **2**	128) **4**	129) **4**	130) **4**
131) **4**	132) **4**	133) **2**	134) **1**	135) **4**	136) **2**	137) **4**	138) **2**	139) **4**	140) **2**
141) **3**	142) **1**	143) **2**	144) **1**	145) **1**	146) **3**	147) **3**	148) **3**	149) **1**	150) **1**
151) **3**	152) **2**	153) **4**	154) **2**	155) **1**	156) **2**	157) **1**	158) **1**	159) **3**	160) **4**

HINTS & SOLUTIONS

1. Given points are collinear

$\Rightarrow \overline{AC} = \alpha \overline{AB}$; for some α

$\Rightarrow (\lambda+2)\bar{i} - 3\bar{j} - 6\bar{k} = \alpha\left(3\bar{i} - \bar{j} - 2\bar{k}\right)$

$\Rightarrow \alpha = 3$; $\lambda + 2 = 3\alpha$

$\Rightarrow \lambda = 7$

2. $x\bar{a} + y\bar{b} = \bar{c}$

$\Rightarrow 2x - y = 5, -x + 4y = 1$

$\Rightarrow x = 3, y = 1$

3. $\left(\bar{i} + \bar{j} + 3\bar{k}\right)x + \left(3\bar{i} - 3\bar{j} + \bar{k}\right)y + \left(-4\bar{i} + 5\bar{j}\right)Z$

$= \lambda\left(x\bar{i} + y\bar{j} + z\bar{k}\right)$

$\Rightarrow (1-\lambda)x + 3y - 4z = 0$

$\Rightarrow x + (-3-\lambda)y + 5z = 0$

$3x + y - \lambda z = 0$

$$\Rightarrow \begin{vmatrix} 1-\lambda & 3 & -4 \\ 1 & -3-\lambda & 5 \\ 3 & 1 & -\lambda \end{vmatrix} = 0$$

$\Rightarrow \lambda = 0, -1$

4. Ratio $-2-1:1-7$

$\Rightarrow -3:-6$

$\Rightarrow 1:2$

5. If D is the mid point of

BC then $\overline{AD} = \frac{1}{2}\left(\overline{AB} + \overline{AC}\right)$

$= 4\bar{i} - \bar{j} + 4\bar{k}$

$\Rightarrow \left|\overline{AD}\right| = \sqrt{16+1+16} = \sqrt{33}$

6. Let $\overline{OA} = \bar{a}, \overline{OB} = \bar{b} : \overline{OP} = \bar{r} \Rightarrow \overline{OC} = \dfrac{\bar{a} + \bar{b}}{2}$

$\overline{PA} + \overline{PB} = \bar{a} - \bar{r} + \bar{b} - \bar{r}$

$= \bar{a} + \bar{b} - 2\bar{r}$

$= 2\overline{OC} - 2\overline{OP}$

$= 2\overline{PC}$

7. Conceptual

$\overline{SA} + \overline{SB} + \overline{SC} = \overline{SO}$

8. Circum centre $= 2\bar{i} + \left(\dfrac{3+4}{2}\right)\bar{j} + \left(\dfrac{5+7}{2}\right)\bar{k}$

$= 2\bar{i} + \frac{7}{2}\bar{j} + 6\bar{k}$

9. $AB = 7, BC = 7, CD = 7, DA = 7$

$AC = \sqrt{74}, BD = \sqrt{122}$

$\therefore ABCD$ is a rhombus.

10. $\bar{a}+S\left(\bar{b}+\bar{c}\right)=\bar{b}+t\left(\bar{c}+\bar{a}\right)$

$\Rightarrow s=1, \quad t=1$

$\therefore$ Point of intersection $=\bar{a}+\bar{b}+\bar{c}$

11. By verification

Ans: 4

12. $0\le\left|\bar{a}+\bar{b}+\bar{c}\right|^2=\left(\bar{a}\right)^2+\left(\bar{b}\right)^2+\left(\bar{c}\right)^2 2\left(\bar{a}.\bar{b}\right)+\left(\bar{c}.\bar{b}+\bar{c}.\bar{a}\right)$

$\Rightarrow \bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a}\ge -\frac{3}{2}$

Now $\left|\bar{a}-\bar{b}\right|^2+\left|\bar{b}-\bar{c}\right|^2+\left|\bar{c}-\bar{a}\right|^2=2\left[\left(\bar{a}\right)^2+\left(\bar{b}\right)^2+\left(\bar{c}\right)^2-\left(\bar{a}.\bar{b}+\bar{a}.\bar{c}+\bar{b}.\bar{c}\right)\right]$

$\le 2\left(3+\frac{3}{2}\right)=9$

13. $\overline{AC}=\overline{OC}-\overline{OA}=\left(a-2\right)\bar{i}-2\bar{j}$

$\overline{BC}=\overline{OC}-\overline{OB}=\left(a-1\right)\bar{i}+6\bar{k}$

$C=\frac{\pi}{2}\Rightarrow \overline{AC}.\overline{BC}=0$

$\Rightarrow\left(a-2\right)\left(a-1\right)=0$

$\Rightarrow a=1,2.$

14. Orthogonal projection of $\bar{a}$ on $\bar{b}$ is

$\frac{\left(\bar{a}.\bar{b}\right)\bar{b}}{\left|\bar{b}\right|^2}=\frac{9\left(5\bar{i}-3\bar{j}+\bar{k}\right)}{35}$

15. $\left|\bar{a}-\bar{b}\right|^2=\bar{a}^2+\bar{b}^2-2\bar{a}.\bar{b}$

$=\bar{a}^2+\bar{b}^2-2\left(\bar{a}\right)\left(\bar{b}\right)\cos\theta$

$=2-2\cos\theta$

$=2\left(1-\cos\theta\right)$

$\therefore\left|\bar{a}-\bar{b}\right|=2\sin\left(\frac{\theta}{2}\right).$

16. $\left(\bar{a}+\bar{b}+\bar{c}\right)^2=0$

$\Rightarrow \bar{a}^2+\bar{b}^2+\bar{c}^2+2\left(\bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a}\right)=0$

$\Rightarrow 1+4+9+2\left(\bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a}\right)=0$

$\Rightarrow \bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a}=-7$

17. obtuse angle than

$\bar{a}.\bar{b}<0$

$\Rightarrow cx^2-12+6<x<0;\forall x$

$\therefore c<0$ and $36x^2+48x<0$

$\Rightarrow c<0, 3c+4>0$

$\Rightarrow c<0, c<\frac{-4}{3}$

$\therefore -\frac{4}{3}<c<0$

18. Point on the line is $\left(2,-2,3\right)$

Given plane $x+5y+z=5$
Distance of line form the plane=
Perpendicular distance from $(2,-2,3)$
To plane is $\frac{|2-10+3-5|}{\sqrt{1+25+1}}=\frac{10}{3\sqrt{3}}$

19. Let $\bar{a}=2\bar{i}-\bar{j}-2\bar{k}, \bar{b}=3\bar{i}-6\bar{j}+2\bar{k}$
$\therefore \cos\theta=\frac{\bar{a}.\bar{b}}{|\bar{a},\bar{b}|}=\frac{16}{3\times 7}=\frac{16}{21}$

20. $\overline{AB}=\overline{OB}-\overline{OA}=-2\bar{i}-2\bar{j}-2\bar{k}$
Work done $=\bar{F}.\overline{AB}$
$=\left(2\bar{i}-3\bar{j}+2\bar{k}\right).\left(-2\bar{i}-2\bar{j}-8\bar{k}\right)$
$=4+6-4=-2$

21. Area $=\frac{1}{2}\left|\left(\bar{a}-2\bar{b}\right)\times\left(3\bar{a}-2\bar{b}\right)\right|$
$=\frac{1}{2}\left|3\left(\bar{a}\times\bar{a}\right)+2\left(\bar{a}\times\bar{b}\right)-6\left(\bar{b}\times\bar{a}\right)-4\left(\bar{b}\times\bar{b}\right)\right|$
$=\frac{1}{2}\left(8\left(\bar{a}\times\bar{b}\right)\right)=4|\bar{a}||\bar{b}|\sin\left(\bar{a}\ \bar{b}\right)$
$=4(5)(5)\sin 45^0=50\sqrt{2}sq.unit$

22. $|\bar{u}\times\bar{v}|=\left|\left(\bar{a}-\bar{b}\right)\times\left(\bar{a}+\bar{b}\right)\right|=2|\bar{a}\times\bar{b}|$
$=2\sqrt{\bar{a}^2\bar{b}^2-\left(\bar{a}.\bar{b}\right)^2}=2\sqrt{16-\left(\bar{a}.\bar{b}\right)^2}$

23. The angle between $\bar{a}\times\bar{b}$ and $\bar{b}\times\bar{a}$ is 180^0

24. $\left(\bar{a}\times\bar{b}\right)^2+\left(\bar{a}.\bar{b}\right)^2=|\bar{a}|^2|\bar{b}|^2\Rightarrow 144=16|\bar{b}|^2\Rightarrow|\bar{b}|^2=9$
$\Rightarrow|\bar{b}|=3$

25. Unit vector perpendicular to both $\bar{a}\,\&\,\bar{b}$ is $\frac{\bar{a}\times\bar{b}}{|\bar{a}\times\bar{b}|}$

26. $\left(\bar{r}\times\bar{i}\right).\left(\bar{r}\times\bar{j}\right)+xy=\left(-y\bar{k}+z\bar{j}\right).\left(x\bar{k}-2\bar{i}\right)+xy=-xy+xy=0$

27. $\left(\bar{a}\times\bar{i}\right)^2+\left(\bar{a}\times\bar{j}\right)^2+\left(\bar{a}\times\bar{k}\right)^2=2\left(\bar{a}\right)^2$

28. $\bar{x}\times\bar{b}=\bar{c}\times\bar{b}\Rightarrow\left(\bar{x}-\bar{c}\right)\times\bar{b}=0$
$\Rightarrow\bar{x}-\bar{c}$ is parallel to $\bar{b}$
$\Rightarrow\bar{x}-\bar{c}=\lambda\bar{b}$
$\therefore$ for some scalar $\lambda=\bar{x}=\bar{c}+\lambda\bar{b}$
$\Rightarrow\bar{x}.\bar{a}=0\Rightarrow\left(\bar{c}+\lambda\bar{b}\right).\bar{a}=0\Rightarrow\bar{c}.\bar{d}+\lambda\bar{b}.\bar{a}=0\Rightarrow\lambda=-\frac{\bar{c}.\bar{a}}{\bar{b}.\bar{a}}$
$\Rightarrow\bar{x}=\bar{c}-\frac{\bar{c}.\bar{a}}{\bar{b}.\bar{a}}\bar{b}$

29. The perpendicular distance from A to $\overline{BC}$ is $\frac{|\overline{BA}\times\overline{BC}|}{|\overline{BC}|}$

30. $\left[\bar{a}\,\bar{b}\,\bar{c}\right]=\begin{vmatrix}1 & 0 & -1\\ x & 1 & 1-x\\ y & x & 1+x-y\end{vmatrix}$

$c_3 \to c_3 + c_1$

$=\begin{vmatrix}1 & 0 & 0\\ x & 1 & 1\\ y & x & 1+x\end{vmatrix}$

$=(1+x)-x=1$ which depends neither on x nor on y

31. $\bar{c}=\alpha\left(\bar{i}+\bar{j}\right)+\beta\left(\bar{j}+\bar{k}\right)=\alpha\bar{i}+(\alpha+\beta)\bar{j}+\beta\bar{k}$

Given vectors are coplanar $\Rightarrow\begin{vmatrix}\alpha & \alpha+\beta & \beta\\ 1 & -2 & 1\\ 3 & 2 & -1\end{vmatrix}=0$

$\Rightarrow\frac{\alpha}{\beta}=-3.$

32. $Wkt\;\bar{i}\times\left(\bar{a}\times\bar{i}\right)+\bar{j}\times\left(\bar{a}\times\bar{j}\right)+\bar{k}\times\left(\bar{a}\times\bar{k}\right)=2\bar{a}$

$=2\left|3\bar{i}+4\bar{j}-5\bar{k}\right|=2\sqrt{9+16+15}=2\sqrt{50}=10\sqrt{2}$

33. $\left|\left[\bar{a}\;\bar{b}\;\bar{c}\right]\right|=\left|\bar{a}.\left(\bar{b}\times\bar{c}\right)\right|=\left|\bar{a}\right|\left|\bar{b}\times\bar{c}\right|\cos\left(\bar{a}.\bar{b}\times\bar{c}\right)=\left|\bar{a}\right|\left|\bar{b}\times\bar{c}\right|$

$=\left|\bar{a}\right|\left|\bar{b}\right|\left|\bar{c}\right|\sin\left(\bar{b}\,\bar{c}\right)$

$=2.3.4\sin 2\frac{\pi}{3}$

$=24\left(\frac{\sqrt{3}}{2}\right)=12\sqrt{3}$

34. $\Rightarrow\begin{vmatrix}a & 1 & 1\\ 1 & b & 1\\ 1 & 1 & c\end{vmatrix}=0$

$\Rightarrow R_1\to R_1-R_2,R_2\to R_2-R_3$

$\Rightarrow\begin{vmatrix}a-1 & 1-b & 0\\ 0 & b-1 & 1-c\\ 1 & 1 & c\end{vmatrix}=0$

$\Rightarrow(1-a)(1-b)(1-c)\begin{vmatrix}-1 & 1 & 0\\ 0 & -1 & 1\\ \frac{1}{1-a} & \frac{1}{1-b} & \frac{1}{1-c}\end{vmatrix}=0$

$\Rightarrow -1\left(\frac{-c}{1-c}-\frac{1}{1-b}\right)-1\left(0-\frac{1}{1-a}\right)=0$

$\Rightarrow\frac{c}{1-c}+\frac{1}{1-b}+\frac{1}{1-a}=0$

$\Rightarrow\frac{1}{1-c}+\frac{1}{1-b}+\frac{1}{1-a}=1.$

35. Volume = 1

$\Rightarrow \frac{1}{6}\left|\left[\bar{a}\ \bar{b}\ \bar{c}\right]\right| = 1$

$\Rightarrow \frac{1}{6}\begin{vmatrix} 2 & 1 & -1 \\ 1 & a & 1 \\ 1 & 2 & -1 \end{vmatrix} = 1$

$\Rightarrow \frac{1}{6}|-a-4| = 1$

$\Rightarrow a+4 = \pm 6 \Rightarrow a = 2, -10$

36. $\left|\left(\bar{a}\times\bar{b}\right).\bar{c}\right| = |\bar{a}||\bar{b}||\bar{c}| \Rightarrow |\bar{a}\times\bar{b}||\bar{c}|\cos\left(\bar{a}\times\bar{b}.\bar{c}\right) = |\bar{a}||\bar{b}||\bar{c}|$

$\Rightarrow |\bar{a}||\bar{b}||\bar{c}|\sin\left(\bar{a},\bar{b}\right)\cos\left(\bar{a}\times\bar{b}.\bar{c}\right) = |\bar{a}||\bar{b}||\bar{c}|$

$\Rightarrow \sin\left(\bar{a},\bar{b}\right)\cos\left(\bar{a}\times\bar{b}.\bar{c}\right) = 1$

$\Rightarrow \left(\bar{a},\bar{b}\right) = \frac{\pi}{2}, \left(\bar{a}\times\bar{b}.\bar{c}\right) = 0\ (or)\ \pi$

$\Rightarrow \left(\bar{a},\bar{b}\right) = \frac{\pi}{2}, \bar{c}\perp\bar{a}$ and $\bar{c}\perp\bar{b}$

$\Rightarrow \bar{a}.\bar{b} = \bar{b}.\bar{c} = \bar{c}.\bar{a} = 0$

37. $\frac{1}{\sqrt{2}}\left(-\bar{j}+\bar{k}\right).\left(2\bar{i}+\bar{j}+\bar{k}\right) = 0$

$\left[\bar{a}\ \bar{b}\ \bar{c}\right] = \frac{1}{\sqrt{2}}\begin{vmatrix} 2 & 1 & 1 \\ 1 & 2 & -1 \\ 0 & -1 & 1 \end{vmatrix} = \frac{1}{\sqrt{2}}\left[2(2-1)-1\left(1+0+1(-1-0)\right)\right] = 0$

38. $\left|\bar{a}\times\left(\bar{b}\times\bar{c}\right)\right| = \left(\bar{a}.\bar{c}\right)\bar{b} - \left(\bar{a}.\bar{b}\right)\bar{c} = \left|2\left(\bar{i}+\bar{j}+\bar{k}\right) - 1\left(4\bar{i}+2\bar{j}+3\bar{k}\right)\right|$

$= \left|-2\bar{i}-\bar{k}\right| = \sqrt{5}$

39. $\left(\bar{a}\times\bar{b}\right)\times\bar{c} = \frac{1}{3}|\bar{b}||\bar{c}|\bar{a} \Rightarrow \left(\bar{c}.\bar{a}\right)\bar{b} - \left(\bar{c}.\bar{b}\right)\bar{a} = \frac{1}{3}|\bar{b}||\bar{c}|\bar{a}$

$\Rightarrow \bar{c}.\bar{a} = 0, \bar{b}.\bar{c} = -\frac{1}{3}|\bar{b}||\bar{c}|$

$\Rightarrow \cos\theta = -\frac{1}{3}$

$\Rightarrow \sin\theta = \frac{2\sqrt{2}}{3}.$

40. $\bar{a}\times\left(\bar{b}\times\bar{c}\right) = \frac{\bar{b}+\bar{c}}{\sqrt{2}}$

$\Rightarrow \left(\bar{a}.\bar{c}\right)\bar{b} - \left(\bar{a}.\bar{b}\right)\bar{c} = \frac{1}{\sqrt{2}}\bar{b} + \frac{1}{\sqrt{2}}\bar{c}$

$\Rightarrow \bar{a}.\bar{c} = \frac{1}{\sqrt{2}};\ \bar{a}.\bar{b} = -\frac{1}{\sqrt{2}}$

$\Rightarrow |\bar{a}||\bar{b}|\cos\left(\bar{a}.\bar{b}\right) = -\frac{1}{\sqrt{2}}$

$\Rightarrow \cos\left(\bar{a}.\bar{b}\right) = -\frac{1}{\sqrt{2}}$

$\Rightarrow \left(\bar{a},\bar{b}\right] = \frac{3\pi}{4}$.

MATHS-B

41. Let $f(x) = \cos x, x = 60^0, \Delta x = 1^0$

$f(x+\Delta x) \cong f(x) + f^1(x)\Delta x$

42. $A = \pi r^2, r = 5, 5r = 0.06, \frac{\Delta A}{A} \times 100 = ?$

43. $r = 3, 8r = -0.02, SV \cong dV, V = \frac{4}{3}\pi r^3$

44. Given $\Delta r = \pm\frac{0.04}{2} = \pm 0.02; r = 10$

Volume $V = \frac{4}{3}\pi r^3$, ‘ take “log’ on b.s and differentiating

$\Rightarrow \frac{\Delta V}{V} \times 100 = 3, \frac{\Delta r}{r} \times 100 = \pm 0.6$

45. $\Delta f = f(x+\Delta x) - f(x)$

46. Let $f(x) = \sqrt{x}, x = 49, \Delta x = 1$

$f(x+\Delta x) \cong f(x) + f^1(x)\Delta x$

47. Use $T = 2\pi\sqrt{\frac{l}{g}}$ and apply “log” on b.s and differentiating

48. Let $\alpha, \beta \in [0,1]$, $f(x)$ is continuous on $[\alpha, \beta]$ and differentiable on (α, β) and $f(\alpha) = f(\beta) = 0$

$\therefore C \in (\alpha, \beta)$ such that $f^1(c) = 0$

$\Rightarrow c = \pm 1 \notin (0,1)$

49. Let $f(x) = ax^3 + bx^2 + cx$

$f^1(x) = 3ax^2 + 2bx + c$

$f^1(c) = 0, f(0) = f(1) \Rightarrow a + b + c = 0$

50. $f^1(c) = 0 \Rightarrow 2c(c-2) + (c-2)^2 = 0$

$\Rightarrow (c-2)[2c + c - 2] = 0$

$\Rightarrow (c-2)[3c-2] = 0$

$\therefore c = 2, \frac{2}{3}$

51. $f(1) = a + b - 5, f(3) = 3a + b - 27$

$f(1) = f(3) \Rightarrow a = 11$

$\therefore f(1) = f(3)$ is independent of b

$\therefore a = 11, b \in R$

52. Apply Lagrange’s theorem $f^1(c) = \frac{f(q) - f(p)}{q - p}$

53. by definition

54. $f^1(x) = x^x(1 + \log x) < 0 \Rightarrow x < \frac{1}{e}$

55. On verification $f^1(x) > 0$

56. For maxima or minima $f^1(x)=0$

$2\left[a^2\sec^2 x\tan x-b^2\cos ec^2 x\cot x\right]=0$

$\Rightarrow \tan^4 x=\frac{b^2}{a^2}\Rightarrow x=\tan^{-1}\sqrt{\frac{b}{a}}$.

57. $f^1(x)=0\Rightarrow x=e$ stationary point $(e, f(e))$

58. Clearly x= 5, $f^1(x)=0$ and $f^{11}(x)>0$

Minimum value $f(5)$

59. The minimum value of $\frac{7}{4\sin x+3\cos x+2}$

$=\frac{7}{\max of\ (4\sin x+3\cos x+2)}=\frac{7}{\sqrt{16+9+2}}=\frac{7}{7}=1$

60. $y^1=3x^2-3=0, 0\le x\le 2\Rightarrow x=\pm 1$

Max = max $\{f(0), f(1), f(2)\}=4$

61. Area $=2x_1y_1=2\times 3\times 4=24$

62. $\frac{dy}{dx}=x,$ slope of $(x,y),(0,5)$ is $\frac{y-5}{x}=m_2$

$=m_1$

$m_1\times m_2=-1\Rightarrow x\times\frac{y-5}{x}=-1\Rightarrow y=4$

Hence $x=2\sqrt{2}$

63. $\frac{x^2}{25}+\frac{y^2}{16}=1\Rightarrow\frac{x^2}{a^2}+\frac{y^2}{b^2}=1\Rightarrow a=5, b=4$

Required area $=2ab=2\times 5\times 4=40$

64. $y=0$, verify the distance

65. $\frac{dx}{d\theta}=a(1-\cos\theta),\frac{dy}{d\theta}=a\sin\theta$

Slope $(m)=\frac{dy}{d\theta}=\frac{a\sin\theta}{a(1-\cos\theta)}=\frac{2\sin\frac{\theta}{2}\cos\frac{\theta}{2}}{2\sin^2\frac{\theta}{2}}$

$(m)_{\theta=\frac{\pi}{2}}=\cot\frac{\theta}{2}=\cot\frac{\theta}{4}=1$

Slope of the normal $=\frac{-1}{m}=-1$

66. $y=\sin x\Rightarrow\frac{dy}{dx}=\cos x\Rightarrow\cos x=0$

$x=(2x+1)\frac{\pi}{2}, n\in Z$

67. Equation of the tangent $P(\theta)$ to

$x^{\frac{2}{3}}+y^{\frac{2}{3}}=a^{\frac{2}{3}}$ is $\frac{x}{a\cos\theta}+\frac{y}{a\sin\theta}=1$

Sum of the squares of intercepts $=a^2\left[\cos^2\theta+\sin^2\theta\right]=a^2$

68. Find $\frac{dy}{dx}$ and the equation of the tangent

69. Find the equation of tangent and then use $\frac{c^2}{2|ab|}$

70. $y^n = a^{n-1}x, x^{n-1}, y^n = a^{n-1}, m = -1, n = n$

Length of the sub tangent $= \left|\frac{nx}{m}\right| = \left|\frac{nx}{-1}\right| = |nx|$

71. Length of sub-normal $= |y_1 m|$

72. $x = \frac{\pi}{4}, m_1 = \frac{1}{\sqrt{2}}, m_2 = \frac{-1}{\sqrt{2}}$

$\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right|$

73. $m_1.m_2 = -1$

74. Find $\frac{dy}{dx}$ and substitute $x = \frac{\pi}{3}$ and find equation

75. $a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$

76. $S = 80t - 16t^2, V = \frac{ds}{dt} = 80 - 32t$

Maximum height $\Rightarrow v = 0, t = \frac{5}{2} = 2.5\sec$

77. $y^2 = 18x \Rightarrow 2y\frac{dy}{dt} = 18\frac{dx}{dt}$

Given $\frac{dy}{dt} = 2\frac{dx}{dt}$ …………….(1)

(1) $\Rightarrow 2y\left[2.\frac{dx}{dt}\right] = 18\frac{dx}{dt} \Rightarrow y = \frac{9}{2}$

Hence $x = \frac{9}{8}$

78. $\frac{dx}{dt} = 2cm/\sec, x = 10, A = \frac{\sqrt{3}}{4}x^2$

$\frac{dA}{dt} = 10\sqrt{3}\ sq\ cm/\sec$

79. $a = 0 \Rightarrow t = 4, v = 3t^2 - 24t + 6 = -42$

80. Let side be =a, given $\frac{d}{dt}(4a) = k.\frac{d}{dt}(a)$

$\Rightarrow k = 4$.

PHYSICS

81. Conceptual

82. $V_{rms} = \sqrt{\frac{1^2 + 0^2 + 2^2 + 3^2}{4}} = \sqrt{3.5}m/\sec$

83. $T_1 = 273 + 27 = 300K$

$T_2 = 273 + 927 = 1200K$

$V_{rms}\alpha\sqrt{T}$ T has becomes four times

$\therefore$ V_{rms} will become two times

84. Average kinetic energy per molecule is $= \frac{f}{2}KT = \frac{5}{2}KT \qquad (f = 5)$

85. $E \propto T$

$\frac{E_2}{E_1} = \frac{T_2}{T_1} \qquad T_2 = 2T_1 = 2(273+10)$

$\frac{2E}{E} = 2 \qquad\qquad = 566K$

$= 293^0 C$

86. Conceptual

87. If P = constant, then $V \propto T$

88. It means rod is compressed from its natural length by Δl

Strain $= -\frac{\Delta l}{l} = \frac{-l\alpha\Delta\theta}{l} = -\alpha\Delta\theta$

$= -(12\times10^{-6})(50)$

$= -6\times10^{-4}$

89. $\Delta l_1 = \Delta l_2$

$l_1\alpha_2\Delta\theta = l_2\alpha_2\Delta\theta$

$\frac{l_1}{l_2} = \frac{\alpha_2}{\alpha_1} = \frac{19}{11}$

In option (1) ratio is $\frac{19}{11}$

90. $V = \frac{nRT}{P} = \frac{mR(t+273)}{MP} \quad \frac{m}{p}$ ratio is same

$\therefore$ slope and intercept of straight line between v and t should also remain same

91. $P \propto V^2$

$\frac{T}{V} \propto V^2 \quad T \propto V^3 \quad V \propto T^{\frac{1}{3}}$

T is increasing so v will also increase.

Hence work done will be positive.

92. In adiabatic compression temperature increases

Hence, PV increases as $T \propto PV$

93. $1 \rightarrow$ Isobaric

$2 \rightarrow$ Isothermal

$3 \rightarrow$ Adiabatic

Minimum area is under graph – 3

94. $\eta = \left(1 - \frac{T_2}{T_1}\right)\times100 \quad T_2 = 300K \qquad T_1 = 600K$

$\eta = 50\%$

95. $P = \frac{nRT}{V}$ V= constant, but temperature will decrease with time, so P will decrease

96. In adiabatic compression, internal energy of gas increase. So temperature increases

97. $PT^{\frac{r}{1-r}} =$ constant (or) $P \propto T^{\frac{r}{r-1}}$

$\alpha = \frac{r}{r-1} = \frac{1.4}{1.4-1} = 3.5$

98. $C = C_V + \frac{R}{1-x}$

$= \frac{5}{2}R + \frac{R}{1-x} = \frac{5}{2}R - \frac{R}{x-1}$

C is negative if $x-1 < \frac{2}{5}$

$x < 1.4$

If x line between 1 and 1.4, then also C is negative

99. $C_V = \frac{n_1 C_{V_1} + n_2 C_{V_2}}{n_1 + n_2}$

$C_V = \frac{2\left(\frac{3}{2}R\right) + 4\left(\frac{5}{2}R\right)}{6}$

$C_V = \frac{13R}{6}$

100. $\lambda_m \propto \frac{1}{T}$

$\frac{(\lambda_m)_2}{(\lambda_m)_1} = \frac{T_1}{T_2} = \frac{2000}{3000} = \frac{2}{3}$

$(\lambda_m)_2 = \frac{2}{3}(\lambda_m)_1$

101. At higher temperature radiation is more so cooling is fast

102. $Q_1 = Q_2$

$mS_1(32-20) = mS_2(40-32)$

$\frac{S_1}{S_2} = \frac{8}{12} = \frac{2}{3}$

103. $W = \int dQ = \int_1^2 mSdT$

$= \int_1^2 (1)(aT^3)dT = \frac{15a}{4}$

104. $\lambda_m \alpha \frac{1}{T}$

$\frac{(\lambda_m)_1}{(\lambda_m)_2} = \frac{T_2}{T_1}$

$\frac{T_1}{T_2} = \frac{(\lambda_m)_2}{(\lambda_m)_1} = \frac{350}{510} = 0.69$

105. $dQ = CdT$

$\frac{dT}{dQ} = \frac{1}{C} =$ skioe if T-Q graph

106. Thermal resistance $= \frac{l}{KA} = \frac{l}{K(\pi R^2)} \alpha \frac{1}{R^2}$

The rod for which $\frac{l}{R^2}$ is minimum will conduct maximum heat

107. Heat taken by 1g ice in transformation from ice at 0^0C to water at 100^0C is

$Q = mL + ms\Delta\theta$

$= 1(80) + 1(1)(100)$

$= 180\,Cal$

$m = \frac{Q}{L} = \frac{180}{540} = \frac{1}{3}g$

This is less than 1g(or) total mass of steam.

$\therefore$ whole steam is not condensed and mixture temperature is 100^0C

108. $H_A = H_{Total}$

$\frac{(TD)_A}{R_A} = \frac{TD}{R_A + R_B}$

$(TD)_A = \left(\frac{R_A}{R_A + R_B}\right)TD$

$= \left(\frac{1}{1 + \frac{R_B}{R_A}}\right)TD$

$\frac{R_B}{R_A} = \frac{l_B}{l_A}\left(\frac{K_A A}{K_B A}\right) = \left(\frac{20}{10}\right)3 = 6$

$(TD)_A = \left(\frac{1}{1+6}\right) \times 35 = 5^0C$

109. Thermal resistance $R = \frac{l}{KA}\,\alpha\,\frac{1}{K} \Rightarrow K_A = 2K_B$

$R_A = \frac{R_B}{2}$

$H_A = H_B$

$\frac{(TD)_A}{R_A} = \frac{(TD)_B}{R_B}$

$(TD)_A = \left(\frac{R_A}{R_B}\right)(TD)_B$

$= \left(\frac{R}{2R}\right)(36^0C) = 18^0C$

110. $R = \frac{l}{KA}$

$\frac{R_2}{R_1} = \left(\frac{l_2}{l_1}\right)\left(\frac{k_1}{k_2}.\frac{A_1}{A_2}\right)$

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

$\therefore$ Thermal resistance of 2nd rod is half

Hence rate of heat flow will be twice

111. $A_1V_1 = A_2V_2$

$\pi\left(\frac{D}{2}\right)^2 V = \pi\left(\frac{d}{2}\right)^2 v^1 \quad v^1 = \frac{D^2 v}{nd^2}$

112. $V_B = n^{2/3}V_{\perp mall}$

113. In case of soap bubble

$W = T \times 2 \times \Delta A$

$= 0.03 \times 2 \times 40 \times 10^{-4}$

$W = 2.4 \times 10^{-4} J$

114. $V_t \alpha r^2$ $\quad$ $V \alpha r^3$

$V_t \alpha V^{2/3}$ $\quad$ $r \alpha V^{1/3}$

115. The excess pressure of soap bubble

$\Delta P = \dfrac{4T}{R}$

$h\rho g = \dfrac{4T}{R}$

$T = \dfrac{Rh\rho g}{4} = 0.0392\ N/m$

116. Conceptual
117. Conceptual
118. Conceptual
119. Conceptual
120. Conceptual

CHEMISTRY

121. sp^2 carbons and the atoms connected to them are planar.

$H_3C-\underset{H}{C}=\underset{H}{C}-CH_3$. The four carbons and two H-atoms connected to doubly bonded carbons are in the same plane H-atoms of $-CH_3$ groups are tetra- hedrally arranged on those sp^3 carbons.

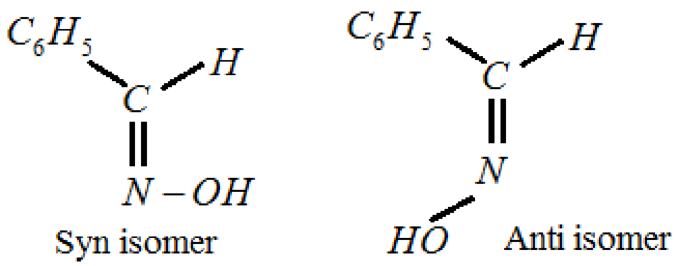
122. Acetylene $H-C\equiv C-H$

$3\sigma, 2\pi$.

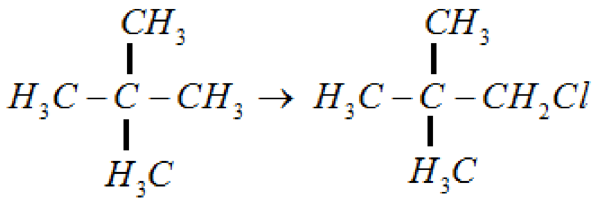
123. In kjeldahl method, nitrogen is estimated as NH_3.
124. Fractional crystallization is based on the difference in the solutilities of the components in the same solvent. Less soluble component crystallizes first leaving the more soluble component in the solution.
125. Ninhydrin gives violet colour with amino acids.
126. Aldehyde is taken as principal functional group, keto group is subsistent.

2-oxo cyclo hexane carbaldehyde.

127. Vinyl acetic acid is $H_2C=CH-CH_2COOH$
128. All exist in keto-enol forms.
129. The carbon in (d) has two different groups so it exhibits geometrical isomerism



130. Optical isomers have the same physical and chemical properties. They differ only in the angle of rotation of plane polarized light.
131. Conceptual
132. decreases stability by – M effect as positive charge of carbocation further increases.
133. $-CCl_3$ group is a stronger electron with drawing group than others and exerts strong – I effect and stabilizes the conjugate base of b.
134. Only neopentane gives a single mono chloro derivative



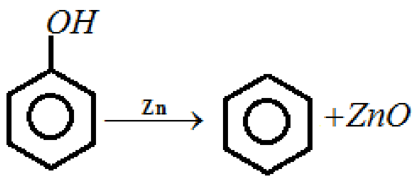
135. Methane can not be prepared by these reactions
136. Acetic acid, on decarboxylation gives CH_4 and gives ethane on Kolbe's electrolysis
137. $Na, NH_{3(l)}$ and Na, ethanol both give trans alkene.
138. $H_3C-CH=CH_2 \xrightarrow[Peroxide]{HBr} H_3C-\dot{C}H-CH_2-Br$
139. As Br_2/H_2O is decolourized by both alkenes and alkynes it cannot be distinguish them. Alkynes with a H-atom on triply – bonded carbon give a white precipitate with Ammonical $AgNO_3$. Alkenes cannot give similarly , Cu_2Cl_2/NH_4OH gives a red precipitated with alkynes, but not with alkenes.
140. It is an electrophilic addition and initiated by Cl^+.
141. $HCCl_3 + 6Ag + Cl_3CH \xrightarrow{\Delta} HC \equiv CH + 6AgCl$
142. $CH \equiv CH + 2(O) \xrightarrow{SeO_2} CHO-CHO_{(Glyoxal)}$
143. $H_3C-C\equiv C-CH_2-CH_2-CH_3 \xrightarrow{H_2O\ HgSO_4, H_2SO_4}$

$H_3C-\overset{O}{\overset{\|}{C}}-CH_2CH_2CH_2CH_3 + H_3C-CH_2-\overset{O}{\overset{\|}{C}}-CH_2CH_2CH_3$

Hexan – 2 – one   Hexan – 3 – one

These are position isomers.

144. $HC\equiv CH \xrightarrow[HgSO_4 H_2SO_4]{H_2O} CH_3CHO \xrightarrow[NaOH]{3Cl_2} Cl\overset{Cl}{\underset{Cl}{C}}H \xrightarrow[\Delta]{Ag} HC\equiv CH$
145. With high heat of formation acetylene is more useful. Heats of formation of alkynes are in the order Acetylene > Propyne > Butyne -1 > Butyne – 2
146.



Phenol   Benzene

147. Conceptual
148. If the side chain has no $\alpha - H$, it is not oxidized by alk, $KMnO_4$.
149. Chloroniumion formed due to interoction of Cl_2 with $AlCl_3$. It is intraduced in the benzene ring as electrophile.
150. The light oil fraction of coaltar contains benzene. After washing with acid, alkali and water, it is distilled. The fraction obtained at 80^0C is benzene.
151. Carboxylic acids and esters are functional isomers.
152. An organic compound is extracted from its aqueous solution by solvent extraction.
153. Conceptual
154. Composition of asbestos is $CaMg_3(SiO_3)_4$ (or) $CaO.3MgO.4SiO_2$
155. Sn^{2+} is less stable than Sn^{4+} but Pb^{2+} is more stable than Pb^{4+} due to inert pair effect.
156. $SiC + 4NaOH + 2O_2 \rightarrow Na_2SiO_3 + Na_2CO_3 + 2H_2O$
157. Conceptual
158. $CO_2 \xrightarrow{C} 2CO \xrightarrow{Cl_2} COCl_2 \xrightarrow{H_2O} 2HCl + CO_2$
159. Fake diamonds can be identified by using thermal conductivity
160. Conceptual