1. Surfaces $\phi_1(x,y,z)=C_1$ and $\phi_2(x,y,z)=C_2$ are orthogonal if :

(A) $\phi_1 \cdot \phi_2 = 0$

(B) $\nabla \cdot (\phi_1 + \phi_2) = 0$

(C) $\nabla \phi_1 \cdot \nabla \phi_2 = 0$

(D) $\nabla \phi_1 \times \nabla \phi_2 = 0$

2. Gradient of a scalar function $\phi(x,y,z)$ is :

(A) $\frac{\partial \phi}{\partial x} + \frac{\partial \phi}{\partial y} + \frac{\partial \phi}{\partial z}$

(B) $\frac{\partial \phi}{\partial x}\hat{i} + \frac{\partial \phi}{\partial y}\hat{j} + \frac{\partial \phi}{\partial z}\hat{k}$

(C) $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + \frac{\partial^2 \phi}{\partial z^2}$

(D) None of the above

3. Let $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $r = |\vec{r}|$, then :

(A) $\nabla e^r = \frac{e^r}{r}$

(B) $\nabla e^r = e^r \vec{r}$

(C) $\nabla e^r = \frac{e^r}{r}\vec{r}$

(D) $\nabla e^r = e^{-r} r\, \vec{r}$

4. Divergence of vector field $F = (x^2 y, y^2, z^2 x)$ at a point $(-1,2,3)$ is :

(A) -5

(B) 10

(C) 14

(D) -6

5. For the scalar function f, div$[\text{grad } f]$ is equal to :

(A) $\frac{\partial f}{\partial x}\hat{i} + \frac{\partial f}{\partial y}\hat{j} + \frac{\partial f}{\partial z}\hat{k}$

(B) 0

(C) $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$

(D) None of the above

6. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then $\nabla \cdot \vec{r} =$

(A) 0

(B) 3

(C) -3

(D) 1

7. If $\vec{F} = (x+3y)\hat{i} + (y-2z)\hat{j} + (x+mz)\hat{k}$ is solenoidal, then the value of m is :

(A) 2

(B) 3

(C) -2

(D) 0

8. The curl of a vector function $\vec{F} = x^2\hat{i} + 2z\hat{j} - y\hat{k}$ is :

(A) $-3\hat{k}$

(B) $-3\hat{i}$

(C) 0

(D) $-3\hat{j}$

9. If $\frac{dy}{dx}=\frac{x+y+1}{x+y-1}$, then it is reduced to homogeneous by :

(A) $x+y=v+1$

(B) $x+y=v$

(C) $x-y=v$

(D) $x+y+1=v$

10. $\frac{dx}{dy}+xy=y^2$ is :

(A) linear in x

(B) linear in y

(C) non-linear in x

(D) none of the above

11. If $z_1=x_1+iy_1, z_2=x_2+iy_2$, then real part of z_1z_2 is :

(A) $x_1y_2+x_2y_1$

(B) $x_1y_1+x_2y_2$

(C) $x_1x_2-y_1y_2$

(D) $x_1x_2+y_1y_2$

12. Arg (z) at $z=0$ is :

(A) 0

(B) not defined

(C) $\frac{\pi}{2}$

(D) $\frac{-\pi}{2}$

13. If $z=1-i$, then conjugate of conjugate of z is :

(A) $1+i$

(B) $1-i$

(C) $-1+i$

(D) $-1-i$

14. If $z=x+iy$, then $z+\bar{z}$ is equal to :

(A) x

(B) $2x$

(C) $2y$

(D) $2x+i2y$

15. If $z=2+3i$, then modulus of z is :

(A) 13 (B) 5

(C) $\sqrt{13}$ (D) 15

16. Imaginary part of $\frac{z_1}{z_2}$ is, where $z_1=x_1+iy_1, z_2=x_2+iy_2$:

(A) $\frac{x_2y_1-x_1y_2}{x_2^2+y_2^2}$

(B) $\frac{x_2y_1-x_1y_2}{x_1^2+y_1^2}$

(C) $\frac{x_2y_1-x_1y_2}{x_1^2+y_2^2}$

(D) $\frac{x_2y_1-x_1y_2}{x_1^2+x_2^2}$

17. If $x+iy=\frac{2-3i}{4+7i}$, then :

(A) $x=\frac{1}{5}, y=\frac{-2}{5}$

(B) $x=\frac{-1}{5}, y=\frac{2}{5}$

(C) $x=\frac{-1}{5}, y=\frac{-2}{5}$

(D) $x=\frac{1}{5}, y=\frac{2}{5}$

18. The differential equation

$\frac{2dy}{dx} + x^2 y = 2x + 3$ is :

(A) linear

(B) non-linear

(C) linear with constant coefficients

(D) none of the above

19. A differential equation is ordinary if it has :

(A) one dependent variable

(B) one independent variable

(C) both (A) and (B)

(D) none of the above

20. Differential equation $Mdx + Ndy$ is exact iff :

(A) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$

(B) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$

(C) $\frac{\partial M}{\partial y} \neq \frac{\partial N}{\partial x}$

(D) $\frac{\partial M}{\partial x} \neq \frac{\partial N}{\partial y}$

21. Fourier series uses which domain representation of signals ?

(A) Time domain

(B) Frequency domain

(C) Both (A) and (B)

(D) None of the above

22. General solution of $(x^2+1)\frac{dy}{dx} = y$ is :

(A) $y = \frac{x^3}{3} + x + c$

(B) $y = c(x^2+1)$

(C) $y = ce^{x^2+1}$

(D) $y = ce^{\tan^{-1} x}$

23. Integrating factor of $\frac{dy}{dx} + Py = Q$ is :

(A) $\int_e^{Pdy}$

(B) $\int_e^{Pdx}$

(C) $\int e^P dx$

(D) None of the above

24. $(y - \cos x) + (x + \sin y)\frac{dy}{dx} = 0$ is :

(A) exact ODE

(B) not exact ODE

(C) linear in y

(D) linear in x

25. Directional derivative of f in the direction of unit vector $\hat{u}$ is :

(A) $\nabla f \cdot \vec{u}$

(B) $\nabla f \, \hat{u}$

(C) $\nabla f \cdot \hat{u}$

(D) None of the above

26. Solution of $\frac{dy}{dx}=\frac{x}{y}$ is :

(A) $y^2=x^2+y$

(B) $y=x^3$

(C) $y^2=x^2+c$

(D) $y=e^x$

27. If $\frac{dy}{dx}=\frac{1+y^2}{1+x^2}$, then its solution is :

(A) $\tan^{-1}y=\tan^{-1}x+c$

(B) $\tan^{-1}y=2$

(C) $y=1+x^2$

(D) $1+y^2=1+x^2+c$

28. If $f(x,y)=x^3+y^3+2$, then $f(x,y)$ is :

(A) homogeneous f^n of degree 3

(B) homogeneous f^n of degree 0

(C) non-homogeneous of degree 2

(D) non-homogeneous f^n

29. $\frac{dy}{dx}+Py=Qy^n$ is linear if :

(A) $n=2$

(B) $n=1$

(C) $n=0$

(D) $n=0,1$

30. For equation $\frac{dv}{dx}+\frac{2}{x+1}v=x^3$, integrating factor is :

(A) $x+1$

(B) $(x+1)^2$

(C) $(x+1)^3$

(D) $(x+1)^4$

31. $(1-x^2)\frac{dy}{dx}+xy=xy^2$

can be transformed to linear by rule :

(A) $\frac{1}{y^2}=v$

(B) $\frac{1}{y}=v$

(C) $y^2=v$

(D) $y=v$

32. $\frac{dy}{dx}=\frac{x+2y+3}{2x+3y+4}$ is reducible to homogeneous if :

(A) $x=X+1, y=Y+2$

(B) $x=X-1, y=Y-2$

(C) $x=X+1, y=Y-2$

(D) None of the above

33. Integrating factor of $\frac{dv}{dx}+2xv=x^3$ is :

(A) e^x

(B) x^3

(C) e^{x^2}

(D) x^2

34. A vector field is irrotational if :

(A) $\nabla \times \vec{F} = 0$

(B) $\nabla \cdot \vec{F} = 0$

(C) $\nabla^2 \vec{F} = 0$

(D) None of the above

35. If $\vec{F} = yz\hat{i} + zx\hat{j} + xy\hat{k}$ and $\vec{F} = \nabla\phi$ then ϕ is :

(A) $x + y + z + c$

(B) $x^2 + y^2 + z^2 + c$

(C) $xyz + c$

(D) $x^2 + y + z + c$

36. Conjugate of the complex number $(6+5i)^2$ is :

(A) $10 + 60i$

(B) $11 - 60i$

(C) $11 + 60i$

(D) $6 - 5i$

37. Value of $\dfrac{(1+i)^{20}}{(1-i)^{20}}$ is :

(A) -1

(B) $-i$

(C) i

(D) 1

38. Value of $(i)^{19}$ is equal to :

(A) -1

(B) $-i$

(C) i

(D) 1

39. Find the particular integral of $(D^2 - 4)y = 1$:

(A) $\dfrac{-1}{6}$

(B) $\dfrac{-1}{5}$

(C) $\dfrac{-1}{4}$

(D) $\dfrac{1}{4}$

40. Find the P.I. of $(D^2 + 4)y = \cos 2x$:

(A) $\dfrac{x}{4}\sin 2x$

(B) $\dfrac{x}{4}\cos 2x$

(C) $\dfrac{x}{2}\sin 2x$

(D) $x\sin 2x$

41. Particular integral of $(D^2 - 1)y = x$ is :

(A) x

(B) x^2

(C) $-x$

(D) -1

42. Solution of $(D^2 + 1)y = 0$ is :

(A) $c_1 e^x + c_2 e^{-x}$

(B) $c_1 \cos x + c_2 \sin x$

(C) $c_1 \cos x - c_2 \sin x$

(D) Both (B) and (C)

43. If $f(x)$ is discontinuous at $x=l$ in $[a,b]$ then $f(l)$ is :

(A) $\dfrac{\lim_{h\to 0} f(l-h)+\lim_{h\to 0} f(l+h)}{2}$

(B) $\lim_{h\to 0} f(l+h)$

(C) $\lim_{h\to 0} f(x)$

(D) None of the above

44. $\dfrac{dy}{dx}=x$, then general solution is :

(A) $y=\dfrac{x^2}{2}$

(B) $y=\dfrac{x^2}{2}+c$

(C) $y=x^2+c$

(D) $y=\left(\dfrac{x}{2}\right)^2+c$

45. If $y=ce^x$, then corresponding differential equation is :

(A) $\dfrac{dy}{dx}=y$

(B) $\dfrac{dy}{dx}=cy$

(C) $\dfrac{dx}{dy}=y$

(D) $\dfrac{dx}{dy}=cy$

46. Which of the following is ODE ?

(A) $y=dx$

(B) $dy=dx$

(C) $x=y$

(D) $y=x^2$

47. Order of differential equation $\dfrac{d^2y}{dx^2}+y^2=0$ is :

(A) 2

(B) 1

(C) not defined

(D) None of the above

48. $\dfrac{dy}{dx}+y=y^2$ is :

(A) linear ODE

(B) non-linear ODE

(C) homogeneous ODE

(D) linear PDE

49. Degree of ODE

$\dfrac{d^2y}{dx^2}+\sqrt{1+\left(\dfrac{dy}{dx}\right)^3}=0$ is :

(A) 2

(B) 3

(C) $\dfrac{1}{2}$

(D) 1

50. If $\dfrac{dy}{dx}=\cot x$, then it is linear in variable :

(A) x only

(B) both x and y

(C) y only

(D) none of the above

51. If $|z|=4$ and $\arg(z)=\frac{5\pi}{6}$, then z is :

(A) $2\sqrt{3}-2i$

(B) $2\sqrt{3}+2i$

(C) $-2\sqrt{3}+2i$

(D) None of the above

52. Operator form of $\frac{d^3y}{dx^3}+\frac{dy}{dx}+y=0$ is :

(A) $D^3+D+1=0$

(B) $(D^3+D+1)y=0$

(C) $D^3+D+y=0$

(D) None of the above

53. If $z_1=1+i, z_2=1-i$, then z_1z_2 is :

(A) 1

(B) $1-i$

(C) i

(D) 2

54. Euler's formula for b_n in Fourier series in $[a,b]$ is :

(A) $\int_a^b f(n)\cos nx dx$

(B) $\int_a^b f(n)\sin nx dx$

(C) $\int_a^b f(n) dx$

(D) $\frac{2}{b-a}\int_a^b f(n)\sin\left(\frac{2n\pi x}{b-a}\right)dx$

55. If $f(n)$ is periodic in $-l<x<l$, then Fourier coefficient a_0 is :

(A) $\frac{1}{2l}\int_{-l}^{l} f(n)dx$

(B) $\frac{1}{l}\int_{-l}^{l} f(n)dx$

(C) $\int_{-l}^{l} f(n)dx$

(D) None of the above

56. $\frac{dy}{dx}=x+y$, then integrating factor is :

(A) e^x

(B) e^y

(C) e^{-x}

(D) e^{-y}

57. If $z=-2+3i$, then principal argument is :

(A) $\pi-\tan^{-1}\left|\frac{3}{2}\right|$

(B) π

(C) $\frac{\pi}{2}$

(D) $\tan^{-1}\left(\frac{3}{2}\right)$

58. If $\vec{F} = x^2yz\,\hat{i} + xy^2z\,\hat{j} + xyz^2\,\hat{k}$, then div $\vec{F}$ at (1, 2, 3) is :

(A) -12

(B) 6

(C) 12

(D) 15

59. Function $f(x) = \cos x$ is periodic with period :

(A) π

(B) 2π

(C) 4π

(D) 6π

60. In the expansion of Fourier series of $f(x)$ in $[a,b]$ a_0 is :

(A) $a_0 = \frac{1}{b-a}\int_a^b f(x)dx$

(B) $a_0 = \frac{1}{b}\int_a^b f(x)dx$

(C) $a_0 = \frac{1}{a}\int_a^b f(x)dx$

(D) $a_0 = \frac{1}{a-b}\int_a^b f(x)dx$

61. If $f(n) = x, 0 < x < 2\pi$ then Fourier coefficient a_n is equal to :

(A) 2π

(B) 0

(C) π

(D) $\frac{-2}{n}$

62. If $f(n) = x^2, -\pi < x < \pi$, then Euler formula gives :

(A) $a_n = 0$

(B) $a_n = 2$

(C) $b_n = 0$

(D) $b_n = 2$

63. If $f(x)$ is periodic in interval $[-\pi, \pi]$ then time period w is equal to :

(A) π

(B) $-\pi$

(C) 2π

(D) None of the above

64. If $f(n) = x^3, -\pi < x < \pi$ then constant term a_0 is equal to :

(A) $2(-1)^n$

(B) 0

(C) 2

(D) $(-1)^n$

65. If $f(t) = \begin{cases} 0, -5 < t < 0 \\ 3, \ 0 < t < 5 \end{cases}$ is periodic then time period T is :

(A) 0

(B) 5

(C) $-5 < t < 5$

(D) 10

66. Normal vector to the surface $\phi(x,y,z)=c$ is :

(A) $\nabla\cdot\phi$

(B) $\nabla\phi$

(C) $\nabla\times\phi$

(D) None of the above

67. Greatest rate of increase of ϕ is :

(A) grad ϕ

(B) curl ϕ

(C) div ϕ

(D) None of the above

68. If $\vec{a}=i+j+k$, then unit vector $\hat{a}$ is :

(A) $\frac{i+j+k}{3}$

(B) $\frac{i+j+k}{\sqrt{3}}$

(C) $i+j+k$

(D) None of the above

69. If $f(x)$ is odd function, then Fourier coefficient a_n is :

(A) $a_n=0$ for all intervals

(B) $a_n=0$ in $-\pi<x<\pi$

(C) $b_n=0$ in $-\pi<x<\pi$

(D) None of the above

70. If $\vec{v}=(x-y)\hat{i}+(x+y)\hat{j}+z\hat{k}$, then curl $\vec{v}$ is equal to :

(A) $2\hat{i}$

(B) $2\hat{j}$

(C) $2\hat{k}$

(D) $\hat{k}$

71. Given differential equation $\frac{d^2y}{dx^2}-y=0$ has solution as :

(A) $c_1\cos x+c_2\sin x$

(B) $c_1e^{2x}+e^{-x}$

(C) $c_1e^{x}+c_2e^{-x}$

(D) $(c_1+c_2x)e^{x}$

72. Solution of ODE $\frac{dy}{dx}=xy$ is :

(A) $y=x+c$

(B) $\log y=\frac{x^2}{2}+c$

(C) $\log y=x^2$

(D) $y=e^{x^2}+c$

73. If $\vec{F}$ is conservative field then :

(A) curl $\vec{F}=0$

(B) div $\vec{F}=0$

(C) grad $\vec{F}=0$

(D) None of the above

74. Multiplicative inverse of complex number $z=1+i$ is :

(A) 0

(B) $1+i$

(C) $\frac{1-i}{2}$

(D) None of the above

75. Region defined by $|z| \geq 1$ is :

(A) $x^2 + y^2 \geq 1$

(B) $x^2 - y^2 \geq 1$

(C) $z \geq 1$

(D) $x + iy \geq 1$

76. Vector normal to the surface $f(x, y, z) = c$ is :

(A) ∇f

(B) $\nabla^2 f$

(C) $\nabla \cdot f$

(D) $\nabla \times f$

77. If $\phi(x, y, z)$ is constant then gradient of ϕ is :

(A) constant

(B) 0

(C) can not be 0

(D) None of the above

78. Greatest rate of increase of $\phi = xyz^2$ at point (1, 0, 3) is :

(A) $\sqrt{9}$

(B) $9\hat{j}$

(C) $9\hat{i}$

(D) 9

79. Vector field $\vec{F}$ is solenoidal if :

(A) divergence of $\vec{F} \neq 0$

(B) divergence of $\vec{F} = 0$

(C) curl $\vec{F} = 0$

(D) curl $\vec{F} \neq 0$

80. Which of the following is not true ?

(A) $\text{div}(A + B) = \text{div}(A) + \text{div}(B)$

(B) Grad (constant) = 0

(C) $\nabla \cdot (A + B) = \nabla \cdot A + \nabla \cdot B$

(D) Divergence (i + j) = 2

81. grad $\left(\frac{1}{r}\right)$ is equal to :

(A) 0

(B) $\frac{1}{r^2}$

(C) $\frac{-1}{r}$

(D) None of the above

82. If $r^n r$ is solenoidal, then :

(A) $n = 3$

(B) $n = -3$

(C) $n = 2$

(D) $n = -2$

83. Curl of $\vec{a} \times \vec{r}$ is :

(A) 0

(B) $\vec{a}$

(C) $\vec{r}$

(D) $2\vec{a}$

84. If $r = \sqrt{x^2 + y^2 + z^2}$, then :

(A) $\nabla r^2 = 2\vec{r}$

(B) $\nabla r^2 = 2r$

(C) $\nabla r^2 = 2r \, \nabla r$

(D) None of the above

85. Polar form of $z=-1+\sqrt{3i}$ is :

(A) $z=2\left[\cos\frac{2\pi}{3}+i\sin\frac{2\pi}{3}\right]$

(B) $z=4\left[\cos\frac{\pi}{3}+i\sin\frac{\pi}{3}\right]$

(C) $z=2\left[\cos\frac{\pi}{3}+i\sin\frac{\pi}{3}\right]$

(D) $z=2e^{\frac{2\pi}{3}}$

86. Find the real number B if $A+iB=\frac{3-2i}{7+4i}$:

(A) $B=\frac{2}{5}$

(B) $B=\frac{-2}{5}$

(C) $B=\frac{1}{5}$

(D) $B=\frac{-1}{5}$

87. If $z=-1-\sqrt{3}\,i$, then $|z|$ is :

(A) 4

(B) 2

(C) $\frac{\pi}{3}$

(D) $\frac{\pi}{6}$

88. Argument of $z=\frac{1+7i}{(2-i)^2}$ is :

(A) 2π

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

(C) $\frac{3\pi}{4}$

(D) None of the above

89. If $\vec{r}=xi+yj+zk$, then ∇r is :

(A) $\vec{r}$

(B) r

(C) $\frac{\vec{r}}{r}$

(D) $2r$

90. $\nabla\left[\frac{f}{g}\right]$ is equal to :

(A) $\frac{g\nabla f-f\nabla g}{g^2}, g\neq 0$

(B) $\frac{g\nabla f+f\nabla g}{g^2}, g\neq 0$

(C) $\frac{\nabla g}{\nabla f}$

(D) $\frac{\nabla f}{\nabla g}$

91. If $\vec{r}=xi+yj+zk$, then ∇r^n is :

(A) nr^{n-1}

(B) $nr^{n-2}\vec{r}$

(C) $nr^{n-1}\vec{r}$

(D) nr^{n-2}

92. The locus of the points z satisfying the condition $\arg\left(\frac{z-1}{z+1}\right)=\frac{\pi}{3}$ is a :

(A) Parabola

(B) Circle

(C) Pair of straight lines

(D) None of the above

93. If $z=re^{i\theta}$ then $\left|e^{iz}\right|$ is equal to :

(A) $e^{-r\sin\theta}$

(B) $re^{-r\sin\theta}$

(C) $e^{-r\cos\theta}$

(D) $re^{-r\cos\theta}$

94. If cube roots of unity are $1, w, w^2$ then :

(A) $1+w+w^2=2$

(B) $1+w+w^2=0$

(C) $w^3=-1$

(D) $w^2=1$

95. Let $z=i$, then arg z is equal to :

(A) $-\frac{\pi}{2}$

(B) π

(C) $\frac{\pi}{2}$

(D) $-\pi$

96. Which of the following is true ?

(A) $|z_1 z_2| \geq |z_1||z_2|$

(B) $|z_1+z_2| \leq |z_1|-|z_2|$

(C) $|z_1-z_2| = |z_1|-|z_2|$

(D) $|z_1+z_2| \leq |z_1|+|z_2|$

97. Modulus of $z=x+iy$ is :

(A) x^2+y^2

(B) $\sqrt{x^2+y^2}$

(C) $x+y$

(D) $x-iy$

98. Real part of $z=\frac{a+ib}{c+id}$ is :

(A) $\frac{ac+bd}{a^2+b^2}$

(B) $\frac{ac+bd}{c^2+a^2}$

(C) $\frac{ac+bd}{a^2+d^2}$

(D) $\frac{ac+bd}{c^2+d^2}$

99. Modulus amplitude form of $z=x+iy$ is :

(A) re^{θ}

(B) $re^{i\theta}$

(C) $e^{i\theta}$

(D) r

100. Argument of $z=1-i$ is :

(A) $\frac{\pi}{2}$

(B) $\frac{\pi}{4}$

(C) $\frac{-\pi}{4}$

(D) $\frac{-\pi}{2}$