CLASS TEST

S.No.: 02 SK_EC+EE_E_252023

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ENGINEERING MATHEMATICS

EC & EE

Date of Test : 02/05/2023

ANSWER KEY

1.	(b)	7.	(b)	13.	(b)	19.	(a)	25.	(d)
2.	(a)	8.	(a)	14.	(a)	20.	(c)	26.	(b)
3.	(a)	9.	(a)	15.	(b)	21.	(a)	27.	(d)
4.	(b)	10.	(b)	16.	(b)	22.	(a)	28.	(c)
5.	(a)	11.	(d)	17.	(a)	23.	(b)	29.	(c)
6.	(d)	12.	(c)	18.	(a)	24.	(c)	30.	(b)

DETAILED EXPLANATIONS

1. (b)

Let $e^x = p$

$$e^x dx = dp$$

$$I = \int_0^\infty \frac{dx}{e^x + e^{-x}} = \int_0^\infty \frac{e^x dx}{e^{2x}+1}$$

$$= \int_{p=e^0=1}^{p=e^\infty=\infty} \frac{dp}{p^2+1} \Rightarrow \left(\tan^{-1} p\right)_1^\infty$$

$$= \tan^{-1}\infty - \tan^{-1} 1$$

$$= \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$$

2. (a)

Eigen value of A are, $\lambda_1, \lambda_2, \lambda_3$

$$|A| = \lambda_1 \cdot \lambda_2 \cdot \lambda_3$$

Eigen value of A^{-1} is $\frac{1}{\lambda_1}, \frac{1}{\lambda_2}, \frac{1}{\lambda_3}$

$$\frac{1}{\lambda_1} = 1 \Rightarrow \qquad \lambda_1 = 1$$

$$\frac{1}{\lambda_2} = 2 \Rightarrow \qquad \lambda_2 = \frac{1}{2}$$

$$\frac{1}{\lambda_3} = 5 \Rightarrow \qquad \lambda_3 = \frac{1}{5}$$

$$\lambda_1 \lambda_2 \lambda_3 = (1)\left(\frac{1}{2}\right)\left(\frac{1}{5}\right) = \frac{1}{10} = 0.1$$

$$|A| = 0.1$$

3. (a)

Diverge of curl of a vector is always zero.

4. (b)

$$2x + y + 2z = 0$$
$$x + y + 3z = 0$$
$$4x + 3y + z = 0$$

$$[A:B] = \begin{bmatrix} 2 & 1 & 2 & 0 \\ 1 & 1 & 3 & 0 \\ 4 & 3 & 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 3 & 0 \\ 2 & 1 & 2 & 0 \\ 4 & 3 & 1 & 0 \end{bmatrix}$$

$R_2 \to R_2 - 2R_1$, $R_3 \to R_3 - 4R_1$

$$= \begin{bmatrix} 1 & 1 & 3 & 0 \\ 0 & -1 & -4 & 0 \\ 0 & -1 & -11 & 0 \end{bmatrix}$$

$R_3 \to R_3 - R_2,$

$$= \begin{bmatrix} 1 & 1 & 3 & 0 \\ 0 & -1 & 4 & 0 \\ 0 & 0 & -7 & 0 \end{bmatrix}$$

Rank of $[A : B] = 3$
Rank of $[A] = 3 =$ Rank of $[A : B] =$ number of unknowns
So, unique soluton exists

5. (a)

$$I = \int_0^{\pi/2} \log\left(\frac{\sin x}{\cos x}\right) dx$$

$$= \int_0^{\pi/2} [\log(\sin x)dx - \log(\cos x)dx] \qquad \left[\int_a^b f(x)dx = \int_a^b f(a+b-x)dx\right]$$

$$= \int_0^{\pi/2} \log\sin\left(\frac{\pi}{2} - x\right) dx - \int_0^{\pi/2} \log(\cos x)dx$$

$$= \int_0^{\pi/2} \log(\cos x)dx - \int_0^{\pi/2} \log(\cos x)dx$$

$$I = 0$$

6. (d)

For function to be differentiable i.e. continuous $\lim_{x\to 0^-} f(x) = \lim_{x\to 0^+} f(x)$

$$f(0^-) = \lim_{x\to 0^-} \frac{\sin(3p-1)x}{3x} \times \frac{(3p-1)}{(3p-1)}$$

$$= \lim_{x\to 0^-} \frac{\sin(3p-1)x}{(3p-1)x} \times \frac{(3p-1)}{3} = \frac{(3p-1)}{3}$$

$$f(0^+) = \lim_{x\to 0^+} \frac{\tan(3p+1)x}{2x} \times \frac{(3p+1)}{(3p+1)}$$

$$= \lim_{x\to 0^+} \frac{\tan(3p+1)x}{(3p+1)x} \times \frac{3p+1}{2} = \frac{3p+1}{2}$$

For function to be continuous,

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

By solving, we get, $\quad p = -\frac{5}{3}$

7. (b)

We have

$$y = e^x (A\cos x + B\sin x)$$

$$y' = e^x (A\cos x + B\sin x) + e^x (-A\sin x + B\cos x)$$

$$= y + e^x [-A\sin x + B\cos x]$$

$$y'' = y' + e^x (-A\sin x + B\cos x) + e^x (-A\cos x - B\sin x)$$

$$= y' + y' - y - y$$

$$= 2y' - 2y$$

$\Rightarrow$ Order $= 2$

Degree $= 1$

8. (a)

$$\nabla \cdot \vec{F} = 0 \quad \text{[For solenoidal vector]}$$

$$\frac{\partial(y^2 - z^2 + 3yz - 2x)}{\partial x} + \frac{\partial(3xz + 2xy)}{\partial y} + \frac{\partial(2xy - axz + 2z)}{\partial z} = 0$$

$$-2 + 2x - ax + 2 = 0$$

From here, $a = 2$

9. (a)

Greatest rate of increase of ϕ is magnitude of directional derivative at that point.

$$\nabla\phi = (2xyz + 4z^2)\hat{i} + x^2z\hat{j} + (x^2y + 8xz)\hat{k}$$

$$\nabla\phi|_{(1,-2,1)} = \hat{j} + 6\hat{k}$$

$$\text{Greatest rate of increase} = \sqrt{1^2 + 6^2} = \sqrt{37} = 6.08$$

10. (b)

Probability of first item being defective,

$$P_1 = \frac{15}{50}$$

Probability of second item being defective,

$$P_2 = \frac{14}{49}$$

Probability of third item being defective,

$$P_3 = \frac{13}{48}$$

Probability that all three are defective,

$$P = P_1P_2P_3 = \frac{15}{50} \times \frac{14}{49} \times \frac{13}{48} = \frac{13}{560}$$

11. (d)

$$D^2 + 7D + 12 = 0$$

$$(D + 3)(D + 4) = 0$$

$$D = -3, -4$$

$$y = C_1 e^{-3x} + C_2 e^{-4x}$$

$$y(0) = C_1 + C_2 = 1$$

$$y'(0) = -3C_1 - 4C_2 = 0$$

$$\Rightarrow \quad -3C_1 - 4C_2 = 0$$

$$3C_1 + 3C_2 = 3$$

$$C_2 = -3$$

$$C_1 = 4$$

$$y(x) = 4e^{-3x} - 3e^{-4x}$$

12. (c)

For a diagonal matrix

$$\lambda_1, \lambda_2 = a, b$$
$$\lambda_1 = a$$
$$\lambda_2 = b$$
$$ab = 25$$

we know, $AM \geq GM$

$$\frac{\lambda_1 + \lambda_2}{2} \geq \sqrt{\lambda_1 \lambda_2} = \sqrt{ab} = 5$$
$$\lambda_1 + \lambda_2 \geq 10$$
$$\min(\lambda_1 + \lambda_2) = 10$$

13. (b)

If $A^T = A^{-1} \Rightarrow A \cdot A^T = I$

$$\Rightarrow \begin{bmatrix} \frac{3}{5} & \frac{4}{5} \\ x & \frac{3}{5} \end{bmatrix} \begin{bmatrix} \frac{3}{5} & x \\ \frac{4}{5} & \frac{3}{5} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\frac{3}{5}x + \frac{4}{5} \times \frac{3}{5} = 0$$

$$\Rightarrow x = \frac{-4}{5}$$

14. (a)

$$\left[\begin{array}{ccc|ccc} 1 & 3 & -2 & 1 & 0 & 0 \\ 0 & 2 & 4 & 0 & 1 & 0 \\ 0 & 0 & -1 & 0 & 0 & 1 \end{array}\right] = \left[\begin{array}{ccc|ccc} 1 & 3 & -2 & 1 & 0 & 0 \\ 0 & 1 & 2 & 0 & 1/2 & 0 \\ 0 & 0 & -1 & 0 & 0 & 1 \end{array}\right]$$

$$= \left[\begin{array}{ccc|ccc} 1 & 0 & -8 & 1 & -3/2 & 0 \\ 0 & 1 & 2 & 0 & 1/2 & 0 \\ 0 & 0 & -1 & 0 & 0 & 1 \end{array}\right]$$

$$= \left[\begin{array}{ccc|ccc} 1 & 0 & -8 & 1 & -3/2 & 0 \\ 0 & 1 & 2 & 0 & 1/2 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 \end{array}\right]$$

$$= \left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 1 & -3/2 & -8 \\ 0 & 1 & 0 & 0 & 1/2 & 2 \\ 0 & 0 & 1 & 0 & 0 & -1 \end{array}\right]$$

$$\therefore A^{-1} = \begin{bmatrix} 1 & -3/2 & -8 \\ 0 & 1/2 & 2 \\ 0 & 0 & -1 \end{bmatrix}$$

15. (b)

$$\int_0^y \cos t^2\, dt = \int_0^{x^2} \frac{\sin t\, dt}{t}$$

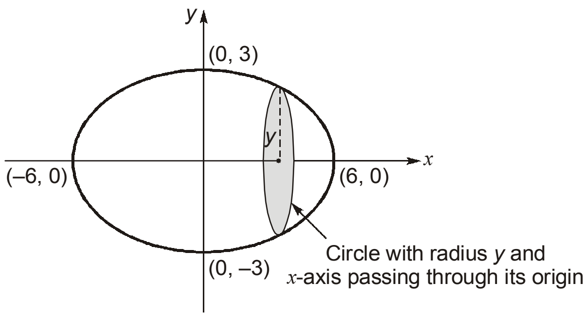
Differentiating both sides w.r.t x

$$\frac{d}{dy}\left(\int_0^y \cos t^2 dt\right)\cdot\frac{dy}{dx} = \frac{d}{dx^2}\left(\int_0^{x^2}\frac{\sin t}{t}dt\right)\cdot\frac{dx^2}{dx}$$

$$\cos y^2 \cdot \frac{dy}{dx} = \frac{\sin x^2}{x^2}\cdot 2x$$

$$\frac{dy}{dx} = \frac{2\sin x^2}{x\cdot\cos y^2}$$

16. (b)



$$\text{Volume generated} = \int_{-6}^{6} \pi y^2 dx = \int_{-6}^{6} \pi\left(\frac{36 - x^2}{4}\right) dx$$

$$= \frac{\pi\times 2}{4}\int_0^6 (36 - x^2)dx = \frac{\pi}{2}\left[36x - \frac{x^3}{3}\right]_0^6$$

$$= 72\pi \text{ unit}^3$$

17. (a)

For particular integral,

$$PI = \frac{96x^2}{D^2(D^2+4)} = 96\frac{1}{4D^2\left(1+\frac{D^2}{4}\right)}x^2 = \frac{96}{4}\left[\frac{\left(1-\frac{D^2}{4}\right)x^2}{D^2}\right]$$

$$= 24\frac{\left(x^2 - \frac{1}{2}\right)}{D^2}$$

$$PI = 24\left[\frac{x^4}{4\times 3} - \frac{x^2}{4}\right] = 2x^2(x^2 - 3)$$

$$PI\big|_{x=2} = 2\times 2^2(4-3) = 8$$

18. (a)

$$\int_{-\infty}^{\infty} f(x)dx = 1$$

$$\int_0^2 kx\,dx + \int_2^4 2k\,dx + \int_4^6 (-kx+6k)dx = 1$$

$$\left.\frac{kx^2}{2}\right|_0^2 + 2kx\Big|_2^4 + \left.\left(\frac{-kx^2}{2} + 6kx\right)\right|_4^6 = 1$$

$$\frac{k}{2}(2^2-0) + 2k(4-2) - \frac{k}{2}(6^2-4^2) + 6k(6-4) = 1$$

$$2k + 4k - 10k + 12k = 1$$

$$8k = 1 \quad \Rightarrow k = \frac{1}{8}$$

$$\text{Mean} = \int_{-\infty}^{\infty} xf(x)dx = \int_0^2 \frac{1}{8}x^2dx + \int_2^4 \frac{1}{4}xdx + \int_4^6 \left(-\frac{1}{8}x^2 + \frac{3}{4}x\right)dx$$

$$= \left.\frac{1}{8}\frac{x^3}{3}\right|_0^2 + \left.\frac{1}{4}\frac{x^2}{2}\right|_2^4 - \left.\frac{1}{8}\frac{x^3}{3}\right|_4^6 + \left.\frac{3}{4}\frac{x^2}{2}\right|_4^6$$

$$= \frac{1}{3} + \frac{3}{2} - \frac{19}{3} + \frac{15}{2} = 3$$

19. (a)

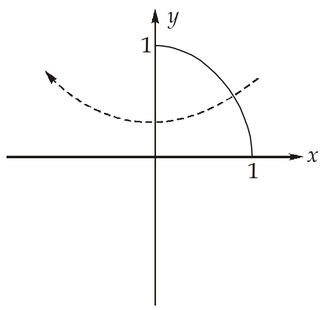
$$x = \sin\left(\frac{\pi k}{2}\right), y = \cos\left(\frac{\pi k}{2}\right)$$

Just by seeing, we can know that it represents a circle in $x - y$ plane, given by

$$x^2 + y^2 = 1$$

Given $0 \le k \le 1$, which gives $0 \le x \le 1$; $0 \le y \le 1$

or $$0 \le \frac{\pi k}{2} \le \frac{\pi}{2}$$



So we get a quarter circle, when this is rotated with respect to y-axis by 360 degree, it creates a hemisphere of radius 1.

Surface area of hemisphere,

$$A_S = 2\pi r^2$$

$$= 2\pi(1)^2 = 2\pi$$

20. (c)

$$f(y) = y^2 e^{-y}$$

$$f'(y) = y^2(-e^{-y}) + e^{-y} \times 2y$$

$$= e^{-y}(2y - y^2)$$

Putting $f'(y) = 0$

$$e^{-y}(2y - y^2) = 0$$

$$e^{-y} y(2 - y) = 0$$

$y = 0$ or $y = 2$ are the stationary points

Now, $$f''(y) = e^{-y}(2 - 2y) + (2y - y^2)(-e^{-y})$$

$$= e^{-y}(2 - 2y - 2y + y^2)$$

$$= e^{-y}(y^2 - 4y + 2)$$

At $y = 0$, $$f''(0) = e^{-0}(0 - 0 + 2) = 2$$

Since $f''(0) = 2$ is > 0 at $y = 0$ we have a minima

Now, at $y = 2$ $$f''(2) = e^{-2}(2^2 - 4 \times 2 + 2)$$

$$= e^{-2}(4 - 8 + 2)$$

$$= -2e^{-2} < 0$$

$\therefore$ At $y = 2$ we have a maxima.

21. (a)

$$\sin x \cos y dx + \cos x \sin y dy = 0$$

Divide by $\cos x \cos y$, we get ,

$$\tan x\, dx + \tan y dy = 0$$

Integrating the equation,

$$\log \sec x + \log \sec y = C_1$$

$$\log \frac{1}{\cos x \cos y} = C_1$$

$$\cos x \cos y = C$$

Since it passes through $\left(0, \frac{\pi}{3}\right)$

$$\cos(0) \cos\left(\frac{\pi}{3}\right) = C$$

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

$\Rightarrow$ The equation of curve is,

$$\cos x \cos y = \frac{1}{2}$$

22. (a)

To obtain maximum value of $f(x)$, first $f'(x)$ should be equated to zero.

$\Rightarrow \quad f'(x) = 6x^2 - 6x - 36 = 0$

$\Rightarrow \quad x^2 - x - 6 = 0$

$\Rightarrow \quad (x - 3)(x + 2) = 0$

$\therefore \quad f'(x) = 0 \quad$ at $x = 3$ and -2

Now, $\quad f''(x) = 12x - 6$

$f''(3) = 30 > 0$

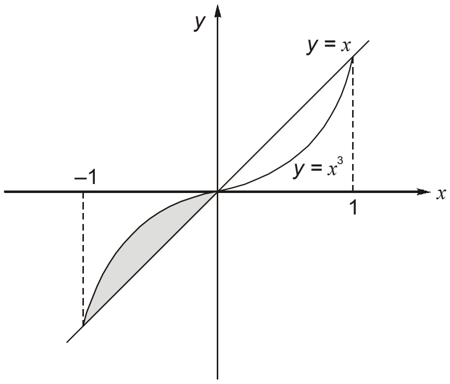
at $x = 3$, there is local minima

and $\quad f''(2) = -30 < 0$

$\therefore$ at $x = -2$, a local maxima is observed.

23. (b)

Point of inter-section of the two curves are $x = 0, 1, -1$



$$\text{Area} = \int_{-1}^{0}(x^3 - x)dx = \left[\frac{x^4}{4} - \frac{x^2}{2}\right]_{-1}^{0} = \frac{0-(-1)^4}{4} - \frac{0-(-1)^2}{2} = \frac{1}{4}$$

24. (c)

$$\frac{d^2y}{dx^2} = y$$

$\Rightarrow \quad D^2y = y \quad (\because d/dx = D)$

$(D^2 - 1)y = 0$

$D^2 - 1 = 0$

$D = \pm 1$

$y = C_1 e^x + C_2 e^{-x}$

Given point passes through origin

$\Rightarrow \quad 0 = C_1 + C_2$

$C_1 = -C_2 \quad$ ...(i)

Also, point passes through (ln 2, 3/4)

$$\Rightarrow \quad \frac{3}{4} = C_1 e^{\ln 2} + C_2 e^{-\ln 2}$$

$$\frac{3}{4} = 2C_1 + \frac{C_2}{2}$$

$\Rightarrow$ $$C_2 + 4C_1 = 1.5 \qquad \text{...(ii)}$$

From (i) $$C_1 = -C_2, \text{ putting in (ii), we get}$$

$\Rightarrow$ $$-3C_2 = 1.5$$

$$C_2 = -0.5$$

$\therefore$ $$C_1 = 0.5$$

$\Rightarrow$ $$y = 0.5\,(e^x - e^{-x})$$

$$y = \frac{e^x - e^{-x}}{2}$$

25. (d)

$$f(x) = 2x^3 - 3x^2 - 12x + 5$$

$$f'(x) = 6x^2 - 6x - 12$$

For minima/maxima, $$f'(x) = 0$$

$$6x^2 - 6x - 12 = 0$$

$$x^2 - x - 2 = 0$$

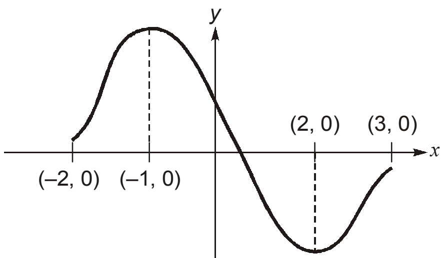
$$(x+1)(x-2) = 0$$

$$x = -1, 2$$

$$f''(x) = 12x - 6$$

$$f''(-1) = -12 - 6 = -18 < 0$$

$$f''(2) = 24 - 6 = 18 > 0$$



$\Rightarrow$ maxima

$\Rightarrow$ minima

The function has maxima at $x = -1$ and minima at $x = 2$.

The function is decreasing between –1 and 2.

26. (b)

z varies from 0 to $\frac{x^2+y^2}{4}$; y varies from 0 to $\sqrt{16-x^2}$; x varies from 0 to 4.

$$\text{Volume} = \iiint dx\,dy\,dz = \int_0^4 \int_0^{\sqrt{16-x^2}} \int_0^{\frac{x^2+y^2}{4}} dz\,dy\,dx$$

$$= \frac{1}{4}\int_0^4 \int_0^{\sqrt{16-x^2}} (x^2+y^2)\,dy\,dx = \frac{1}{4}\int_0^4 \left(x^2 y + \frac{y^3}{3}\right)\Bigg|_0^{\sqrt{16-x^2}} dx$$

$$= \frac{1}{4}\int_0^4 \left(x^2\sqrt{16-x^2} + \frac{\left(\sqrt{16-x^2}\right)^3}{3}\right) dx$$

Let, $$x = 4\sin\theta \qquad x \to 0 \text{ to } 4$$

$$dx = 4\cos\theta\, d\theta \qquad \theta \to 0 \text{ to } \frac{\pi}{2}$$

$$\text{Volume} = \frac{1}{4}\left[4^4 \int_0^{\pi/2} \sin^2\theta\cos^2\theta\, d\theta + \frac{4^4}{3}\int_0^{\pi/2} \cos^4\theta\, d\theta\right]$$

$$= \frac{1}{4}\left[4^4 \times \frac{\Gamma\left(\frac{3}{2}\right)\times\Gamma\left(\frac{3}{2}\right)}{2\,\Gamma\left(\frac{6}{2}\right)} + \frac{4^4}{3}\times\frac{\Gamma\left(\frac{5}{2}\right)\times\Gamma\left(\frac{3}{2}\right)}{2\,\Gamma\left(\frac{6}{2}\right)}\right]$$

$$= \frac{1}{4}\left[4^4 \times \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2!}\pi + \frac{4^4}{3}\times\frac{3}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2!}\times\pi\right]$$

$$= \frac{1}{4}[16\pi + 16\pi] = 8\pi = 25.13 \text{ unit}^3$$

27. (d)

$$c(y+c)^2 = x^3 \quad \text{...(i)}$$

Differentiating, we get

$$2c(y+c)\frac{dy}{dx} = 3x^2$$

$$\Rightarrow \frac{2x^3}{(y+c)^2}(y+c)\frac{dy}{dx} = 3x^2 \qquad \left(\because c = \frac{x^3}{(y+c)^2}\right)$$

$$\Rightarrow \frac{2x^2}{y+c}\frac{dy}{dx} = 3x^2$$

$$\Rightarrow \frac{2x}{3}\left(\frac{dy}{dx}\right) = y + c$$

$$\Rightarrow c = \frac{2x}{3}\left(\frac{dy}{dx}\right) - y$$

Putting this value of 'c' in equation (i)

$$\left[\frac{2x}{3}\left(\frac{dy}{dx}\right) - y\right]\left[\frac{2x}{3}\frac{dy}{dx}\right]^2 = x^3$$

28. (c)

Suppose $$y = \lim_{x\to\infty}\left(\frac{x+6}{x+1}\right)^{x+4}$$

$$\Rightarrow y = \lim_{x\to\infty}\left[\left(1+\frac{5}{x+1}\right)^{\frac{x+1}{5}}\right]^{\left[\frac{5(x+4)}{x+1}\right]}$$

$$\Rightarrow \ln y = \lim_{x\to\infty}\frac{5(x+4)}{(x+1)}\ln\left(1+\frac{5}{x+1}\right)^{\frac{x+1}{5}} \quad \text{...(i)}$$

$\lim\limits_{x\to\infty}\frac{5(x+4)}{(x+1)}$ is in the form of $\frac{\infty}{\infty}$ and $\lim\limits_{x\to\infty}\ln\left(1+\frac{5}{x+1}\right)^{\frac{x+1}{5}}$ is in the form of 0^0.

Calculating the limits of both terms separately

$$\lim_{x\to\infty}5\frac{(x+4)}{(x+1)} = \lim_{x\to\infty}5\frac{\left(1+\frac{4}{x}\right)}{\left(1+\frac{1}{x}\right)} = 5\frac{(1+0)}{(1+0)}$$

$$= 5$$

We can use direct result of $\lim\limits_{t\to 0}(1+t)^{1/t} = e$ ...(ii)

$$\Rightarrow \quad \lim_{x\to\infty} ln\left[1+\frac{5}{x+1}\right]^{\frac{x+1}{5}} = ln(e)$$

$$= 1 \qquad ...(iii)$$

$$\therefore \quad ln\, y = 5(1)$$

$$\Rightarrow \quad y = e^5$$

29. (c)

The matrix formed by the coefficients is $\begin{bmatrix} a & 1 & 2 \\ 1 & 2 & 1 \\ 2 & 1 & a \end{bmatrix}$

$$\text{Determinant} = 2a^2 - 2a - 4$$

$\therefore$ $D = 0$ for $a = 2$ or $a = -1$

(A) If $D \neq 0$, then the system will have unique solution.

(B) If $a = 2$, the matrix formed by the coefficients is $\begin{bmatrix} 2 & 1 & 2 \\ 1 & 2 & 1 \\ 2 & 1 & 2 \end{bmatrix}$

The rank of matrix is 2.

Considering 'z' as side unknown.

The characteristic determinant will be $\begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & b \\ 2 & 1 & 0 \end{bmatrix}$

The determinant of this is 0.

The system will have infinite solutions when $a = 2$.

(C) If $a = -1$, the matrix formed by the coefficients is $\begin{bmatrix} -1 & 1 & 2 \\ 1 & 2 & 1 \\ 2 & 1 & -1 \end{bmatrix}$

Its rank is 2.

Considering 'z' as side unknown.

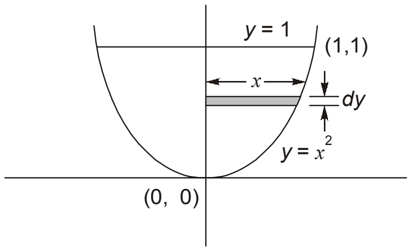
The characteristic matrix is $\begin{bmatrix} -1 & 1 & 0 \\ 1 & 2 & b \\ 2 & 1 & 0 \end{bmatrix}$

The determinant of this matrix is $3b$.

The system will have no solution if $b \neq 0$

$\therefore$ For $a = -1$ and $b \neq 0$, the system will have no solution.

30. (b)



$y = x^2$ and $y = 1$ intesect at (1, 1)

Small disk of radius 'x' and depth 'dy' are integrated to compute the volume

$$\text{Volume} = \int_0^1 \pi x^2 dy$$

$$= \int_0^1 \pi y\, dy = \pi \left[\frac{y^2}{2}\right]_0^1 = \frac{\pi}{2} \qquad (\because \; y = x^2)$$

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