Analytical Methods (Mathematics) Module code - ACH400

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Question 1 [5]

$V_{min} = 200$

$w = 490332$

$\rho = 0.41$

$C_L = 0.52$

a) $V_{min} = \sqrt{\frac{w}{S} \times \frac{2}{\rho} \times \frac{1}{C_L}}$

$V_{min}^2 = \frac{w}{S} \times \frac{2}{\rho} \times \frac{1}{C_L}$ $\quad V_{min}^2 (S \times \rho \times C_L) = w \times 2 \times 1$

$V_{min}^2 S \times V_{min}^2 \rho \times V_{min}^2 C_L = w \times 2 \times 1$

$V_{min}^2 S = \frac{w \times 2 \times 1}{(V_{min}^2 \rho \times V_{min}^2 C_L)}$ $\quad \left(\frac{\sqrt{\frac{490332 \times 2 \times 1}{200^4 (0.41 \times 0.52)}}}{200} \right)$

$V_{min} S = \sqrt{\frac{w \times 2 \times 1}{V_{min}^2 \rho \times V_{min}^2 C_L}}$ $\quad \left(\frac{\sqrt{\frac{980664}{3345600000}}}{200} \right)$

$S = \left(\frac{\sqrt{\frac{w \times 2 \times 1}{(V_{min}^2 \rho) \times (V_{min}^2 C_L)}}}{V_{min}} \right)$

$S = 1.465 \times 10^{-6}$

$S = \left(\frac{\sqrt{\frac{w \times 2 \times 1}{V_{min}^4 (\rho \times C_L)}}}{V_{min}} \right)$

6) 1) $\frac{8x-3}{5} = \frac{-5x+6}{-3}$

$-3(8x-3) = -3(-5x+6)$

$-24x+9 = 15x-18$

$15x+24x = -18-9$

$39x = -27$

$\frac{-27}{39} \rightarrow x = 1.\dot{4}$

2) $\frac{(4x-1)}{3} - \frac{x}{4} = \frac{(4x+3)}{2}$

CF (12)

$4(4x-1) - 3(x) = 6(4)x+3)$

$16x-4-3x = 24x+3$

$13x-4 = 24x+3$

$-4-3 = 24x-13x$

$-7 = 11x$

$\frac{-7}{11} \rightarrow x = 0.\dot{6}\dot{3}$

3) $2\log(5x+3) = \log(x+1) + \log(x+2)$

$\cancel{\log}(5x+3)^2 = \cancel{\log}(x+1)(x+2)$

(3rd law) (1st law)

$(5x+3)(5x+3) = (x+1)(x+2)$

$5x^2+15x+15x+9 = x^2+2x+x+2$

$\underset{A}{4x^2} + \underset{B}{12x} + \underset{C}{7}$

$$x = \frac{-b \pm \sqrt{(B)^2 - 4(A \times C)}}{2 \times A}$$

$$x = \frac{-12 \pm \sqrt{32}}{8}$$

$$x = \frac{-12 \pm \sqrt{(12)^2 - 4(4 \times 7)}}{2 \times 4}$$

$$x = \frac{-12 \pm = 5.657}{8}$$

$$x = \frac{-12 \pm \sqrt{144 - 112}}{8}$$

$$x = \frac{6.343}{8} \qquad \frac{-17.657}{8}$$

$$x = 0.7928 \qquad x = -2.207$$

4) $7^x \times 3^{x+2} = 5^{x-1}$

3rd law

$$\log 7^x \times \log 3^{x+2} = \log 5^{x-1}$$

3rd law

$$= (x-1)\, 0.699$$

$$(x)\, 0.845 \times (x+2)\, 0.477$$

$$(0.845x)(0.477x + 0.954) = (0.699x - 0.699)$$

$$0.403x^2 + 0.806x = 0.699x - 0.699$$

$$\underset{A}{0.403x^2} + \underset{B}{0.107x} = \underset{C}{-0.699}$$

$$x = \frac{-0.107 \pm \sqrt{(0.107)^2 - 4(0.403 \times -0.699)}}{2 \times 0.403}$$

$$x = \frac{-0.107 \pm \sqrt{0.011 - (-1.127)}}{0.806}$$

$$x = \frac{-0.107 \pm \sqrt{1.138}}{0.806} \qquad \cancel{x = \frac{-0.107 \pm \sqrt{1.067}}{0.806}}$$

$$x = \frac{-0.107 \pm 1.067}{0.806}$$

$$x = \frac{0.96}{0.806} \qquad x = \frac{-1.174}{0.806}$$

$$x = 1.191 \qquad x = -1.457$$

c) $21R^2 + 24R + 5$

Question 3

a) $12x^2 = 31x + 15$

$$x = \frac{-31 \pm \sqrt{(-31) - 4(12 \times -15)}}{2 \times 12}$$

$\underset{a}{12}x^2 - \underset{b}{31}x - \underset{c}{15}$

$$x = \frac{31 \pm \sqrt{961 (- -) 720}}{24}$$

$$x = 31 \pm \frac{\sqrt{1681}}{24} \qquad x = x = 31 \pm \frac{(41)}{24}$$

$$x = \frac{72}{24} \qquad x = 3 \qquad x = \frac{-10}{24} \qquad x = -0.42$$

b) $0° < 360°$

1) $\cos x = 0.62$

$\cos^{-1} = 51.683$
$- 360$
$= 308.317$

S	A
T	C

2) $7 \sin x = 4$ $\quad \frac{4}{7} = 0.571 \quad x = \sin^{-1} = 34.820 - 180$
$x = 145.180$

3) $-5 \tan = 4$ $\quad \frac{4}{-5} = 0.8 \quad x = \tan^{-1} = 38.660 - 270$
$x = 231.34$

4) $-3\sin x = -2$ $\quad \frac{-2}{-3} = 0.\dot{6}$ $\quad x = \sin^{-1} = 41.810 - 180$

$x = 138.190$

c) $x^2 - 3x + 10$ $\quad 0° < 360°$

$(x + 2)(x - 5) \leftarrow (2 \times 5)$ $\quad \tan x + 3x - 10 = 0$

$(x^2 - 5x + 2x + 10)$ $\quad \cancel{(x+2)(-3x+0)}$

$x = \frac{-3 \pm \sqrt{(-3)^2 - 4(1 \times 10)}}{2 \times 1}$ $\quad x = \frac{+3 \pm \sqrt{9 - 40}}{2}$

$x = \frac{3 \pm \sqrt{-31}}{2}$ $\quad x = \frac{+3 \pm 5.568}{2}$ $\quad x = \frac{8.568}{2}$

$x = \frac{2.568}{2}$ $\quad x = 1.284$ $\quad x = 4.284$

$\tan x + 3x(1.284 // 4.284) = 10$

$3 \times 1.284 = 3.852$ $\quad x = \tan^{-1}(1.285 = 52.11$

$3 \times 4.284 = 12.852$ $\quad x = 217.89$

(-270)

$x = \tan^{-1}(0.385 = 21.057$

$x = 248.943$

(-270)

d) $y = \sin^2\left(\frac{3\theta}{2}\right)$ [θ]

$\sqrt{y} = \sin^2\left(\frac{3\theta}{2}\right.$ $\frac{\sqrt{y}}{2\sin} = 3\theta$

$3\left(\frac{\sqrt{y}}{2\sin}\right) = y$