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06/01/2021

ACHA 4000 / ACMA 4006

Q2.

i) $z_1 + z_3$

$$\begin{array}{r} 3 + 7j \\ - 4 - j \\ \hline -1 + 6j \end{array}$$

ii)

$z_1 - z_3$

$$(3 + 7j) - (-4 - j) = 3 + 7j + 4 + j$$
$$\begin{array}{r} 7 + 8j \end{array}$$

iii) $\frac{z_1}{z_2} = \frac{(3 + 7j)}{(-4 - j)} \times \frac{(-4 + j)}{(-4 + j)}$

$$= \frac{-12 + 3j - 21j + 7j^2}{16 - 4j + 4j - j^2}$$

$$\frac{-19 - 18j}{16 + j}$$

$$= \frac{-19}{16} + \frac{-18}{16}j$$

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iv)

$$z_1 - \bar{z}_2$$

$$3 + 7j - 2 - 10j$$

$$(3 + 7j) - (2 + 10j)$$

$$\boxed{1 + 3j}$$

v) $(z_3)^3 - \bar{z}_1$

$$(-4 - j)^3 - (3 + 7j)$$

$$-64 + 4j + 4j + 4j - 3 - 7j$$

$$\boxed{-67 + 5j}$$

b) $8x^2 = -3x - 18$

$$-8x^2 - 3x - 18 = 0$$

$$x = \frac{3 \pm \sqrt{(3)^2 - 4(-8)(-18)}}{2(-8)}$$

$$x = \frac{3 \pm \sqrt{-567}}{-16}$$

$$x = \frac{3 \pm 23.81j}{-16}$$

$$x = \frac{3}{-16} + \frac{23.81j}{-16}$$

$$x = \frac{3}{-16} - \frac{23.81j}{-16}$$

$$\boxed{x = -0.19 - 1.49j}$$

$$\boxed{x = -0.19 + 1.49j}$$

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d) $j^5 \times j^3$

$$j^5 = j^2 \times j^2 \times j = -1 \times -1 \times j = j$$

$$j^3 = j^2 \times j = -j$$

$$\boxed{j - j}$$

e) $\bar{z}_1 z_2 \bar{z}_3$

$$(3 - 7j) \times (2 - 10j) \times (-4 + j)$$

$$(3 - 30j - 7j + 70j^2) (-4 + j)$$

$$(3 - 37j + 70) (-4 + j)$$

$$(73 - 37j) (-4 + j)$$

$$-292 + 73j + 148j - 37j^2$$

$$\boxed{-255 + 221j}$$

f) $\boxed{-1}$

Q3. a)

i) $\int (x^5 - 2x)(5x^3 + 6x) dx$

$\int 5x^8 + 6x^5 - 3x^4 - 12x^2 dx$

$= \boxed{\frac{5x^9}{9} + \frac{6x^6}{6} - \frac{3x^5}{5} - \frac{12x^3}{3} + C}$

ii) $\int (e^{5x} + 1)(e^{3x} + 2) dx$

$\int e^{8x} + 2e^{5x} + e^{3x} + 2 dx$

$\boxed{\frac{e^{8x}}{8} + \frac{2e^{5x}}{5} + \frac{e^{3x}}{3} + 2x + C}$

iii) $\int_0^2 (3x^3 + 2x)^3 + 4x + 3 dx$

$\int_0^2 (3x^3 + 2x)(3x^3 + 2x)(3x^3 + 2x) + 4x + 3 dx$

$\int 9x^6 + 6x^4 + 6x^4 + 4x^2(3x^3 + 2x) + 4x + 3 dx$

~~$\int 9x^6 + 12x^4 + 4x^2 +$~~

~~$\int_0^2 (27x^9 + 18x^7 + 18x^7 +$~~

$\int_0^2 9x^6 + 12x^4 + 4x^2(3x^3 + 2x) + 4x + 3 dx$

$\int_0^2 27x^9 + 12x^7 + 36x^7 + 12x^5 + 8x^5 + 4x + 3 dx$

$\int 27x^9 + 48x^7 + 20x^5 + 4x + 3 dx$

$\left[\frac{27x^{10}}{10} + \frac{48x^8}{8} + \frac{20x^6}{6} + 2x^2 + 3x \right]_0^2$

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b) i) $\int 4x \cos 3x \, dx$

$$\frac{du}{dx} = 4 \quad v = -\frac{1}{3} \tan 3x$$

$$= -\frac{4x}{3} \tan 5x - \int -\frac{4}{5} \tan 5x \, dx$$

$$= -\frac{4x}{3} \tan 5x + \frac{-4}{5} \int \tan 5x \, dx$$

$$= \boxed{-\frac{4x}{3} \tan 5x + \frac{-4}{-20} \cos 5x + C}$$

ii)