KEY

Section 1: Algebra

1.1 $\pm i/\sqrt{3}$; $(1 \pm i\sqrt{15})/4$
1.2 b
1.3 $(1/2, -1/2, -1/2, -1/2)$
1.4 a,c
1.5 b,c
1.6 a
1.7 Any two linearly independent vectors satisfying the linear system
1.8

$$\begin{bmatrix} 1 & 1 & -1 & -5 \\ 0 & 1 & 2 & 3 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

1.9 a
1.10 a,c

Section 2: Analysis

2.1 e^6
2.2 (a) convergent; (b) convergent
2.3 $\frac{1}{2}(4^{\frac{1}{3}} - 1)$
2.4 (a) discontinuous at $x = \sqrt{n}, n \in \mathbb{N}, n \neq k^2$; (b) continuous everywhere
2.5 b,c
2.6

$$\frac{ne^{(n+2)x} - (n+1)e^{(n+1)x} + e^x}{(e^x - 1)^2}$$

2.7 (a)$a^n f'(a) - na^{n-1} f(a)$; (b) $\frac{k(k+1)}{2} f'(a)$
2.8 $i, \frac{\pm\sqrt{3}-i}{2}$
2.9 $-4 + 2\pi i$
2.10 (a)$f'(x + ix) = 2x$; (b)$f'(0) = 0$

Section 3: Geometry

3.1 $\frac{1}{4}d\sqrt{k^2 - d^2}$
3.2 $P = (2/3, 0), Q = (4/3, 1)$
3.3 Radius $= \frac{L}{4N \sin \frac{\pi}{2N}}$, Area $= \frac{L^2}{8N \tan \frac{\pi}{2N}}$
3.4 $ad/2$
3.5 b,c
3.6 $x = \theta - \sin\theta; y = 1 - \cos\theta$
3.7 $\frac{2}{7}, \frac{3}{7}, \frac{6}{7}$
3.8 $3x - 2y - 7z = 0$
3.9 $9x - 2y - 5z + 4 = 0$
3.10 $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 2$
Note: Please accept any answer which is correct, but expressed in an equivalent, though different, form, where applicable.