KEY

Section 1: Algebra

1.1 (1 3)(2 5)
1.2 a. odd ;b. 30
1.3 a,c
1.4 Any example of the form:

$$\mathcal{I} \;=\; \{f \mid f(x) = 0 \text{ for all } x \in S\}$$

where $S \subset [0,1]$ has at least two points.
1.5 $6x + 1$
1.6 a. 5; b. 0
1.7 $\lambda^2 - 1$
1.8 b,c
1.9 b
1.10

$$P \;=\; \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{bmatrix};\; D \;=\; \begin{bmatrix} 2 & 0 \\ 0 & 8 \end{bmatrix}$$

Section 2: Analysis

2.1 $-3e^{-2}$
2.2 None
2.3 $f(0)$
2.4 a,b,c
2.5

$$\sum_{n=1}^{\infty} (-1)^{n-1} \frac{x^{2n}}{(2n-1)(2n)}$$

2.6 $\frac{\pi}{4} - \frac{1}{2}\log 2$
2.7 a,b
2.8 None
2.9 Standard example:$f(z) = z^2$
2.10 b

Section 3: Topology

3.1 b
3.2 a,b
3.3 a
3.4 a,b
3.5 a,b
3.6 a,b,c
3.7 a,b
3.8 b,c
3.9 a,b,c
3.10 b

Section 4: Calculus & Differential Equations

4.1 $\frac{3}{8}\sqrt{\pi}$
4.2 πa
4.3 $\frac{2}{3}$.
4.4 $\frac{\pi}{4}$
4.5 12π
4.6

$$\begin{aligned} x(t) &= x_0 \cos\omega t + y_0 \sin\omega t \\ y(t) &= -x_0 \sin\omega t + y_0 \cos\omega t \end{aligned}$$

4.7

$$\begin{bmatrix} \cos\omega & \sin\omega \\ -\sin\omega & \cos\omega \end{bmatrix}$$

4.8 $y' = u;\; u' = v;\; v' = v - x^2u^2$
4.9 a. All points $(x, 0), x \in \mathbb{R}$; b. $y = c(x^2 + 1)$
4.10 a,b

Section 5: Miscellaneous

5.1 $d^2 \le a^2 + b^2 + c^2$
5.2 10 cms
5.3 $\sqrt{14}$
5.4

$$\alpha_\ell = \binom{n-k}{r-\ell},\; 0 \le \ell \le k$$

5.5 a,c
5.6 $56k + 37,\; k \in \mathbb{Z}$
5.7 $\frac{2}{3}$
5.8 a,c
5.9 $2 \times 5! = 240$
5.10 $10\left(\frac{10}{7}\right)^{\frac{1}{3}} - 11$
Note: Please accept any correct equivalent form of the answers.