

KEY**Section 1: Algebra**

- 1.1 9
 1.2 b,c
 1.3 The multiplicative group $\{-1, 1\}$
 1.4 a,c
 1.5 $a - 2b - c = 0$
 1.6
$$\begin{bmatrix} 1 & 3 & 4 \\ 1 & 0 & 2 \\ 0 & \frac{1}{2} & 0 \\ 0 & 0 & \frac{1}{3} \end{bmatrix}$$

 1.7 0
 1.8 a,b,c
 1.9 a
 1.10 $\lambda^2 - 3\sqrt{2}\lambda + 4$

Section 2: Analysis

- 2.1 $\sin 1$
 2.2 $\frac{4}{e}$
 2.3 b,c
 2.4 a,b
 2.5 $\mathbb{R} \setminus \{-1\}$
 2.6 b
 2.7
$$\int_0^1 |f'(t)| dt$$

 2.8
$$\sum_{n=1}^{\infty} (-1)^{n-1} \frac{x^{2n}}{(2n-1)(2n)}$$

 2.9 $e^{(4n+1)\pi}, n \in \mathbb{Z}$
 2.10 $\{z = x + iy : y \geq 0\}$

Section 3: Topology

- 3.1 b
 3.2 a,c
 3.3 B and D are homeomorphic
 3.4 a,b,c
 3.5 a,b
 3.6 a,b
 3.7 b
 3.8 a,b
 3.9 c
 3.10 b,c

Section 4: Applied Mathematics

- 4.1
$$\lambda = (2n+1)^2 \frac{\pi^2}{4},$$

$$u = C \sin(2n+1) \frac{\pi}{2}, n = 0, 1, 2, \dots$$

 4.2
$$c = \frac{-2}{b-a}$$

 4.3
$$\frac{\pi}{\sqrt{7}}$$

 4.4
$$y(x) = \frac{x^2 - x}{4}$$

 4.5 $L(y'')(s) = s^2 L(y)(s) - sy(0) - y'(0)$
 4.6 $x = 0$, irregular singular point, $x = 1$, regular singular point
 4.7 0
 4.8 $y(x) = x^3 + C_1 x^2 + C_2$
 4.9
$$\int_a^b f(x) dx \sim \frac{(b-a)}{6} [f(a) + 4f((a+b)/2) + f(b)]$$

 4.10 3

Section 5: Miscellaneous

- 5.1
$$\frac{m!(m+1)!}{(m-n+1)!}$$

 5.2 $2^{n-1}(3n+2)$
 5.3 a,b
 5.4 $\log N$
 5.5 0
 5.6 $x^3 - 16x^2 + 64x - 9 = 0$
 5.7 $\sqrt{37}$
 5.8
$$\frac{a+3b}{4}$$

 5.9 a,b
 5.10 a,b