a) $f(x) = (2+ke^x)^3$

$= C_0^3 (2)^3 + C_1^3 (2)^2 (ke^x) + C_2^3 (2)^1 (ke^x)^2 + C_3^3 (ke^x)^3$ 1M

$= 8 + 12ke^x + 6k^2e^{2x} + k^3e^{3x}$

$= 8 + 12k(1 + x + \frac{x^2}{2} + \cdots) + 6k^2(1 + 2x + 2x^2) + k^3(1 + 3x + 4.5x^2 + \cdots)$ 1M

Coefficient of $x = 12k + 12k^2 + 3k^3$ 1A

Coefficient of $x^2 = 6k + 12k^2 + 4.5k^3$ or $\frac{9}{2}$ 1A

b) from (a), we have coefficient of $x = 3k^3 + 12k^2 + 12k$

$3k^3 + 12k^2 + 12k + 9 = 0$

$(k+3)(3k^2 + 3k + 3) = 0$ 1M

$k = -3$ or $k^2 + k + 1 = 0$

$\Delta = (1)^2 - 4(1)(1) = -3 < 0$

$\therefore$ no real roots

$\therefore k = -3$

Coefficient of x^2

$= 6(-3) + 12(-3)^2 + 4.5(-3)^3$ 1M

$= -31.5$ or $\frac{-63}{2}$ 1A

7