5. The complex numbers z and w satisfy the simultaneous equations

$$3z + \mathrm{i}w = -1 + \mathrm{i}$$

$$kz - w = -9\mathrm{i}$$

where k is a real constant.

(a) Show that

$$z = \frac{24 + k + (3 - 8k)\mathrm{i}}{9 + k^2}$$

(3)

Given that $k = 2$

(b) show that $w = 4 + 7\mathrm{i}$

(2)

(c) Hence determine, in simplest form, the exact value of

(i) $\dfrac{|w|}{|z|}$

(ii) $\arg(z + w)$

(3)

(Total for Question 5 is 8 marks)