5 **(a)** On a sketch of an Argand diagram, shade the region whose points represent complex numbers z satisfying the inequalities $|z+2| \leqslant 2$ and $\text{Im}\, z \geqslant 1$. [4]

(b) Find the greatest value of $\arg z$ for points in the shaded region. [2]

6 **(a)** On an Argand diagram shade the region whose points represent complex numbers z which satisfy both the inequalities $|z-4-3\text{i}| \leqslant 2$ and $\arg(z-2-\text{i}) \geqslant \frac{1}{3}\pi$. [5]

(b) Calculate the greatest value of $\arg z$ for points in this region. [2]

4. The number of bacteria on a surface is being monitored.

The number of bacteria, N, on the surface, t hours after monitoring began is modelled by the equation

$$\log_{10} N = 0.35t + 2$$

Use the equation of the model to answer parts (a) to (c).

(a) Find the initial number of bacteria on the surface.

(1)

(b) Show that the equation of the model can be written in the form

$$N = ab^t$$

where a and b are constants to be found. Give the value of b to 2 decimal places.

(3)

(c) Hence find the rate of growth of bacteria on the surface exactly 5 hours after monitoring began.

(2)

1. **In this question you must show all stages of your working.**

Solutions relying entirely on calculator technology are not acceptable.

Solve, for $0 < \theta \leqslant 360°$, the equation

$$3\tan^2\theta + 7\sec\theta - 3 = 0$$

giving your answers to one decimal place.

(5)

3 The square roots of $24-7\text{i}$ can be expressed in the Cartesian form $x+\text{i}y$, where x and y are real and exact.

By first forming a quartic equation in x or y, find the square roots of $24-7\text{i}$ in exact Cartesian form. [5]

6 Solve the quadratic equation $(1-3\text{i})z^2 - (2+\text{i})z + \text{i} = 0$, giving your answers in the form $x+\text{i}y$, where x and y are real. [6]

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3 On a sketch of an Argand diagram, shade the region whose points represent complex numbers z satisfying the inequalities $|z - 3 - i| \leqslant 3$ and $|z| \geqslant |z - 4i|$. [4]

2. The function f is defined by

$$f(x) = \frac{x+3}{x-4} \qquad x \in \mathbb{R}, x \neq 4$$

(a) Find $ff(6)$

(2)

(b) Find f^{-1}

(3)

The function g is defined by

$$g(x) = x^2 + 5 \qquad x \in \mathbb{R}, x > 0$$

(c) Find the exact value of a for which

$$gf(a) = 7$$

(3)

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