# Sample solutions to the 2019 VCAA NHT papers

## Specialist Mathematics Examination 1

**Question 2** (4 marks)

A cubic polynomial has the form $p(z) = z^3 + bz^2 + cz + d$, $z \in C$, where $b, c, d \in R$.

Given that a solution of $p(z) = 0$ is $z_1 = 3 - 2i$ and that $p(-2) = 0$, find the values of $b$, $c$ and $d$.

$$p(z) = (z+2)(z-(3-2i))(z-(3+2i))$$
$$= (z+2)((z-3)+2i)((z-3)-2i)$$
$$= (z+2)((z-3)^2+4)$$
$$= (z+2)(z^2-6z+13)$$
$$= z^3-6z^2+13z+2z^2-12z+26$$
$$= z^3-4z^2+z+26$$
$$\therefore \quad b=-4, \quad c=1, \quad d=26$$

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## Mathematical Methods Examination 2

**Question 5**

Consider the probability distribution for the discrete random variable $X$ shown in the table below.

| $x$ | $-1$ | $0$ | $1$ | $2$ | $3$ |
|---|---|---|---|---|---|
| $\Pr(X = x)$ | $b$ | $b$ | $b$ | $\frac{3}{5} - b$ | $\frac{3b}{5}$ |

The value of $\mathrm{E}(X)$ is

**A.** $\frac{76}{65}$

**B.** 1

**C.** 0

**D.** $\frac{2}{13}$

**E.** $\frac{86}{65}$

$$3b + \frac{3}{5} - b + \frac{3b}{5} = 1 \quad \text{so} \quad b = \frac{2}{13}$$

$$E(X) = -\frac{2}{13} + \frac{2}{13} + 2\left(\frac{3}{5} - \frac{2}{13}\right) + 3\left(\frac{3}{5} \times \frac{2}{13}\right)$$

$$= \frac{76}{65}$$

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## Further Mathematics Examination 1

**Question 5**

The cities of Lima and Washington, DC have the same longitude of 77° W.

The shortest great circle distance between Lima and Washington, DC is 5697 km.

Assume that the radius of Earth is 6400 km.

Lima has a latitude of 12° S and is located due south of Washington, DC.

What is the latitude of Washington, DC?

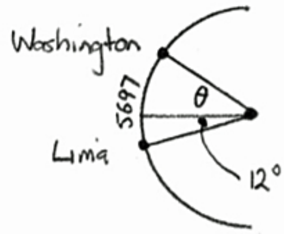
**A.** 39° N

**B.** 51° S

**C.** 51° N

**D.** 63° N

**E.** 65° S




$$\left(\frac{\theta+12}{360}\right) \times 2\pi \times 6400 = 5697$$

$$\theta = 39^\circ$$

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