

External assessment 2023

Multiple choice question book

# Specialist Mathematics

Paper 2 — Technology-active

## General instruction

- Work in this book will not be marked.

## Section 1

### Instruction

- Respond to these questions in the question and response book.
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### QUESTION 1

The acceleration ( $\text{m s}^{-2}$ ) of an object moving with simple harmonic motion is modelled by  $a = -2.95x$ , where  $x$  is its displacement (m) from the origin.

Determine the period of the motion in seconds.

- (A) 1.72
- (B) 2.13
- (C) 2.95
- (D) 3.66

### QUESTION 2

The standard deviation for the scores of 1000 students completing an entry test at a certain university is 13.

A researcher takes repeated random samples of the test results, with each sample comprising 40 scores, and calculates the mean score for each sample.

Determine the standard deviation of the distribution of the sample mean scores.

- (A) 3.08
- (B) 2.06
- (C) 0.41
- (D) 0.33

### QUESTION 3

Given that  $2i$  is a root of  $z^2 - pz - q = 0$ , where  $p, q \in R$ , determine the values of  $p$  and  $q$ .

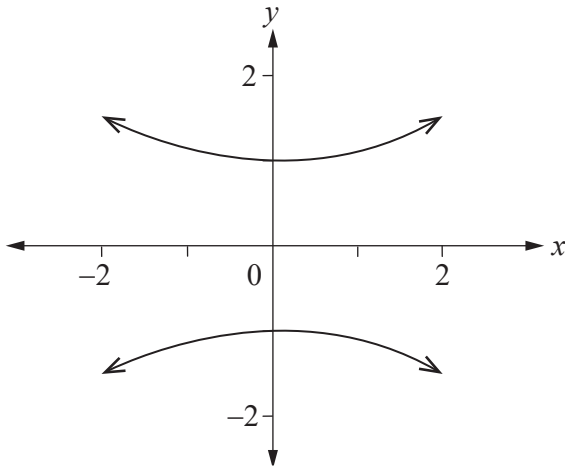
- (A)  $p = -4$  and  $q = -4$
- (B)  $p = -4$  and  $q = 4$
- (C)  $p = 0$  and  $q = -4$
- (D)  $p = 0$  and  $q = 4$

QUESTION 4

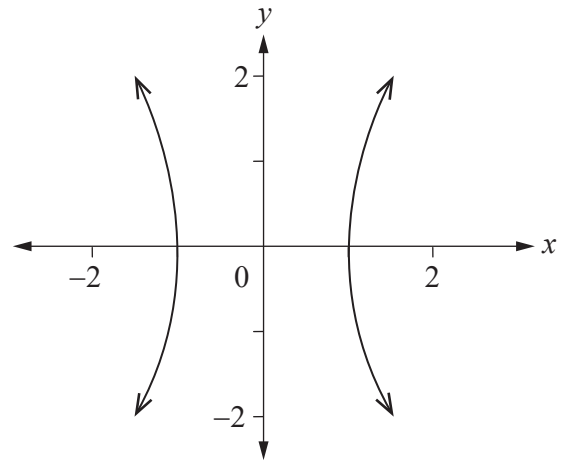
The position of a particle can be modelled using  $\mathbf{r} = \cos(t)\hat{\mathbf{i}} - 2\sin(t)\hat{\mathbf{j}}$ ,  $t \geq 0$ .

Which curve best represents the path of the particle?

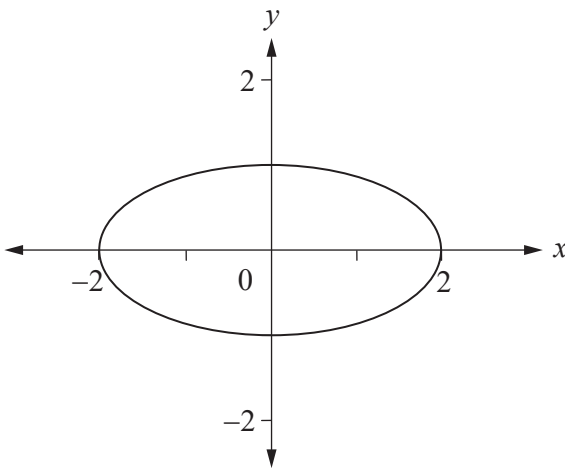
(A)



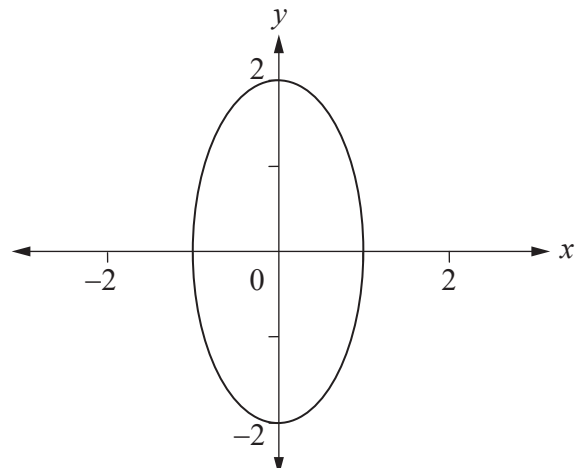
(B)



(C)



(D)



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**QUESTION 5**

A plane contains the origin and the points (1, 2, 3) and (3, 2, 1).

A vector normal to the plane is

(A)  $\begin{pmatrix} 4 \\ -8 \\ 4 \end{pmatrix}$

(B)  $\begin{pmatrix} 4 \\ -8 \\ -4 \end{pmatrix}$

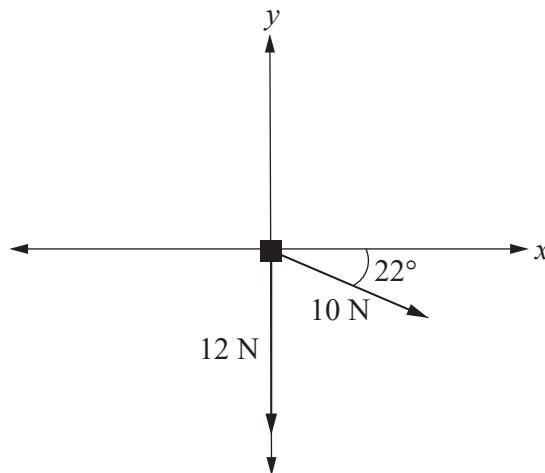
(C)  $\begin{pmatrix} -4 \\ -8 \\ -4 \end{pmatrix}$

(D)  $\begin{pmatrix} -4 \\ -8 \\ 4 \end{pmatrix}$

**QUESTION 6**

Two coplanar forces of magnitudes 12 N and 10 N act on an object in the directions shown.

Not to scale



Determine the magnitude of the resultant force acting on the object.

(A) 12.41 N

(B) 15.55 N

(C) 15.69 N

(D) 18.27 N

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**QUESTION 7**

Matrix  $\mathbf{N}$  represents the results for a competition involving four teams.

$$\mathbf{N} = \begin{array}{c} \text{Winning teams} \\ \begin{array}{c} \text{P} \\ \text{Q} \\ \text{R} \\ \text{S} \end{array} \end{array} \begin{array}{c} \text{Losing teams} \\ \begin{array}{c} \text{P} \quad \text{Q} \quad \text{R} \quad \text{S} \end{array} \end{array} \begin{bmatrix} 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$

**Key:** Team P lost to team Q but won against teams R and S.

Using the ranking model  $\mathbf{N} + 0.5\mathbf{N}^2$ , the teams that placed first, second and third respectively are

- (A) P, S and Q.
- (B) P, S and R.
- (C) S, P and Q.
- (D) S, P and R.

**QUESTION 8**

Given  $f(x) = \tan^{-1}(2x)$ , determine  $f'(3)$ .

- (A) 0.05
- (B) 0.15
- (C) 2.17
- (D) 3.10

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**QUESTION 9**

The time in minutes between the arrival of customers at a certain shop is assumed to be a random variable  $X$  with an exponential distribution that has the probability density function

$$f(x) = \begin{cases} 0.12e^{-0.12x}, & x \geq 0 \\ 0 & , \text{ otherwise} \end{cases}$$

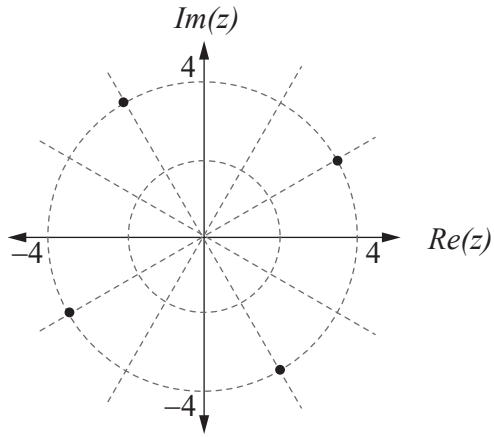
A customer arrives at the shop. The probability that the next customer arrives within 30 to 60 seconds, to the nearest percent, is

- (A) 3%
- (B) 5%
- (C) 7%
- (D) 11%

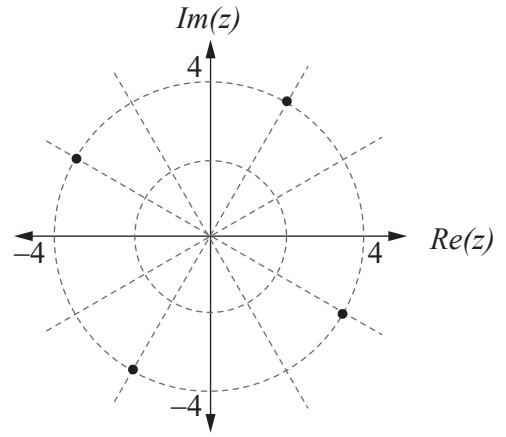
QUESTION 10

The Argand diagram that represents the solutions to  $z^4 = 16 \operatorname{cis}\left(\frac{2\pi}{3}\right)$ ,  $z \in \mathbb{C}$  is

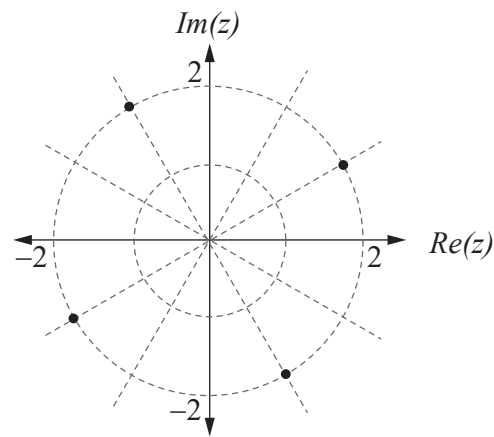
(A)



(B)



(C)



(D)

