Sample assessment 2020

Specialist Mathematics

Paper 2 — Technology-active

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Section 1

Instructions

- Answer all questions in the question and response book.
- This book will not be marked.

QUESTION 1

Let $z = \text{cis}\left(\frac{2\pi}{5}\right)$.

$Im\,(z^4)$ is

    (A) -0.95

    (B) 0.09

    (C) 0.31

    (D) 0.81

QUESTION 2

The line l is described by the vector equation

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 7 \\ 13 \end{pmatrix} + k \begin{pmatrix} 4 \\ 16 \\ -2 \end{pmatrix}$$

Which of the following points lies on line l?

    (A) $(0, 7, 11)$

    (B) $(2, 15, 12)$

    (C) $(4, 16, 11)$
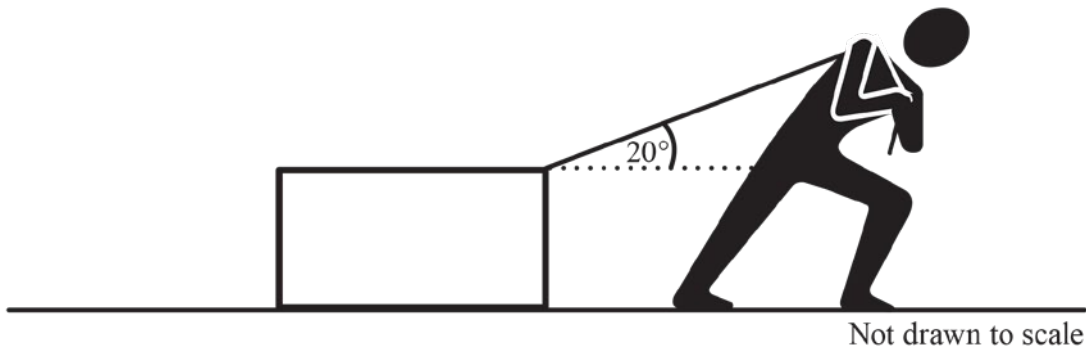
    (D) $(4, 23, 15)$

QUESTION 3

Use implicit differentiation to determine the value of the gradient of $2e^x - 3y^2 + 3\pi^2 = 2e$ at $(1, \pi)$.

    (A) -24.17

    (B) -13.41

    (C) 0.29

    (D) 2.85

QUESTION 4

An object lies on a horizontal plane as shown in the diagram below.

When a force of 350 N is applied at an angle of 20°, the object remains stationary.

Not drawn to scale

The frictional force acting on the object, correct to the nearest unit, is

- (A)   119 N
- (B)   120 N
- (C)   328 N
- (D)   329 N

QUESTION 5

When using proof by mathematical induction to show that $(1 + i)^{4n} = (-4)^n$ where $n \in Z^+$, the inductive step requires the proof of

- (A) $(1 + i)^4 = (-4)^1$
- (B) $(1 + i)^{4k} = (-4)^k$
- (C) $(1 + i)^{4k+1} = (-4)^{k+1}$
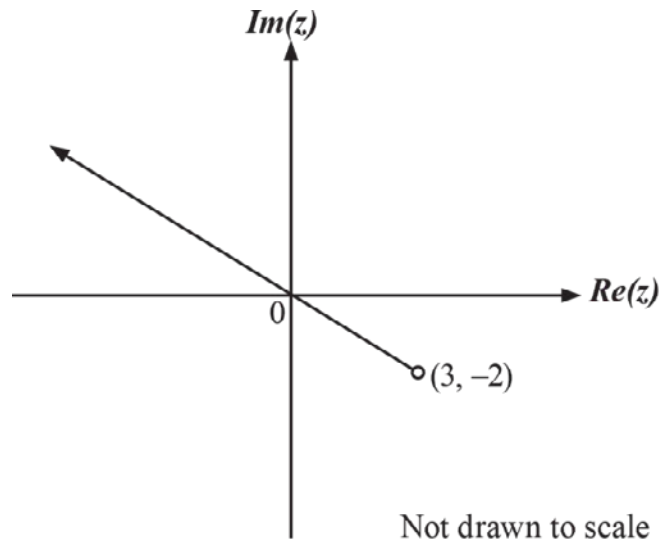- (D) $(1 + i)^{4k+4} = (-4)^{k+1}$

QUESTION 6

The vector $\begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}$ is normal to the plane containing the points $(0, 0, 0), (3, 4, 5)$ and $(2, k, 4)$.

The value of k is

- (A) -6.5
- (B) -3
- (C) 3
- (D) 6.5

QUESTION 7

Consider the line that passes through the origin as shown in the complex plane below.

Not drawn to scale

The subset of the complex plane that **best** defines this line is

(A) $|z - 3 + 2i| = 3.6$

(B) $|z + 3 - 2i| = 3.6$

(C) $\arg(z - (3 - 2i)) = 123.7°$

(D) $\arg(z - 3 + 2i) = 146.3°$

QUESTION 8

Which of the following is a solution of the equation $z^2 + 2iz - 5 = 0$?

(A) $1 - 2i$

(B) $1 + 2i$

(C) $2 - i$

(D) $2 + i$

QUESTION 9

The win/loss results after a soccer competition involving four teams are represented in the matrix **M** shown below.

$$\mathbf{M} = \begin{array}{c} \\ \text{Winning teams} \end{array} \begin{array}{c} \\ A \\ B \\ C \\ D \end{array} \overset{\displaystyle \text{Losing teams}}{\begin{array}{cccc} A & B & C & D \\ \left[\begin{array}{cccc} 0 & 2 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 2 & 0 & 1 \\ 2 & 1 & 1 & 0 \end{array}\right] \end{array}}$$

Key: Team A defeated Team B, drew with Team C and lost to Team D.

Given the model $\mathbf{M} + \mathbf{M}^2 + \mathbf{M}^3$ to rank the teams, determine their final positions from first to fourth.

- (A) C, A, D, B
- (B) C, D, A, B
- (C) D, A, C, B
- (D) D, C, A, B

QUESTION 10

The velocity v (m s^{-1}) of a particle at time t (s) is given by $v = \sin^{-1}(t)$ $(0 \le t \le 1\ \text{s})$.

The acceleration of the particle when $t = 0.2$ s is

- (A) 0.20 m s^{-2}
- (B) 1.02 m s^{-2}
- (C) 1.04 m s^{-2}
- (D) 1.37 m s^{-2}

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