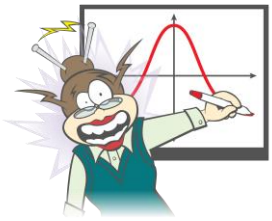
QCE Specialist Mathematics Examination Preparation using TI-84 Plus Technology



Each of the questions included here can be solved using the TI-84 Plus technology.

Question 1

Taken from the Specialist Mathematics Sample Paper 2020, Multiple choice section:

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

Response:

Question 2

Taken from the Specialist Mathematics Sample Paper 2020, Multiple choice section:

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) $2 + i$

Response:

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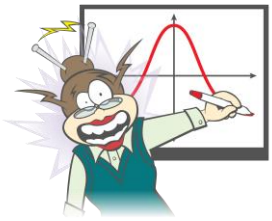

Question 3

Taken from the Specialist Mathematics Sample Paper 2020, Multiple Choice Section:

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

$$\mathbf{M} = \begin{array}{c} \\ \text{Winning teams} \end{array} \begin{array}{c} \begin{array}{cccc} \text{Losing teams} & & & \\ \text{A} & \text{B} & \text{C} & \text{D} \end{array} \\ \begin{bmatrix} 0 & 2 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 2 & 0 & 1 \\ 2 & 1 & 1 & 0 \end{bmatrix} \end{array} \begin{array}{l} \text{A} \\ \text{B} \\ \text{C} \\ \text{D} \end{array}$$

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

Response:

Question 4

Taken from the Specialist Mathematics Sample Paper 2020, Multiple Choice Section:

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

Response:

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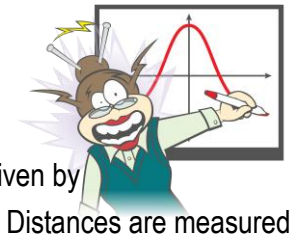

Question 5

The position vector of a projectile at time t seconds, relative to a point on level ground, is given by $\boldsymbol{r}(t) = 10t\hat{\boldsymbol{i}} + \left(19.6t - 4.9t^2\right)\hat{\boldsymbol{j}}$ for $t \geq 0$ where $\hat{\boldsymbol{i}}$ is horizontal and $\hat{\boldsymbol{j}}$ is vertically upwards. Distances are measured in metres.

The maximum height reached by the projectile is

(A) 4.9

(B) 10

(C) 19.6

(D) 20

Response:

Question 6

Taken from the Specialist Mathematics 2020 Sample Paper, Extended Response Section:

A research student has collected fertility and survival rates for a certain endangered species over a number of years. A small group of this species has been moved into a secure property. The Leslie matrix for the survival rates of the species is:

$$\mathbf{L} = \begin{pmatrix} 0 & 0.1 & 0.8 & 0.5 \\ 0.95 & 0 & 0 & 0 \\ 0 & 0.83 & 0 & 0 \\ 0 & 0 & 0.64 & 0 \end{pmatrix}$$

The female population of species moved into the property at the start of Year 1 is:

$$\mathbf{N}_1 = \begin{pmatrix} 5 \\ 50 \\ 25 \\ 20 \end{pmatrix}$$

a. Explain the meaning of the number 0.8 in the Leslie matrix
b. Calculate the expected total female population in the property at the start of Year 2.
c. Determine the expected total population in the property at the start of Year 11 based on 55% of the population being female.

Response:

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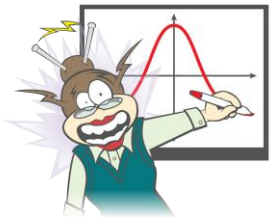

Question 7

Taken from the Specialist Mathematics 2020 Sample Paper, Extended Response section:

A cubic function of the form $y = ax^3 + bx^2 + cx$ passes through the points $(2, 2)$, $(3, 1)$ and $(5, 5)$.

a) Use matrix algebra to determine the values of a, b and c. *[5 marks]*

Response:

Question 8

Taken from the Specialist Mathematics 2020 Sample Paper, Extended Response section:

The heights of male and female students in a secondary school are summarized below.

	Sample size	Mean height (cm)	Standard deviation (cm)
Female	78	167.4	4.3
Male	62	176.3	5.1

a. Determine the approximate 95% confidence interval for the population mean of the heights of the female students.

The confidence interval (175.377 cm, 177.223 cm) was calculated for the population mean of the heights of the male students.

b. Determine the confidence level that was used to calculate this interval. Give your answer correct to 0.1%.

Response:

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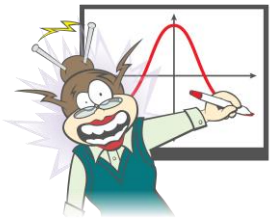

Question 9

The position vector of a particle at time t is given by $\boldsymbol{r}(t) = \cos^2(t)\hat{\boldsymbol{i}} + 4\sin^2(t)\hat{\boldsymbol{j}}$, $t \geq 0$.

(a) Find the Cartesian equation of the path of the particle.

(b) Sketch the path of the particle indicating any points of intersection with the coordinate axes.

(c) State the position of the particle at $t = 0$.

Response:

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