

SECTION A (MULTIPLE CHOICE QUESTIONS)

There is only one correct answer for each question. Circle the correct answer in the space provided.

Q1 Which of the following statement is true regarding the number sequence

120, -90, 67.5, -50.625, ...?

- (A) Sum to infinity exists and has a value of approximately 68.57
- (B) Sum to infinity exists and has a value of 480
- (C) Sum to infinity does not exist as the common ratio, r , is not within the range of -1 to 1.
- (D) Sum to infinity does not exist as this is an arithmetic number sequence.

Q2. Given an geometric sequence with $a=1000$ and $r=0.8$, what is the 10th term, T_{10} ?

- (A) 107.37
- (B) 134.22
- (C) 1007.2
- (D) 5000

Q3. Which of the following is the equation of the graph in Figure A1?

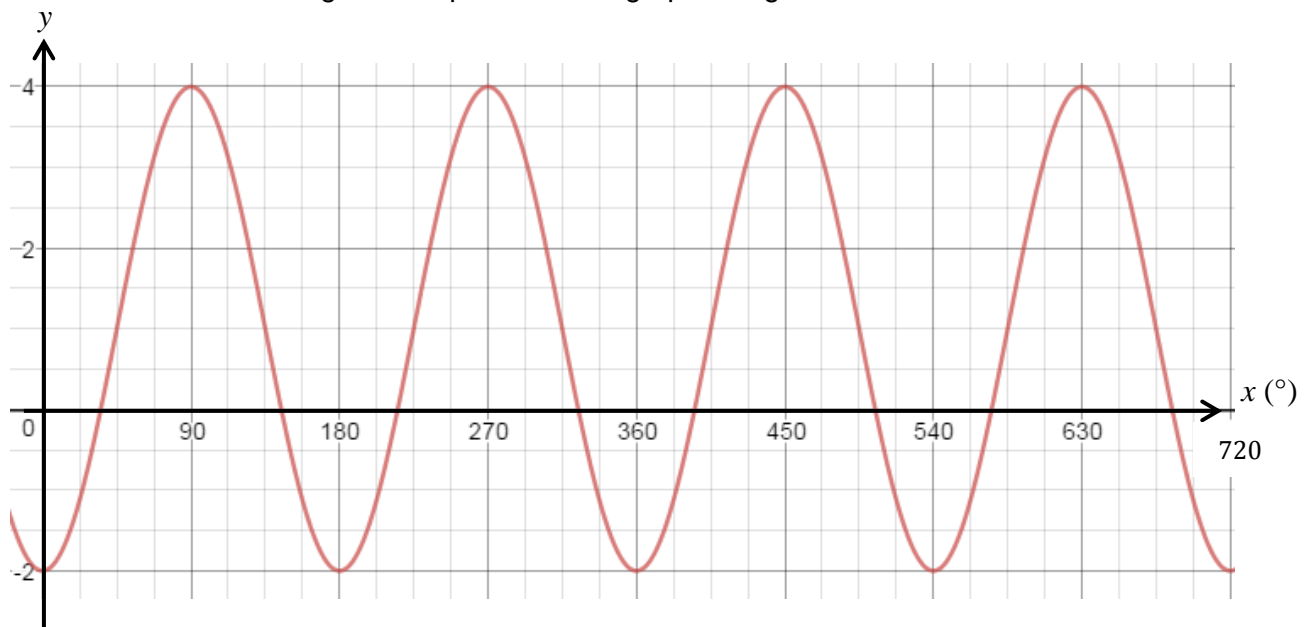


Figure A1 (Not drawn to scale)

- (A) $y = -3\cos 4x + 1$
- (B) $y = -3 \cos 2x + 1$
- (C) $y = 3\cos 2x + 1$
- (D) $y = 3 \cos 4x + 1$



Name: _____

Q4. Which of the following vectors is parallel to $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$?

- (A) $\begin{pmatrix} -2 \\ -4 \end{pmatrix}$
- (B) $\begin{pmatrix} 10 \\ -5 \end{pmatrix}$
- (C) $\begin{pmatrix} 0.5 \\ -1 \end{pmatrix}$
- (D) $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$

Q5. Which of the following vectors is perpendicular to **both** $\begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 4 \\ 1 \\ 2 \end{pmatrix}$?

- (A) $\begin{pmatrix} -7 \\ 10 \\ 9 \end{pmatrix}$
- (B) $\begin{pmatrix} -1 \\ 4 \\ 3 \end{pmatrix}$
- (C) $\begin{pmatrix} 1 \\ 2 \\ -3 \end{pmatrix}$
- (D) $\begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$

Q6. Point A undergoes a 30° clockwise rotation about the origin, followed by a translation of $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$, to become $(-4, 6)$. What are the coordinates of point A?

- (A) (2.46, 10.79)
- (B) (-2.46, 10.20)
- (C) (-0.70, 10.79)
- (D) (-3.23, 1.60)

Q7. What is the remainder when $2x^2 + 3x - 7$ is divided by $x - 2$?

- (A) -21
- (B) -9
- (C) -5
- (D) 7

Q8. Given that $2x^3 + 5x^2 - x - 6$ has factors $(x - 1)$, $(x + 2)$ and $(2x - p)$, what is the value of p ?

- (A) 3
- (B) -3
- (C) -6
- (D) 6

Q9. With reference to the Argand diagram in Figure A2, which point represents the complex number $12e^{\frac{-\pi}{3}}$?

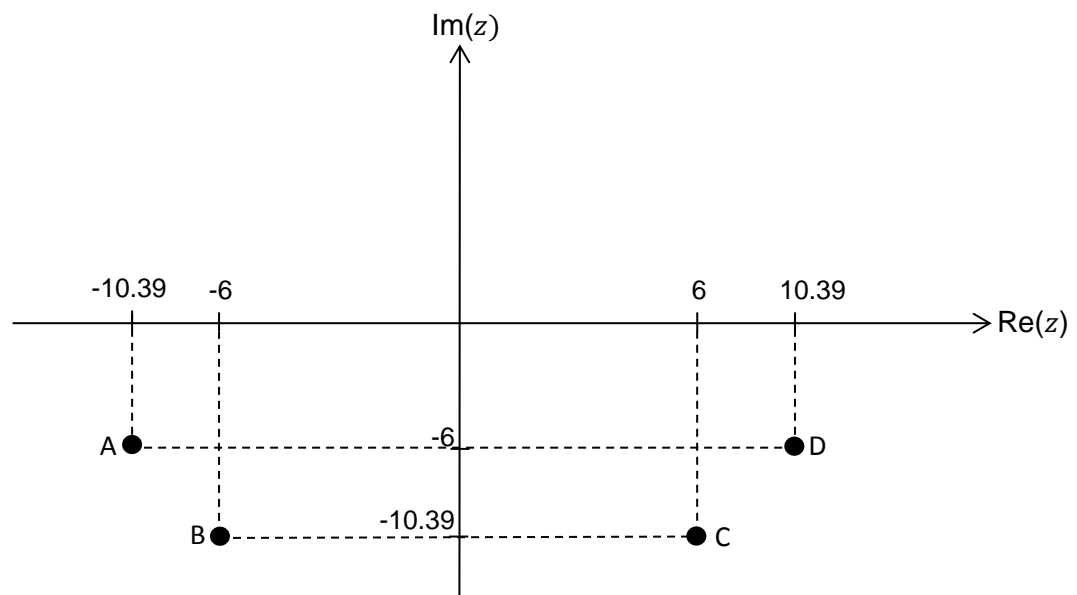


Figure A2 (Not drawn to scale)

- (A) Point A
- (B) Point B
- (C) Point C
- (D) Point D

Q10. Figure A3 shows how Q changes with time t . Which labelled point indicates negative rate of change of Q ?

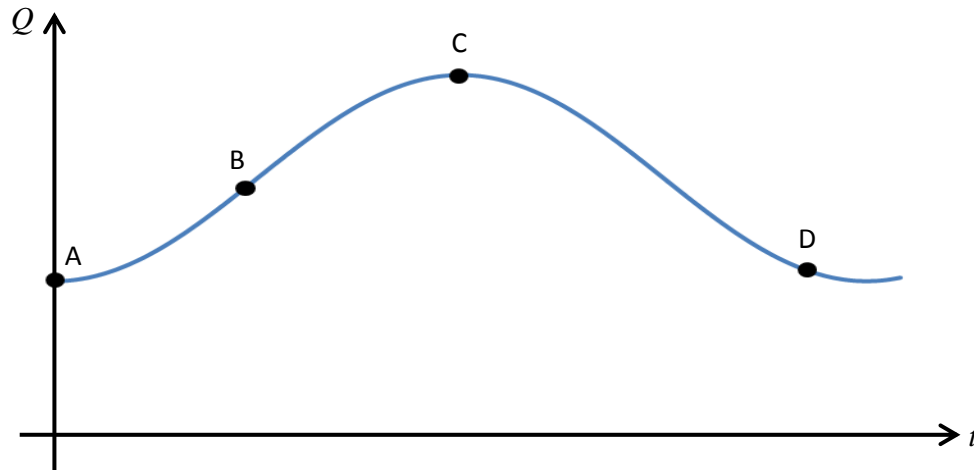


Figure A3 (Not drawn to scale)

- (A) Point A
- (B) Point B
- (C) Point C
- (D) Point D

Q11. Figure A4 shows how the rate of change of P changes with time t . At which point does quantity P start to increase?

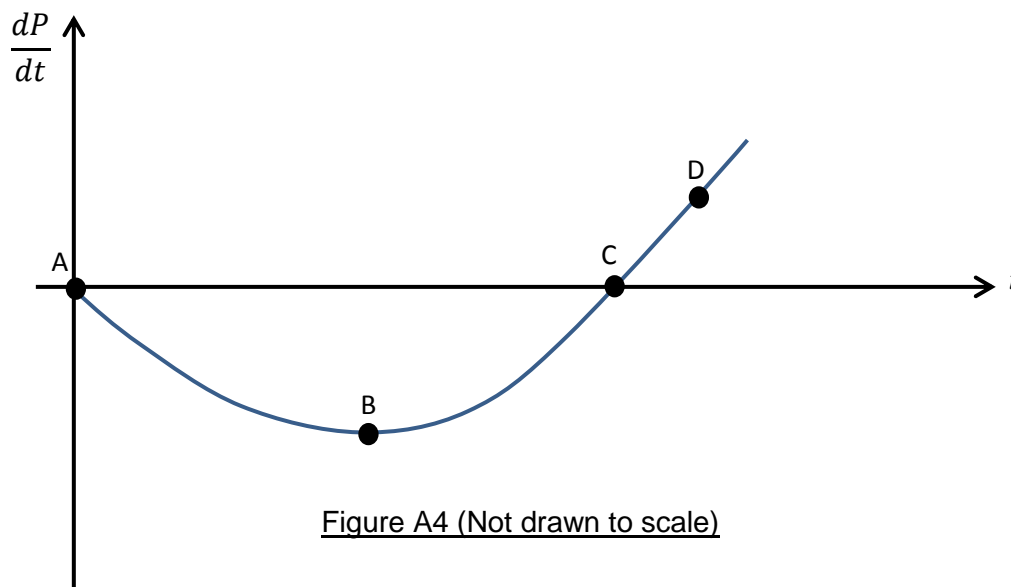


Figure A4 (Not drawn to scale)



Name: _____

- (A) Point A
- (B) Point B
- (C) Point C
- (D) Point D

Q12. Given $y = 4x^2 + x - 5$, which of the following is the correct expression for $\frac{dy}{dx}$?

- (A) $4x + 1$
- (B) $4x^2 + 1$
- (C) $8x + 1$
- (D) $8x^3 + x^2 - 5x$

Q13. Which of the following fractions is the same as the partial fraction, $\frac{5}{x+4} + \frac{3}{x-2}$?

- (A) $\frac{8x+14}{(x+4)(x-2)}$
- (B) $\frac{8x+2}{(x+4)(x-2)}$
- (C) $\frac{8x+14}{2x+2}$
- (D) $\frac{8}{(x+4)(x-2)}$

Q14. Which of the following shows the correct values for variables A and C for the equation of the graph in Figure A5, given that $y = A\sin(x + C)$?

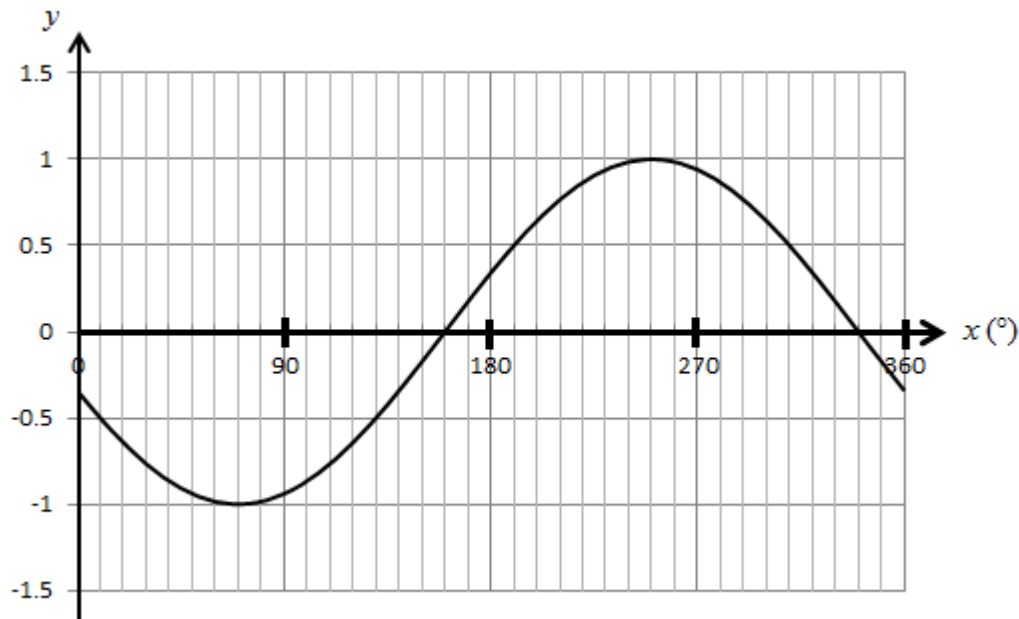


Figure A5

- (A) $A = -1, C = 20^\circ$
- (B) $A = -1, C = -20^\circ$
- (C) $A = 1, C = 20^\circ$
- (D) $A = 1, C = -20^\circ$

Q15. Fuel is being consumed by an automobile at a rate of $v = 0.04t + 0.01$, where v is the rate in liters per minute and t is the time measured in minutes. Given that there is no fuel consumed at initial time $t = 0$ minutes, what is the **total volume** of fuel consumed (in liters) after 5 minutes?

- (A) 0.04
- (B) 0.05
- (C) 0.21
- (D) 0.55

SECTION B**Show your workings clearly. Give your answers to 2 decimal places, where applicable.**

- a) Solve the following equation, where $0^\circ \leq x \leq 360^\circ$.

$$4 \cos^2 x = 3$$

- b) Given vector $\mathbf{h} = \begin{pmatrix} -4 \\ -5 \end{pmatrix}$ as shown in Figure B1, determine
- its magnitude, $|\mathbf{h}|$.
 - the value of θ (in degrees), the anti-clockwise angle it makes with the positive horizontal axis.

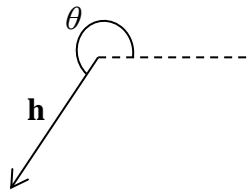


Figure B1 (Not drawn to scale)

- c) Determine the angle (in degrees) between vectors $\begin{pmatrix} 1 \\ -4 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} -9 \\ -2 \\ 1 \end{pmatrix}$.
- d) Given that matrix \mathbf{A} is a singular matrix, where $\mathbf{A} = \begin{pmatrix} -3 & -6 \\ 2 & q \end{pmatrix}$, determine the value of q .
- e) It is given that $\begin{pmatrix} 3 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 11 \\ -13 \end{pmatrix}$ and $\begin{pmatrix} 3 & -1 \\ 1 & 3 \end{pmatrix}^{-1} = \begin{pmatrix} 0.3 & 0.1 \\ -0.1 & 0.3 \end{pmatrix}$. Determine the values of x and y .



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Section C

Show your workings clearly. Give your answers to 2 decimal places, where applicable.

Answer this section with reference to the following complex numbers.

$$z_1 = -1 + 7j, \quad z_2 = 2 - 9j, \quad z_3 = 2e^{\frac{\pi}{3}j}, \quad z_4 = 12e^{\frac{\pi}{2}j}$$

- a) Determine $z_1 - 3z_2$ in Cartesian form.
- b) Determine $z_1 \times z_2$ in Cartesian form.
- c) Determine $\frac{z_1}{z_2}$ in Cartesian form.
- d) Express z_1 in Euler form.
- e) Express z_3 in Cartesian form.
- f) Determine $z_3 \times z_4$ in Euler form.
- g) Determine $\frac{z_4}{z_3}$ in Euler form.
- h) Determine z_3^6 in Euler form, leaving your argument in the principal argument range.

Section D**Show your workings clearly. Give your answers to 2 decimal places, where applicable.**a) Determine $\frac{dy}{dx}$ for the following:

i. $y = 3x^2 + x + 3$

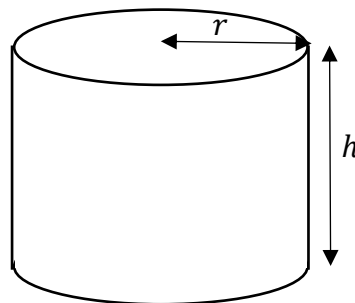
ii. $y = 3e^{2x} - 3e^{-7x}$

iii. $y = -3 \sin x + 4 \cos x$

iv. $y = \frac{1}{x^2} + \sin(3x)$

b) Determine the coordinates of turning points of $y = 2x^3 - 15x^2 - 36x + 4$.c) An open-top cylindrical container, of base radius r cm and height h cm, is to be constructed to hold $729\pi \text{ cm}^3$ of liquid (see Figure D1).The material for the curved surface of the container costs \$0.025 per cm^2 and the material for the base costs \$0.03 per cm^2 .i) Show that the cost in dollars, C , of the material required to make the container is given by $C = \frac{36.45\pi}{r} + 0.03\pi r^2$.

ii) Find the minimum cost of making the container.

[Hint: For a cylinder with radius r and height h , its base area is computed as πr^2 , curved surface area as $2\pi rh$, and volume as $\pi r^2 h$]Figure D1 (Not drawn to scale)



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Section E

Show your workings clearly. Give your answers to 2 decimal places, where applicable.

- a) Evaluate $\int (6x + 5) dx$.
- b) Evaluate $\int (-4 \sin x + 6 \cos 3x) dx$.
- c) Evaluate $\int_0^1 (e^{-x} + 3x^2) dx$.

In a lab experiment, the bacteria count of a specimen increases at a rate of Q' per day, where $Q' = 4t + 2$ and t is measured in days.

- d) What is the rate of increase of bacteria count after 10 days?
- e) What is the increase of bacteria from $t = 3$ to $t = 8$ days?
- f) Given that the initial bacteria count is 100, what is the bacteria count after 12 days?

In a second lab experiment under different conditions, an initial bacteria count of 200 increases at a constant rate of 30 per day. Both experiments begin at the same time.

- g) After how many days would the bacteria count of the first experiment exceed that of the second experiment? Leave your answer rounded up to the nearest whole number.

Section F

Show your workings clearly. Give your answers to 2 decimal places, where applicable.

- a) Given that $3x^2 + ax + 4$ has a remainder of 2 when divided by $x - 1$, determine the value of a .
- b) Determine the quotient when $2x^3 + 6x^2 - 3x - 8$ is divided by $x + 4$.
- c) Determine whether $x - 1$ is a factor of $x^4 + 6x^2 - 2x + 2$.
- d) The graph of $h(x)$ is shown in Figure F1. Given that $h(x)$ is a cubic function which can be expressed as $h(x) = (2x - 1)(x^2 + bx + c)$, determine the values of b and c .

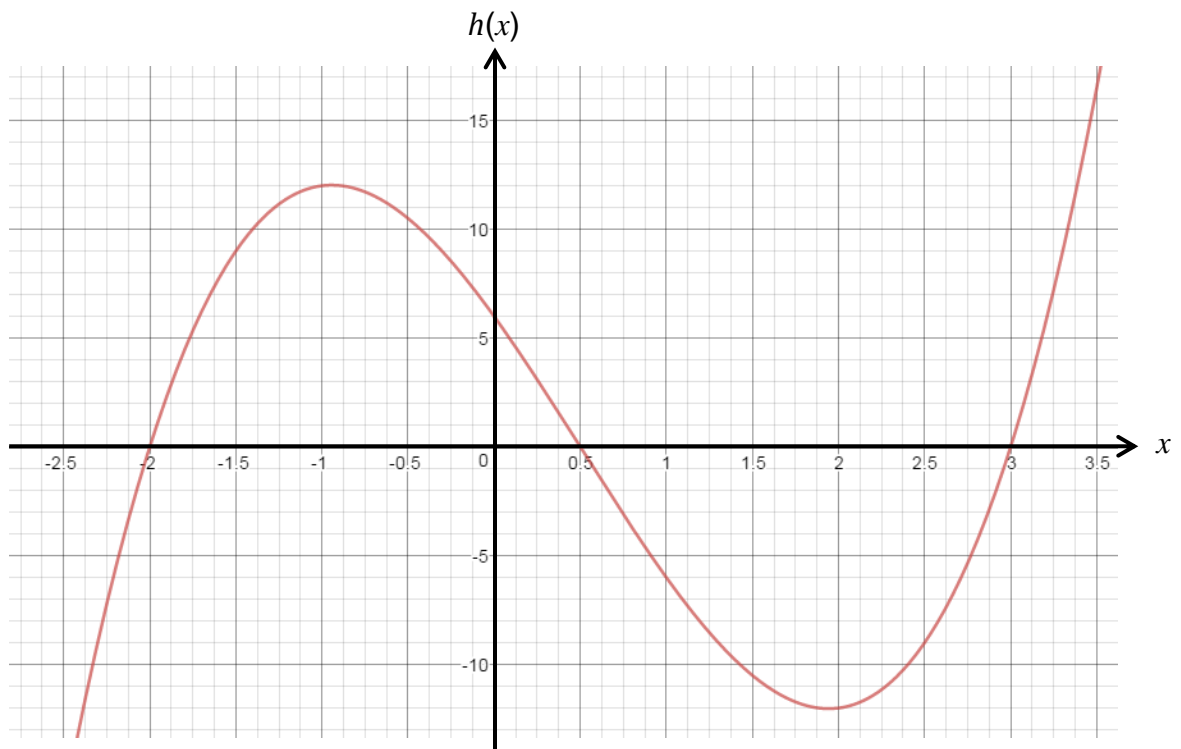


Figure F1 (Not drawn to scale)

- e) Express the following in partial fractions.

i. $\frac{2x-11}{(x+2)(x-3)}$

ii. $\frac{4x^2-x}{(x+1)(x^2-2x+2)}$



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