1. Given that function \( g : x \rightarrow 3x - h \) and \( g^{-1} : x \rightarrow 2kx - \frac{5}{9} \), where \( h \) and \( k \) are constants. Find the values of \( h \) and \( k \). [4 marks]

2. Differentiate \( 4x^2(2x - 5)^3 \) with respect to \( x \). Simplify your answer. [4 marks]

3. Given that \( \int_{-1}^{k} (2x - 5) \, dx = 8 \), and \( k > -1 \), find the value of \( k \). [3 marks]

4. A particle moves along a straight path with a displacement, \( s \, m \) from a fixed point \( O \) is given as \( s = \frac{t^3}{3} - \frac{9t^2}{2} + 18t \), where \( t \) is the time in seconds after leaving \( O \). Find
   a) the initial velocity and acceleration.
   b) the minimum velocity achieved by the particle
   c) the range of values of \( t \) when the velocity is negative
   d) the total distance traveled by the particle from \( t = 1 \) s to \( t = 4 \) s [10 marks]

5. a) Diagram 1 shows a curve \( y = 6x - x^2 \) intersect the straight line \( 2x + y = 12 \) at points \( A \) and \( B \). Find
    i) the coordinates of \( A \) and \( B \).
    ii) the area of the shaded region. [4 marks]

   b) Diagram 2 shows the region bounded by the curve \( y^2 = 7x \), \( y = k \) and the \( y-axis \). When the region is rotated through \( 360^\circ \) about the \( y \)-axis, the volume generated is \( \frac{243\pi}{245} \) unit\(^3 \). Find the value of \( k \). [3 marks]

6. A particle moves in a straight line passes through a fixed point \( O \) with a velocity of 12 m/s. Its acceleration, \( a \, ms^{-2} \), \( t \) seconds after passing through \( O \) is given by \( a = 12t - 18 \).
   a) Determine the velocity function and displacement function of the particle [3 marks]
   b) Find the values of \( t \) when the particle is momentarily at rest. [2 marks]
   c) Find its displacement when it is momentarily at rest [2 marks]
   d) Calculate the total distance traveled from \( t = 0 \) until it is at rest for the second time. [3 marks]

7. Diagram 3 shows that \( \overrightarrow{AB} = 5\hat{i} + 3\hat{j} \), \( \overrightarrow{AC} = 2\hat{i} + 9\hat{j} \) and \( M \)
is a point on the line \( CB \) such that \( CM: MB = 1:2 \).
   Find \( \overrightarrow{AP} \) in terms of \( \hat{i} + \hat{j} \). [3 marks]

8. Is it possible to construct an aquarium with a glass top and two square ends that holds 16 m\(^3\) of water and requires 40 m\(^2\) of glass for its construction? If yes, what should be the dimension of the aquarium? From the solutions, what do you think should be a probable one?
   [3.12 m by 3.12 m by 1.64 m (approximately) or 2m by 2m by 4 m] [10 marks]

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