Differentiation MS

0 min

0 marks

1. (a) $g'(x) = 4x^3 + 9x^2 + 4x + 1$ (A3) 3

    Note: Award (A3) for all five terms correctly differentiated, (A2) for four terms, (A1) for three terms, (A0) for two or less terms correctly differentiated.

    (b) $g'(1) = 4(1)^3 + 9(1)^2 + 4(1) + 1$ (M1)
    $= 4 + 9 + 4 + 1$
    $= 18$ (A1)

    OR

    18 (G2) 2

[5]

2. (a) $f'(x) = 6x^2 - 10x + 3$ (A1)(A1)(A1)

    Notes: Award (A1) for each correct term and no extra terms.
    Award (A1)(A1)(A0) if each term correct and extra term seen.
    (A1)(A0)(A0) if two terms correct and extra term seen.
    Award (A0) otherwise. (C3)

    (b) $f'(2) = 7$ (A1)(ft) (C1)

    (c) $y = 7x - 11$ or equivalent (A1)(ft)(A1)(ft)

    Notes: Award (A1)(ft) on their (b) for 7x (must have x)
    (A1)(ft) for –11.
    Accept y – 3 = 7(x – 2). (C2)

[6]

3. (a) $f'(x) = 4x + 1$ (A1)(A1)(A1)   (C3)

         Note: *Award (A1) for each term differentiated correctly.*
         Award at most (A1)(A1)(A0) if any extra terms seen.

(b) $f'(-3) = -11$ (A1)(ft)   (C1)

(c) $4x + 1 = 0$ (M1)

      $x = -\dfrac{1}{4}$ (A1)(ft)   (C2)

                                                             [6]

4. (a) -1.10, 0.218, 3.13 (A1)(A1)(A1)

(b) $f'(x) = 12x^2 - 18x - 12$ (A1)(A1)(A1)

         Note: *Award (A1) for each correct term and award maximum*
         of (A1)(A1) if other terms seen.

(c) $f'(x) = 0$ (M1)

      $x = -0.5, 2$

      $x = -0.5$ (A1)

         Note: *If x = –0.5 not stated, can be inferred from working*
         below.

      $y = 4(-0.5)^3 - 9(-0.5)^2 - 12(-0.5) + 3$ (M1)

      $y = 6.25$ (A1)(G3)

         Note: *Award (M1) for their value of x substituted into f(x).*
         Award (M1)(G2) if sketch shown as method. If coordinate pair
         given then award (M1)(A1)(M1)(A0). If coordinate pair given
         with no working award (G2).

(d) $(0, 3)$ (A1)

         Note: *Accept x = 0, y = 3.*

(e) $f'(0) = -12$ (M1)(A1)(ft)(G2)

         Note: *Award (M1) for substituting x = 0 into their derivative.*

(f)   Tangent: $y = -12x + 3$ (A1)(ft)(A1)(G2)

         Note: *Award (A1)(ft) for their gradient, (A1) for intercept = 3.*
         Award (A1)(A0) if y = not seen.

(g)   –12   (A1)(ft)

        Note: Follow through from their part (e).

(h) $12x^2 - 18x - 12 = -12$ (M1)
     $12x^2 - 18x = 0$ (M1)
     $x = 1.5, 0$
     At Q, $x = 1.5$ (A1)(ft)(G2)

        Note: Award (M1)(G2) for $12x^2 - 18x - 12 = -12$ followed by
        x = 1.5.
        Follow through from their part (g).

                                                                                  [19]

5.   (a) $f'(x) = 2 + 25x^{-2}$ (A2) (C2)

   (b) $2 + 25x^{-2} = 6$ (M1)
      $25 = 4x^2$ (M1)
      $x^2 = \dfrac{25}{4}$
      $x = \pm 2.5$ (A1)(A1) (C4)

                                                                                    [6]

6.   (a) $g'(x) = 3x^2 + 12x + 12$ (A3)   3

   (b) $3x^2 + 12x + 12 = 0$
      $x^2 + 4x + 4 = 0$ (M1)
      $(x + 2)^2 = 0$
      $x = -2$ (A1)
                                         or (G2)   2

   (c)   (i) $x = -3 \Rightarrow \dfrac{dy}{dx} = 3$ (A1)

      (ii) $x = 0 \Rightarrow \dfrac{dy}{dx} = 12$ (A1)

      (iii)   (a)   Increasing   (A1)

            (b)   Increasing   (A1)   4

                                                                                 [9]

7. (a) $y = 13.5x + 4.5$ (M1)

               ***Note:** Award (M1) for 13.5x seen.*

           gradient $= 13.5$ (A1) (C2)

(b) $4x^3$ (A1) (C1)

(c) (i) $4x^3 = 13.5$ (M1)

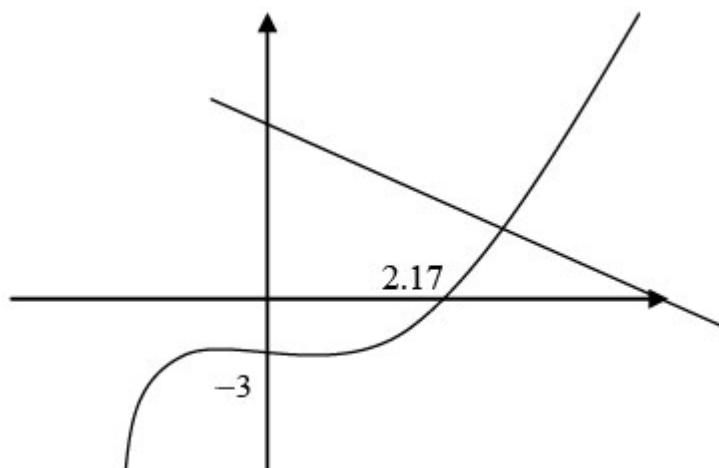   ***Note:** Award (M1) for equating their answers to (a) and (b).*

            $x = 1.5$ (A1)(ft)

      (ii) $\dfrac{81}{16}$ (5.0625, 5.06)   (A1)(ft) (C3)

              ***Note:** Award (A1)(ft) for substitution of their (c)(i) into x^4 with working seen.*

                                                           [6]

8. (a)

                                                        (G3)   3

(b)   line drawn with −ve gradient and +ve y-intercept   (G1)

         (2.45, 2.11)   (G1)(G1)   3

(c) $f'(1.7) = 3(1.7)^2 - 4(1.7) + 1$ (M1)   2

              ***Note:** Award (M1) for substituting in their f′(x)*

        2.87   (A1)(G2)

                                                            [8]

9. (a) $2x + 3$ (–1 for each extra term)   (A2) (C2)

                    Note: If correct and an extra term included,
                    award (A1) only.

    (b) Equating the gradient to 5 $(2x + 3 = 5)$ (M1)
        For solving attempt   (M1)
        For $x = 1$ (A1)
        Co-ordinates (1, 2)   (A1) (C4)

                                                                 [6]

10. (a) $\dfrac{3x^2}{2} - 4x$ (A1)(A1)

                    Note: Award (A1) for each correct term and
                    no extra terms; award (A1)(A0) for both terms
                    correct and extra terms; (A0) otherwise.   (C2)

    (b) $3x - 4$ (A1)(ft)(A1)(ft)

        accept $3x^1 - 4x^0$ (C2)

    (c) $y = -2.5x + 4$ or equivalent   (A1)(ft)(A1)

                    Notes: Award (A1)(ft) on their (a) for –2.5x
                    (must have x), (A1) for 4 or equivalent correct
                    answer only.
                    Accept y – 1.5 = –2.5 (x – 1)   (C2)

                                                                 [6]