1. Attempting to integrate.
\[ y = x^3 - 5x + c \]
substitute (2, 6) to find \( c \) \( (6 = 2^3 - 5(2) + c) \)
\[ c = 8 \]
\[ y = x^3 - 5x + 8 \] (Accept \( x^3 - 5x + 8 \))

2. (a) \( x = \frac{1}{5} \), \( 5x - 1 = 0 \)
(b) \[ f'(x) = \frac{(5x-1)(6x) - (3x^2)(5)}{(5x-1)^2} \]
\[ = \frac{30x^2 - 6x - 15x^2}{(5x-1)^2} \] (may be implied)
\[ = \frac{15x^2 - 6x}{(5x-1)^2} \] (accept \( a = 15, b = -6 \))

3. (a) intersection points \( x = 3.77, x = 8.30 \) (may be seen as the limits)
(b) \[ g(x) = 2 \sin (0.5x) \]
\[ \int_{x_1}^{x_2} f(x) dx = -\int_{x_2}^{x_1} f(x) dx \]
\[ \int_{3.77}^{5} f(x) dx \] (do not accept 4 as this is show that)
\[ A = 6.46 \]

4. (a) \[ f'(x) = \frac{3}{3x-2} \]
\[ g'(x) = 2 \sin (0.5x) \]
\[ f''(x) = 2x^2 + 4 \] (may be seen later)

5. (a) evidence of factorizing 3/4 division by 3
\[ \int f(x) dx = \frac{3}{3} \int f(x) dx \]
\[ \int f(x) dx = \frac{1}{3} \int f(x) dx \]
\[ \int f(x) dx = -4 \]

6. (a) \[ f'(x) = x^2 + 4x - 5 \]
(b) evidence of attempting to solve \( f'(x) = 0 \)
\[ (x + 5)(x - 1) = -4 \pm \sqrt{16 + 20} \]
\[ x = -5, x = -1 \]
\[ x = -5 \]

(c) \[ f''(x) = 2x + 4 \] (may be seen later)
evidence of use of symmetry
eg midpoint of max/min, reference to shape of cubic
correct calculation
eg $x = \frac{-5+1}{2}$.

(d) attempting to find the value of the derivative when $x = 3$

\[ f'(3) = 16 \]

valid approach to finding the equation of a line
eg
\[
y - 12 = 16(x - 3), \quad 12 = 16 \times 3 + b
\]

\[ y = 16x - 36 \]

7.

Notes:
On interval $[−2,0]$, award A1 for decreasing, A1 for concave up.
On interval $[0,1]$, award A1 for increasing, A1 for concave up.
On interval $[1,2]$, award A1 for change of concavity, A1 for concave down.

8. (a) $\frac{dy}{dx} = 3 \cos 3x$

(b) $\frac{dy}{dx} = \frac{x}{\cos^2 x} + \tan x = x \sec^2 x + \tan x$

(c) METHOD 1
Evidence of using the quotient rule
\[
\frac{dy}{dx} = \frac{x \times \frac{1}{x} - \ln x}{x^2}
\]

METHOD 2
\[
y = x^{-1} \ln x
\]
Evidence of using the product rule
\[
\frac{dy}{dx} = x^{-1} \times \frac{1}{x} + \ln x(−1)(x^{-2})
\]

9. (a)

Notes: Award A1 for both asymptotes shown.
The asymptotes need not be labelled.
Award A1 for the left branch in approximately correct position,
A1 for the right branch in approximately correct position.

(b) (i) $y = 3, \quad x = \frac{5}{2}$ (must be equations)

(ii) $x = \frac{14}{6} \left(\frac{7}{3} \text{ or } 2.33, \text{ also accept } \left(\frac{14}{6}, 0\right)\right)$

(iii) $y = \frac{14}{6} \left(\text{accept } \left(\frac{14}{6}, 0\right) \text{ or } (0, 2.8)\right)$

(c) (i) $\int \left[9 + \frac{6}{2x-5} + \frac{1}{(2x-5)^3}\right] dx = 9x + 3 \ln (2x - 5) - \frac{1}{2(2x-5)} + C$

METHOD 1
Evidence of using the quotient rule
\[
\frac{dy}{dx} = \frac{1 - \ln x}{x^2}
\]

METHOD 2
\[
y = x^{-1} \ln x
\]
Evidence of using the product rule
\[
\frac{dy}{dx} = x^{-2} \times x - \ln x(−1)(x^{-2})
\]
Substituting \( \frac{9a + 3\ln(2a - 5) - \frac{1}{2(2a - 5)}}{27 + 3\ln(2a - 5)} = \left( \frac{28}{3} + 3\ln 3 \right) \) A1

Setting up an equation (M1)

\[
9a - \frac{1}{2(2a - 5)} = 27 + \frac{1}{2} + 3\ln(2a - 5) - 3\ln 1 = \left( \frac{28}{3} + 3\ln 3 \right)
\]

Solving gives \( a = -4 \) A1 N2

10. \( f'(x) = 12x^2 + 2 \) A1A1

When \( x = 1, f(1) = 6 \) (seen anywhere) (A1)

When \( x = 1, f'(1) = 14 \) (A1)

Evidence of taking the negative reciprocal (M1)

\[ e^{-1}x, \frac{1}{14}, -0.0714 \]

Equation is \( y - 6 = -\frac{1}{14}(x-1) \) \( y = -\frac{1}{14} \left( \frac{85}{14} \right) \) \( y = -0.0714x + 6.07 \) A1 N4

11. (a) (i) \( p = 1, q = 5 \) (or \( p = 5, q = 1 \)) A1A1 N2

(ii) \( x = 3 \) (must be an equation) A1 N1

(b) \( y = (x-1)(x-5) \)

\[ = x^2 - 6x + 5 \]

\[ = (x-3)^2 - 4 \] (accept \( h = 3, k = -4 \)) A1A1 N3

(c) \[ \frac{dy}{dx} = 2(x-3) = 2x - 6 \] A1A1 N2

(d) When \( x = 0, \frac{dy}{dx} = -6 \)

\[ y - 5 = -6(x - 0) \] \( y = -6x + 5 \) or equivalent) A1 N2

12. (a) Evidence of using \( \alpha = \frac{dv}{dt} \) (M1)

\[ eg \ 3e^{2t} = 2 \]

\[ \alpha(1) = 3e \] (= 8.15) A1 N2

(b) Attempt to solve \( 3e^{2t} - 2 = 22.3 \) (M1)

\[ eg \ (3t-2) \ln e = \ln 22.3, sketch \]

\( t = 4.70 \) A1 N2

(c) Evidence of using \( s = \int \) (limits not required) M1

\[ eg \ \int e^{2t} dt \]

\[ \frac{1}{3} \left[ e^{2t} \right] \]

\[ \frac{1}{3} \left[ e^{4} - e^{-2} \right] \]

\[ = \frac{1}{3} \left[ e^4 - \frac{1}{e^2} \right] = 0.861 \] A1 N1

13. (a) EITHER

Recognizing that tangents parallel to the x-axis mean maximum and minimum (may be seen on sketch) R1

Sketch of graph of \( f \) M1

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14. Using \( V = \int \pi y^2 \) (M1)

Correctly integrating \( \int \frac{x^2}{2} \) \( dx = \frac{x^2}{2} \) A1

\[ V = \pi \left[ \frac{x^3}{2} \right]_0^1 \]

\[ = \frac{\pi a^2}{2} \] (A1)

Setting up their equation \( \frac{1}{2} \pi a^2 = 0.845 \pi \) M1

\[ a^2 = 1.69 \]

\[ a = 1.3 \] A1 N2

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