1. (a) -4 (b) 1 (c) \( \frac{1}{2\sqrt{3}} \) (d) 1

2. (a)

\[
f'(x) = \frac{(12x^3 - 1)(2x^5 + 2\sin x) - (x^2 - x + 6)(10x^4 + 2\cos x)}{(2x^5 + 2\sin x)^2}
\]

(b)

\[
g'(x) = (\sec x + x\sec x\tan x)e^x + x\sec x e^x
\]

3. Many correct answers are possible. You just need to give two tangent lines which are perpendicular: there are an infinite number of such lines. To every tangent line to this curve, there is a perpendicular one, so you can just pick one, and then find the perpendicular tangent. Answers include

- \( y = x - \frac{9}{4}, y = -x - \frac{1}{4} \)
- \( y = 2x - 4, y = -\frac{1}{2}x - \frac{9}{16} \)
- \( y = 4x - 9, y = -\frac{1}{4}x - \frac{49}{64} \)
- \( y = -2x, y = \frac{1}{2}x - \frac{25}{16} \)
- \( y = x - 2.25, y = -x - 0.25 \)

4. To show the function is continuous, you need to show that

\[
\lim_{x \to 0} f(x) = f(0).
\]

We see that \( f(0) = 0 \).

To evaluate the limit, we note that

\[
\lim_{x \to 0} f(x) = \lim_{x \to 0} x \sin \left( \frac{1}{x^3} \right).
\]

To evaluate this limit, note that

\[
1 \leq \sin \left( \frac{1}{x^3} \right) \leq 1
\]

and so, for \( x > 0 \),

\[
-x \leq x \sin \left( \frac{1}{x^3} \right) \leq x.
\]
Since
\[ \lim_{x \to 0^+} -x = \lim_{x \to 0^+} x = 0, \]
by the Squeeze Theorem we may conclude that
\[ \lim_{x \to 0^+} x \sin \left( \frac{1}{x^3} \right) = 0. \]

By a similar argument,
\[ \lim_{x \to 0^-} x \sin \left( \frac{1}{x^3} \right) = 0, \]
and so we can conclude that
\[ \lim_{x \to 0} x \sin \left( \frac{1}{x^3} \right) = 0 = f(0) \]
and so \( f \) is continuous at 0.

5. Let \( \epsilon > 0 \). Let \( \delta = \epsilon / 3 \). Then, if \( |x - 2| < \delta \),
\[ |3x + 4 - 10| = |3x - 6| = 3|x - 2| < 3\delta = \epsilon. \]

6. The tangent line to the curve at \((a, 1/a)\) is
\[ y = -\frac{1}{a^2} x + \frac{2}{a}. \]
This line has \( y \)-intercept \( 2/a \) and \( x \)-intercept \( 2a \). So the area is
\[ \frac{1}{2} \left( \frac{2}{a} \right) 2a = 2. \]