Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

- form $\frac{0}{0}$
- $\lim \dfrac{3\cos 3x}{1} = \mathbf{3}$

2.2

- form $\frac{0}{0}$
- $\dfrac{1/x}{1}$
- $\mathbf{1}$

2.3

- $\frac{0}{0}$: $\lim \dfrac{\sin x}{2x}$
- still $\frac{0}{0}$: $\lim \dfrac{\cos x}{2}$
- $\mathbf{\frac{1}{2}}$

3.1

- form $\frac{\infty}{\infty}$
- $\dfrac{1/x}{1/(2\sqrt{x})}$
- $= \dfrac{2}{\sqrt{x}}$
- $\to \mathbf{0}$

3.2

- $0 \cdot (-\infty)$: write $\dfrac{\ln x}{1/x}$
- form $\frac{-\infty}{\infty}$
- $\dfrac{1/x}{-1/x^2} = -x$
- $\to \mathbf{0}$

3.3

(a) $f(2) = g(2) = 0$, so the form is $\frac{0}{0}$; by L'Hospital's Rule $\dfrac{f'(2)}{g'(2)} = \dfrac{3}{-6} = \mathbf{-\frac{1}{2}}$

(b) $\frac{0}{0}$: $\dfrac{2e^{2x}-2}{2x}$; still $\frac{0}{0}$: $\dfrac{4e^{2x}}{2}$; $\mathbf{2}$

(c) $\frac{0}{0}$: $\dfrac{1-\cos x}{3x^2}$; $\frac{0}{0}$: $\dfrac{\sin x}{6x}$; $\frac{0}{0}$: $\dfrac{\cos x}{6}$; $\mathbf{\frac{1}{6}}$

(d) $\frac{0}{0}$: $\dfrac{a\cos(ax)-b}{3x^2}$; the bottom $\to 0$ and the limit is finite, so $a-b=0$; then $\dfrac{-a^2\sin(ax)}{6x}$, then $\dfrac{-a^3\cos(ax)}{6} \to -\dfrac{a^3}{6}$; $a^3 = 27$: $\mathbf{a = b = 3}$

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