$f'''(0) = e^{-0}(16(1+0)^{-3} + 12(1+0)^{-2} + 6(1+0)^{-1} - \text{Log}(1+0))$
$= 34$ ✓

$\therefore f(z) = f(0) + \frac{f'(0)z}{1!} + \frac{f''(0)z^2}{2!} + \frac{f'''(0)z^3}{3!} + \dots$

$= 0 + \frac{2z}{1!} - \frac{8z^2}{2!} + \frac{34z^3}{3!} + \dots$

$\frac{4\frac{1}{2}}{5}$ A, M $= 2z - 4z^2 + \frac{17z^3}{3}$ up to z^3 ✓

ii) $f(z) = \cos(\sin 2z)$

$f'(z) = \frac{d}{dz}(\cos(\sin 2z))$
$= -2\cos 2z \sin(\sin 2z)$

$f''(z) = -2\frac{d}{dz}(\cos 2z \sin(\sin 2z))$

$= 4\sin 2z \sin(\sin 2z) - 4\cos^2 2z \cos(\sin 2z)$ ✓

$f'''(z) = 4\frac{d}{dz}(\sin 2z \sin(\sin 2z) - \cos^2 2z \cos(\sin 2z))$

$= 4(2\cos 2z \sin(\sin 2z) + 2\sin 2z \cos 2z \cos(\sin 2z)$
$+ 4\sin 2z \cos 2z \cos(\sin 2z) + 2\cos^3 2z \sin(\sin 2z))$ ✓
$= 8((1+\cos^2 2z)\cos 2z \sin(\sin 2z) + \cancel{6}\,3\sin 2z \cos 2z \cos(\sin 2z))$

$f^{iv}(z) = 8\frac{d}{dz}((1+\cos^2 2z)\cos 2z \sin(\sin 2z) + 6\sin 2z \cos 2z \cos(\sin 2z))$

$= 8(-4\sin 2z \cos^2 2z \sin(\sin 2z) - 2(1+\cos^2 2z)\sin 2z \sin(\sin 2z)$
$+ 2(1+\cos^2 2z)\cos^2 2z \cos(\sin 2z) + 12\cos^2 2z \cos(\sin 2z)$
$- 12\sin^2 2z \cos(\sin 2z) - 12\sin 2z \cos^2 2z \sin(\sin 2z))$.

As you want $f^{iv}(0)$ you don't want any terms that give a zero contribution

$f(0) = \cos 0 = 1$ ✓

$f'(0) = 0$ ✓

$f''(0) = -4$ ✓ $\qquad f''(0) = 80$

$f'''(0) = 0$ ✓

$f^{iv}(0) = 8(0 - 0 + 4 + \cancel{12}\,6 - 0 - 0) = \cancel{128}$ 80

$f(z) = f(0) + \frac{f'(0)z}{1!} + \frac{f''(0)z^2}{2!} + \frac{f'''(0)z^3}{3!} + \frac{f^{iv}(0)z^4}{4!} + \dots$

$\frac{3\frac{1}{2}}{5}$ A, M $= 1 + 0 - \frac{4z^2}{2!} + 0 + \frac{128z^4}{4!} + \dots$

$\boxed{\frac{8}{10}}$ $= 1 - 2z^2 + \frac{16z^4}{3}$ up to z^4