1

$f'(x) = 3x(3^x \ln 3) + 3^x(3) = 0$

Divide both side by $3^x(3)$

$x(\ln 3) + 1 = 0$

$x = \frac{-1}{\ln 3}$ or approximately -0.9102

$f(-10) = -30(3^{-10}) - 1 \approx -1.0005$

$f\left(\frac{-1}{ln\ 3}\right) = \frac{-3}{ln\ 3}\left(3^{-1/\ln 3}\right) - 1 \approx -2.0046$ (minimum value)

$f(10) = 30(3^{10}) - 1 \approx 1771469$ (maximum value)

2

$18x - 2y - 3 = 0$ can be expressed as $y = 9x - \frac{3}{2}$ so it has slope of 9

$\frac{dy}{dx} = 9e^{3x} = 9$

Divide by 9

$e^{3x} = 1$

$x = 0$

If $x = 0$, then $y = 3$

Equation of line with point (0, 3) and slope of 9 is

$y - 3 = 9(x - 0)$

$y = 9x + 3$

3

We can simplify the function further as

$E(t) = 6t \ln t$

The derivative is

$$E'(t) = 6t\left(\frac{1}{t}\right) + 6 \ln t$$

$E'(t) = 6 + 6 \ln t = 0$

$6 \ln t = -6$

Divide both sides by 6

$\ln t = -1$

$t = e^{-1}$ or $t = \frac{1}{e}$

$$E(e^{-1}) = \frac{6}{e}(-1) = \frac{6}{e}$$

The derivative $E'(t) = 6 + 6 \ln t$ is always positive for $t > 0$

Therefore, as time t increases, the effectiveness also increases without bound.

4

Differentiate both sides

$$6e^{2xy}\left(2x\frac{dy}{dx} + 2y\right) = 2 + \frac{dy}{dx}$$

$$12xe^{2xy}\frac{dy}{dx} + 12ye^{2xy} = 2 + \frac{dy}{dx}$$

$$(12xe^{2xy} - 1)\frac{dy}{dx} = 2 - 12ye^{2xy}$$

$$\frac{dy}{dx} = \frac{2 - 12ye^{2xy}}{12xe^{2xy} - 1}$$

If $x = 0$, then $y = 6$ and

$$\frac{dy}{dx} = \frac{2 - 12(6)e^0}{0 - 1} = 70$$