$$= 200\frac{\Delta r}{r} + 100\frac{\Delta h}{h} = 200\left(\frac{0.001}{0.05}\right) + 100\left(\frac{0.001}{0.12}\right) = 200\left(\frac{1}{50}\right) + 100\left(\frac{1}{120}\right)$$

$$= 4 + \frac{10}{12} = 4\frac{5}{6}\% = 4.83\dot{3}\%$$

3) I) $w = x^2 + y^2$. $x = \cos t$, $y = \sin t$

substituting for x & y

$w = \cos^2 t + \sin^2 t$. However $\cos^2 t + \sin^2 t = 1$

so $w = 1$ and $\frac{dw}{dt} = 0$

II) $w = \frac{x}{z} + \frac{y}{z}$. $x = \cos^2 t$ & $y = \sin^2 t$. The question doesn't state that z is a function, so we shall assume that it is an independent variable (ie that z is independent of t).

substituting for x & y

$w = \frac{\cos^2 t}{z} + \frac{\sin^2 t}{z}$. $\cos^2 t + \sin^2 t = 1$, so $w = \frac{1}{z}$

$\frac{dw}{dt} = 0.$

III) $w = 2ye^x - \log_e z$. $x = \log_e(t^2+1)$, $y = \tan^{-1} t$. As in (II), we shall assume that z is an independent variable (ie z is independent of t).

substituting for x & y

$w = 2(\tan^{-1} t)(t^2+1) - \log_e z$.

to work out $\frac{dw}{dt}$, we need to know that $\frac{d}{dt}(\tan^{-1} t) = \frac{1}{t^2+1}$

$$\frac{dw}{dt} = 2(t^2+1)\frac{d}{dt}(\tan^{-1} t) + 2(\tan^{-1} t)\frac{d}{dt}(t^2+1)$$

$$= 2(t^2+1)\frac{1}{t^2+1} + 2(\tan^{-1} t)(2t)$$

$$= 2 + 4t\tan^{-1} t$$

4) I) $F = x^2 + xy + y^2$. Find the gradient at $P_0(-1,1)$, along with the direction of steepest climb and steepest fall.

The gradient is $\frac{\partial F}{\partial x}\underline{i} + \frac{\partial F}{\partial y}\underline{j}$