2. State of strain

$$\varepsilon_x = -500 \times 10^{-6} \quad \left(\text{ie } -500 \text{ microstrain}\right)$$
$$\varepsilon_y = 140 \times 10^{-6}$$
$$\gamma_{xy} = 360 \times 10^{-6}$$

To find the principal planes (on which extensional strain ε_θ is a maximum and a minimum, and shear strain γ_θ is zero)

$$\tan 2\theta = \frac{\gamma_{xy}}{\varepsilon_x - \varepsilon_y} = \frac{360}{-500 - 140}$$

$$= -0.5625$$

$$2\theta = -29.4^\circ \text{ and } 150.6^\circ$$

$$\therefore \quad \theta = -14.7^\circ \text{ and } 75.3^\circ$$

To obtain the principal strains, substitute these two values of θ into the strain transformation eqt^n.

$$\varepsilon_\theta = \tfrac{1}{2}(\varepsilon_x + \varepsilon_y) + \tfrac{1}{2}(\varepsilon_x - \varepsilon_y)\cos 2\theta + \tfrac{1}{2}\gamma_{xy} \sin 2\theta$$

ie $$\varepsilon_{-14.7} = \tfrac{1}{2}(-500 + 140) + \tfrac{1}{2}(-500 - 140)\cos(-29.4^\circ)$$
$$+ \tfrac{1}{2} \cdot 360 \sin(-29.4^\circ)$$

$$= -180 - 278.8 - 88.4$$

$$= \underline{-547 \text{ microstrain}} \quad (\varepsilon_2)$$