1. a) \( \sin \frac{\pi}{2} = 1 \)

b) \( \cos \frac{5\pi}{6} = -\cos \frac{\pi}{6} = -\frac{\sqrt{3}}{2} \)

c) \( \tan \frac{\pi}{3} = \frac{\sin \frac{\pi}{3}}{\cos \frac{\pi}{3}} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3} \)

2. a) \( \theta = \sin^{-1} 0.5 = 30^\circ, \frac{\pi}{6}, 150^\circ, \frac{5\pi}{6} \)

b) \( \theta = \cos^{-1} 0.876 \approx 151.16^\circ, 208.84^\circ \)

c) \( \theta = \tan^{-1} -1 \approx -45^\circ \)

\[ \therefore \theta = 315^\circ, 135^\circ, \frac{3\pi}{4}, \frac{7\pi}{4} \]

3. a) \( \cos \left( \frac{3\pi}{12} \right) = \cos \left( \frac{\pi}{12} + \frac{4\pi}{12} \right) \)

\[ = \cos \left( \frac{\pi}{4} + \frac{\pi}{3} \right) \]

\[ = \cos \frac{\pi}{4} \cdot \cos \frac{\pi}{3} - \sin \frac{\pi}{4} \cdot \sin \frac{\pi}{3} \]

\[ = \frac{1}{\sqrt{2}} \cdot \frac{1}{2} - \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{3}}{2} \]

\[ = \frac{1 - \sqrt{3}}{2\sqrt{2}} = \frac{\sqrt{2}(1 - \sqrt{3})}{2\sqrt{2}\sqrt{2}} = \frac{\sqrt{2}(1 - \sqrt{3})}{4} \]
6) \[ \sin \left( \frac{5\pi}{12} \right) = \sin \left( \frac{3\pi}{12} + \frac{2\pi}{12} \right) \\
= \sin \left( \frac{\pi}{4} + \frac{\pi}{6} \right) \\
= \sin \frac{\pi}{4} \cdot \cos \frac{\pi}{6} + \sin \frac{\pi}{6} \cdot \cos \frac{\pi}{4} \\
= \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{3}}{2} + \frac{1}{2} \cdot \frac{1}{\sqrt{2}} \\
= \frac{\sqrt{3} + 1}{2\sqrt{2}} \\
= \frac{\sqrt{2}(\sqrt{3} + 1)}{2\sqrt{2}\sqrt{2}} \\
= \frac{\sqrt{2}(\sqrt{3} + 1)}{4} \\
\]

4. \[ \text{Cosine rule} \]
\[ a^2 = e^2 + f^2 - 2ef\cos D \\
= 13^2 + 38^2 - 2 \cdot 13 \cdot 38 \cdot \cos 140^\circ \\
= 2369.85191 \\
= 48.68\text{ cm} \]

\[ \text{Sine rule to find} \quad d \]
\[ d = \frac{13 \cdot \sin 140^\circ}{\sin E} \]
\[ \approx 48.68\text{ cm} \]

\[ \Rightarrow \frac{\sin E}{13} = \frac{\sin D}{d} \]
\[ \sin E \approx \frac{13 \cdot \sin 140^\circ}{48.68} \]
\[ \sin E \approx 9.88^\circ \]
\[ \text{(Could use sine rule to find (check F))} \]

\[ \therefore E \approx \sin^{-1} \left( \frac{13 \cdot \sin 140^\circ}{48.68} \right) \]
\[ \approx 9.88^\circ \]
\[ \therefore F \approx 180 - 140 - 9.88^\circ \]
\[ \approx 30.12^\circ \]
5. \[ \frac{f}{\sin F} = \frac{d}{\sin D} \]

\[ f \approx \frac{26 \cdot \sin 29.46}{\sin 129} \]

\[ \approx 11.6945 \]

\[ \approx 11.69 \text{ m} \]

Anie rule

\[ \frac{\sin D}{d} = \frac{\sin E}{e} \]

\[ \frac{\sin 129}{26} = \frac{\sin E}{17} \]

\[ \Rightarrow \sin E = 17 \sin 129 \]

\[ \Rightarrow E = \sin^{-1} \left( \frac{17 \sin 129}{26} \right) \]

\[ \approx 30.5^3 \]

\[ \approx 30.5^4 \]

\[ \therefore F \approx 180 - 129 - 30.5^4 \]

\[ \approx 20.46 \text{ m} \]

6.

i. \[ 27 = 3^3, \text{ so } \log_3 27 = 3 \]

ii. \[ \frac{1}{9} = 3^{-2}, \text{ so } \log_3 \frac{1}{9} = \log_3 3^{-2} = -2. \text{ Hence the answer is } -2. \]

iii. \[ 1000 = 10^3, \text{ so } \log_{10} 1000 = 3 \]

iv. \[ \frac{1}{10000} = 10^{-4}, \text{ so } \log_{10} \frac{1}{10000} = -4 \]

v. \[ \ln e^{12} = 12 \]

vi. \[ \frac{1}{e^{18}} = e^{-18}, \text{ so } \ln \frac{1}{e^{18}} = \ln e^{-18} = -18. \text{ Hence the answer is } -18. \]

vii. \[ 4 = 64^{\frac{1}{3}}, \text{ so } \log_{64} 4 = \frac{1}{3} \]

viii. \[ \log_{16} 16^{18} = 18 \]
(a) \( R = \log_{10} \left( \frac{I}{I_0} \right) \), so \( 10^R = \frac{I}{I_0} \) so \( I = 10^R I_0 \).

(b) \( I = 10^R I_0 \), so \( I = 10^{8.9} I_0 \approx 794,328,234.7 I_0 \).

Thus the quake has an intensity almost 800,000,000 times the benchmark figure.

(c) Let \( I_A \) and \( R_A \) be the intensity and Richter measurement of the 2004 quake and \( I_B \) and \( R_B \) be the figures for Brisbane. Then \( \frac{I_A}{I_B} = \frac{10^{R_A} I_0}{10^{R_B} I_0} = \frac{10^{R_A}}{10^{R_B}} = 10^{R_A - R_B} = 10^{8.9 - 2.9} = 10^6 \). Hence the 2004 quake was 1,000,000 times the intensity of the Brisbane quake.

(d) Let \( E \) be the amount of energy released in a quake, and \( E_0 \) be the amount of energy released in a magnitude 1 quake, so \( E_0 = 10 \) kg of TNT.

\[
S_0 \quad E = 30^{R-1} \cdot E_0
\]

\[
= 30^{8.9-1} \cdot 10
\]

\[
= 30^{7.9} \cdot 10
\]

\[
\approx 4.67 \times 10^2 \text{ tonnes of TNT}
\]