

MATHEMATICS ANSWERS

Level Two

Mountains

Remembering all the notation given in the question

$$\text{Angle AEB} = 45^{\circ}12'37'' = \alpha$$

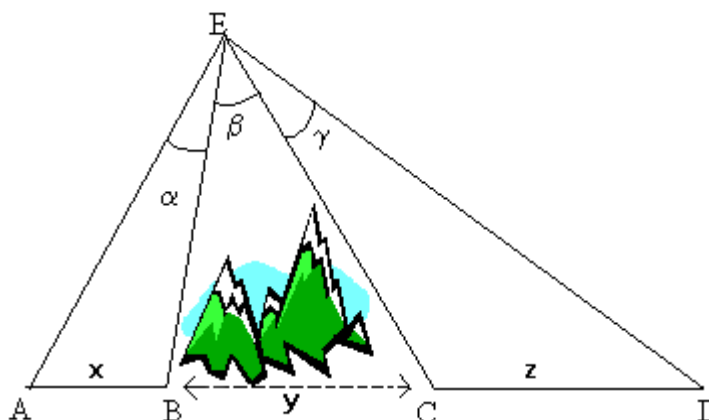
$$\text{Angle BEC} = 38^{\circ}25'48'' = \beta$$

$$\text{Angle CED} = 54^{\circ}33'28'' = \gamma$$

$$\text{Length AB} = 436.325\text{m} = x$$

$$\text{Length BC} = ? = y$$

$$\text{Length of CD} = 542.80\text{m} = z$$



- 1) If we let the length of BC = y, Consider $\triangle EAB$

$$\frac{EB}{\sin(EAB)} = \frac{x}{\sin(\alpha)} \quad \Rightarrow \text{Rearranging gives} \quad EB = \frac{x \sin(EAB)}{\sin(\alpha)}$$

- 2) Then $\triangle ECA$.

$$\frac{EC}{\sin(EAC)} = \frac{x+y}{\sin(\alpha+\beta)} \quad \Rightarrow \text{Rearranging gives} \quad EC = \frac{(x+y) \sin(EAC)}{\sin(\alpha+\beta)}$$

- 3) Since EB and EC both contain an angle that has not been measured, establish the fraction:

$$\frac{EB}{EC} = \frac{x \sin(EAB)}{\sin(\alpha)} \cdot \frac{\sin(\alpha+\beta)}{(x+y) \sin(EAC)} = \frac{x \sin(\alpha+\beta)}{(x+y) \cdot \sin(\alpha)}$$

angle EAB = angle EAC (since A,B and C are collinear)

- 4) Now consider the same for $\triangle EBD$ and $\triangle ECD$ The same reasoning for the two triangles shows that

$$\frac{EB}{EC} = \frac{(y+z)\sin(EDB)}{\sin(\beta+\gamma)} \cdot \frac{\sin(\gamma)}{z.\sin(EDC)} = \frac{(y+z)\sin(\gamma)}{z.\sin(\beta+\gamma)}$$

5) Rearranging the equations to solve for y and hence find the distance BC.

$$\Rightarrow \frac{x\sin(\alpha+\beta)}{(x+y).\sin(\alpha)} = \frac{(y+z)\sin(\gamma)}{z.\sin(\beta+\gamma)}$$

The only unknown in the equation is y, the distance BC. The equation can be rearranged into a quadratic in y.

$$y^2 + y.(x+z) + xz.\left[1 - \frac{\sin(\alpha+\beta).\sin(\beta+\gamma)}{\sin(\alpha).\sin(\gamma)}\right] = 0$$

$y_1 = 150.26\text{m}$ and $y_2 = -1129.36\text{m}$. The length of BC is obviously **150.26m**, since you cannot have a negative distance value.

NB – students may prefer to substitute known values before rearranging.

6) The length of the baseline is **1129.36m**