## Question 1.

See attached diagram.

## Question 2.

The length of side $A$ is clearly 320 m (given in the question). Similarly, side $B$ is 240 m.

To find the remaining sides, we first determine the internal angles. To do this, we draw horizontal and vertical lines extending outwards from the vertices of the quadrilateral and we that they form 4 triangles. Given an initial direction of N 32° W, we have $a = 58^\circ$ using $a = 90^\circ - 32^\circ$. We then have $b = 32^\circ$ since the internal angles of a triangle must sum to 180° and we know that the dotted lines form a 90° angle. We use a similar method to find angles $d$, $f$ and $g$ (given $c$ and $e$). To find $h$, we work backwards from $i$ using the triangle method.

Now to find $C$ and $D$, we use the law of cosines and law of sines. The distance between the starting point and the oak tree (we call this $M$) can be expressed as

$$\begin{aligned}\sqrt{B^2 + A^2 - 2AB\cos(b+c)} &= \sqrt{(280\text{ m})^2 + (320\text{ m})^2 - 2(320\text{ m})(280\text{ m})\cos(56^\circ + 32^\circ)} \\ &= 417.787\text{ m}.\end{aligned}$$

Using law of sines, and letting the angle formed by $M$ and $B$ be $\angle MB$,

$$\frac{\sin(\angle MB)}{A} = \frac{\sin(c+b)}{M}.$$

Rearranging, we have

$$\begin{aligned}\angle MB &= \sin^{-1}\left(\frac{A\sin(c+b)}{M}\right) \\ &= \sin^{-1}\left(\frac{(320\text{ m})\sin(56^\circ + 32^\circ)}{417.787\text{ m}}\right) \\ &= 49.949^\circ.\end{aligned}$$

To find $\angle MC$,

$$\begin{aligned}\angle MC + \angle MB &= d + f \\ \angle MC &= 34^\circ + 68^\circ - 49.949^\circ \\ &= 52.051^\circ.\end{aligned}$$

Thus, using sine law again,

$$\begin{aligned}\frac{D}{\sin(\angle MC)} &= \frac{M}{\sin(g+h)} \\ D &= \frac{M\sin(\angle MC)}{\sin(g+h)} \\ &= \frac{(417.787\text{ m})\sin(52.051^\circ)}{\sin(22^\circ + 68^\circ)} \\ &= 329.449\text{ m}.\end{aligned}$$

Using a similar method, we find $C$ to be 256.923 m. Thus, $A = 320$ m, $B = 280$ m, $C = 256.9$ m and $D = 329.4$ m

## Question 3.

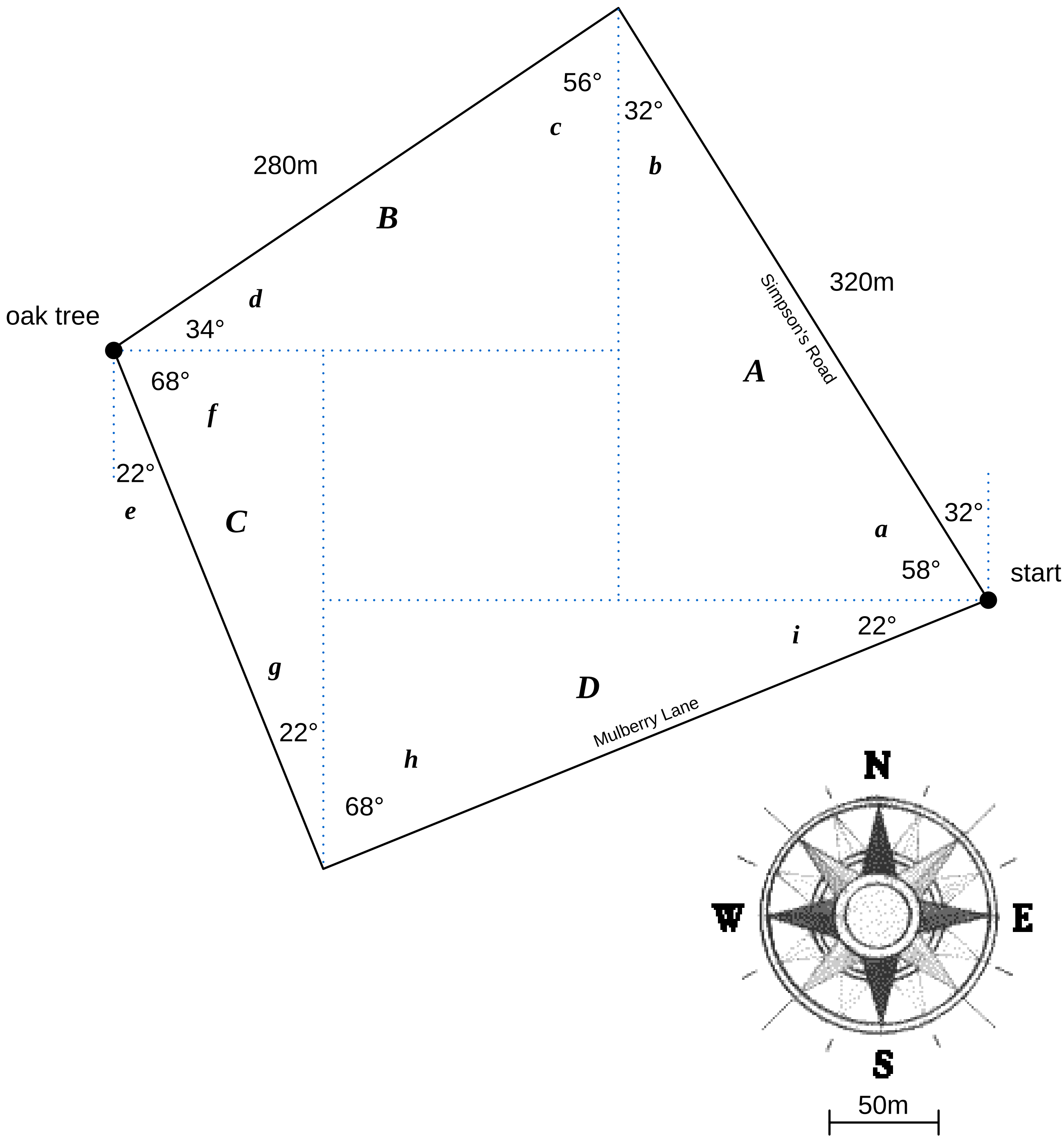
The area of a quadrilateral can be found by finding the total area enclosed by the triangle $ABM$ and $CBM$ using the Hero Formula ($A = \sqrt{(s(s-a)(s-b)(s-c))}$ where $a$, $b$ and $c$ are the triangle's side lengths and $s = \frac{a+b+c}{2}$). For the triangle $ABM$,

$$\begin{aligned} S &= \frac{A+B+M}{2} \\ &= \frac{280 \text{ m} + 320 \text{ m} + 417.797 \text{ m}}{2} \\ &= 508.899 \text{ m} \end{aligned}$$

and thus by simple calculation, $A = \sqrt{S(S-A)(S-B)(S-M)} = 44772.782 \text{ m}^2$. Similarly, for the lower triangle, $A = 42321.513$, for a total area of 87094.295 $\text{m}^2$ or 87094 $\text{m}^2$ to the nearest square meter.

## Question 4.

The conversion factor from $\text{m}^2$ to acres is 0.000247105381 acres/$\text{m}^2$. Thus, 87094 $\text{m}^2$ is equivalent to 21.521469 acres. Thus, the total cost will be $\$500 + (\$175)(21.75)(4) = \$15725$ where the total acreage has been rounded up to the next quarter acre.



56°
32°
c
b
280m
B
320m
Simpson's Road
oak tree
d
34°
68°
f
A
22°
e
C
32°
a
58°
start
i
22°
g
D
Mulberry Lane
22°
h
68°
N
W
E
S
50m