

Shapes

Excellence

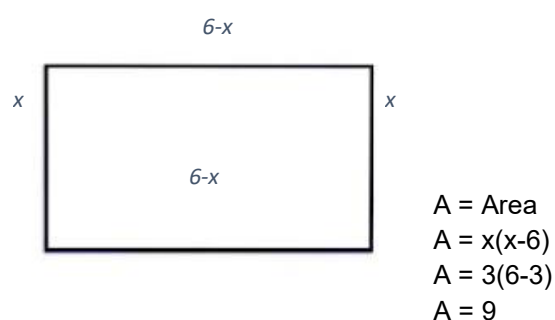
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Width (x)	Base (m)	Area (m ²)
1	5	5
2	4	8
3	3	9
4	2	8
5	1	5

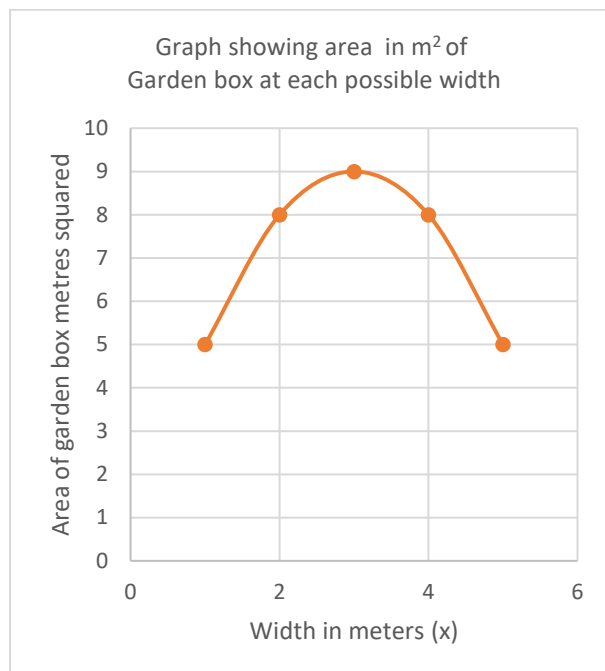
$$x = 3\text{m}$$

When $x = 3$ area is 9m^2

The dimensions of a rectangular garden box to have a maximised area is 3m by 3m . This allows for an area of 9m^2 . You can see this on the table above. These dimensions make a square.



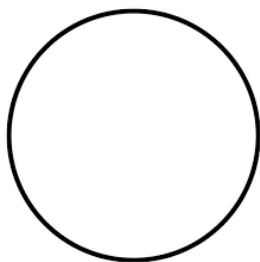
Therefore the equation is $y = -(x - 3)^2 + 9$



A square garden 3m by 3m would give an area of 9m^2

Other possible shapes:

- Circle
- Octagon



circumference of 12m

If it were circular

$$12/\pi = \text{diameter}$$

$$\text{Diameter} = 3.82 \text{ m}$$

$$\text{Radius} = 3.82/2$$

$$\text{Radius} = 1.91\text{m}$$

$$\text{Area} = \pi r^2$$

$$\text{Area} = \pi \times 1.91^2$$

$$\text{Area} = 11.46\text{m}^2$$

The area of a circular garden bed with a circumference of 12m would be 11.46m^2 which is 2.46m^2 more than the square one with same perimeter of 12m. This larger area would be good as you can plant and grow more plants and get the most out of your time and money/benefit the most from it. However, a limitation of this circular garden bed is that it would be difficult to make a perfect circle out of the macrocarpa sleepers because they are very solid. Because of this limitation, a shape similar to a circle but with many sides would be a more practical alternative.

I suppose an octagon.

If it were an octagon the area would be 10.86m^2

Area of octagon

$$\text{Area} = 2(1 + \sqrt{2}) a^2 \text{ where } a = \text{one side of the octagon}$$

$$\text{one side} = 12/8 = 1.5$$

$$\text{Area} = 2(1 + \sqrt{2}) 1.5^2$$

$$\text{Area} = 10.86 \text{ m}^2$$

This area is less than the area of the circle but is more practical. Cutting the eight sides out of the macrocarpa sleepers is possible.

$$\text{Area difference is } 0.6\text{m}^2$$

I believe that the octagon is the better option as you get more area than a square for planting and growing, while it is also practical to build unlike a circle which is one curved side.

Garden mix

Water tank has a radius of 25cm

Converting to meters radius = 0.25m

Area of base of water tank

$$\text{Area} = \pi r^2$$

$$\text{Area} = \pi \times 0.25^2$$

Growing space available = total area of the octagon – the base area of the water tank

$$= 10.86\text{m}^2 - 0.196\text{m}^2$$

$$= 10.664\text{m}^2$$

Volume of the octagon = 10.664×0.15 (height of soil in the garden)

$$= 1.5996\text{m}^3$$

Preferred garden mix = \$8.83 for 40L

1 cubic meter = 1000 litres

$$1.5996\text{m}^3 = 1599.6 \text{ litres}$$

So, to fill the octagonal garden of 1599.6 litres of soil you would need to buy 39.99 bags. As you can only buy the garden mix in 40 litre bags so rounded up is **40 bags**.

40 bags would cost $\$8.83 \times 40 = \353.20 including GST

If another shape was to be used, for example, a 3m by 3m square:

The area would be $9\text{m}^2 - 0.196\text{m}^2 = 8.804\text{m}^2$

Volume would be $8.804\text{m}^2 \times 0.15\text{m} = 1.3206\text{m}^3$

Converting m^3 to litres

$$1.3206 \times 1000 = 1320.6 \text{ litres which is about } \mathbf{34 \text{ bags}} \text{ of mix } (1320.6/40 = 33.015)$$

Rounding up as garden mix only come in 40 litre bags = 34 bags.

$$34 \text{ bags} \times \$8.83 = \$300.22$$

The price for the garden mix for the square 3m by 3m garden is less as it is only 1320.6 litres and the cost would be less for the garden mix as there are only 34 bags required rather than 40 bags for the octagon garden bed. This is 6 less bags. This would save \$52.98 including GST. $6 \times 8.83 = \$52.98$ or 46.07 excluding GST ($\$52.98/1.15 = \46.07)

This means that you have less planting area and the community does not benefit as much. This volume of the square is less than the volume of the octagon garden and so there would be less space for plants to grow. If the same number of plants were grown in this bed as an octagonal bed they would be more crowded.

However, in the long term using the octagonal garden bed the savings would be much greater because growing your own vegetables is cheaper than buying them. So you would save on groceries if you were harvesting your own vegetables from the garden. This means that a bigger volume is better because of the advantage for the saving of money because you can grow more. Consequently the octagon is the best option.

Cost of macrocarpa sleepers/timber

Wood for timber framing.

4m at \$130 and 2.1m at \$66.78

Since the sides of the octagon are 1.5 m each 4m lengths would be good because you wouldn't have to cut the wood as often as you would if you used the 2.1m lengths. For the 2.1m lengths you would end up with 0.6 meters left after each cut which would need another 0.9 meters to make one side of the octagon. This would result in extra time, money and effort put into making the sides: it would cost more to pay builders to be working for longer to achieve this.

Assuming each side of the octagon will be cut and then assembled to make the garden bed, you'd be able to cut two sides with the 4m length and have 1m left. From the next length you would also get 2 sides and have 1m length left and likewise from the third. If you took one of the 1m lengths and cut them into two 0.5meter lengths this would allow to make the other two sides of the octagon, so all sides are now 1.5meters long.

A cheaper option for macrocarpa I believe would be three 4m lengths. The cost of three 4m lengths at \$130 each ($3 \times \$130 = \390) including GST. If I were to use the 2.1 meter lengths I would need just under 6 lengths however they only come in 2.1 meter lengths so I would need 6. So six 2.1 lengths at \$66.78 each ($6 \times \$66.78 = \400.68) including GST. This would cost more. The three 4 meter lengths are cheaper.

But joining the sides at the vertices may prove to be difficult as it is a 135 degree angle – each joining point $360/8 = 45$ so therefore $180 - 45 = 135$ degrees.

Therefore I believe it would be most practical to buy two 4m lengths of timber and two 2.1m lengths of timber which adds to 12.2m. This gives the builder 0.2m extra just in case they need it. They may want to make the first side they cut a little longer in order to make sure that the angle is perfect and they know exactly how to cut it before they do the rest. This is assuming the builders are cutting by hand and there won't be a machine doing it.

The cost for buy two 4m lengths of timber and two 2.1m lengths of timber is
 $(2 \times 130) + (2 \times 66.78) = \393.56 incl GST

This is only \$3.56 extra and likely will ensure that the job is done to the highest quality because of reasons stated above regarding the builders.

Overall cost – octagonal concept

Timber cost + garden mix cost = $\$393.56 + \$353.20 = \$746.76$ including GST

Without GST $\$746.76/1.15 = \649.36