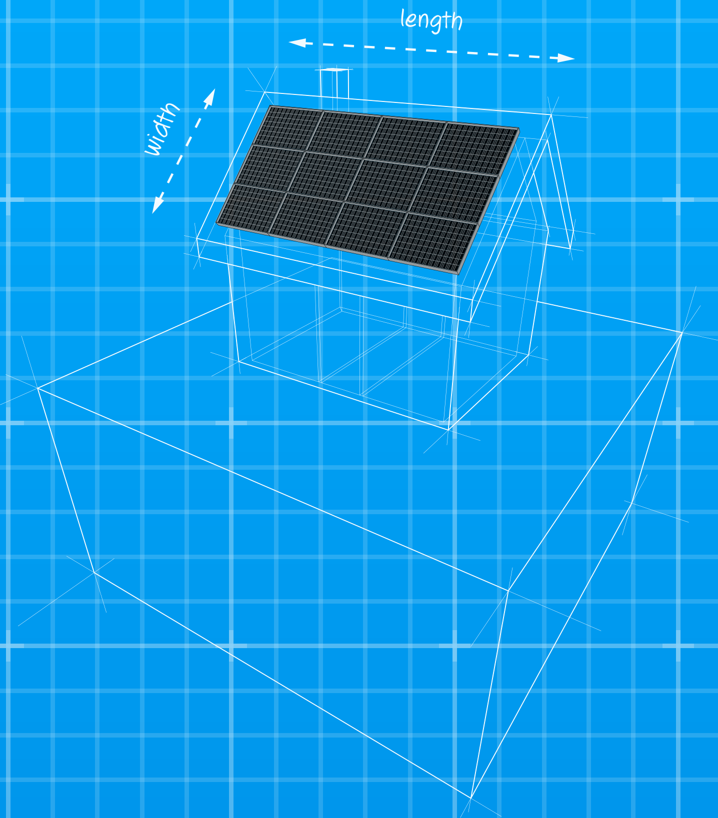
DEPLOYABLE **STRUCTURES**

Solar panels



ROYAL ACADEMY OF ENGINEERING

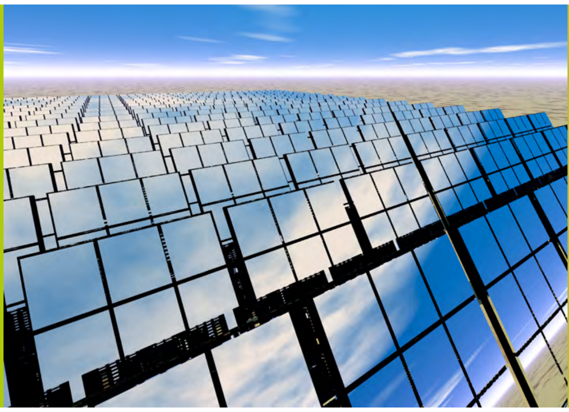
THIS IS ENGINEERING

This resource aims to give students the chance to put their knowledge of area into use within the context of using solar panels as a way of generating electricity.

Solar panels

Scientists and engineers across the world are currently trying to develop better ways to generate the electricity needed to power the world. One way that is already in use is solar panels.

Examples of solar panels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Activity 1 – Discussion

Spend a few minutes thinking about and discussing with others what you already know about solar panels. What do they do? How do they work?

ACTION: **Write down your thoughts.**


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There are many different ways of generating electricity including burning fossil fuels such as coal and gas, using nuclear power or using renewables such as wind, wave and hydroelectric power.

Activity 2 – Discussion

What are the advantages and disadvantages of solar panels over other ways of generating electricity. There are some really obvious ones even if you have not learnt about this before!

ACTION: **Write down your thoughts.**

Activity 3 – Calculation

You can generate electricity for your home by putting solar panels on the roof. Figure 1 is a layout of a roof that needs to be covered. It has been broken down into 0.5 m squares. Calculate the area needed to be covered and show how you got to your answer.

ACTION:
Make sure you write down your answers and show your workings.

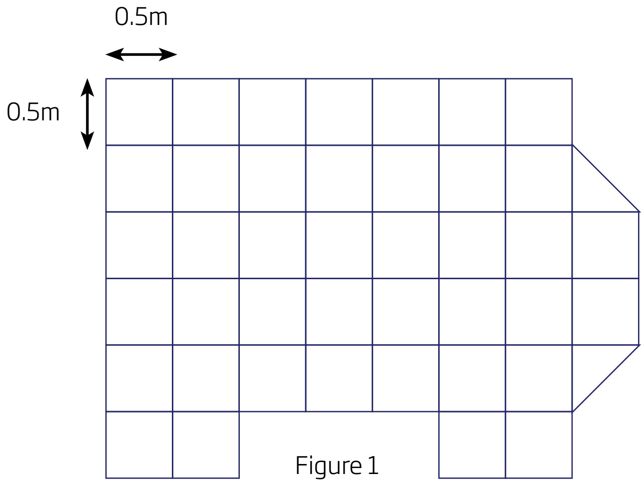


Figure 1

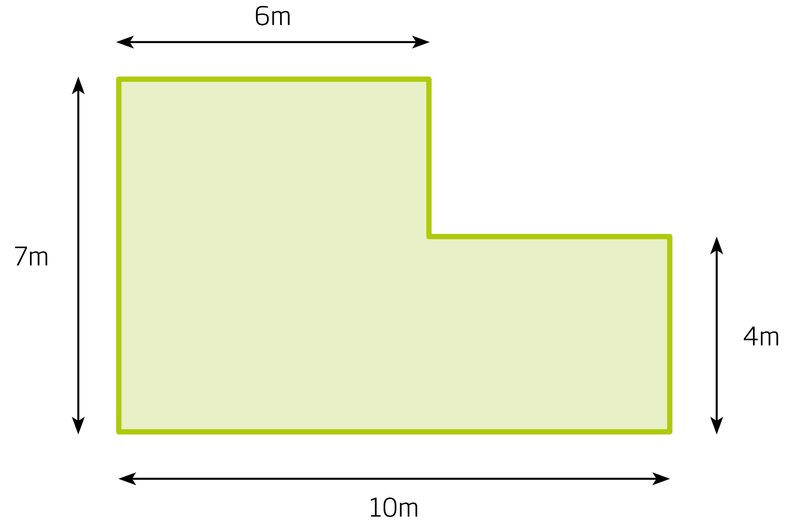
Eric Broder Van Dyke / Shutterstock.com

Activity 4 – Solar powered cars

Engineers are trying to develop cars that can be powered by solar panels. These would not give off greenhouse gases and would therefore be better for the environment. As well as cars, many other things could be powered by solar panels. Therefore, you can have more complex areas that need to be covered with solar panels.

ACTION:
Calculate the shaded area of the diagrams (on the next page) which is the area that needs covering with solar panels.

A



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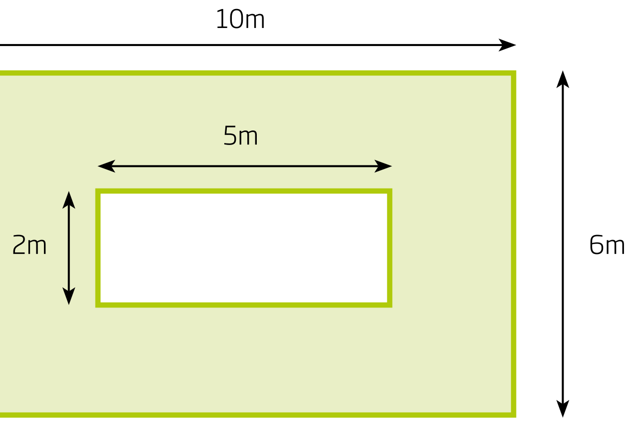
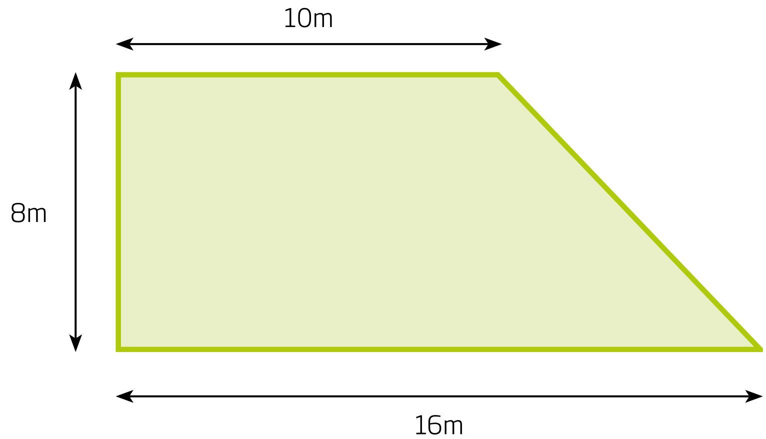
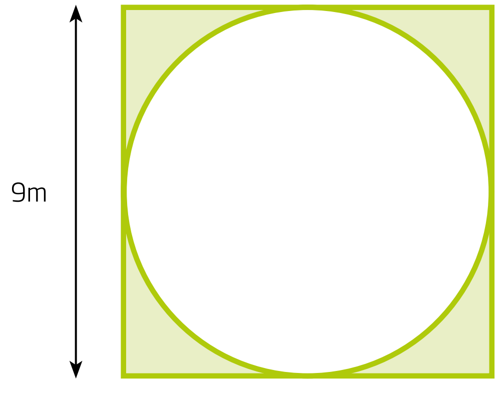


C



D



Stretch and challenge activity

Part 1

One of the problems with solar panels is that they do not produce enough energy in a small enough space to be used to power things that require lots of energy, like cars. Solar-powered cars have been produced but they have been very light compared to a typical car you would buy for yourself, and they would not work as a practical car.

The aim of this activity is to work out the area of solar panels that would be required to power a small car. The answer will show why it is currently not possible to power a car using solar panels.

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Use the following information to come up with an estimate of the area of solar panels required to power a small car such as the one in the photograph.

- A typical small car requires an engine that has a power of 50-60bhp. (bhp stands for brake horsepower)
- 1bhp is the same as around 746W. (W stands for Watts)
- On a clear day with the sun overhead, 1m² of solar panels has 1000W of sunlight on it. But on a typical day, with some cloud cover and with the sun at an angle, there would be around 400W.
- Standard solar panels only turn about 15% of the sunlight into electricity to power the car.

Part 2

If you wanted the solar panels to be arranged in a square you would have to square root your answer from part 1 to get the length of the sides of the square. Do this now and write down your answer.

Look at your answer and decide whether it would be possible to have a square of solar panels of this size on top of a car.

Notes for teachers

Activity 2

The 'really obvious' disadvantage referred to is the fact that solar panels only work during the day when there is light available.

Here is a table with some suggested advantages and disadvantages.

Advantages	Disadvantages
■ Sunlight is free ■ Sunlight will not run out for a very long time ■ No greenhouse gases	■ Solar energy is only available during the day ■ When it is cloudy there is less energy available ■ You need a lot of land to have enough solar panels to get enough energy ■ Batteries for storage of electricity are expensive

Activity 3

The answer is $10.5m^2$

Activity 4

A – the shape should be split into two rectangles. One example of a calculation would be $(7 \times 6) + (4 \times 4) = 58\ m^2$

B – the calculation should be $(10 \times 6) - (5 \times 2) = 50\ m^2$

C – the shape could be split into a rectangle and a triangle. The calculation would be $(10 \times 8) + ((6 \times 8) \div 2) = 104\ m^2$

D – the calculation is the area of the square take away the area of the circle. The radius of the circle is 4.5m. So the calculation is $(9 \times 9) - (\pi \times 4.5^2) = 17.38\ m^2$ to two decimal places.

Stretch and challenge

Part 1

An example of the calculation required could be:

- Assume the car engine is in the middle of the range given at 55bhp.
- 55 x 746 = 41030 Watts is the power of the engine.
- 1m^2 of solar panels has 400W of sunlight on it but 15% of 400 is 60W so assume the 1m^2 of solar panels produces 60W of power.
- 41030 ÷ 60 = 683.83m^2

This calculation is probably very generous in how much sunlight falls on 1m^2 and also assumes that all the energy from the solar panel can be converted to energy powering the wheels of the car. It also assumes that the car uses all its power all the time. In reality, it could store some energy in batteries when the full power was not being used. All these factors and others would adjust the area of solar panels required.

Part 2

The square root of 683.83 is 26 (rounded to the nearest whole number) so a car would have to have a 26m x 26m square of solar panels to power it, which is clearly impractical.

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