

The Climate Quiz

In this 3-part challenge, mathematical problems are given to reveal the issues and consequences of climate change. We're challenging students across Scotland to see how you can use maths to better the world. Whether it's by calculating the water flow in the world's rivers or comparing the biggest CO₂ emitters, we want to see what you've got! The solution to these problems can empower you to make green choices in your own life and sort fact from misinformation, so give it a go and you could win one of our prizes!

Round 1

1) 5 solar panels left in the sun for 5 days collectively generate 5 units of electricity. Under the same conditions, how many units of electricity would be generated by 1 solar panel in 10 days?

- A: 0.4
- B: 2
- C: 2.5

2) A lake in the shape of a rectangular prism has dimensions 10 metres by 20 metres by 1.5 metres. If the lake has 175 cubic metres of water in it, express this as a fraction of the total volume the lake can contain.

- A: $\frac{1}{2}$
- B: $\frac{4}{7}$
- C: $\frac{7}{12}$

3) Sarah calculates it takes an hour and costs 30p to heat her house fully when cold, and 15p per hour to maintain that temperature afterwards. If she has spent £1.20 on heating today, and her house was cold at the start of the day, how many hours has Sarah's heating been on?

- A: 5 hours
- B: 6 hours
- C: 7 hours

4) Rodrigo has a rain collector which has a surface area of 100,000 square centimetres. How

much water, in litres, will he collect in a thunderstorm where 4cm of rain falls.
You may use the fact that 1000cm^3 of liquid is one litre.

- A: 40 litres
- B: 400 litres
- C: 4000 litres

5) In the months of July, August and September 2019, 20% of energy in the UK was generated by wind power, 12% by biomass and 6% by solar power.
Express this as a ratio in its simplest terms.

Source: <https://www.carbonbrief.org/analysis-uk-renewables-generate-more-electricity-thanfossil-fuelsforfirsttime#:~:text=In%20the%20third%20quarter%20of,biomass%20and%206%25%20from%20solar>

- A: 1:2:3
- B: 3:2:1
- C: 10:6:3

6) Between the years 1975-2017, the average volume of water flowing in Australia's rivers was 134 billion litres per annum. In the final 6 years of this period an average of 46 billion litres has been flowing per annum. On average, how much water was flowing each year between 1975 and 2011 to 2 significant figures?

Source: <https://www.csiro.au/en/Research/OandA/Areas/Assessing-our-climate/State-of-theClimate-2018/Australias-changingclimate#:~:text=As%20the%20climate%20warms%2C%20heavy,cent%20per%20degree%20of%20warming.>

- A: 150 billion litres
- B: 134 billion litres
- C: 90 billion litres

7) In 2019, Country A emitted 200 million tonnes of carbon dioxide, while country B emitted 150 million tonnes. Country A will cut its emissions by 7 million tonnes each year while country B will increase its emissions by 5 million tonnes each year.

In which year will the emissions of each country be closest to each other?

- A: 2021
- B: 2023
- C: 2025

8) It costs £600 to keep Amelia's house warm through winter, if she were to purchase a new type of insulation for £300 it would then only cost her £500 to

keep her house warm during winter. Assuming Amelia only uses her heating during winter, after how many years will the new insulation have saved her money?

Source: <https://www.weflip.com/articles/average-gas-electric-bill-uk/>

- A: 2 years
- B: 3 years
- C: Never

9) A cylindrical iceberg has a radius of 20m. A while later, it was discovered that the iceberg had lost 36% of its surface area (on the top face) due to melting and had remained cylindrical. What is the new radius of the iceberg?

- A: 12.8m
- B: 14m
- C: 16m

10) The roof of a house can be modelled as a triangular prism, the triangular face is isosceles with width 6m and perpendicular height of 4m and the roof is 10m long. George has a supply of solar panels which have dimensions 2 metres by 1 metre, what is the maximum number of solar panels can George install on his roof? Assume George lives in a terraced house such that he cannot install them on the triangular faces.

- A: 50
- B: 25
- C: 40

Round 2

This round allows for the use of a calculator.

1) It takes 14980 litres of water to produce one kilogram of beef, and 899 litres to produce one kilogram of corn. If the water used to produce one kilogram of beef was instead used to make corn, how many kilograms of corn could be produced to 2dp?

Source: <https://www.waterfootprint.org/en/resources/interactive-tools/product-gallery/>

- A: 0.06 kg
- B: 16.66 kg
- C: 18.53 kg

- 2) 2.1 billion single-use carrier bags were sold by large retailers in the UK in 2017 for 5p each. If the UK population was 65.7 million that year, how much did the average Brit spend on single use carrier bags to the nearest penny?

Sources: <https://www.ons.gov.uk/aboutus/transparencyandgovernance/freedomofinformationfoi/ukpopulation2017>
<https://www.gov.uk/government/publications/carrier-bag-charge-summary-of-data-in-england/single-use-plastic-carrier-bags-charge-data-in-england-for2016to2017#:~:text=Large%20retailers%20in%20England%20sold,months%20in%202015%20to%202016>

- A: £0.15
B: £1.36
C: £1.60

- 3) In the USA, from January 1st to September 8th, 4.2 million acres of land were burnt in wildfires in 2019, compared to 4.7 million acres in 2020 over the same period. Calculate, to the nearest percent, the percentage increase in land burnt from 2019 to 2020.

Source: <https://www.iii.org/fact-statistic/facts-statistics-wildfires>

- A: 11%
B: 12%
C: 111%

- 4) A circular solar panel has a diameter of 150mm, what is the area of this solar panel in millimetres squared to the nearest whole number?

- A: 22500
B: 17671
C: 70686

- 5) In the morning, Mr Cage drives his car to work. It is a 5 minute drive and he travels at an average speed of 24 miles per hour. That evening, he decides to be eco-friendly and he walks home - this takes him 40 minutes at an average speed of 3 miles per hour. Find Mr Cage's average speed over his morning and evening commute to 3 significant figures.

- A: 4.33 mph
B: 13.5 mph
C: 5.33 mph

- 6) Below is a table consisting of the top 5 countries which emitted the most CO₂ in the year 2017, where the units are mega tonnes of CO₂ and figures are given to 1 decimal place. What was the mean mass of CO₂ produced by the top 3 countries (in 2017) in mega tonnes to 1 decimal place?

Source <https://ec.europa.eu/jrc/en/publication/fossil-co2-emissions-all-world-countries2018-report>.

| | 1990 | 2005 | 2017 |
|---------------|---------------|---------------|----------------|
| China | 2397.0 | 6263.0 | 10877.2 |
| USA | 5085.9 | 5971.6 | 5107.4 |
| India | 606.0 | 1210.8 | 2454.8 |
| Russia | 2379.0 | 1734.0 | 1764.9 |
| Japan | 1149.4 | 1276.9 | 1320.8 |

- A: 4305.0 mega tonnes
B: 6146.5 mega tonnes
C: 6146.3 mega tonnes

- 7) Using the table below and considering all 5 countries given, find the ratio N/P where N is the mean CO₂ produced in 2005, and P is the mean CO₂ produced in 1990, give your answer correct to 3 significant figures.

Source: <https://ec.europa.eu/jrc/en/publication/fossil-co2-emissions-all-world-countries-2018-report>.

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- A: 1.42
B: 1.63
C: 1.39

- 8) A bathtub in the shape of a rectangular prism (1.5m long x 50cm wide x 1m high) is half full of water. A block of ice (1m x 20cm x 20cm) is placed into the

bath. Considering water expands by about 9% when frozen, find, to 3dp, the new height of the water in the bath when all the ice has melted.

Source: Serway, R.A. and Jewett, J.W. (2019). Physics for scientists and engineers. Australia ; Brazil ; Mexico ; Singapore ; United Kingdom ; United States Cengage, p.368.

- A: 0.549m
- B: 0.558m
- C: 0.562m

9) A wind turbine goes through 20 revolutions per minute, given that the blades are 36.5 metres long, how fast is the tip of the blade rotating in metres per second? Give your answer to 1 decimal place.

Sources: http://www.acua.com/uploadedFiles/Site/About_Us/WindFarm.pdf

- A: 76.4
- B: 38.2
- C: 52.4

10) The Atla wind energy centre generates 1500 million joules per second on 3200 acres (13 square kilometres) of land. The Bhadla Solar park generates 2245 million Joules of energy per second on 57 square kilometres of land. Calculate the difference in energy generated per second per square kilometre to 2 significant figures.

Sources:

<https://www.power-technology.com/projects/alta-wind-energy-center-awec-california/>
https://en.wikipedia.org/wiki/Alta_Wind_Energy_Center
<https://mercomindia.com/world-largest-solar-park-bhadla/>

- A: 76
- B: 80
- C: 18