GCSE to A-level progression: Student transition activities answer booklet – Environmental Science

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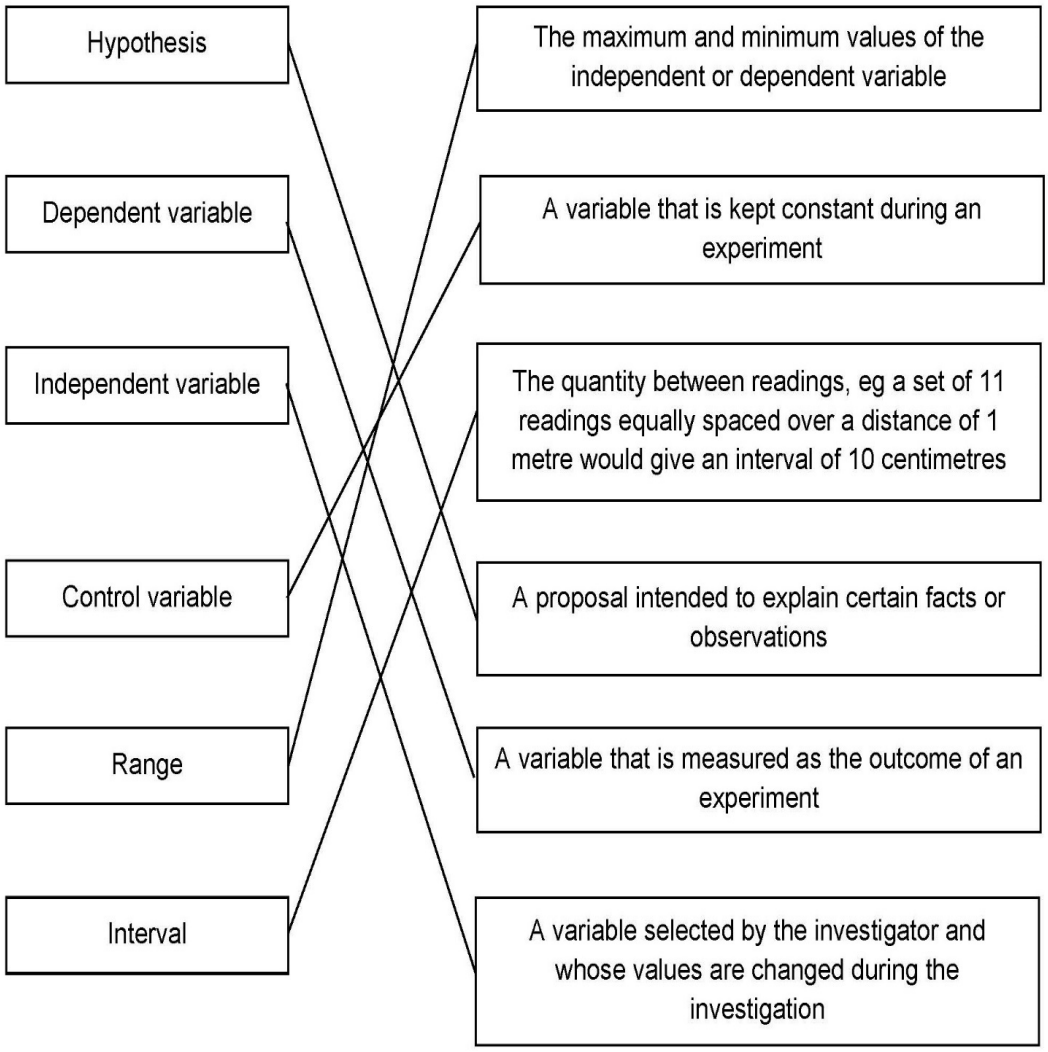
Activity 1 Scientific vocabulary: Designing an investigation



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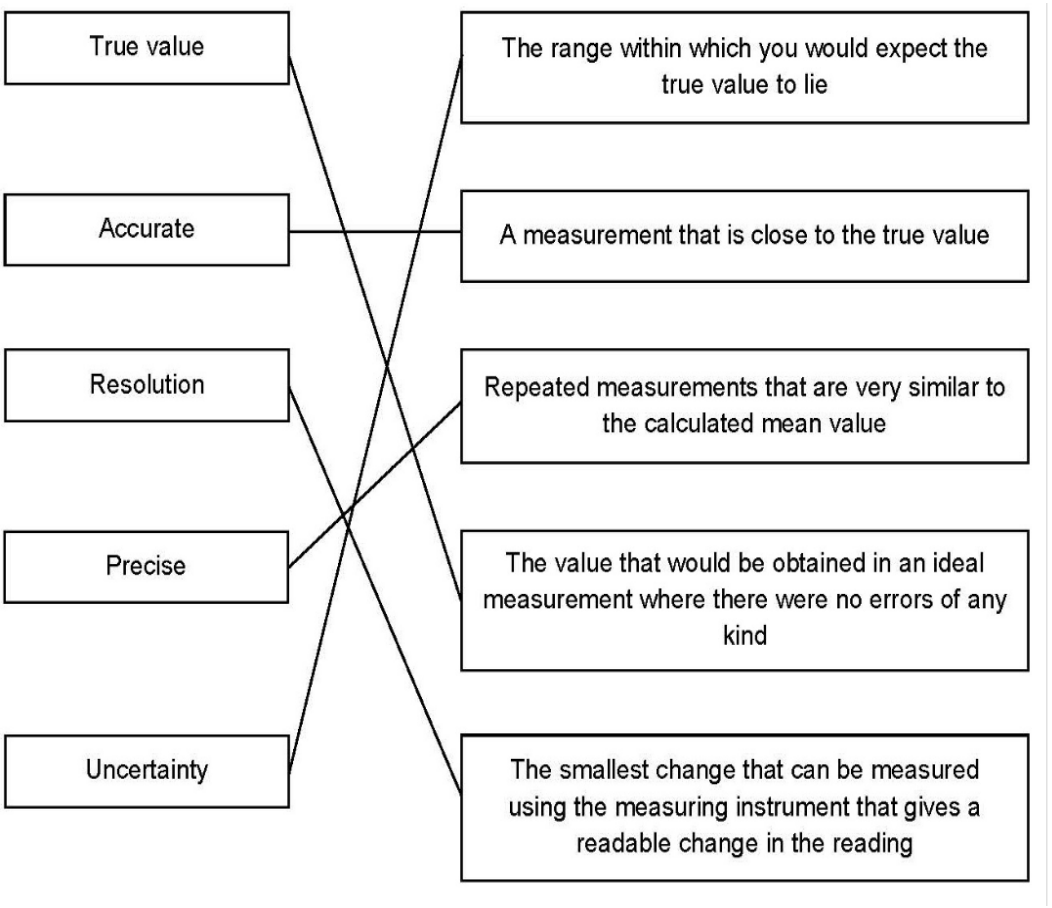
Activity 2 Scientific vocabulary: Making measurements



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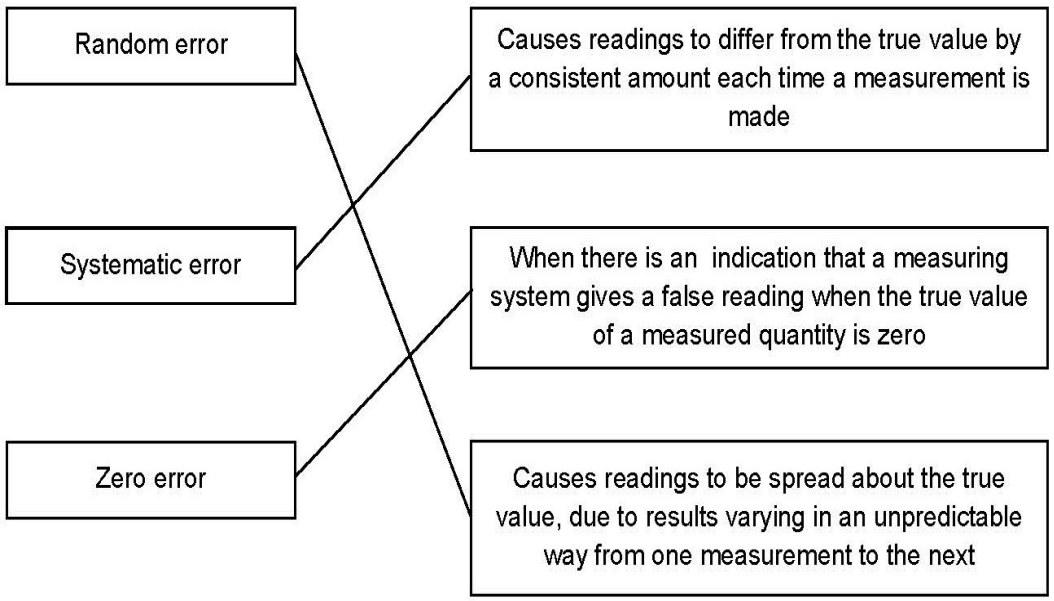
Activity 3 Scientific vocabulary: Errors



Activity 4 SI units and prefixes

1. cm
2. km
3. μm
4. g or kg
5. m^3
6. $m^3 s^{-1}$

Activity 5 Converting data

1. a) mm b) 1.042 g c) 1.1202 km d) 70 ml e) 7 l
2. 33 Gt
3. 1.496 × 108 km
4. 27 million km3

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Activity 6 Investigating woodlice behaviour
1. A suitable statement that links the numbers of woodlice with levels light intensity. For example: *The distribution of woodlice in a habitat depends on the light intensity*.
2. A prediction that links higher light levels with low numbers of woodlice. For example: *I predict that the areas of the choice chambers that are receiving a high level of light (fewer layers of tracing paper) will have lower numbers of woodlice than the section which is getting low levels of light intensity (many layers of tracing paper).*
3. **Independent variable**: number of layers of tracing paper. **Dependent variable:** number of woodlice in each section after 2 minutes. **Control variables**: anything that refers to keeping the environment in the choice chamber the same eg temperature, level of dampness.
4. **Repeatable:** if I repeat the investigation again, using the same method and equipment and I obtain the same results or measurements as before. **Reproducible:** if someone else does the investigation or if the investigation is done using different equipment or using a different technique and the same results/measurements are obtained.
5. The results suggest that woodlice prefer low levels of light, because the darkest sector has a much higher number of woodlice than the others.
6. Results are said to be accurate if they are judged to be close to the true value. This investigation was only done once for 2 minutes, so repeating the investigation a number of times will give you more values to see if they are close to the true value or expected pattern in this case.

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Activity 7 Investigating dandelion abundance

1. There is an uneven distribution of dandelions
   or
   it's more representative / valid or it avoids bias
   or
   it gives a more accurate / precise mean.

2. Showing your working:

   correct mean per m^2 = 6 or 6.0

   correct field area = 55 000 (m^2)

   mean × area = 6(.0) × 55 000

   = 330 000

   Answer = value in standard form = 3.3×10^5

3. To achieve full marks the method needs to lead to a valid outcome.
   All key steps are identified and logically sequenced.
   The structure of your answer is important.
   The indicative content that could be included is shown below but the key ideas of
   - using a large number of quadrats randomly, or along a transect, and
   - counting the number of dandelions in areas of differing light intensity

   need to be given to produce a valid outcome.

   Indicative content:
   - placing of quadrat
   - large number of quadrats used
   - how randomness achieved − e.g. table of random numbers **or** random number button on calculator **or** along transect
   - quadrats placed at coordinates **or** regular intervals along transect
   - in each of two areas of different light intensities **or** transect running through areas of different light intensity
   - for each quadrat count number of dandelions
   - for each quadrat measure light intensity
   - compare data from different light intensity

4. Any **two** from:

• temperature	allow heat
• water	allow moisture / rain
• (soil) pH	allow acidity
• minerals /ions	allow, eg, magnesium ions or nitrate allow salts / nutrients
• winds	
• herbivores	allow trampling

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Activity 8 Investigating weed killer

1. Water acts as a control for comparison, it allows you to see the difference.

2.

Mean	10	9	2	**11**

3. $\frac{10-2}{10} \times 100$

   Answer = 80%

4. Validity is the **suitability** of the investigative procedure to answer the question being asked. A valid conclusion is a conclusion supported by valid data, obtained from an appropriate experimental design and based on sound reasoning.

   Your answer should be about an improvement to do with:

   - data collection – for example:
     use more or larger quadrats or take repeat readings
     (reason) as the original data may not have been representative or the weeds may have been unevenly distributed.

     or

   - the length of time the investigation was done for – for example:
     leave for more than 2 weeks **(reason)** as the original data may not have representative as the weed killer takes longer than 2 weeks to work.

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Activity 9 Investigating moths

1. Standardisation can be achieved by controlling variables that may otherwise affect the results. Ways in which this method could be standardised include:

Standardisation feature	Reason
The same duration of time the moth traps were left on	Same sample size
The same brightness of the bulb	A brighter bulb may be more attractive
Same positioning of the trap in the field e.g. in the centre	Moths may prefer to flying in open spaces/ next to vegetation
Same weather conditions	Moths may not fly when it is raining or too cold
Same time of year	The time the moth exists will be limited to a certain time of the year

2. Food source
   Pollination

Activity 10 Climate change

1. There are two trends in the graph:

   - an overall increase in CO_2
   - annual fluctuation in CO_2

2. The increase in the concentration of carbon dioxide in the atmosphere absorbs more long-wavelength / infrared radiation.

3. Burning of (fossil) fuels or any named activity which leads to burning fuels eg driving cars or central heating.

4. Photosynthesis

5. Methane or CFC

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Activity 11 Analysing graphs
1. As temperature increases oxygen content decreases.
2. This is a negative correlation.
3. At 0°C oxygen content is 10 cm^3 per dm^3 At 14°C oxygen content is 6 cm^3 per dm^3 Difference = 10 – 6 = 4 cm^3 oxygen per dm^3 The oxygen levels decreased by 4 cm^3 oxygen per dm^3
4. Graph **C** shows the increase in the water density from 0 °C to 4 °C and the decrease in water density as temperature increases from 4 °C to 16 °C.
5. It is important that you look carefully at the key and axes labels when analysing data in multivariate graphs. Make sure you are reading data from the correct side. You should use numerical data from the graph in your answer and include the main changes in the data ie the increase and decrease. The catch increased from 25 thousand tonnes in 1973 to a peak catch of 210 thousand tonnes in 1976 Then declined to 60 thousand tonnes in 1980

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Activity 12 Maths skills

When carrying out Maths calculations it is important to remember that there is often more than one way to arrive at the correct answer.

Full marks will always be given for the correct answer regardless of the method used. Mark schemes will show one or two common ways through the calculation.

The mark scheme will show the steps you need to go through. We encourage students to show their working as there are often compensatory marks even if the numbers used may have been incorrectly calculated because of previous errors.

1. $120 \times 0.55 = 6$

$$\frac{75 \times 66}{100} = 49.5 \text{ m}^3$$

2. Total volume replaceable water = 17 + 10 + 5 + 45 = 77 litres

Overall total water = 138 litres

$$\frac{77}{138} \times 100 = 55.79 \text{ or } 56\%$$

The data in the diagram is represented to 2 significant figures. The convention is to express your answer to the lowest number of significant figures the data given. In an examination if you are not asked to give your answer to a particular number of significant figures a correct answer from the calculation will gain full marks.

3. There is more than one way of doing this calculation

From the table, in 2010, 60.3% was 'Not recycled, composted or reused' and 39.7% was.

15 628 (000 tonnes) is 60.3% of the total. We can use this information to calculate 39.7% by first calculating 1%:

$$\frac{15\,628}{60.2} = 259.17 \text{ (= 1\%)}$$

You can then use this value to calculate 39. 7% = 259.17 × 39.7

Giving an answer of 10 289 (000 tonnes)

Or

$\frac{100}{60.3}$ x 15628 = x 25 917 (total tonnage)

25 917 x 39.7% = 10 289 (000 tonnes)

4. Mass of sewage sludge produced by 67 million people in year

$$\frac{67}{1.9} \times 500\,000 = 17\,631\,578.95 \text{ tonnes}$$

Answer in standard form = 1.76×10^7 tonnes or 1.8×10^7 tonnes.

5. $3.6 \times 10^5 = 360\,000$ tree planted in the first year

   So need to plant 3 000 000 – 360 000 = 2 640 000 trees in the remaining 24 years

   $$\frac{2\,640\,000}{24} = 110\,000$$

   $= 1.1 \times 10^5$ trees remaining to be planted each year .

6. There is more than one way of doing this calculation. We have shown the steps that need to be thought through. The unit conversion can be done at the beginning, in the middle or at the end.

   You need to do two unit conversions:

   125 mg to g = 0.125 g

   1 dm^3 to cm^3 = 1000 cm^3

   So using these calculations you can work out that the mass in 250 cm^3 is

   (250 ÷1000 = 0.25) × 0.125 g

   = 0.031 g (2 sig. figs)

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Activity 14 Key concepts from GCSE Biology
1. Light intensity CO_2 Temperature
2. Other factors will limit the rate, eg light or temperature.
3. An increase in temperature may increase the rate of photosynthesis which will absorbs more CO_2 so reducing the (*enhanced*) greenhouse effect.
4. To transport water and mineral ions to the leaves for photosynthesis and growth.
5. High temperatures will increase the rate of transpiration because there is more energy to evaporate and diffuse water out of the stomata. High humidity will reduce the rate of transpiration because there will be a higher concentration of water vapour outside of the leaf which will slow diffusion. Greater air flow will increase the rate of transpiration because there will be a lower concentration of water vapour surrounding the leaf reducing diffusion.
6. Any from: High growth rates / yields Disease resistance Pest resistance Temperament (animals) Muscle mass
7. Reduced gene pool may lead to: • Inbreeding, where individuals are at higher risk of inheriting harmful genetic defects. • Reduced ability to respond to environmental change eg disease, increase in temperature.
8. Community
9. Habitat
10. Population is all the organisms of one species living in a habitat.
11. Producer
12. Any from: • Mates • Territory

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• Space
13. **Abiotic factors**: temperature and oxygen levels **Biotic factors**: availability of food, new predators arriving, new diseases (pathogens), one species outcompeting another so the numbers are no longer sufficient to breed.
14. Biodiversity is the variety of all the different species of organisms on Earth or within an ecosystem.
15. a, c, e
16. a, d, e

Activity 15 Key concepts from GCSE Chemistry

1. The lower the pH the ~~**lower**~~ **/ higher** the content of H^+ ions and so the more **acidic /** ~~**alkaline**~~ the solution is.

2. A factor of 1000

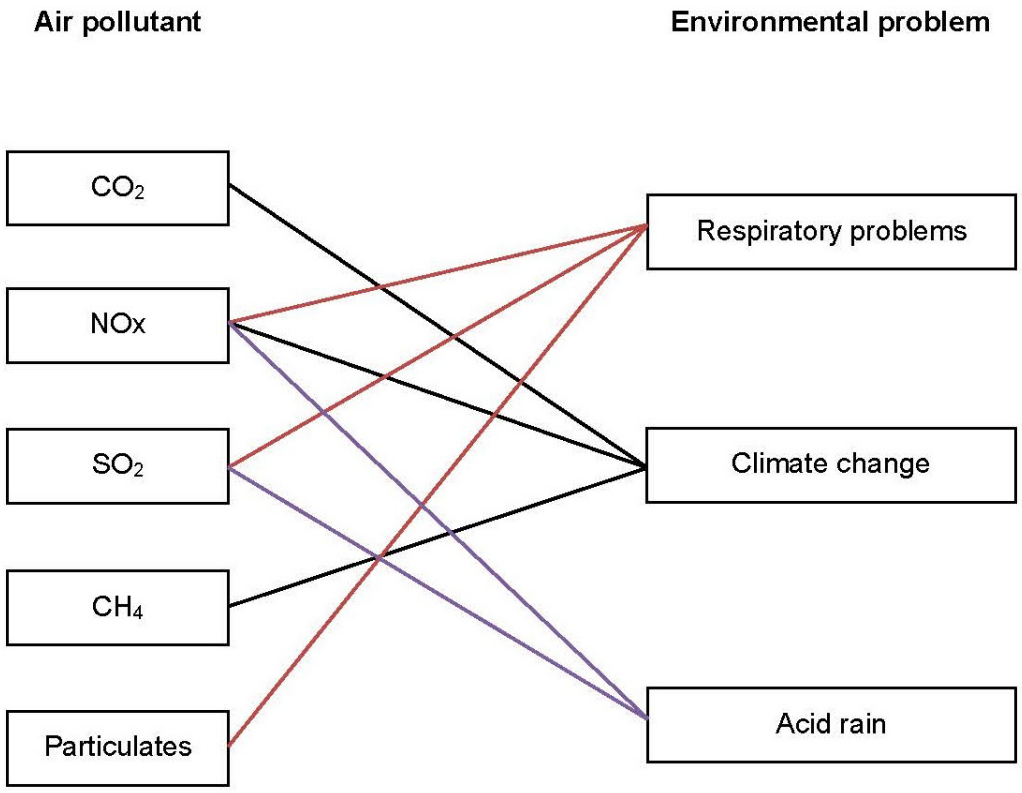
3.

Gas	% volume
Nitrogen	71
Oxygen	21
Carbon dioxide	0.04

4. Absorption by the oceans.

5. Photosynthesis

6.



7. CO_2 ,SO_2 and particulates are released from the combustion of coal and oil.

   NO_x forms during high-temperature combustion.

   CH_4 is released accidentally during the extraction or transportation of natural gas.

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8. Extraction of raw materials.

   Manufacturing and packaging.

   Using of the product during its lifetime.

   Product disposal, including transport and distribution at each stage.

9. Any three from:
   - Use of energy
   - Use of water
   - Production of some waste
   - Pollutants
   - Resources

10. Reduces waste to be disposed of.

    Reduces pollution caused from the disposal.

    Reduced environmental impact of extraction of resource to make products.

    Reduces energy impacts of making new products.

11. Wood is a renewable resource, oil used to make plastic is non-renewable.

    Timber logging and carpentry does not use as much energy (or water) as fractional distillation, cracking and polymerisation, the processes used to make plastics.

    Wood can be easily recycled into new wood products with a low energy input. Plastic has a limited recycling future and uses more energy to be recycled.

    Wood biodegrades. Plastics cause marine pollution.

12. No pathogens

    pH 6.5 – 8.5

    low dissolved salts

13. Sewage treatment includes

    - Screening and grit removal
    - Sedimentation to produce sewage sludge and effluent
    - Anaerobic digestion of sewage sludge
    - Aerobic biological treatment of effluent.

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Activity 16 Key concepts from GCSE Physics

1. Independent variable: thermal insulating material
   Dependent variable: water temperature

2. Size and shape of the container – as this would affect the surface area to volume ratio.
   Temperature of the water at the beginning of the experiment.
   The material the containers were made of – as this would affect the rate of conduction.

3. Do at least three repeats of each of the different insulating materials to find a mean.
   Run the experiment for longer.

4.

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

5.

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

Useful energy = 1500 – 500 = 1000

$$\text{efficiency} = \frac{1000}{1500}$$

= 67%

6.

Energy resource	Renewable	Non-renewable
Coal		✓
Wind	✓	
Gas		✓
Geothermal	✓	
Solar	✓	
Nuclear		✓
Wave	✓	
Hydroelectric	✓	
Oil		✓
Biofuel	✓	
Tidal	✓	

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7. Advantages: No greenhouse gas emissions during generation of electricity – meaning no contribution to climate change. Renewable – meaning it will not run out. **Disadvantages:** Less energy dense –wind does not produce as much energy as coal (per unit area/mass). Less reliable – it is not always windy and it is difficult to predict exactly how windy it will be over a period of time. This makes provision difficult.
8. Joule
9. First work out the temperature difference: 80 °C – 10 °C = 70 °C Then apply the formula: 2.00 kg × 4200 J × 70°C = 588 000 J
10. The rate of energy transfer.
11. Watt
12. Joule is just a measure of energy. (*Watt is a measure of energy transferred per unit time – J/s*)
13. 180 / 60 = 3 3 MW
14. 0 years 40 g 5730 years = 20 g 5730 years = 10 g 5730 years = 5 g 5730 years = 2.5 g Total = 22 920 years
15. Gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves, radio waves.

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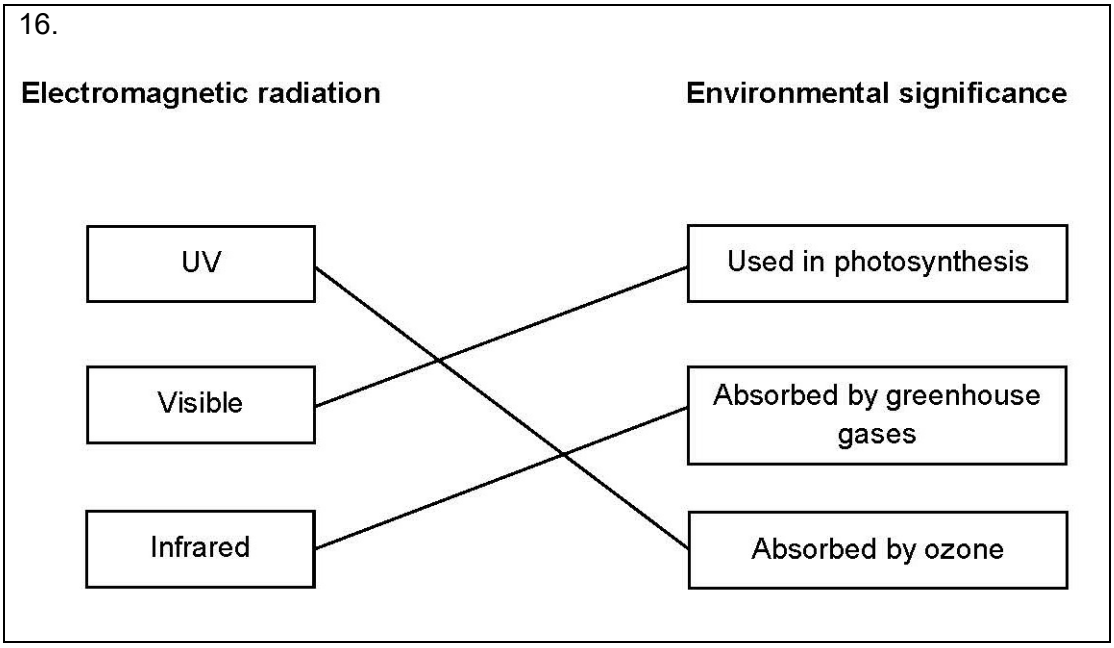
16.



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