

SOLUTIONS

CHALLENGE 1: PLAN YOUR RATIIONS

Example answers

Rations for an adult soldier, 16,000 kJ.

Note that the soldier needs much more energy from carbohydrates, sugars and fats to fuel their activities, but keeps to within the recommended maximum of 6g of salt per day.

| Food | Serving (g) | Energy (kJ) | Total carbs (g) | Sugars (g) | Fats (g) | Protein (g) | Fibre (g) | Salt (g) |
|----------------------------------------------|-------------|-------------|-----------------|------------|----------|-------------|-----------|----------|
| Large apple, grated | 220 | 213 | 30 | 22 | 0 | | 5 | 0 |
| Raw almonds | 50 | 1200 | 7 | 2 | 25 | 14 | 3 | 0 |
| Large instant porridge oat sachets x 2 | 80 | 1187 | 46 | 1 | 6 | 8 | 7 | 0 |
| Semi-skimmed milk 500ml | 500 | 982 | 23 | 23 | 9 | 18 | 0 | 0 |
| Banana x 2 | 280 | 750 | 46 | 24 | 0 | 2 | 6 | 0 |
| Ready to eat Mexican grains and pulses pouch | 250 | 1725 | 75 | 7 | 2 | 11 | 6 | 2 |
| Feta cheese | 100 | 1155 | 1 | 0 | 23 | 17 | 0 | 2 |
| Dried fruit and nut mix | 100 | 2006 | 50 | 44 | 28 | 12 | 6 | 0 |
| Wholegrain rice, ready to eat | 250 | 1630 | 60 | 0 | 3 | 8 | 5 | 0 |
| Medium Balti Curry cooking sauce | 200 | 700 | 14 | 8 | 11 | 2 | 0 | 1 |
| Chickpeas, cooked | 120 | 580 | 16 | 1 | 3 | 8 | 8 | 0 |
| Chicken breast, cooked | 180 | 870 | 0 | 0 | 3 | 44 | 0 | 0 |
| Flapjack | 90 | 1300 | 52 | 28 | 13 | 6 | 3 | 0 |
| Chocolate bar | 100 | 2224 | 56 | 56 | 16 | 8 | 2 | 0 |
| TOTALS | 2520g | 16522k J | 476g | 216g | 142g | 158g | 51g | 5g |

Drinks options: squash, tea and coffee sachets, whitener sachets.

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Extra Challenge

Rations for a female teenager 9,600kJ

| Food | Serving (g) | Energy (kJ) | Total carbs (g) | Sugars (g) | Fats (g) | Protein (g) | Fibre (g) | Salt (g) |
|----------------------------------------------|-------------|-------------|-----------------|------------|----------|-------------|-----------|----------|
| Large instant porridge oat sachets x 2 | 80 | 1187 | 46 | 1 | 6 | 8 | 7 | 0 |
| Semi-skimmed milk 500ml | 500 | 982 | 23 | 23 | 9 | 18 | 0 | 0 |
| Banana | 140 | 376 | 23 | 12 | 0 | 1 | 3 | 0 |
| Wholemeal pitta bread x 2 | 120 | 1170 | 52 | 5 | 2 | 11 | 8 | 1 |
| Hummus | 100 | 1187 | 12 | 1 | 23 | 6 | 4 | 1 |
| Dried fruit and nut mix | 50 | 1003 | 25 | 22 | 14 | 6 | 3 | 0 |
| Cheese and broccoli pasta in sauce, 1 packet | 120 | 564 | 24 | 4 | 2 | 6 | 2 | 1 |
| Semi-skimmed milk 250ml | 250 | 489 | 12 | 12 | 4 | 9 | 0 | 0 |
| Tuna in brine, 1 can, drained | 100 | 460 | 0 | 0 | 1 | 24 | 0 | 1 |
| Chocolate bar | 100 | 2224 | 56 | 56 | 16 | 8 | 2 | 0 |
| TOTALS | 1560 g | 9643 kJ | 273 g | 136 g | 77 g | 97 g | 29 g | 4 g |

Drinks options: low calorie squash and hot chocolate sachets

THINGS TO THINK ABOUT

01. Carbohydrates and fats/oils give us energy. Protein makes new cells and repairs damaged tissues. Fibre helps food to pass through our digestive system (because we don't absorb fibre, it's not technically a nutrient).
02. Vitamins and minerals are important because they help us to use other nutrients and support essential body processes.
03. An unbalanced diet can lead to obesity (if we consume too much energy) or to being underweight (if we consume too little energy). In turn, obesity can lead to diabetes or some cancers, for example.

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CHALLENGE 2: TEST YOUR VISION

Example answer

| | Movement | | Colour | | Shape | |
|-------|----------|-------|--------|-------|-------|-------|
| | Left | Right | Left | Right | Left | Right |
| Red | 90° | 90° | 55° | 60° | 30° | 30° |
| Blue | 90° | 90° | 45° | 55° | 30° | 30° |
| Green | 90° | 90° | 50° | 45° | 30° | 30° |

Add up the left and right angles to find your range of vision.

This person can reliably observe:

Movement through an angle of 180°

Colour through an angle of about 95–115°

Shape through an angle of 60°

Our peripheral vision is good at sensing movement, but not good at seeing detail.

THINGS TO THINK ABOUT

01. Our eyes contain more rod and cone cells at the back of our eye (at the centre of our vision), but fewer of these cells towards the sides, top and bottom of our eye (at the edges of our vision).
02. Most people can see colours before shapes, because they have more cone cells than rod cells around the edges of their retina.
03. Our peripheral vision evolved to be very good at sensing movement to help us avoid predators.

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CHALLENGE 3: HOW FAR AWAY?

Example answer

Multiplying each delay by the speed of sound gives:

| Time | Delay | Distance | Likely location |
|-------|-------------|----------|-----------------|
| 20:20 | 2.0 seconds | 686m | 1 |
| 21:15 | 3.5 seconds | 1200m | 3 |
| 22:30 | 5.0 seconds | 1715m | 4 |

The soldiers were at positions 1, 3 and then 4.

During the evening they moved in a north-easterly direction (NE).



THINGS TO THINK ABOUT

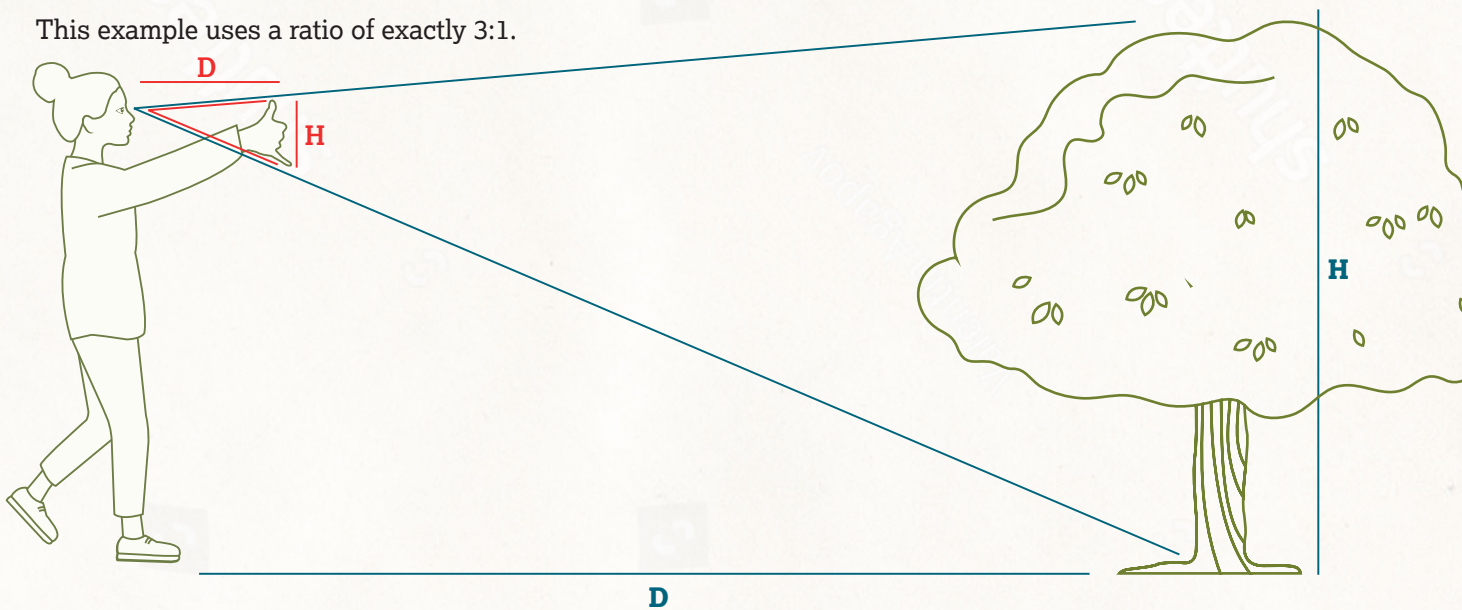
01. A compass can tell you the direction of the sound but not its distance, which you also need in order to identify a possible location.
02. The sound of the echo must first reach the cliff and bounce back to location 3. This will take 4 seconds $(686 \times 2)/343$. Then, the sound must travel from location 3 to your position, which you already know is 3.5 seconds away. $4 + 3.5 = 7.5$ seconds in total.
03. When the drone is directly above you the engine noise takes $5000/343 = 14.6$ seconds to reach you. In 14.6 seconds, the drone has travelled $14.6 \times 100 = 1,460\text{m}$ further forward – it is now 1.46km away.

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CHALLENGE 4: HOW TALL IS IT?

Example answer

This example uses a ratio of exactly 3:1.



The tree is 24 paces away.

Each pace is 80cm.

24 paces x 80cm = 1920cm or 19.2m.

The tree is 1/3 of this, or 6.4m tall.

THINGS TO THINK ABOUT

01. The distance from your fingertips to your eye, compared to the distance between your first two fingers, is about 8:1.
02. The angles at each corner of two similar triangles will have the same values.
03. You will need a range of people of different heights, from as short to as tall as possible. Ask each person to walk a number of paces, say 50 or 100. Measure this distance for each person, then divide the distance by the number of paces, to find their average pace length. Then, plot a chart of pace length (y-axis) v height (x-axis) and draw a line of best fit. The gradient of this line is the ratio of pace length to height.

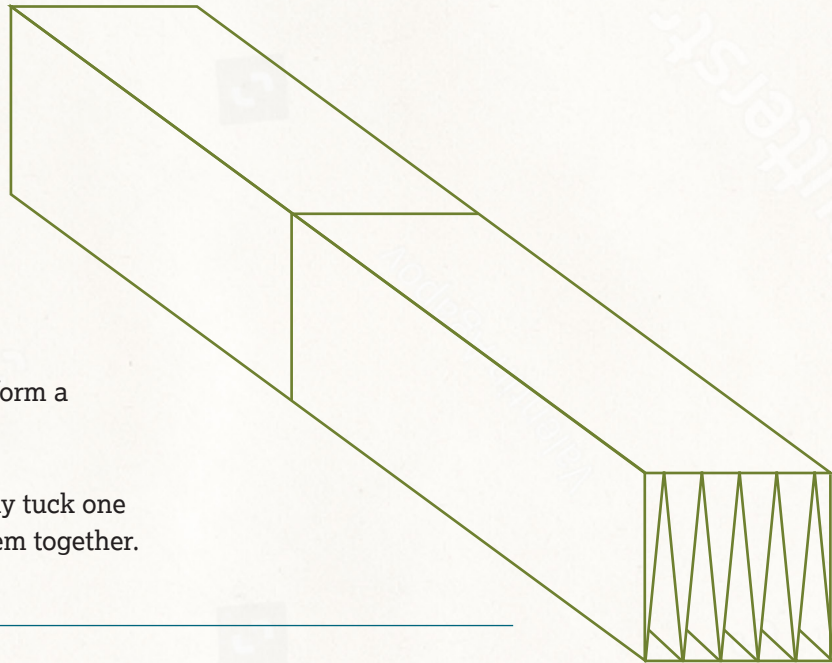
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CHALLENGE 5: CROSS THE RIVER

Example answer

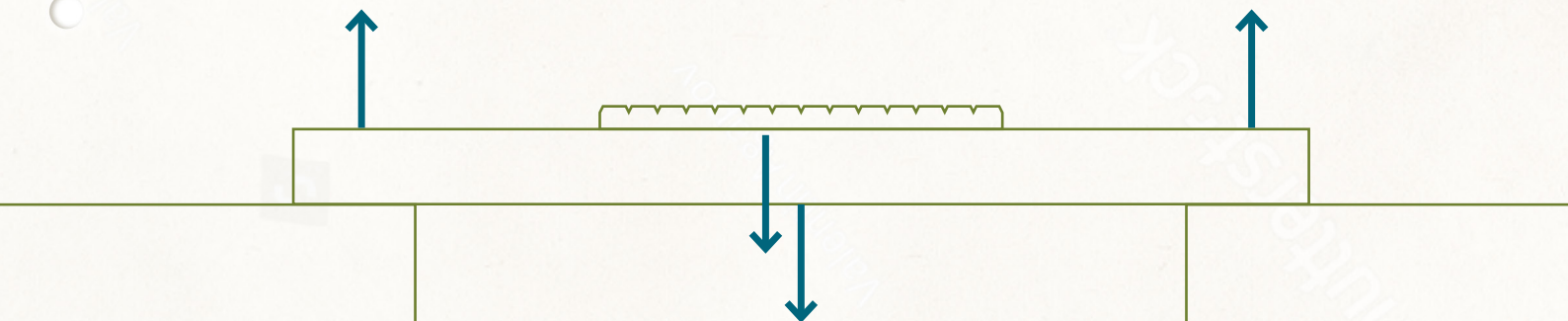
This solution uses 4 sheets.

01. Fold sheet lengthways lots of times.
02. Wrap in another sheet to form a square or rectangle tube.
03. Make another and carefully tuck one inside the other to join them together.



THINGS TO THINK ABOUT

01. The weight of the chocolate will create a downwards force on the bridge (remember that when gravity pulls on an object's mass, it creates the force we think of as its weight). The bridge also has mass, so its own weight also creates a downward force. We can think of these forces as acting through the middle of the bridge. Since the bridge is still, some force needs to balance these. At each end, there is an upwards reaction force that is half of the total of the weight of the bridge and the weight of the chocolate bar.

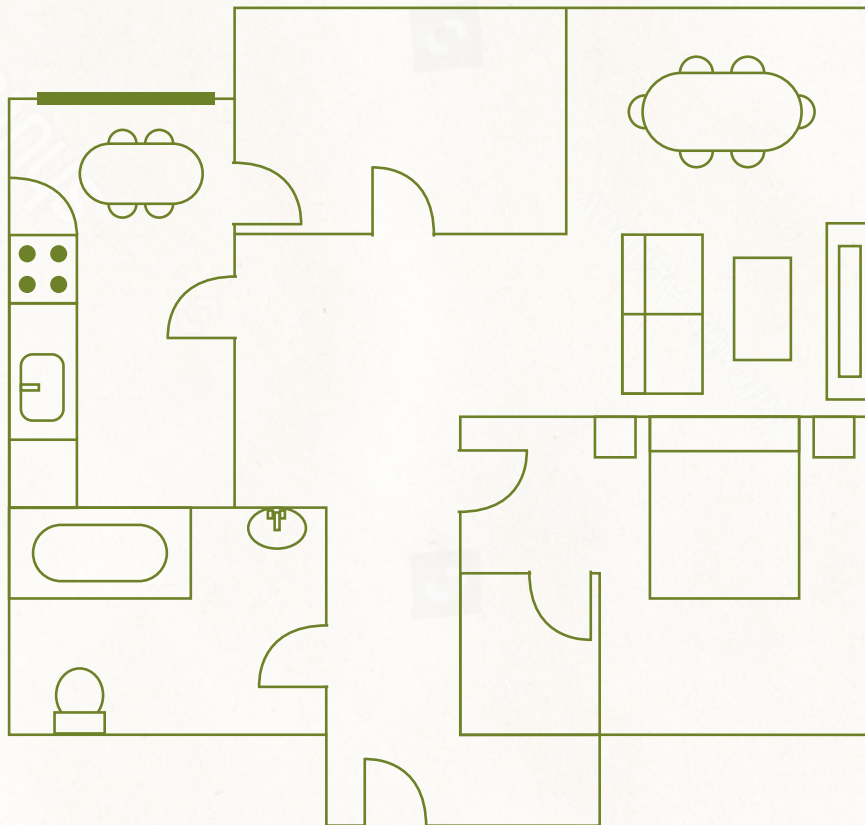


02. Sides can help your bridge to be stronger because they resist the forces that make your bridge collapse.
03. Other soldiers can stand on the end of the bridge to hold it in place.

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CHALLENGE 6: MAKE A MAP

Example answer



Scale: 1:100

THINGS TO THINK ABOUT

01. Measure the object on the map and then use the scale to multiply up. Something that is 2.5cm on a 1:100 map will be 2.5m in real life.
02. You can find the real size of the largest and smallest feature on your map by measuring them on the map and scaling up as above, or by visiting them and measuring them in real life.
03. You can improve the accuracy of a map by using a larger scale (that is, a smaller ratio, like 1:20 instead of 1:100), by using a sharp pencil and by measuring and drawing carefully.