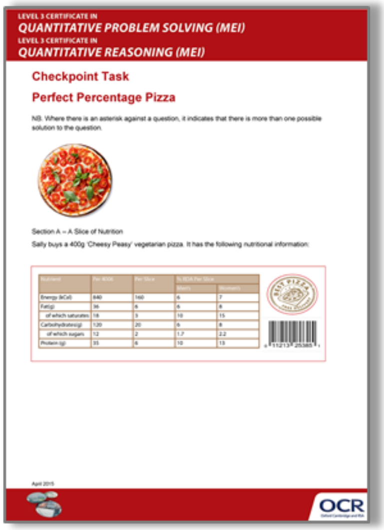
This Checkpoint Task should be used in conjunction with the KS4–Core Maths Percentages Transition Guide.

# Checkpoint Task

## Perfect Percentage Pizza

## *Instructions and answers for teachers*

***These instructions should accompany the OCR resource 'KS4–Core Maths Percentages' Transition Guide*** *which supports OCR's Level 3 Quantitative Problem Solving (MEI) and Quantitative Reasoning (MEI) qualifications.*


LEVEL 3 CERTIFICATE IN
QUANTITATIVE PROBLEM SOLVING (MEI)
LEVEL 3 CERTIFICATE IN
QUANTITATIVE REASONING (MEI)
Checkpoint Task
Perfect Percentage Pizza

### The Activity:

The Checkpoint Task questions cover a range of difficulty and require interpretation of contextual data as well as selecting appropriate calculations. It is suitable for working in groups or individually, enabling self/peer assessment. Formative assessment can be carried out through observation and questioning as the task progresses.

In some questions there is deliberate ambiguity in order to promote discussion about whether mathematical terminology is always used correctly in real life.

Some questions are marked with a (*). This signifies that there is more than one possible solution path and better students can be asked to find several solutions and reflect on the efficiency of each.

Another possible extension activity is to ask students to think about errors that are likely to be seen in this type of question.

The task provides several opportunities for investigation using spreadsheets.

*This activity offers an opportunity for maths skills development.*

### Associated materials:

'Checkpoint Task Perfect Percentage Pizza' learner sheet.

# Percentage Checkpoint Task – Perfect Percentage Pizza – Teacher Comments and Model Answers

## Section A – A Slice of Nutrition

Questions 1 to 4 of this section should be accessible to students from foundation level GCSE, although it may require pertinent information to be highlighted for weaker students.

Sally buys a 400 g 'Cheesy Peasy' vegetarian pizza. It has the following nutritional information:

| Nutrient | Per 400 g | Per Slice | % RDA Per Slice | |
|---|---|---|---|---|
| | | | Men's | Women's |
| Energy (kCal) | 840 | 140 | 6 | 7 |
| Fat (g) | 36 | 6 | 6 | 8 |
| of which saturates | 18 | 3 | 10 | 15 |
| Carbohydrates (g) | 120 | 20 | 6 | 8 |
| of which sugars | 12 | 2 | 1.7 | 2.2 |
| Protein (g) | 35 | 6 | 10 | 13 |

RDA stands for 'Recommended Daily Allowance' – an indication of how much of each nutrient an average person should consume each day.

Question 1 is about finding percentage and making decisions about which numbers are relevant.

1. a) What percentage of the carbohydrates are sugars?

$$\frac{12}{120} \times 100\% = 10\%$$

This question requires students to select carefully the appropriate numbers from the information total. A theme throughout this section is 'Percentage of what?' Make sure that students are clear about the difference between 'percentage of the whole pizza' and 'percentage of carbohydrates'.

b) What percentage of the pizza is protein?

$$\frac{35}{400} \times 10 = 8.75\%$$

This question is deliberately slightly ambiguous as it does not say that percentage by weight is required. Although most students will do this intuitively, it does provide an opportunity to discuss with more able students how much choice we can have whenever we wish to make a comparison. We could have looked at the proportion by volume or cost instead.

c) What percentage of the pizza is fat?

$$\frac{36}{400} \times 10 = 9\%$$

d) What percentage of the pizza is not accounted for?

Mass accounted for $= 36\text{ g} + 120\text{ g} + 35\text{ g} = 191\text{g}$

Mass not accounted for $= 400\text{ g} - 191\text{g} = 209\text{ g}$

This question also tests skills of selection. Many students will double count the saturated fat and sugar category.

Percentage not accounted for $= \frac{209}{400} \times 100\% = 52.25\%$

e) How many slices is the pizza cut into?

Ratio of energy $= \frac{840}{140} = 6$ so there are 6 slices.

The ratio in any category gives an answer of 6, apart from protein which gives an answer of 5.8. For any student that picks up on this it provides an interesting discussion point about the accuracy of the figures given and how we often have to deal with rounding when using reported figures.

2. Sally eats 3 slices of pizza.

Question 2 is about when percentages can be added like a number and when proportions remain fixed.

a) What percentage of her RDA of protein has she consumed?

$3 \times 10\% = 30\%$

An answer of 10% is fairly rare here, but would indicate that students are only aware of percentage as proportions and do not understand that percentages can also represent quantities.

b) What percentage of these slices is protein?

Still 8.75%

The best students will simply restate the answer from 1(b). Students who recalculate the answer may have forgotten 1(b) or it may indicate that they are unsure whether in this new situation the proportion remains constant. An answer of $3 \times 8.75\% = 26.25\%$ indicates that students have not understood that percentages can represent proportions.

3. This question is about finding the whole from a percentage.

a) What is the Recommended Daily Allowance of energy for women? (*)

140 kCal is 7% so 20 kCal is 1% so 2000 kCal is the full RDA.

This type of question is sometimes confused with an 'undoing percentage change' type question, especially by students who are very focussed on remembering methods. Answers involving finding 7% of 140 kCal, such as 9.8 kCal or 149.8 kCal are indicative of this. If you see an answer like this, you might want to ask 'What is the 7% a percentage of?' The Singapore Bar Method may also provide visual learners with a good visualisation of this:
http://geogebratube.com/material/show/id/15311

An answer of $\frac{140}{0.07}$ would indicate very good algebraic understanding.

b) How many slices can a man eat to consume his full RDA of protein?

Each slice is 10% so $\frac{100}{10} = 10$ slices.

c) If a woman does not want to exceed her RDA in any category, what is the maximum number of slices she can eat?

The limiting factor will be the nutrient with the largest RDA, which is saturated fat with an RDA of 15%. The number of slices is less than $\frac{100}{15} = 6.66$ so the maximum number of slices is 6.

This question can reveal several errors even when b) is answered correctly. Some students may check all the different nutrients rather than realise that the largest RDA is the only one needed. Some students may round the answer to 7. For some students, mental methods when working with 5%, 10%, 25% and similar are very advanced, giving an illusory impression of general understanding as they can struggle to adapt them to non-standard percentages.

4. A 400 g low-fat pizza claims to contain 5% less fat than the regular vegetarian pizza.

   a) How much fat (in grams) is in the low-fat pizza? (*)

   $36\text{ g} \times 0.95 = 34.2\text{ g}$

Finding 5% of 36 g and subtracting is a perfectly acceptable method for this problem, but may indicate someone who is not comfortable with the multiplicative factor method of performing percentage decreases.

b) What percentage of the low fat pizza is fat? (*)

$\frac{34.2}{400} \times 100\% = 8.55\%$ or $9\% \times 0.95 = 8.55\%$

A common error to watch out for here is $9\% - 5\% = 4\%$. This indicates a possible misunderstanding that between 'decreasing the percentage' and 'percentage decrease'. It might be useful to bring in the vocabulary of 'percentage point decrease'.

5. A 500 g pepperoni pizza contains 20% fat by mass. If a family has a 500 g pepperoni pizza and a normal 400 g vegetarian pizza for dinner, what percentage of the dinner is fat?

Total mass of fat $= 0.2 \times 500\text{ g} + 36\text{ g} = 136\text{ g}$.

Total mass of pizza $= 900\text{ g}$

Percentage of fat $= \frac{136}{900} \times 100 \approx 15.1\%$

This question is more typical of the Core Maths style rather than GCSE as it requires a reasonable amount of planning and organising information. You might want to ignore it with weaker groups, or turn it into an estimating question – perhaps "Will it be closer to 20% or the 9% you found earlier?"

## Section B – Some Financial Toppings

This section tests understanding of material from the Higher Level GCSE course

Sally is shopping around to get the best deal on her ‘Cheesy Peasy’ pizza. She finds the following prices in the shops:

| Shop | Labelled Price | Special Offer |
|---|---|---|
| Buymore | £5 | Limited time sale |
| Cheap and Cheery | £6 | 25% off labelled price |
| Pizzas R Us | £10 | 40% off labelled price |

1. Showing your working, explain which shop provides the best value.

   The cost of Buymore is £5.

   The cost of Cheap and Cheery is $= £6 \times 0.75 = £4.50$ .

   The cost of Pizzas R Us is $= £10 \times 0.6 = £6$ .

   Therefore Cheap and Cheery is the cheapest shop.

2. What is the percentage difference between the cheapest and most expensive prices you would pay for each of these pizzas? (*)

   Pizzas R Us is $= \frac{1.50}{4.50} \times 100\% \approx 33\%$ more expensive than Cheap and Cheery.

   OR

   Cheap and Cheery is $= \frac{1.50}{6.00} \times 100\% = 25\%$ cheaper than Pizzas R Us.

This question should cause some discussion amongst students about which is ‘correct’. You might want to discuss which number Cheap and Cheery would use in their advertising and use this as an opportunity to discuss the ease with which statistics can be manipulated.



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3. In the Buymore sale all of the labelled prices were reduced by 20%. How much will a Buymore Pizza cost when the sale is over?

Original price $= \frac{£5}{0.8} = £6.25$

A very common error here is for students to increase the cost by 20%, getting an answer of £6. If this is happening, try asking them whether the 20% represents a percentage of the original or the new cost.

4. Pizzas R Us have a policy of increasing the labelled cost of their pizza by 10% each year.

a) How much will it cost next year?

$£10 \times 1.1 = £11$

b) How much will it cost in 3 years? (*)

$£10 \times 1.1^3 = £13.31$

Look out for students doing this in three separate calculations. This may indicate unfamiliarity with the compound interest formula or a weakness with indices.

c) How much will it cost in 100 years?

$£10 \times 1.1^{100} = £137806$

This can cause some interesting discussion. Firstly, most students find this a surprisingly large value for a pizza, and you can discuss our poor intuition for exponential growth and inflation.

Secondly, some very good students may worry about rounding issues, since the calculation performed here assumes that money can be divided into infinitely small parts. They can investigate this on a spreadsheet and will hopefully find that if the shop rounds to the nearest penny the answer will be £137783.83, if they always round down to the nearest penny the result will be £137443.98 and if they always round up to the nearest penny the result with be £138325.70.

5. Extension Question:

10 years ago the labelled cost of a Cheap and Cheery Pizza was £4. What was the average annual rate of percentage increase over these 10 years?

Over 10 years the increase has been $\frac{£2}{£4} \times 100\% = 50\%$. This is a factor of 1.5

The average increase factor is $\sqrt[10]{1.5} = 1.0414$

So the average annual increase is 4.14%

This question is very much within the realms of Core Maths rather than GCSE and you may like to only use it with very good students. However, even weaker students can access this using trial and improvement methods, perhaps on a spreadsheet. For those students who try to solve it analytically, common errors include finding $\sqrt[10]{0.5} = 0.933$ or $\sqrt[10]{50} = 1.48$. This indicates a lack of clear understanding of the relationship between percentages and multiplicative factors.

Another very common error is to get an average by doing $\frac{50\%}{10} = 5\%$. You might like to get people to check whether 105% increases actually produces the desired result and use that to start a discussion about the arithmetic versus geometric mean.

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