

# Check-Up

33

## Increasing or decreasing by a percentage

- a) The following prices are exclusive of VAT, which has to be added at  $17\frac{1}{2}\%$ . What is the overall cost of each? Use a calculator only for the second example.
- i) A television monitor listed at £320
  - ii) A printer listed at £196.50
- b) A secondary school has 87 unauthorised absences in one term. To achieve at least a 12% reduction in this figure, what is the school's target for unauthorised absences the following term? Do this both without and with a calculator.
- c) One year a primary school has 67% of pupils achieving level 4 or above in the Key Stage 2 English test. What would be their target for next year in order to increase this figure by 10 percentage points? What would be their target to increase it by 10%?

## Answers to check-up 33

- a) i) £376.    ii) £230.89.    b) 76.    c) 77%, 73.7%.

## Discussion and explanation of check-up 33

Problems about percentage increases and decreases always contain three elements: the starting value, the percentage change and the finishing value. There are, therefore, basically three types of problems: (i) given the starting value and the percentage change, to find the finishing value; (ii) given the starting value and the finishing value, to find the percentage change; (iii) given the percentage change and the finishing value, to find the starting value. This check-up deals with the first of these.

a) To find  $17\frac{1}{2}\%$ , we can piece together 10%, 5% and  $2\frac{1}{2}\%$ , which is easy to do mentally for £320. 10% of £320 is £32, so (halving this) 5% is £16 and (halving again)  $2\frac{1}{2}\%$  is £8. So the increase is  $£32 + £16 + £8 = £56$ , giving the finishing price as £376. The calculation of  $17\frac{1}{2}\%$  of £196.50 is a bit tricky to do mentally, so we'll use a calculator. Now the obvious approach is to use the calculator to find  $17\frac{1}{2}\%$  of £196.50 and then use the calculator again to add this on to the £196.50. But there's a quicker way that I always use. When we have added on the  $17\frac{1}{2}\%$  we will then have  $117\frac{1}{2}\%$  of what we started with. So I can go straight to the finishing price just by calculating  $117\frac{1}{2}\%$  of £196.50. I can do that on a calculator in just one step, by converting the percentage (117.5%) to a decimal (1.175), giving  $196.50 \times 1.175 = 230.8875$ , which rounds to £230.89.

b) You can find 12% of 87 mentally by piecing together 10%, 1% and 1%. That gives us  $8.7 + 0.87 + 0.87 = 10.44$ . We will have to round this *up* to 11 to achieve the target reduction. Subtracting this from 87 gives the target as 76. Doing this with a calculator, we could say that the target for next term is 88% (100% – 12%) of the figure for this term. Since 88% = 0.88 we can do this just by entering this one calculation:  $87 \times 0.88$ . This gives 76.56, so the target is 76.

c) When the starting and finishing values are themselves percentages, there can be confusion when we talk about percentage changes. To increase the 67% *by 10 percentage points* means just to add 10% to the 67%, giving 77%. The 10%, 67% and 77% are all percentages of the whole quantity or set. But if we say that we aim to increase the score of 67% *by 10%* we mean that the 10% increase is 10% of the 67%, i.e. 6.7%. This gives a finishing figure of  $67\% + 6.7\% = 73.7\%$ .

### Summary of key ideas

- ◆ VAT at  $17\frac{1}{2}\%$  can be found mentally by piecing together 10%, 5% and  $2\frac{1}{2}\%$ .
- ◆ Many percentage increases and decreases can be calculated mentally by such informal methods (e.g. a decrease of 18% can be worked out as  $10\% + 5\% + 1\% + 2\%$ ).
- ◆ The finishing value after a percentage increase or decrease can be found on a calculator in one step (e.g. to increase by 27% multiply by 1.27; to decrease by 27% multiply by 0.73).
- ◆ If the starting and finishing values are themselves percentages, then increasing or decreasing by a number of *percentage points* is not the same as increasing or decreasing by a *percentage* (e.g. 80% decreased by 5 percentage points is 75%, but 80% decreased by 5% is 76%).

## Further practice

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- 33.1** In the Key Stage 1 writing task, 56% of a primary school's Year 2 pupils achieve level 2 or above. What would this be next year if the school were to achieve an increase of 5 percentage points? What would it be if this figure were increased by 5%? (No calculator required.)
- 33.2** What would you enter on a calculator to find the result of increasing 6543 by 21%? And what would you enter to find the result of decreasing 6543 by 21%?
- 33.3** A computer is listed at £789, to which must be added VAT at  $17\frac{1}{2}\%$ . The firm offers schools a reduction of 12%. Would you prefer the VAT to be added first or the reduction to be applied first? Answer this intuitively and then use a calculator to work it out.