



Mathematics Enhancement Programme

Primary Demonstration Project

9B Percentages

Help Booklet



Support for Primary Teachers
in Mathematics

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Mathematics Enhancement Programme

Help Module 9

PERCENTAGES

Part B

Contents of Part B

Preface
Activities
Tests
Answers

Contents of Part A

Preface
Introductory Notes
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Answers

PREFACE

This is one of a series of *Help Modules* designed to help you gain confidence in mathematics. It has been developed particularly for primary teachers (or student teachers) but it might also be helpful for non-specialists who teach mathematics in the lower secondary years. It is based on material which is already being used in the *Mathematics Enhancement Programme: Secondary Demonstration Project*.

The complete module list comprises:

- | | |
|--------------|-----------------------|
| 1. ALGEBRA | 6. HANDLING DATA |
| 2. DECIMALS | 7. MENSURATION |
| 3. EQUATIONS | 8. NUMBERS IN CONTEXT |
| 4. FRACTIONS | 9. PERCENTAGES |
| 5. GEOMETRY | 10. PROBABILITY |

Notes for overall guidance:

- Each of the 10 modules listed above is divided into 2 parts. This is simply to help in the downloading and handling of the material.
- Though referred to as 'modules' it may not be necessary to study (or print out) each one in its entirety. As with any self-study material you must be aware of your own needs and assess each section to see whether it is relevant to those needs.
- The difficulty of the material in **Part A** varies quite widely: if you have problems with a particular section do try the one following, and then the next, as the content is not necessarily arranged in order of difficulty. Learning is not a simple linear process, and later studies can often illuminate and make clear something which seemed impenetrable at an earlier attempt.
- In **Part B**, **Activities** are offered as backup, reinforcement and extension to the work covered in Part A. **Tests** are also provided, and you are strongly urged to take these (at the end of your studies) as a check on your understanding of the topic.
- The marking scheme for the revision test includes B, M and A marks.

Note that:

- | | |
|----------------|---|
| M marks | are for method; |
| A marks | are for accuracy (awarded only following a correct M mark); |
| B marks | are independent, stand-alone marks. |

We hope that you find this module helpful. Comments should be sent to:

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The full range of Help Modules can be found at

www.ex.ac.uk/cimt/help/menu.htm

ACTIVITY 9.1

Currency Exchange

The chart shows the exchange rate between the pound and various foreign currencies on Monday 10 March 1997.

THE £ ABROAD		
Australia	A \$	2.03
Canada	C \$	2.20
Denmark	D Kr	10.41
France	F Fr	9.20
Germany	DM	2.73
Hong Kong	HK \$	12.40
Ireland	IR£	1.03
Italy	L	2712.00
Japan	Y	194.91
Spain	Pes	231.40
Switzerland	S Fr	2.36
U.S.	\$	1.60

- How many
 - \$ can you obtain for £10,
 - DM can you obtain for £5,
 - A\$ can you obtain for £20,
 - L can you obtain for £2.50?

You can also use the table for converting foreign currency to pounds.

- How many pounds can you obtain for
 - 24 F Fr
 - 47 DM
 - 101000 L
 - 100 \$
 - 4000Y?

In practice, most currency exchanges charge commission, either a percentage or a fixed amount.

- Find how much you can obtain for £200 in
 - \$ with a commission charge of 2%,
 - DM with a commission charge of 1.5%,
 - F Fr with a fixed commission charge of £2.50.

Banks have different rates for buying and selling foreign currency, as well as commission charges.

MEP BANK		
	BUY	SELL
£1	2.90 DM	2.73 DM
Commission charge	3%	2%

- How many DM do you get for £1000 at the *MEP Bank*? (Use selling rates.)
- After changing your £1000 into DM, you find that your trip is cancelled.
 - How many pounds do you get back, using the buying and commission rates shown opposite?
 - How much money have you lost?
- Suppose you change £1000 to U.S.\$ at the *SELL* rate above, with 2% commission charge. To what level does the *BUY* rate of the pound have to fall in order to break even when you change back to pounds? (Assume a 3% commission charge.)

ACTIVITY 9.2

Taxi Fares

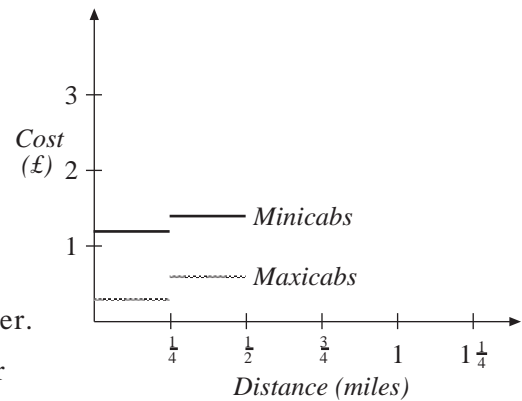
Two local taxi firms offer the rates shown.

<i>Minicabs</i>	£1 plus 20p for every $\frac{1}{4}$ mile
<i>Maxicabs</i>	30p for every $\frac{1}{4}$ mile

1. Find the cost for *both* firms of journeys of length
 (a) $\frac{1}{2}$ mile (b) 1 mile (c) 2 miles

2. (a) Copy and complete the table below. (b) Display the information on a graph as shown below.

Distance (miles)	up to					
	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	.... 3
<i>Minicabs</i>	1.20	...	...	...	2.00	.....
<i>Maxicabs</i>	0.30	...	...	...	1.50	.....



3. When is it more economical to use *Minicabs*?
4. *Minicabs* also charge 25p for each extra passenger. If there are two people travelling, how does your answer to Question 3 change?

The current *London Taxi* fares are shown opposite.

5. How much will it cost for a journey of length
 (a) $\frac{1}{2}$ mile (b) 1 mile (c) 2 miles
 using a *London Taxi*?

LONDON TAXI FARES		
£1	for the first	873 yards
25p	for every	291 yards

6. Illustrate the costs by drawing a cost/distance graph.

(1760 yards = 1 mile)

Extension

London Taxis also charge 40p for each extra person.

The *Underground* train fare for Inner London is £1.20 per person.

If 5 people are travelling together in London, at what distance does it become more expensive to use a *London Taxi* rather than the *Underground*?

ACTIVITY 9.3

VAT Problems

In the UK most articles are sold at the basic price plus

Value Added Tax (VAT) of $17\frac{1}{2}\%$.

Some goods such as cars and fuel, have an extra tax, whilst others such as food and children's clothes are exempt from VAT.

For example, a portable music centre of basic price £200, will also have VAT of

$$£200 \times \frac{17.5}{100} = £35$$

added, to give a total price of £235.

Finding the VAT to be charged using a calculator is relatively straightforward. However, even *without* a calculator, VAT is easy to find by calculating 10%, 5% and $2\frac{1}{2}\%$, and then adding them up.

So, for £200, we have	10% → £ 20	
	5% → £ 10	(divide by 2)
	$2\frac{1}{2}\%$ → £ 5	(divide again by 2)
	$17\frac{1}{2}\%$ → £ 35	(add up)

1. *Without* using a calculator, find the VAT to be added for articles at basic price
 - (a) £120
 - (b) £80
 - (c) £500.

Businessmen and companies can often claim back VAT. For example, if the total price is £235, they can claim back £35.

2. What is the VAT when the total price is (a) £117.50 (b) £470 ?
3. If £17.50 is the VAT part of a total price of £117.50,
 - (a) what is the VAT part of a total price of £1.00 ?
 - (b) what is the VAT part of a total price of £x ?
4. (a) Explain why dividing the total price by 6.71 approximately gives the VAT .
 (b) Give the values of the divisor (correct to 5 significant figures), which should be used for more accurate calculations.
5. (a) Suppose VAT is increased to 19%. What divisor is now needed to find the VAT part of the total price?
 (b) Use your divisor to find the VAT included in these total prices:
 - (i) £119
 - (ii) £50
 - (iii) £80.

Extension

Generalise the formulae for the divisor for VAT at a rate of $r\%$

ACTIVITY 9.4.1

Premium Bonds

Despite the success of the National Lottery, the public continue to invest in £1 *National Savings Premium Bonds*. These are safer than the lottery as you do not lose your initial investment. In 1996, a £1 million monthly winner was introduced, as well as 349 999 lower value wins. The prize breakdown in April 1997 is given below.

£1m	£100 000	£50 000	£25 000	£10 000	£5000	£1000	£500	£100	£50
1	4	9	17	44	85	1882	5646	128 468	213 844

1. Check that there are 350 000 winners in total.
 2. What was the total prize money given out in April 1997?
- 4.75% of the total money invested in *Premium Bonds* is given out each year in 12 monthly prize draws.
3. Assuming the same amount of prize money is given out each month, what is the total prize money given out in 1997? Estimate the total amount of money invested in *Premium Bonds* in 1997.
 4. How many prizes are given in total in a year?
 5. What is the probability of winning once a year if you hold one £1 Premium Bond?
 6. How many Premium Bonds do you need to hold to expect to win one prize in a year?

Extension

If you invest in 10 000 £1 Premium Bonds, on average how many wins will you expect in a year?

ACTIVITY 9.4.2

Premium Bonds

Currently, the actual number of prizes in each category is worked out along the following lines.

<p>Prize Value (£)</p> <table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">1 000 000</td> <td rowspan="6" style="font-size: 3em; vertical-align: middle;">}</td> <td rowspan="6" style="padding-left: 20px; vertical-align: middle;">'Higher' value prizes</td> <td rowspan="6" style="padding-left: 20px; vertical-align: middle;">10% of monthly prize fund</td> <td rowspan="6" style="font-size: 3em; vertical-align: middle;">{</td> <td rowspan="6" style="padding-left: 20px; vertical-align: middle;">One £1 million prize and the remaining shared out so that, in each category, the same amount of money is paid out.</td> </tr> <tr><td>100 000</td></tr> <tr><td>50 000</td></tr> <tr><td>25 000</td></tr> <tr><td>10 000</td></tr> <tr><td>5 000</td></tr> </table>	1 000 000	}	'Higher' value prizes	10% of monthly prize fund	{	One £1 million prize and the remaining shared out so that, in each category, the same amount of money is paid out.	100 000	50 000	25 000	10 000	5 000	
1 000 000	}						'Higher' value prizes	10% of monthly prize fund	{	One £1 million prize and the remaining shared out so that, in each category, the same amount of money is paid out.		
100 000												
50 000												
25 000												
10 000												
5 000												
<table style="border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">1000</td> <td rowspan="2" style="font-size: 3em; vertical-align: middle;">}</td> <td rowspan="2" style="padding-left: 20px; vertical-align: middle;">'Medium' value prizes</td> <td rowspan="2" style="padding-left: 20px; vertical-align: middle;">15% of monthly prize fund</td> <td rowspan="2" style="font-size: 3em; vertical-align: middle;">{</td> <td rowspan="2" style="padding-left: 20px; vertical-align: middle;">Allocated in the ratio of one £1000 prize for every three £500 prizes.</td> </tr> <tr> <td>500</td> </tr> </table>	1000	}	'Medium' value prizes	15% of monthly prize fund	{	Allocated in the ratio of one £1000 prize for every three £500 prizes.	500					
1000	}						'Medium' value prizes	15% of monthly prize fund	{	Allocated in the ratio of one £1000 prize for every three £500 prizes.		
500												
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100	}						'Lower' value prizes	75% of monthly prize fund	{	Allocated so that there are the maximum number of £100 prizes consistent with a total of 350 000 prizes.		
50												

1. If there is a £25 million monthly prize fund, how much is allocated to 'Higher', 'Medium' and 'Lower' value prizes?
2. How much is allocated each month to each category of the 'Higher' value prizes (after the £1 million prize has been allocated)?
How many of each of the 'Higher' value prizes will be given out?
3. How many £1000 and £500 prizes will there be each month?

Extension

Let x = number of £100 prizes, y = number of £50 prizes. Find two simultaneous equations satisfied by x and y . Hence solve for x and y .



ACTIVITY 9.5

APR

Interest on investment money, and interest on loans such as credit cards, can be offered in a confusing variety of ways (see opposite). To help compare different accounts or loans, the concept of

Annual Percentage Rate (APR)

was developed.


MEP Building Society


Investment Accounts

Choose the account to suit **you!**

9.25% p.a.	paid yearly
8.88% p.a.	paid monthly
8.83% p.a.	paid daily

For an account paying interest at $r\%$ per annum once a year, the APR is $r\%$. But for an account paying interest of, say, 10% per annum, every six months, the APR will be more than 10%.

Suppose you invest £100 at the beginning of the year. After six months, the interest payable is

$$£100 \times (10 \times \frac{1}{2})\% = £100 \times \frac{5}{100} = £5$$

This is added to the account, to give a balance after 6 months of £105. After the next 6 months, i.e. after one year from the start of the investment, the interest payable is

$$£105 \times (10 \times \frac{1}{2})\% = £105 \times \frac{5}{100} = £5.25$$

giving an end of year balance of £110.25. So the APR is 10.25%. This is not much more than the advertised yearly rate, but significant if you are borrowing or investing a large sum of money.

1. Find the APR for the following investment accounts:
 - (a) 9% p.a. paid monthly (the monthly rate will be $\frac{1}{2} \times 9\%$)
 - (b) 12% p.a. paid monthly.

The method of finding the APR generalises to accounts paying interest monthly, weekly or even daily.

2. Find the APR for the following investment account:
 - (a) 20% p.a. paid monthly
 - (b) 19% p.a. paid weekly
 - (c) 18.5% p.a. paid daily.
3. One savings account advertises a yearly rate of interest but states that it is *paid daily*. They claim this gives an APR of 10%. What rate is given in the advertisement?
4. Go back to the advertisement at the top of this sheet. Does it matter which account you choose to invest in?

Extension

The table opposite gives three ways of buying an *MEP GTi*.

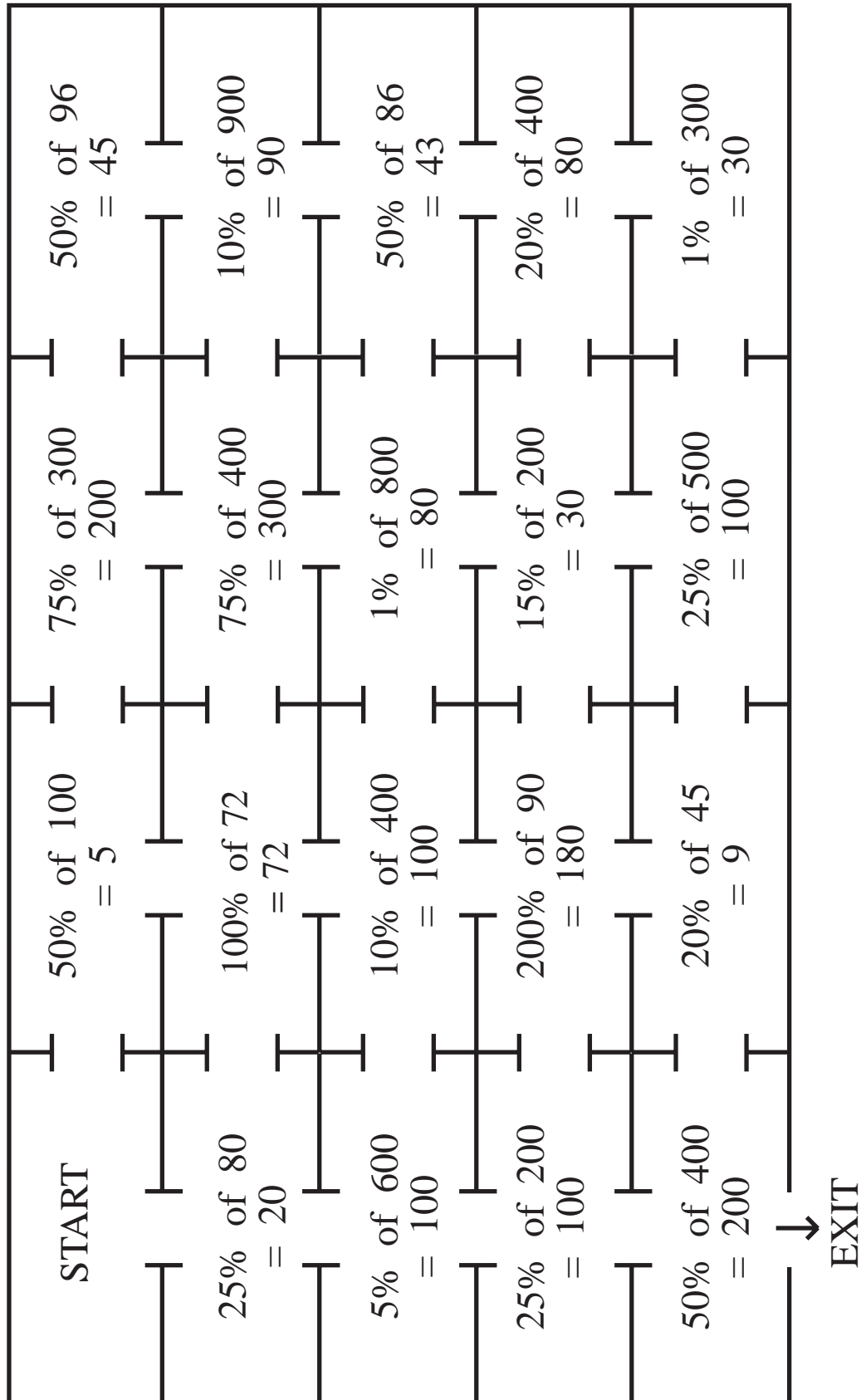
Explain how the APR values quoted are calculated.

<i>MEP GTi</i>	on the road price £10 156		
Payment over	24 months	36 months	48 months
Flat rate	0 %	3.4%	4.9 %
APR	0 %	7.7%	9.6 %
Initial deposit	50 %	20%	10 %
Initial payment	£5078.00	£2031.20	£1015.60
Monthly payments	£211.57	£252.04	£227.75
Admin. fee	NIL	£35.25	£35.25
Total Payment	£10 156.00	£11 139.89	£11 982.85

ACTIVITY 9.6

Percentages of Quantities

Look at the diagram below. START from the top left box and enter the next box which displays a correct statement. Carry on in the same manner until you EXIT.



ACTIVITIES 9.1 – 9.6

Notes for Solutions

Notes and solutions given only where appropriate.

- 9.1**
- (a) 16 \$ (b) 13.65 DM (c) 40.6 A\$ (d) 6780 L
 - (a) £2.61 (b) £17.22 (c) £37.24 (d) £62.50 (e) £20.52
 - (a) 313.6 \$ (b) 537.81 DM (c) 1817 F Fr
 - 2675.4 DM
 - (a) £894.88 (b) £105.12
 - 1.52

- 9.2**
- Minicabs* is cheaper for distances over $2\frac{1}{2}$ miles.
 - Minicabs* is cheaper for distances over 3 miles.
 - (a) £1.25 (b) £2.00 (c) £3.50

Extension: Just under 3 miles

- 9.3**
- (a) £21 (b) £14 (c) £87.50
 - (a) £17.50 (b) £70
 - (a) 0.1489 (b) $0.1489x$
 - (b) 6.7143
 - (a) 6.2632 (b) (i) £19 (ii) £7.98 (iii) £12.77

- 9.4.1**
- £31 384 000
 - £376 608 000 ; £7 928 589 474
 - 4 200 000
 - 1 in 1888 chance or 0.0005297
 - about 1888

Extension; About 5.3 times

- 9.4.2**
- £2 500 000, £3 750 000, £18 750 000
 - £300 000 ; 3, 6, 12, 30, 60
 - 1500 £1000 prizes and 4500 £500 prizes

Extension: $100x + 50y = 18\,750\,000$, $x + y = 343\,888$

$$x = 31\,112 \quad , \quad y = 312\,776$$

- 9.5**
- (a) 9.38% (b) 12.68%
 - (a) 21.94% (b) 20.88% (c) 20.31%
 - 9.53% per annum
 - First two accounts are slightly better (APR 9.25% compared to 9.23%).

TESTS

9.1 Mental Practice

9.2 Mental Practice

9.3 Revision

Answers

Test 9.1**Mental Practice**

Answer these questions as quickly as you can, but without the use of a calculator.

1. Write 25% as a fraction in its simplest form.
2. Convert 0.37 to a percentage.
3. Convert $\frac{9}{20}$ to a percentage.
4. Find 15% of 200 gm.
5. Your hourly rate of pay of £2.50 is increased by 10%. What is the new rate of pay?
6. A shopkeeper buys chocolate bars for 20p each and sells them for 25p each. What is his percentage profit on each bar?
7. VAT is currently $17\frac{1}{2}\%$. What is the VAT to be added to a bill of £400?
8. The cost of a one minute telephone call decreases from 20p to 17p. What is the percentage decrease?
9. A person invests £100 in an account that pays 10% interest each year. Find the value of the investment after 2 years.
10. After a 20% discount, the new price is £160. What was the original price?

Test 9.2**Mental Practice**

Answer these questions as quickly as you can, but without the use of a calculator.

1. Write 30% as a fraction in its simplest form.
2. Convert 0.4 to a percentage.
3. Convert $\frac{3}{25}$ to a percentage.
4. Find 30% of 250 litres.
5. Your hourly rate of pay of £3.00 is increased by 5%. What is the new rate of pay?
6. You bought a CD player for £50 and sold it for £65.
What is the percentage profit made?
7. VAT is currently $17\frac{1}{2}\%$. What is the VAT to be added to a bill of £500?
8. The cost of a ticket is reduced from £25 to £20. What is the percentage decrease?
9. You invest £1000 in an account that pays 20% interest each year.
Find the value of your investment after 2 years.
10. After a 10% discount, the new price is £360. What was the original price?

Test 9.3

Revision

40 minutes are allowed

1. The passing mark for a test was 40 out of a total of 80. Ann scored 45% in this test. By how many marks did she fail the test? (3 marks)

2. An ice-cream seller receives as wages 18% of the takings for each day. Given that the takings for Friday, Saturday and Sunday are £175, £200 and £180 respectively, find out how much in total the ice-cream seller earns for the three days. (4 marks)

3. A survey on traffic travelling down a street was made. The results are shown in the table.

Type of Vehicle	Car	Lorry	Motorcycle	Bicycle
% of Total No. of Vehicles Using the Road	70%	10%	15%	5%

- (a) If there was a total of 80 vehicles, how many cars used the road?
 - (b) Find the total number of motorcycles and bicycles using the road. (6 marks)

4. The sides of a rectangle are 30 cm and 20 cm. Each side of the rectangle is increased by 10%. Find
 - (a) the length and breadth after the increase,
 - (b) the percentage increase in area. (5 marks)

5. Normally, Mrs Brown works for 36 hours a week. For this she is paid £138.60.
 - (a) Calculate her hourly rate of pay. (2 marks)
 - (b) Extra hours worked beyond 36 count as 'overtime'. For overtime, Mrs Brown's hourly rate of pay is doubled.
 - (i) Calculate how much she is paid for each hour of overtime that she works.
 - (ii) One week she works 14 hours overtime. Calculate her total pay for that week. (4 marks)
 - (c) In January 1994, Mrs Brown opened a post office savings account. Each month she paid £22.50 into it. £3.62 interest was added to the account on June 30th, and £7.29 on December 31st. Calculate how much she had in her account at the end of 1994. (2 marks)
 - (d) The rate of interest given by a bank is 5%. Explain what 5% means. (1 mark)

Test 9.3 Revision

6. Andy and Susie want to buy a house costing £46 000. They plan to pay a 15% deposit on this amount.
- (a) (i) Calculate how much deposit they will pay. (2 marks)
 - (ii) They will borrow the remaining amount for the house.
Calculate the amount they will borrow. (2 marks)
 - (b) The Mammoth Building Society is willing to lend them an amount equal to $2\frac{1}{2}$ times Andy's annual salary. How much must his salary be in order to afford the house? (2 marks)
 - (c) Actually, Andy's salary is £10 250, and Susie's salary is £11 000. The Safebuild Building Society will lend them any amount up to twice the total of their two salaries.
 - (i) Calculate the maximum amount that Safebuild will lend them. (3 marks)
 - (ii) With a loan from Safebuild, can they afford the house? (1 mark)

(SEG)

7. Three girls found a purse while out for a walk.
They handed it back to the owner who gave them a reward of £4.50.
Sam said, "I'll have 50% of the £4.50 reward because I saw the purse first."
Kate said, "I picked the purse up so I'll have one third of the reward."
Sharon said, "I'll have the rest."
- (a) How much did Sam claim? (2 marks)
 - (b) How much did Kate claim? (2 marks)
 - (c) How much was left for Sharon? (2 marks)
- (NEAB)

8.

<i>NEAB CAR INSURANCE</i>	
<i>RENAULT</i>	£570 per year
<i>FORD FOXY</i>	£360 per year

- (a) Ahmed has a Renault car.
He is given a reduction of 45% of his car insurance because he has not had a car accident.
This is called a 'No Claims' reduction.
Calculate the price Ahmed has to pay to insure his car (3 marks)

Test 9.3 Revision

- (b) Barbara has a Ford Foxy car.
After taking her 'No Claims' reduction off she has to pay £234 to insure her car.
Calculate her 'No Claims' reduction as a percentage of £360. *(2 marks)*
- (c) Christine has a Rover car.
She is given a 60% 'No Claims' reduction.
After taking her 'No Claims' reduction off she has to pay £82 to insure her car.
Calculate the original price of her car insurance. *(2 marks)*
(NEAB)

Tests 9.1 and 9.2**Answers**

Test 9.1

1. $\frac{1}{4}$
2. 37%
3. 45%
4. 30 gm
5. £2.75
6. 25%
7. £70
8. 15%
9. £121
10. £200

Test 9.2

1. $\frac{3}{10}$
2. 40%
3. 12%
4. 75 litres
5. £3.15
6. 30%
7. £87.50
8. 20%
9. £1440
10. £400

Test 9.3

Answers

1. $\frac{45}{100} \times 80 = 36$; $40 - 36 = 4$ M1 A1 A1 (3 marks)
2. Friday – £31.50, Saturday – £36, Sunday – £32.40 B1 B1 B1
 Total = £99.90 B1 (4 marks)
3. (a) $80 \times \frac{70}{100} = 56$ M1 A1
- (b) $\left(80 \times \frac{15}{100}\right) + \left(80 \times \frac{5}{100}\right) = 12 + 4 = 16$ M2 A1 A1 (6 marks)
4. (a) length = $30 \times \frac{110}{100} = 33$ cm B1
 breadth = $20 \times \frac{110}{100} = 22$ cm B1
- (b) % increase in area = $\left(\frac{33 \times 22 - 30 \times 20}{30 \times 20}\right) \times 100\%$ M2
 = 21% A1 (5 marks)
5. (a) $\pounds \frac{138.60}{36} = \pounds 3.85$ M1 A1
- (b) (i) $2 \times \pounds 3.85 = \pounds 7.70$ B1
 (ii) $14 \times \pounds 7.70 = \pounds 107.80$ M1 A1
 $\pounds 138.60 + \pounds 107.80 = \pounds 246.40$ B1
- (c) $\pounds 22.50 \times 12 + \pounds 3.62 + \pounds 7.29 = \pounds 280.91$ M1 A1
- (d) Money invested gains $5\% \equiv \frac{1}{20}$ each year B1 (9 marks)
6. (a) (i) $\pounds 46\,000 \times \frac{15}{100} = \pounds 6900$ M1 A1
 (ii) $\pounds 46\,000 - \pounds 6900 = \pounds 39100$ M1 A1
- (b) $\pounds \frac{39100}{2.5} = \pounds 15640$ M1 A1
- (c) (i) $\pounds 10\,250 + \pounds 11\,000 = \pounds 21250$ B1
 $2 \times \pounds 21250 = \pounds 42500$ M1 A1
 (ii) Yes B1 (10 marks)
7. (a) $\pounds 4.50 \times \frac{50}{100} = \pounds 2.25$ M1 A1
- (b) $\frac{1}{3} \times \pounds 4.50 = \pounds 1.50$ M1 A1
- (c) $\pounds 4.50 - (\pounds 2.25 + \pounds 1.50) = \pounds 0.75$ M1 A1 (6 marks)

Test 9.3 Answers

8. (a) $£570 \times \frac{45}{100} = £256.50$ M1 A1
cost = $£570 - £256.50 = £313.50$ B1
- (b) reduction = $£360 - £234 = £126$ B1
% reduction = $\frac{126}{360} \times 100\% = 35\%$ B1
- (c) $£82 \times \frac{100}{40} = £205$ M1 A1 (7 marks)
- (TOTAL MARKS 50)**