2nd Year Booklet 2018 part 3

Topics covered:

1. Currency
2. Compound Interest
3. Ratio
4. Time
5. Speed

OL

Section 5.6 Currency transactions

When we visit a country that does not use the euro, we generally change our euro into the currency of that country.

In Britain, their money is pounds sterling (£).

In the USA, money is in US dollars (US$).

If you visit a foreign exchange counter, you will generally see displayed the amounts of other currencies that you will receive for €1. An example of such a table is shown on the right.

€1 =	
Sterling	0.85
US dollar	1.40
Japanese yen	110
Swiss franc	1.3

When working out how much of one currency you should get in exchange for another, always put the currency you **require** on the **right-hand side**.

78

Example 1

If €1 = \$1.4 and €1 = 110 yen, find
(i) how many dollars you would get for €400
(ii) how many euro you would get for 5000 yen.

(i) €1 = \$1.4
$\therefore$ €400 = \$1.4 × 400
= \$560

You require dollars; have dollars on the right.

(ii) 110 yen = €1
1 yen = $€\frac{1}{110}$
5000 yen = $5000 \times \frac{1}{110} = \frac{5000}{110}$ = €45.4545
= €45.45
$\therefore$ 5000 yen = €45.45

Exercise 5.6

1. If €1 = \$1.45 and €1 = 115 yen,
(i) how many dollars would you get for €300
(ii) how many yen would you get for €750?

2. If €1 = 1.3 US dollars, find
(i) how many dollars you would get for €450
(ii) how many euro you would get for 800 dollars.

3. If €1 = 120 yen, find
(i) how many yen you would receive for €900
(ii) how many euro you would receive for 9000 yen.

4. Given that €1 = £0.80 sterling, find
(i) how many pounds sterling you would get for €1200
(ii) how many euro you would get for £600.

5. On a visit to Switzerland, a person bought a leather jacket for 560 Swiss francs.
If €1 = 1.4 Swiss francs, find the cost of the jacket in euro.

6. If €1 = 1.4 Canadian dollars,
(i) how many Canadian dollars would you get for €3500?
(ii) how many euro would you get for 5600 Canadian dollars?

7. If €1 = $1.4 and €1 = £0.85 sterling,
(i) find in euro the cost of a camera which is priced in New York at $350
(ii) find in euro the cost of a watch in London priced at £360.

8. If €1 = 9.2 Swedish krona, find
(i) how much in Swedish krona would you get for €750?
(ii) how much in euro you would get for 1500 krona?

9. A Swiss visitor exchanged 4200 Swiss francs for euro at a bureau de change. The rate of exchange was €1 = 1.45 Swiss francs. Find, correct to the nearest euro, what the visitor received if the bureau charged 1% commission.

10. If €1 = 9.5 South African rand, find
(i) the price in euro of a car in South Africa with a marked price of 64 000 rand
(ii) the cost in rand of a flight from Dublin to Cape Town if the quoted price is €840. Give your answer to part (i) correct to the nearest euro.

Answer to OL

Exercise 5.3

1. (i) €6 (ii) €8 (iii) €8 (iv) €21 (v) €18 (vi) €84
2. (i) €24 (ii) €52.50 (iii) €85.50 (iv) €132 (v) €68 (vi) €812.50
3. (i) €27 (ii) €127.50 (iii) €103.50 (iv) €300 (v) €203 (vi) €29.40
4. (i) €324 (ii) €954 (iii) €1664 (iv) €1960 (v) €1207.50 (vi) €748
5. €48, €96
6. (i) €9 (ii) €42 (iii) €96 (iv) €63 (v) €15 (vi) €130
7. (i) €16 (ii) €60 (iii) €135 (iv) €147
8. (i) €112 (ii) €30 (iii) €144 (iv) €135
9. (i) €684 (ii) €1755 (iii) €1625 (iv) €2250
10. (i) €300 (ii) 2

Exercise 5.4

1. €49.44 **2.** €133.12
3. €92.25 **4.** €188.10
5. €57.12 **6.** €178.50
7. €126.10 **8.** €305.28
9. €162.47 **10.** €224.76
11. €122 **12.** €1505.28
13. €1736.44 **14.** €1663.20
15. €15 540.35

Exercise 5.5

1. €730 **2.** €29 729
3. €120, €120, €78 **4.** €120.50
5. €424 **6.** €136.80
7. €5640
8. (i) €174 (ii) €876
9. (i) €520 (ii) €67.20 (iii) €452.80
10. (i) €3240 (ii) €8660 (iii) €42 100

Exercise 5.6

1. (i) $435 (ii) 86 250 yen
2. (i) $585 (ii) €615.38
3. (i) 108 000 yen (ii) €75
4. (i) £960 (ii) €750
5. €400
6. (i) 4900 Canadian dollars (ii) €4000
7. (i) €250 (ii) €423.53
8. (i) 6900 kr (ii) €163.04
9. (i) €2868
10. (i) €6737 (ii) 7980 rand

Higher Level Currency

Section 4.4 Currency exchange

If we travel to a country not in the euro currency zone, we generally change our euro to the currency of that country.

If you see €1 = $1.35 displayed in a bank, how do you convert $100 to euro?

If we require euro in our answer, we put euro on the right-hand side of the 'equation'.

If €1 = $1.35, then

$1.35 = €1 … Reverse the order

$$\$1 = €\frac{1}{1.35}$$

$$\$100 = €\frac{1}{1.35} \times \frac{100}{1} = €74.07$$

$\therefore$ $100 = €74.07

Put the currency required on the right-hand side of the 'equation'.

61

Example 1

If €1 = 120 yen, find

(i) how many yen you would get for €1200

(ii) how many euro would you get for 8000 yen.

(i) €1 = 120 yen

€1200 = (120 × 1200) yen

= 144 000 yen

(ii) €1 = 120 yen

120 yen = €1

$1 \text{ yen} = €\frac{1}{120}$

$8000 \text{ yen} = €\frac{1}{120} \times \frac{8000}{1}$

= €66.666

8000 yen = €66.67

Example 2

A US visitor exchanged $2000 for euro when the exchange rate was €1 = $1.36. A charge was made for this service. If the person received €1444.20, calculate the charge in euro.

We require euro in our answer, so we put euro on the right-hand side of the equation.

€1 = $1.36

$\Rightarrow$ $1.36 = €1

$\$1 = €\frac{1}{1.36}$

$\$2000 = €\frac{1}{1.36} \times \frac{2000}{1}$

$2000 = €1470.59

The person received €1444.20.

$\Rightarrow$ the charge = €1470.59 − €1444.20 = €26.39

The charge is €26.39.

Exercise 4.4

1. If €1 = 1.3 US dollars, find

(i) how many dollars you would get for €450

(ii) how many euro you would get for 800 dollars.

2. If €1 = 120 yen, find

(i) how many yen you would get for €900

(ii) how many euro you would get for 9000 yen.

3. Given that €1 = £0.80 sterling, find
(i) how many pounds sterling you would get for €1200
(ii) how many euro you would get for £600.

4. On a visit to Switzerland, a person bought a leather jacket for 560 Swiss francs.
If €1 = 1.4 Swiss francs, find the cost of the jacket in euro.

5. If €1 = 1.4 Canadian dollars,
(i) how many Canadian dollars would you get for €3500?
(ii) how many euro would you get for 5600 Canadian dollars?

6. If €1 = 9.2 Swedish krona, find
(i) how much in Swedish krona would you get for €750
(ii) how much in euro you would get for 1500 Swedish krona.

7. A Swiss visitor exchanged 4200 Swiss francs for euro at an exchange bureau.
The rate of exchange was €1 = 1.4 Swiss francs.
Find, in euro, what the visitor received if the bureau charged 1% commission.

8. A Thai tourist paid 140 000 Thai baht to a travel agent for a holiday in Ireland.
The cost to the travel agent of organising the holiday was €2460.
Calculate, in baht, the profit made by the travel agent if €1 = 40 baht.

9. When the exchange rate was €1 = 9.8 South African Rand, a woman exchanged 12 000 South African Rand for euro at a bank. The bank charged a fee for this transaction. If the woman received €1166.60, find, in euro, the fee charged by the bank.

10. On a trip to Sweden, a tourist exchanged €4500 for Swedish krona when the exchange rate was €1 = 8.75 krona. He spent 25 400 krona and then on his return, exchanged what he had left back into euro when the exchange rate was now €1 = 8.60 krona.
How much did he receive in euro?

11. An Australian tourist exchanged A$2500 for euro at an Irish bank.
The bank charged a percentage commission for the transaction.
If the exchange rate was €1 = A$1.36 and the tourist received €1801.47, find the percentage commission charged by the bank.

12. A dealer bought Swiss francs when the exchange rate was €1 = 1.45 francs.
If he received 43 400 francs, find how many euro he exchanged.
Give your answer to the nearest euro.
He sold the Swiss francs when the exchange rate was €1 = 1.28 francs.
Find, correct to the nearest euro, how much the dealer lost or gained in the transaction.

OL

Section 5.3 Annual interest

If we invest money in a bank, building society or credit union, we are paid for the use of this money.

The money we receive is called **interest**.

The sum of money we invest is called the **principal**.

If we are paid 6% interest, we receive €6 each year for every €100 we invest.

The percentage interest that we receive is called the **rate**.

If you invest €100 for 1 year at 8%, you will receive €8 interest.

You will then have €108 in your account at the end of the year.

The sum of money you have in your account at the end of any year is called the **amount**.

Amount = Principal + Interest

Examine the following where the rate of interest is 5%:

€100 earns €5 in 1 year

€400 earns €20 in 1 year

€400 earns €40 in 2 years

Example 1

Find the interest on €600 for 3 years at 4% per annum.

€100 earns €4 in 1 year
€600 earns €24 in 1 year
€600 earns €72 in 3 years

Per annum is per year.

The electronic calculator is very useful when finding the percentage of a number.

To find 8% of €600, we multiply €600 by 0.08 to get €48.

To find $5\frac{1}{2}$% of €300, we multiply €300 by 0.055 to get €16.50.

To find 4%, multiply by 0.04. To find 104% multiply by 1.04.

Example 2

€350 is invested for 1 year at 6% per annum.
Find the amount at the end of the first year.

$$\begin{aligned}\text{Amount} &= 106\% \text{ of } €350\\ &= €350 \times 1.06\\ &= €371\end{aligned}$$

Exercise 5.3

1. Without using a calculator, write down,

(i) 6% of €100 (ii) 8% of €100
(iii) 4% of €200 (iv) 7% of €300
(v) 3% of €600 (vi) 12% of €700.

2. Use your calculator to find

(i) 4% of €600 (ii) 7% of €750
(iii) 9% of €950 (iv) 11% of €1200
(v) 10% of €680 (vi) 13% of €6250.

3. Use your calculator to find

(i) $4\frac{1}{2}$% of €600 (ii) $8\frac{1}{2}$% of €1500
(iii) $7\frac{1}{2}$% of €1380 (iv) $12\frac{1}{2}$% of €2400
(v) $14\frac{1}{2}$% of €1400 (vi) $3\frac{1}{2}$% of €840.

4. Use your calculator to find

(i) 108% of €300 (ii) 106% of €900
(iii) 104% of €1600 (iv) 112% of €1750
(v) 115% of €1050 (vi) 110% of €680.

5. Copy and complete the following to find the interest on €800 for 2 years at 6%:

€100 earns €6 after 1 year

€800 earns ☐ after 1 year

€800 earns ☐ after 2 years.

6. Find the interest earned on each of the following:

(i) €300 after 1 year at 3%
(ii) €700 after 1 year at 6%
(iii) €1200 after 1 year at 8%
(iv) €1400 after 1 year at $4\frac{1}{2}$%
(v) €600 after 1 year at $2\frac{1}{2}$%
(vi) €2000 after 1 year at $6\frac{1}{2}$%.

7. Work out the interest earned on each of these:

(i) €200 for 2 years at 4%
(ii) €500 for 2 years at 6%
(iii) €900 for 3 years at 5%
(iv) €700 for 3 years at 7%.

8. Find the interest earned on each of the following:

(i) €700 for 2 years at 8%
(ii) €400 for 3 years at $2\frac{1}{2}$%
(iii) €1200 for 3 years at 4%
(iv) €1500 for 2 years at $4\frac{1}{2}$%.

9. Find the amount (interest plus principal) for each of these:

(i) €600 after 2 years at 7%
(ii) €1500 after 2 years at $8\frac{1}{2}$%
(iii) €1250 after 3 years at 10%
(iv) €1800 after 2 years at $12\frac{1}{2}$%.

10. (i) A sum of money was invested for 2 years at 5% per annum. If the interest earned was €30, find the sum invested.

(ii) €400 was invested for x years at 6% per annum. If the interest earned was €48, find the value of x.

Section 5.4 Compound interest

Jack invested €500 in a credit union at 6% per annum.

His interest for the first year was €30.

At the end of the first year, he then had €530 in his account.

For the second year, €530 earned interest at 6%.

$$\begin{aligned} 6\% \text{ of } €530 &= €530 \times 0.06 \\ &= €31.80 \end{aligned}$$

Notice that the interest for the second year is greater than the interest for the first year.

This happened because the interest for the first year itself earned interest during the second year.

$\therefore$ the amount at the end of the second year is

$$€530 + €31.80 \quad = €561.80$$

This kind of interest is called **compound interest**.

The basic method for calculating compound interest is illustrated in the following example.

Example 1

€1200 is invested for 3 years at 4% per annum compound interest.
What will the investment amount to?

Principal for the first year	= €1200
Interest for the first year	= 4% of €1200 = 1200 × 0.04 = €48
Principal for the second year	= €1200 + €48 = €1284
Interest for the second year	= 4% of €1248 = 1248 × 0.04 = €49.92
Principal for the third year	= €1248 + €49.92 = €1297.92
Interest for the third year	= 4% of €1297.92 = 1297.92 × 0.04 = 51.9168 = €51.92
∴ Amount at end of third year	= €1297.92 + €51.92 = €1349.84

Exercise 5.4

Find the compound interest on each of the following.

Give your answers correct to the nearest cent, where necessary.

1. €400 for 2 years at 6%

2. €800 for 2 years at 8%

3. €900 for 2 years at 5%

4. €1000 for 2 years at 9%

5. €700 for 2 years at 4%

6. €850 for 2 years at 10%

7. €800 for 3 years at 5%

8. €1200 for 2 years at 12%

9. €700 for 2 years at 11%

10. €1800 for 3 years at 4%

11. Find, correct to the nearest euro, the compound interest on €840 for 2 years at 7% per annum.

12. Find what €1200 will amount to if invested for two years at 12% per annum compound interest.

13. A woman invests €1500 in a building society for three years at 5% per annum compound interest. How much has she in the society at the end of the three years?

14. €1400 was invested for two years at compound interest.
The rate of interest for the first year was 8% and the rate for the second year was 10%.
Calculate the amount at the end of the two years.

15. A farmer borrowed €12 000 from a bank at 9% per annum compound interest.
What did he owe the bank at the end of three years?

HIGHER LEVEL

Section 4.5 Compound interest

If we invest €100 in a bank for one year at 6% per annum (per year), we will earn €6 interest.

€100 is called the **principal (P)**.
6% is the **rate** per annum **(*i*)**.
€106 is called the **final amount (F)**.

Final amount is principal + interest.

Examine the following, where the rate of interest is 5%.

€100 earns €5 in 1 year → €400 earns €20 in 1 year → €700 earns €35 in 1 year

From this we can see that the interest is the principal (P) multiplied by the rate (*i*). The rate *i* is always expressed as a **decimal**.

Interest = P × *i*

If €800 is invested for 1 year at 6% per annum, then

(i) we multiply €800 by 0.06 to get the interest,
i.e. €800 × 0.06 = €48

(ii) We multiply €800 by 1.06 to get the final amount,
i.e. €800 × 1.06 = €848

Compound interest

Jack invested €800 in a credit union at 6% per annum.
His interest for the first year was €800 × 0.06 = €48.
At the end of the first year he had €848 in his account.
For the second year, €848 earned interest at 6%, that is, the interest earned in the first year was now itself earning further interest in the second year.
This kind of interest is called **compound interest**.

The basic method for calculating compound interest is illustrated in the following example.

Example 1

€1200 is invested for 3 years at 4% per annum compound interest.
What will the investment amount to?

Principal for the first year	= €1200
Interest for the first year	= 4% of €1200
	= 1200 × 0.04 = €48
Principal for the second year	= €1200 + €48 = €1248
Interest for the second year	= 4% of €1248
	= 1248 × 0.04 = €49.92

Principal for the third year	= €1248 + €49.92 = €1297.92
Interest for the third year	= 4% of €1297.92
	= 1297.92 × 0.04
	= 51.9168 = €51.92
Final amount at end of third year	= €1297.92 + €51.92
	= €1349.84

Here is another method of finding the final amount in the example above.

If €1200 is invested for 3 years at 4% per annum, the final amount (**F**) can be calculated like this:

$$€1200 \times \underbrace{1.04 \times 1.04 \times 1.04} = €1200 \times (1.04)^3$$

For 3 years, multiply by $(1.04)^3$.

The pattern shown above leads us to a formula for finding the final amount (F) when a sum of money (P) is invested at compound interest, i, for t years.

$$F = P(1 + i)^t$$

F = final amount
P = principal
i = interest rate
t = number of years

Note: The interest rate ***i*** is always given in decimal form.

If the interest is 4%, then $(1 + i) = 1.04$.

If the interest is $2\frac{1}{2}$%, then $(1 + i) = 1.025$.

If the interest is 12%, then $(1 + i) = 1.12$.

Example 2

Use the compound interest formula to find the compound interest which accrues on €2800 invested for 3 years at 7.5% per annum.

$$F = P(1 + i)^t$$
$$= 2800(1 + 0.075)^3$$
$$= 2800(1.075)^3$$
$$F = €3478.43 \quad \text{... by calculator}$$

Compound interest = €3478.43 − €2800 = €678.43

Finding the rate and the principal

If €300 is invested for 1 year at 6% per annum, then the interest is €300 × 0.06 = €18.

However, if we are given that €300 earns €18 in one year, how do we find the interest?

We could reason that if €300 earns €18, then €100 would earn €6, that is, a rate of 6%.

Thus the rate is $\frac{18}{\cancel{300}_{3}} \times \frac{\overset{1}{\cancel{100}}}{1} = \frac{18}{3} = 6\%$

$$\text{Rate} = \frac{\text{Interest}}{\text{Principal}} \times \frac{100}{1}\%$$

Example 3

If €650 amounts to €702 in one year, find the rate.

Interest = €702 − €650 = €52

$$\text{Rate} = \frac{\text{Interest}}{\text{Principal}} \times \frac{100}{1} = \frac{52}{650} \times \frac{100}{1} = 8$$

$\therefore$ the rate = 8%

Example 4

What sum of money, invested at 4% per annum compound interest, will amount to €3149.62 after 3 years?

$F = P(1 + i)^t$

$3149.62 = P(1.04)^3$

$P(1.04)^3 = 3149.62$ … here we are looking for the principal, *P*.

$$P = \frac{3149.62}{(1.04)^3} = \frac{3149.62}{1.1249} = €2800$$

The amount invested was €2800.

Depreciation

If a car depreciates in value by 20% a year, then its value at the end of the first year will be 80% of its value at the beginning of the year.

To find 80% of a sum of money, multiply by 0.8 as 80% = 0.8.

If a car cost €25 000 and depreciates in value by 15% each year, then its value

(i) at the end of the first year = €25 000 × 0.85

(ii) at the end of the second year = €25 000 × 0.85 × 0.85 = €25 000 × $(0.85)^2$

(iii) at the end of the third year = €25 000 × 0.85 × 0.85 × 0.85
= €25 000 × $(0.85)^3$

.....

At the end of 8 years, its value is €25 000 × $(0.85)^8$.

15. €700 will amount to €756 after one year if invested at 8% per annum.

(i) By what number is €700 multiplied to get €756?

(ii) By what number is €756 divided to get €700?

16. A sum of money is invested at 7% per annum.
If it amounts to €6848 after one year, find the sum invested.

17. €2500 was invested in a building society.
If it amounted to €2612.50 after one year, calculate the rate of interest.

18. What sum of money invested for 3 years at 8% per annum compound interest would amount to €1007.77?

19. What sum of money invested at 5% per annum compound interest would amount to €10 988.78 in 6 years?

20. €8000 is invested for 3 years at compound interest.
The rate for the first year is 5% and for the second year is 6%.
Find the amount of the investment at the end of two years.
At the end of the third year, the money invested amounted to €9260.16.
Calculate the rate of interest for the third year.

21. A person borrows €15 000 for two years.
Interest for the first year is charged at 12% per annum.
The person repays €6000 at the end of the first year.
If the amount owed at the end of the second year is €12 042, find the rate of interest for the second year.

22. A sum of money was invested for 2 years.
The rate of interest for the first year was 4% and for the second year was 5%.
The amount at the end of the second year was €9282.

(i) By what number is €9282 divided to get the amount at the end of the first year?

(ii) By what number is the amount at the end of the first year divided to get the sum invested?
What is the sum of money invested?

23. A person invested €10 000 in a building society.
The rate of interest for the first year was $2\frac{1}{2}$%.
At the end of the first year, the person invested a further €1000.
The rate of interest for the second year was 2%.
Calculate the value of the investment at the end of the second year.

At the end of the second year, a further €2000 was invested.
At the end of the third year, the total investment amounted to €14 014.
Calculate the rate of interest for the third year.

24. A machine cost €15 000.
If it depreciated in value by 15% per annum, find its value at the end of two years.

25. Vans depreciate in value by 20% per annum.

(i) If a van is bought for €23 000, find its value at the end of three years.

(ii) If the value of a van is €11 520 after two years, find its value when new.

26. A new car was bought for €24 000. It decreased in value by 20% in the first year.
If its value at the end of the second year was €16 128, by what percentage did its value decrease during the second year?

Example 5

A machine depreciates in value by 10% per annum.
If the machine is worth €58 320 at the end of 3 years, find its value when new.

Let P be the value of the machine when new.
Value of P at the end of 3 years $= P(0.9)^3$

$100\% - 10\%$
$= 90\% = 0.9$

$$\therefore \quad P(0.9)^3 = 58\,320$$
$$P(0.729) = 58\,320$$
$$P = \frac{58\,320}{0.729} = 80\,000$$

The value of the machine when new is €80 000.

Exercise 4.5

Find the compound interest earned on the investments in Questions (**1–10**), without using the compound interest formula.

1. €400 for 2 years at 6%

2. €800 for 2 years at 8%

3. €900 for 2 years at 5%

4. €1000 for 2 years at 9%

5. €700 for 2 years at 4%

6. €850 for 2 years at 10%

7. €800 for 3 years at 5%

8. €1200 for 3 years at 12%

9. €700 for 3 years at 11%

10. €1800 for 3 years at 4%

11. Use the compound interest formula to find the final amount, correct to the nearest cent, of each of the following investments:

(i) €600 for 2 years at 5%
(ii) €1800 for 2 years at 9%
(iii) €3500 for 3 years at $7\frac{1}{2}\%$
(iv) €7800 for 3 years at $3\frac{1}{2}\%$

12. €4600 was invested for 2 years at compound interest.
If the rate for the first year was 4% and for the second year was 5%, find the total interest for the two years.

13. €1500 was invested for 2 years at compound interest.
The rate for the first year was 3% and the rate for the second year was 4%.
Find the final amount at the end of the two years.

14. A company borrowed €12 000 from a bank at 11% per annum compound interest.
The company repaid €5000 at the end of the first year.
How much was owed to the bank at the end of the second year?

2. (a) (i) {2, 3, 4, 5, 7} (ii) {3, 5, 7}
(iii) {1, 6, 9, 10,11} (iv) {1, 9}
(b) (i) 34 (ii) 3 (iii) 6
3. (a) (i) 27 (ii) 11 (iii) 4 (iv) 30
(b) $x = 2, y = 16$
(c) (i) 56 (ii) 38 (iii) 12
4. (a) Intersection of sets is distributive over union
(b) From left: 55, 5, 10, 30
(c) (i) 40 (ii) 10 (iii) 30 (iv) 14
5. (a) (i) $u = a + b - c + d$
(ii) $d = u - a - b + c$
(iii) B A
(iv) a
(b) 9
6. (a) (iv) is true
(b) (i) 4 (ii) 26 (iii) 8 (iv) 34
(c) 9

Chapter 4: Applied Arithmetic

Exercise 4.1

1. (i) 0.07 (ii) 0.035 (iii) 0.12 (iv) 0.15
(v) 0.165 (vi) 1.04 (vii) 1.1 (viii) 1.14
(ix) 1.25 (x) 0.875
2. (i) 132 (ii) 159 (iii) 570 (iv) 717.5
3. (i) €29.12 (ii) €35
4. €25 **5.** €639.60 **6.** €800
7. €180 **8.** €1600
9. (i) €245 (ii) €240
10. (i) €320 (ii) 17%
11. €1104 **12.** 20% **13.** $21\frac{1}{3}$%
14. Store C; €6.15 cheaper than Store A
15. $16\frac{2}{3}$% **16.** Equates to a $57\frac{1}{2}$% reduction

Exercise 4.2

1. €356.72
2. Maher – €161.27; O'Gorman – €223.71
3. 480 **4.** €232.24 **5.** €106.13
6. (i) €900 (ii) 2275 km
7. (i) 8 (ii) €640 (iii) 5
8. (i) 30c (ii) 75c (iii) €1.20
9. (i) €12.60 (ii) €31.52 (iii) 152
10. (i) €77.50 (ii) 234 km
11. Tariff 3

Exercise 4.3

1. €730 **2.** €29 729 **3.** €115.50
4. €424 **5.** €136.80 **6.** €5640
7. (i) €174 (ii) €876
8. (i) €13 160 (ii) €9960
9. (i) €275.20 (ii) €231.20
10. €8080
11. (i) €3308.80 (ii) €53.40
(iii) €3728.80 (iv) €70.90
12. 22 **13.** €1000
14. €4950 **15.** €35 000
16. €46 000
17. (i) €173.60 (ii) €49.90
(iii) €36 (iv) €640.50
18. (i) €10 460 (ii) €3098.80
(iii) €2160 (iv) €38 281.20
(v) 71%
19. (i) €520 (ii) €67.20
(iii) €23.30 (iv) €26
(v) €403.50
20. (i) €11 200 (ii) €5600
(iii) €5600 (iv) €14 000
(v) €42 000

Exercise 4.4

1. (i) $585 (ii) €615.38
2. (i) 108 000 yen (ii) €75
3. (i) £960 (ii) €750
4. €400
5. (i) C$4900 (ii) €4000
6. (i) 6900 kr (ii) €163.04
7. €2970 **8.** 41 600 baht
9. €57.89 **10.** €1625
11. 2% **12.** €29 931; €3975 gain

Exercise 4.5

1. €49.44 **2.** €133.12
3. €92.25 **4.** €188.10
5. €57.12 **6.** €178.50
7. €126.10 **8.** €485.91
9. €257.34 **10.** €224.76
11. (i) €661.50 (ii) €2138.58
(iii) €4348.04 (iv) €8648.00
12. €423.20 **13.** €1606.80
14. €9235.20
15. (i) 1.08 (ii) 1.08
16. €6400 **17.** 4.5%
18. €800 **19.** €8200
20. €8904; 4% **21.** $11\frac{1}{2}$%
22. (i) 1.05 (ii) 1.04; €8500
23. €11 475; 4% **24.** €10 837.50
25. (i) €11 776 (ii) €18 000
26. 16%

Test yourself 4

1. (a) €225.49 (b) €7806 (c) €6675.20
2. (a) €651.60 (b) 2.5%
(c) (i) €420 (ii) $31\frac{1}{4}$%
3. (a) €2.10 (b) 64 g
(c) (i) €5040 (ii) 5%

Ordinary Level

chapter 11

Time and Speed

Key words

a.m. **p.m.** **12-hour clock** **24-hour clock** **speed** **distance**
time **average speed** **kilometres/hour (km/hr)**

Section 11.1 Time and timetables

The clock on the right shows the time to be 9.20.
This could be either 9.20 a.m. or 9.20 p.m..

When we give a time containing a.m. or p.m., we are expressing it in **12-hour clock time**.

The letters **a.m.** are used to indicate times between midnight and midday.

Times between noon and midnight are indicated by **p.m.**.

a.m. stands for *ante meridiem* – before midday
p.m. stands for *post meridiem* – after midday

The **24-hour clock** is another way of telling the time.

This method uses 4 digits, e.g. 10.24.

The first two digits give the hour after midnight and the second two digits give the number of minutes after the hour.

The table below shows times expressed in 12-hour and 24-hour clock times.

12-hour clock	10 a.m.	4.30 p.m.	4.20 a.m.	9.16 p.m.	12.10 a.m.
24-hour clock	10.00	16.30	04.20	21.16	00.10

In most bus, airport and train timetables, for example, the decimal point in the 24-hour time is omitted and 21.16 is written as 2116.

183

Example 1

A film begins at 20.45 and ends at 22.14. How long does it last?

To calculate, we subtract 20.45 from 22.14 as follows:

$$\begin{array}{r} 22.14 \\ -20.45 \\ \hline \end{array}$$

When subtracting a larger number of minutes from a smaller number, change the top line by adding 60 to the minutes and then taking away one hour as follows:

$$\begin{array}{r} 22.14 \\ -20.45 \\ \hline \end{array} = \begin{array}{r} 21.74 \\ -\ 20.45 \\ \hline 1.29 \end{array}$$

… 14 minutes after 10 p.m. = 74 minutes after 9 p.m. (22.00 = 10 p.m.)

The film lasts 1 hour 29 minutes.

Exercise 11.1

1. How many minutes are there in each of these?

(i) $\frac{1}{2}$ hour (ii) $\frac{1}{4}$ hour (iii) $\frac{2}{5}$ hour (iv) $1\frac{3}{4}$ hours (v) $\frac{7}{10}$ hour.

2. Add each of the following:

(i)
hr	min
4	12
3	46

(ii)
hr	min
4	38
3	46

(iii)
hr	min
1	29
3	53

3. How many minutes from 7.20 a.m. to 8.00 a.m.?

How many hours and minutes from 8.00 a.m. to 3.40 p.m.?

Now find how many hours and minutes there are between 7.20 a.m. and 3.40 p.m.

4. How many hours and minutes from

(i) 8.30 a.m. to 11.45 a.m. (ii) 12.30 p.m. to 7 p.m.

(iii) 7.40 a.m. to 3.30 p.m. (iv) 10.10 a.m. to 6.40 p.m.

(v) 8.45 a.m. to 3.50 p.m. (vi) 11.50 a.m. to 7.45 p.m.?

5. Subtract the following:

(i)
hr	min
4	53
2	17

(ii)
hr	min
3	12
1	46

(iii)
hr	min
5	35
3	54

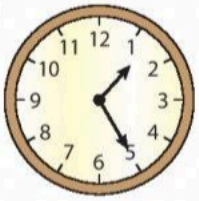
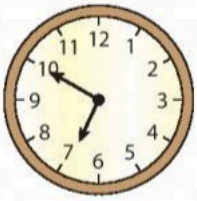
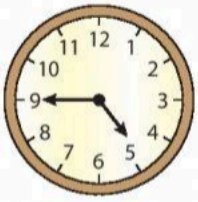
6. Write the following in 24-hour clock time:

(i) 6 a.m. (ii) 10.45 a.m. (iii) 4 p.m. (iv) 5.20 p.m.
(v) 7.30 p.m. (vi) 8.45 a.m. (vii) 12 midday (viii) 11.40 p.m.
(ix) 3.15 a.m. (x) 3.15 p.m.

7. Write the following using a.m. or p.m.:

(i) 11.40 (ii) 15.35 (iii) 12.20 (iv) 00.30 (v) 22.15
(vi) 04.20 (vii) 10.35 (viii) 14.30 (ix) 18.45 (x) 23.12

8. Express each of these in 24-hour clock time:

(i)  a.m.
(ii)  p.m.
(iii)  a.m.
(iv)  p.m.

9. How many hours and minutes from

(i) 10.35 to 14.45 (ii) 12.48 to 16.20 (iii) 10.36 to 18.45
(iv) 8.15 to 10.52 (v) 02.10 to 17.40 (vi) 14.42 to 18.10?

10. The times shown on the clocks below give hours, minutes and seconds.
Match the times on the clocks to the digital times in the blue boxes:

A 7:52:04 **B** 12:09:36 **C** 4:41:52 **D** 1:13:21

(i) 
(ii) 
(iii) 
(iv) 

11. A woman works from 08.45 to 12.30 and from 13.45 to 17.15 for five days each week.
Calculate how many hours she works in the week.

12. A play started at 8.20 p.m. and lasted 2hr 35 min. At what time did it finish?

13. A train leaves Tralee at 10.52 and arrives in Dublin at 14.40.
How long does the journey take?

14. A turkey needs to be cooked and ready for dinner at 18.30.
The cooking time is 28 minutes per kg, plus an extra 20 minutes.
If the turkey weighs 8 kg, what is the latest time it should be put in the oven?

15. The following is an extract from the Dublin to Westport train timetable:

		Train1	Train 2
Dublin Heuston	dep.	08.30	17.10
Athlone	arr.	10.08	18.43
Athlone	dep.	10.10	18.45
Claremorris	arr.	11.25	20.08
Claremorris	dep.	11.44	20.11
Westport	arr.	12.05	20.38

(i) How long does it take *Train 1* to go from Dublin to Westport?
(ii) For how long does *Train 1* stop in Claremorris?
(iii) After the short stop, how long does it take *Train 2* to go from Athlone to Westport?
(iv) Which is the faster train from Dublin to Athlone?
(v) How long does it take *Train 1* to go from Dublin to Claremorris?
(vi) For how long does *Train 2* stop in Athlone?
(vii) If I arrive at Heuston Station in Dublin at 07.52, how long do I have to wait for *Train 1* to depart for Westport?
(viii) Which is the faster train from Dublin to Westport?

16. Fill in the shaded spaces marked A, B, C, D, E and F below:

Train	Time of departure	Time of arrival	Time taken
1	08.43	10.54	A
2	B	12.17	2 h 40 min
3	15.30	C	1 h 54 min
4	23.17	05.18	D
5	06.23	E	4 h 12 min
6	F	12.15	2 h 54 min

17. A car journey began at 10.40 and finished at 13.25.
(i) How long did the journey take?
(ii) If the car uses 6 litres of petrol per hour and each litre costs €1.65, calculate the cost of the petrol for the journey, correct to the nearest euro.

Section 11.2 Speed – Distance – Time

If a car travels 100 km in 2 hours, then we say that the **average speed** of the car for the journey is 50 kilometres per hour (written as 50 **km/hr**).

Again, if a train does 300 km in 3 hours, its average speed is 100 km/hr.

In each of these examples, the average speed $= \frac{\text{distance travelled}}{\text{time taken}}$.

The examples above could also be used to show that

(i) $\text{Time} = \frac{\text{Distance}}{\text{Speed}}$ (ii) $\text{Distance} = \text{Speed} \times \text{Time}$

The triangle on the right below could help you to remember the formulae given.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\text{Distance} = \text{Speed} \times \text{Time}$$

Use your thumb to cover the value you wish to find; for example to find speed, cover S.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

Example 1

A train travels a journey of 210 km in $2\frac{1}{2}$ hours. Find its average speed.

$$\text{Average speed} = \frac{\text{Distance}}{\text{Time}} = \frac{210}{2\frac{1}{2}} = \frac{210 \times 2}{2\frac{1}{2} \times 2} = \frac{420}{5} = 84$$

$\therefore$ the average speed = 84 km/hr.

Example 2

A motorist travelled 500 kilometres in six hours.
Her average speed for the first two hours was 100 km/hr.
Find her average speed, in kilometres per hour, for the last four hours.

Distance travelled in the first 2 hours is $100 \text{ km} \times 2 = 200 \text{ km}$. … Distance = Speed × Time

Therefore she travelled 300 km in the last 4 hours.

$$\text{Average speed} = \frac{\text{Distance}}{\text{Time}}$$

$$= \frac{300}{4} \quad \ldots 500 \text{ km} - 200 \text{ km} = 300 \text{ km and } 6 \text{ hr} - 2 \text{ hr} = 4 \text{ hr.}$$

$$= 75$$

$\therefore$ average speed for the last 4 hours = 75 km/hr.

Exercise 11.2

1. How far will a vehicle travel
(i) in 3 hours at an average speed of 80 km/hr
(ii) in 4 hours at an average speed of 65 km/hr
(iii) in $2\frac{1}{4}$ hours at an average speed of 88 km/hr
(iv) in $\frac{3}{4}$ hour at an average speed of 96 km/hr?

2. Find the time taken to travel
(i) 210 km at an average speed of 70 km/hr
(ii) 200 km at an average speed of 80 km/hr
(iii) 20 km at an average speed of 60 km/hr
(iv) 48 km at an average speed of 64 km/hr.

3. Find the average speed, in km/hr, of a car if it does
(i) 250 km in 5 hours
(ii) 120 km in 2 hours
(iii) 90 km in $1\frac{1}{2}$ hours
(iv) 175 km in $2\frac{1}{2}$ hours
(v) 25 km in $\frac{1}{2}$ hour
(vi) 90 km in 40 mins.

4. A racing car completes a 15 km lap of a track in 5 minutes.
Express the average speed in km/hr.

5. How long would it take a cyclist to travel 45 km at an average speed of 18 km/hr?

6. A car is driven on a motorway for $2\frac{1}{4}$ hours at an average speed of 84 km/hr.
How far does the car travel in that time?

7. The distance from Tralee to Dublin is 312 km. If a motorist completes the journey in 4 hr 20 min, find her average speed in km/hr.

8. A train leaves Dublin at 0925 and reaches Cork at 1210.
If the journey is 286 km long, find the average speed of the train.

9. A speedboat travels at 60 km/hr for two hours and then at 90 km/hr for one hour.
Find its average speed over the three hours.

10. A journey takes 3 hours at an average speed of 120 km/hr.
How long, in hours, would the journey take if the average speed was reduced to 80 km/hr?

11. A trip of 276 km began at 1040 hrs and ended on the same day at 1430 hrs.
Find the average speed in km/hr.

12. It takes 4 hours and 20 minutes to travel a journey at an average speed of 120 km/hr. How many hours and minutes will it take to travel the same journey if the average speed is reduced to 100 km/hr?

13. A motorist travelled 320 km in five hours.
Her average speed for the first 160 km was 80 km/hr.
What was her average speed for the second 160 km?

14. A distance of 18 km is travelled in 25 minutes.
Find the average speed in metres per second.

15. A professional cyclist started a journey of 56 km at 1015 hours and finished the journey at 1135 hours.
Calculate the average speed of the cyclist in km/hr.

16. A distance of 600 metres is travelled in 30 seconds.
Find the average speed in km/hr.

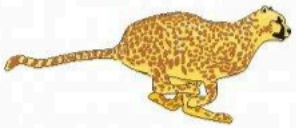
17. Express 72 km/hr in metres per second.

18. Express 400 metres per minute in km/hr.

19. Express 15 metres per second in kilometres per hour.

20. A car journey of 559 kilometres took 6 hours and 30 minutes.
(i) Calculate the average speed, in km/hr, for the journey.
(ii) If the average petrol consumption for the journey was 8.3 km per litre, calculate the number of litres used, correct to the nearest litre.
(iii) Find the cost of the petrol used if each litre cost €1.70.

21. The table on the right shows the times taken by some very fast animals to travel the distances given.
Arrange the animals in order, starting with the fastest.



Animal	Time taken	Distance in metres
Cheetah	18 seconds	500 m
Racehorse	16 seconds	300 m
Antelope	$4\frac{1}{2}$ min	6 000 m
Deer	42 min	32 000 m

22. A jogger sets out at midday to run to the next village, a distance of 12 km.
She wants to arrive at this village at 1330 hours.
At what average speed should she jog?

Chapter 11: Time and Speed

Exercise 11.1

1. (i) 30 (ii) 15 (iii) 24
(iv) 105 (v) 42

2. (i) 7 hr 58 min (ii) 8 hr 24 min
(iii) 5 hr 22 min

3. 40; 7 hr 40 min; 8 hr 20 min

4. (i) 3 hr 15 min (ii) 6 hr 30 min
(iii) 7 hr 50 min (iv) 8 hr 30 min
(v) 7 hr 5 min (vi) 7 hr 55 min

5. (i) 2 hr 36 min (ii) 1 hr 26 min
(iii) 1 hr 41 min

6. (i) 06.00 (ii) 10.45 (iii) 16.00
(iv) 17.20 (v) 19.30 (vi) 08.45
(vii) 12.00 (viii) 23.40 (ix) 03.15
(x) 15.15

7. (i) 11.40 am (ii) 3.35 pm
(iii) 12.20 pm (iv) 12.30 am
(v) 10.15 pm (vi) 4.20 am
(vii) 10.35 am (viii) 2.30 pm
(ix) 6.45 pm (x) 11.12 pm

8. (i) 01.25 (ii) 22.30
(iii) 06.50 (iv) 16.45

9. (i) 4 hr 10 min (ii) 3 hr 32 min
(iii) 8 hr 9 min (iv) 2 hr 37 min
(v) 15 hr 30 min (vi) 3 hr 28 min

10. *A* and (i), *C* and (ii), *D* and (iii), *B* and (iv)

11. $36\frac{1}{4}$ hr (36 hr 15 min)

12. 10.55 pm

13. 3 hr 48 min

14. 14.26

15. (i) 3 hr 35 min (ii) 19 min
(iii) 1 hr 53 min (iv) Train 2
(v) 2 hr 55 min (vi) 2 min
(vii) 38 min (viii) Train 2 (by 7 min)

16. *A* – 2 hr 11 min, *B* – 09.37, *C* – 17.24, *D* – 6 hr 1 min, *E* – 10.35, *F* – 09.21

17. (i) 2 hr 45 min (ii) €27

Exercise 11.2

1. (i) 240 km (ii) 260 km
(iii) 198 km (iv) 72 km

2. (i) 3 hr (ii) $2\frac{1}{2}$ hr
(iii) 20 min (iv) 45 min

3. (i) 50 km/hr (ii) 60 km/hr
(iii) 60 km/hr (iv) 70 km/hr
(v) 50 km/hr (vi) 135 km/hr

4. 180 km/hr **5.** 2 hr 30 min

6. 189 km **7.** 72 km/hr

8. 104 km/hr **9.** 70 km/hr

10. $4\frac{1}{2}$ hours **11.** 72 km/hr

12. 5 hr 12 min **13.** $53\frac{1}{3}$ km/hr

14. 12 m/sec **15.** 42 km/hr

16. 72 km/hr **17.** 20 m/sec

18. 24 km/hr **19.** 54 km/hr

20. (i) 86 km/hr (ii) 67ℓ (iii) €113.90

21. Cheetah (100 km/hr), Antelope (80 km/hr), Racehorse $\left(67\frac{1}{2}\text{ km/hr}\right)$, Deer (45.7 km/hr)

22. 8 km/hr

Test yourself 11

1. (a) (i) 02.40 (ii) 22.50
(b) 1 hr 15 min (c) 40 min each

2. (a) (i) 3 hr 15 min (ii) 8 hr 35 min
(b) (i) $2\frac{1}{2}$ hr (ii) 88 km/hr
(c) 6000 m

3. (a) 12.50 am
(b) (i) 240 km (ii) 3 hours (iii) 80 km/hr
(c) 2160 km

4. (a) (i) 06.15 (ii) 13.45
(iii) 21.52 (iv) 00.15
(b) 9 litres
(c) (i) 40 min (ii) $19\frac{1}{2}$ km/hr

5. (i) 3 hr 12 min (ii) $62\frac{1}{2}$ km/hr
(iii) €44

6. (a) 6 km/hr (b) 12.24 pm
(c) 16.25 (d) 25.2 m

chapter 12

Ratio – Time – Speed

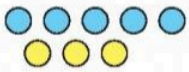
Key words

ratio **simplest form** **direct proportion** **inverse proportion**
12-hour clock **24-hour clock** **time** **distance** **speed** **average speed**

Section 12.1 Ratio and proportion

1. Ratio

We use ratios to compare two quantities.
The ratio of blue discs to yellow discs is 5 : 3.
The ratio 12 : 8 can be simplified by dividing each term by 4.
Thus, 12 : 8 = 3 : 2.
3 : 2 is called the **simplest form** of the ratio.



A ratio is normally expressed as whole numbers.

The ratio $\frac{1}{3} : \frac{5}{6}$ can be expressed as whole numbers by multiplying each term by 6.

$\therefore \frac{1}{3} : \frac{5}{6} = \frac{6}{3} : \frac{5 \times 6}{6} = 2 : 5$

Example 1

A sum of money is divided in the ratio 1 : 3 : 5.
If the smallest part is €250, find the sum of money.

If a sum of money is divided in the ratio 1 : 3 : 5, we divide the total into 9 parts.

$\frac{1}{9}, \frac{3}{9}, \frac{5}{9}$ … nine parts in total

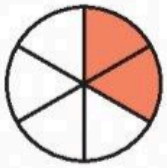
$\Rightarrow \frac{1}{9} = €250$

$\Rightarrow \frac{9}{9} = €250 \times 9 = €2250$

$\therefore$ the sum of money is €2250

2. Proportion

While ratios compare one part to another part, proportion compares a part to the total.
The proportion of the given circle that is shaded red is $\frac{2}{6}$ or $\frac{1}{3}$.
Proportion is generally expressed as a fraction, decimal or percentage.



If 1 litre of petrol costs €1.60, 2 litres cost €3.20 and 3 litres cost €4.80.
Here the costs of 1 litre, 2 litres and 3 litres are in **direct proportion**.

Example 2

A car travels 78 km on 9 litres of petrol.

(i) How far is it likely to travel on 21 litres of petrol?

(ii) How many litres would be required for a journey of 390 km?

(i) Here we are looking for **distance**, so we keep distance last.

9 litres do 78 km

1 litre does $\frac{78}{9}$ km

21 litres do $\left(\frac{78}{9} \times \frac{21}{1}\right)$ km = 182 km.

(ii) Here we are looking for litres, so we keep litres last.

78 km require 9 litres

1 km requires $\frac{9}{78}$ litres

390 km require $\left(\frac{9}{78} \times \frac{390}{1}\right)$ litres = 45 litres

$\therefore$ 390 km would require 45 litres.

3. Inverse proportion

When a dog eats 200 g of dogfood each day, a container lasts him 10 days.
If he eats 400 g each day, the container will last him only 5 days.
Notice that as the quantity of food eaten **increases**, the time that the food lasts **decreases**.
This is an example of of **inverse proportion**.

Example 3

Five painters can paint an office block in 12 days.

(i) How long would it take three painters to paint the block?

(ii) If the office block had to be painted in 3 days, how many painters would be needed?

(i) 5 painters take 12 days

1 painter takes $12 \times 5 = 60$ days … 5 times as long

3 painters take $\frac{60}{3} = 20$ days … $\frac{1}{3}$ as long as 1 painter

(ii) To be painted in 12 days requires 5 painters.

To be painted in 1 day requires 60 painters … 12 times quicker so multiply 5 by 12

To be painted in 3 days requires $\frac{60}{3} = 20$ painters

$\therefore$ 20 painters would be required to paint the office block in 3 days.

Exercise 12.1

1. Express each of these ratios in its simplest form:

(i) 6 : 18 (ii) 25 : 45 (iii) 28 : 98 (iv) 50c : €2

(v) 80c : €2.40 (vi) 50 cm : 4 m (vii) 3 days : 3 weeks (viii) 40 min : 3 hours

2. Express each of these ratios in its simplest form:

(i) $\frac{1}{2} : \frac{1}{4}$ (ii) $\frac{3}{4} : \frac{1}{4}$ (iii) $\frac{1}{3} : \frac{1}{2}$ (iv) $\frac{1}{3} : \frac{1}{4}$

(v) $\frac{2}{5} : \frac{1}{2}$ (vi) $\frac{3}{5} : \frac{7}{10}$ (vii) $3\frac{1}{2} : 1\frac{1}{2}$ (viii) $1\frac{3}{4} : 5\frac{1}{4}$

3. Divide €288 between Ann and David in the ratio 5 : 3.

4. Divide €2800 between three people in the ratio 4 : 2 : 1.

5. Divide €1300 in the ratio $\frac{3}{4} : 1\frac{3}{4}$.

6. €1575 was shared among three people in the ratio $1 : 2 : \frac{1}{2}$.
Calculate the smallest share.

7. (i) Find two pairs of matching statements here.
(ii) Write your own statement that matches the odd one out.

A 20% of the class are girls.

B The ratio of girls to boys is 1 : 5.

C One sixth of the class are girls.

D 25% of the class are girls.

E The number of boys is 4 times the number of girls.

8. In a school, the ratio of girls to boys is 7 : 2.
If there are 735 girls in the school, how many boys are there?

9. A prize fund is divided between A, B and C in the ratio 4 : 3 : 2 respectively.
If C's share is €1224, find the total fund.

10. Brass is made from copper and zinc in the ratio 5 : 3 by weight.
(i) If there are 6 kg of zinc, work out the weight of copper.
(ii) If there are 25 kg of copper, work out the weight of zinc.

11. In a school, the ratio of the number of students to the number of computers is $1 : \frac{2}{5}$.
If there are 100 computers in the school, work out the number of students in the school.

12. Susan has 375 g of butter and adapts her apple pie recipe so that she can use all the butter.
(i) What quantities of the other ingredients would she need?
(ii) How many people would this serve?

Apple Pie (for 4)
3 large apples
25 g brown sugar
200 g flour
75 g butter (or margarine)
50 g caster sugar
1 tablespoon water to mix

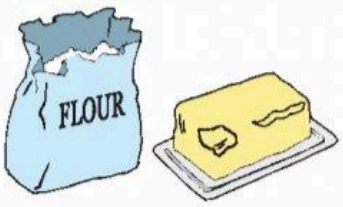
13. A glass contains alcohol and water in the ratio 1 : 4. A second glass has the same quantity of liquid but this time the ratio of alcohol to water is 2 : 3.
Each glass is emptied into a third glass.
What is the ratio of alcohol to water for the final mixture?

14. When a car is moving at 108 km/hr, it travels 18 km on a litre of petrol.
If petrol costs €1.62 a litre, work out the cost of petrol per minute when driving the car at 108 km/hr.

15. Alice builds a model of a house. She uses a scale of 1 : 20.
The height of the real house is 10 metres.
(i) Work out the height of the model.
The width of the model is 80 cm.
(ii) Work out the width of the real house.

16. The number of pages in a comic book was increased from 48 to 80. If the price, which was previously €6.00, is increased in the same ratio, what should the new price be?

17. A pastry mix is made from 2 parts butter mixed with 3 parts flour.
(i) How much of each ingredient is needed to make one kilogram of pastry mix?
(ii) Rachel has 200 g of butter and 400 g of flour. What is the most pastry mix she can make?
(iii) Gina has 1.5 kg of butter and 1125 g of flour. What is the most pastry mix she can make?



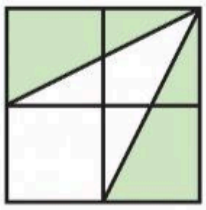
18. A motorist driving 90 km per day has enough diesel to last her 8 days. If she reduces her driving to 72 km per day, how long should the diesel last?

19. 12 blocklayers can build a wall in 15 days.

(i) How long would it take 20 blocklayers working at the same rate to do so?

(ii) How many blocklayers would be needed to build the wall in 10 days?

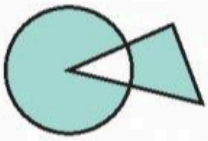
20. What is the ratio of the shaded area to the area of the largest square?



21. One full glass contains vinegar and water in the ratio of 1 : 3. Another full glass of twice the capacity of the first has vinegar and water in the ratio 1 : 4. If the contents of both glasses were mixed together, what then is the ratio of vinegar to water?

22. A male punky fish has 9 stripes and a female punky fish has 8 stripes. I count 86 stripes on the fish in my tank. What is the ratio of male fish to female fish?

23. In the diagram, $\frac{5}{6}$ of the circle is shaded and $\frac{2}{3}$ of the triangle is shaded. What is the ratio of the area of the circle to the area of the triangle?



Section 12.2 Time and timetables

The clock on the right shows the time to be 9.20.

This could be 9.20 a.m. or 9.20 p.m..

When we give a time containing a.m. or p.m. we are expressing it in **12-hour clock time**.

The letters **a.m.** are used to indicate times between midnight and noon.

Times between noon and midnight are indicated by **p.m.**.

The **24-hour clock** is another way of telling the time. This method uses 4 digits, e.g. 10.24.

a.m. means *ante meridiem* – before noon

p.m. means *post meridiem* – after noon

The first two digits give the hour after midnight and the second two digits give the number of minutes after the hour.

The table below shows times expressed in 12-hour and 24-hour clock times.

12-hour clock	10 a.m.	4.30 p.m.	4.20 a.m.	9.16 p.m.	12.10 a.m.
24-hour clock	10.00	16.30	04.20	21.16	00.10

In most bus and train timetables, for example, the decimal point in the 24-hour time is omitted and 21.16 is written as 2116.

Example 1

A film begins at 20.45 and ends at 22.14. How long does it last?

We subtract 20.45 from 22.14 as follows:

$$\begin{array}{r} 22.14 \\ -20.45 \\ \hline \end{array}$$

When subtracting a larger number of minutes from a smaller number, change the top line by adding 60 to the minutes and taking away one hour as follows:

$$\begin{array}{r} 22.14 \\ -20.45 \\ \hline \end{array} = \begin{array}{r} 21.74 \\ -\ 20.45 \\ \hline 1.29 \end{array}$$

… 14 minutes after 10 = 74 minutes after 9

The film lasts 1 hour 29 minutes.

Exercise 12.2

1. Perform the following additions and subtractions:

(i)
$$\begin{array}{rr} \text{hr} & \text{min} \\ 4 & 38 \\ +\ 3 & 46 \\ \hline \end{array}$$

(ii)
$$\begin{array}{rr} \text{hr} & \text{min} \\ 4 & 53 \\ -\ 2 & 17 \\ \hline \end{array}$$

(iii)
$$\begin{array}{rr} \text{hr} & \text{min} \\ 3 & 12 \\ +\ 1 & 46 \\ \hline \end{array}$$

(iv)
$$\begin{array}{rr} \text{hr} & \text{min} \\ 5 & 35 \\ -\ 3 & 54 \\ \hline \end{array}$$

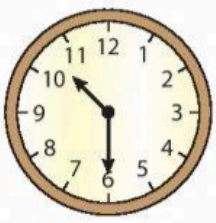
2. Express each of these in minutes:

(i) 3 hours 24 min (ii) 5 hours 36 min (iii) 7 hours 54 min

3. Express each of these in 12-hour clock time:

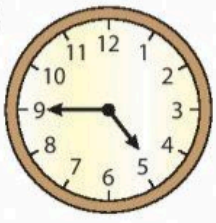
(i)

a.m.

(ii)

p.m.

(iii)

a.m.

(iv)

p.m.

4. Write the following using a.m. or p.m.:

(i) 11.40 (ii) 15.35 (iii) 12.20 (iv) 00.30 (v) 22.15

5. Write in 24-hour clock time:

(i) 6 a.m. (ii) 10.45 a.m. (iii) 4 p.m. (iv) 10.12 p.m. (v) 12 noon

6. How many hours and minutes from

(i) 9.45 a.m. to 2.15 p.m. (ii) 8.45 p.m. to 3.50 a.m.
(iii) 08.30 to 16.45 (iv) 06.42 to 15.10?

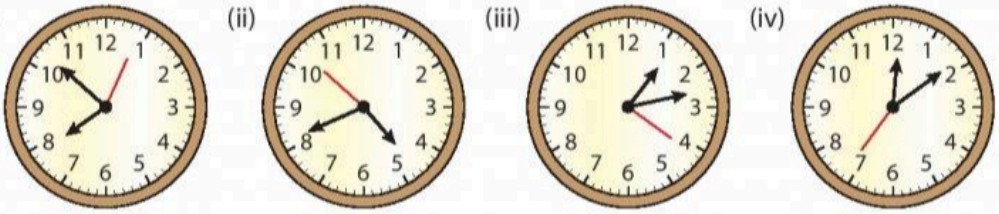
7. How many hours and minutes from

(i) 10.35 to 14.45 (ii) 12.48 to 16.20 (iii) 10.36 to 18.45?

8. The times shown below give hours, minutes and seconds:
Match the times on the clocks to the digital times in the blue boxes:

A 7:52:04 B 12:09:36 C 4:41:52 D 1:13:21

(i) (ii) (iii) (iv)



9. A woman works from 08.45 to 12.30 and from 13.45 to 17.15 for 5 days each week.
Calculate how many hours she works in the week.

10. A play started at 8.20 p.m. and lasted 2hr 35 min. At what time did it finish?

11. A train leaves Tralee at 10.52 and arrives in Dublin at 14.40.
How long does the journey take?

12. A turkey needs to be cooked for dinner at 18.30.
The cooking time is 28 minutes per kg, plus an extra 20 minutes.
If the turkey weighs 8 kg, at what time should it be put in the oven?

13. The following is an extract from the Dublin to Westport train timetable:

		Train1	Train 2
Dublin Heuston	dep.	08.30	17.10
Athlone	arr.	10.08	18.43
Athlone	dep.	10.10	18.45
Claremorris	arr.	11.25	20.08
Claremorris	dep.	11.44	20.11
Westport	arr.	12.05	20.38

(i) How long does it take Train 1 to go from Dublin to Westport?
(ii) For how long does Train 1 stop in Claremorris?
(iii) How long does it take Train 2 to go from Athlone to Westport?
(iv) Which is the faster train from Dublin to Athlone?
(v) How long does it take Train 1 to go from Dublin to Claremorris?
(vi) For how long does Train 2 stop in Athlone?
(vii) If I arrive at Heuston Station in Dublin at 07.52, how long do I have to wait for Train 1 to Westport?
(viii) Which is the faster train from Dublin to Westport?

14. A car journey began at 10.40 and finished at 13.25.
If the car used 6 litres of petrol per hour and each litre costs €1.65, calculate the cost of petrol for the journey.

Section 12.3 Speed – Distance – Time

If a car travels 100 km in 2 hours, then we say that the average speed of the car for the journey is 50 kilometres per hour (written as **50 km/hr**).

Again, if a train does 300 km in 3 hours, its average speed is 100 km/hr.

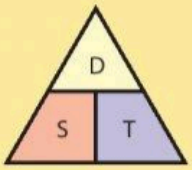
In each of these examples, the average speed $= \frac{\text{distance travelled}}{\text{time taken}}$.

The examples above could also be used to show that

(i) $\text{Time} = \frac{\text{Distance}}{\text{Speed}}$ (ii) $\text{Distance} = \text{Speed} \times \text{Time}$

The triangle on the right could help you to remember the formulae given.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$
$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$
$$\text{Distance} = \text{Speed} \times \text{Time}$$



Use your thumb to cover the value you wish to find; for example to find speed, cover S.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

Example 1

A train travels a journey of 210 km in $2\frac{1}{2}$ hours. Find its average speed.

$$\text{Average speed} = \frac{\text{Distance}}{\text{Time}} = \frac{210}{2\frac{1}{2}} = \frac{210 \times 2}{2\frac{1}{2} \times 2} = \frac{420}{5} = 84$$

$\therefore$ the average speed = 84 km/hr.

Example 2

A motorist travelled 500 kilometres in six hours.
Her average speed for the first two hours was 100 km/hr.
Find her average speed in kilometres per hour for the last four hours.

Distance travelled in the first 2 hours is $100 \text{ km} \times 2 = 200 \text{ km}$.

Therefore she travelled 300 km in the last 4 hours.

$$\text{Average speed} = \frac{\text{Distance}}{\text{Time}}$$

$$= \frac{300}{4} \quad \ldots 500 \text{ km} - 200 \text{ km} = 300 \text{ km and } 6 \text{ hr} - 2 \text{ hr} = 4 \text{ hr.}$$

$$= 75$$

$\therefore$ average speed for the last 4 hours = 75 km/hr.

Exercise 12.3

1. How far will a car travel

(i) in 3 hours at an average speed of 75 km/hr
(ii) in $2\frac{1}{4}$ hours at an average speed of 88 km/hr?

2. Find the time taken to travel

(i) 200 km at an average speed of 80 km/hr
(ii) 48 km at an average speed of 64 km/hr.

3. Find the average speed, in km/hr, of a car if it does

(i) 120 km in 2 hours
(ii) 90 km in $1\frac{1}{2}$ hours
(iii) 25 km in 30 minutes
(iv) 90 km in 40 minutes.

4. A racing car completes a 15 km lap of a track in 5 minutes.
Express this speed in km/hr.

5. A speedboat travels at 60 km/hr for two hours and then at 90 km/hr for one hour.
Find its average speed over the three hours.

6. A journey takes 3 hours at an average speed of 120 km/hr.
How long, in hours, will the journey take if the average speed is reduced to 80 km/hr?

7. A journey of 276 km began at 1040 hrs and ended on the same day at 1430 hrs.
Find the average speed in km/hr.

8. It takes 4 hours and 20 minutes to travel a journey at an average speed of 120 km/hr.
How many hours and minutes will it take to travel the same journey if the average speed is reduced to 100 km/hr?

9. A motorist travelled 320 km in five hours.
Her average speed for the first 160 km was 80 km/hr.
What was her average speed for the second 160 km?

10. A distance of 18 km is travelled in 25 minutes.
Find the average speed in metres per second.

11. A cyclist started a journey of 56 km at 1015 hours and finished the journey at 1135 hours.
Calculate the average speed of the cyclist in km/hr.

12. A distance of 600 metres is travelled in 30 seconds.
Find the average speed in km/hr.

13. A car journey of 559 kilometres took 6 hours and 30 minutes.

(i) Calculate the average speed, in km/hr, for the journey.

(ii) If the average petrol consumption for the journey was 8.3 km per litre, calculate the number of litres used, correct to the nearest litre.

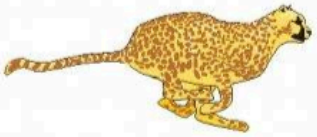
14. A runner sets out at midday to run to the next village, a distance of 12 km.
She wants to arrive at this village at 1330 hours.
At what average speed should she run?

15. A cheetah can run 100 m in 5.4 seconds.
A train takes 12 minutes to travel 7.7 km between two stations.
Which has the faster average speed, the train or the cheetah?
Express the difference in metres per minute.

16. Anne walks a distance of 1.7 km to school from home.
She walks at an average speed of 5.1 km/hr.
What is the latest she can leave home to be in school at 8.55 a.m.?

17. The table on the right shows the times taken by some very fast animals to travel the distances given.
Arrange the animals in order, starting with the fastest.

Animal	Time taken	Distance in metres
Cheetah	18 seconds	500 m
Racehorse	16 seconds	300 m
Antelope	$4\frac{1}{2}$ min	6 000 m
Deer	42 min	32 000 m



18. A train is scheduled to make a journey of 300 km at an average speed of 120 km/hr.
It leaves six minutes late and its average speed is increased so that it arrives on time.
Find the new average speed.

19. Barbara's rule for mountain walkers is:

Allow 1 hour for every 5 km you must walk.
Add $\frac{1}{2}$ hour for every 300 metres you must climb.

Jasmine started a 4 km walk at 0800 hours.
The path climbed 1800 m from start to finish.
Jasmine wanted to work out at about what time she would finish the walk.
If she allows $2\frac{1}{2}$ hours for stops along the way, at about what time should she arrive?

Test yourself 11

1. (i) 2 (ii) (0, −4) (iii) (2, 0) (iv) $-\frac{1}{2}$

2. (i) $\frac{1}{2}$; $y = \frac{1}{2}x + 1$ (ii) B

3. (i) (0, 5); *y*-axis (ii) $\frac{4}{3}$
(iii) $-\frac{3}{4}$ (iv) $3x + 4y = 0$

4. (i) (a) A: $2x - y + 3 = 0$, B: $2x - y - 2 = 0$
(b) $2x - y + c = 0$
(ii) (2, 2)

5. (i) 2 (ii) A(3, 0), B(0, 2); 3 sq. units

6. $a = \frac{-3}{5}$, $b = 3$

7. (i) *b* & *c* (ii) 2 (iii) D & *a*, E & *b*, F & *c*

8. (i) $3x - y - 1 = 0$
(ii) (a) 0.675
(b) Yes as the slope is 0.675, i.e. under 0.7

9. (ii) $-\frac{1}{2}$

10. (i) $2x - y + 1 = 0$
(ii) By checking whether the product of their slopes is −1 (which it isn't)

11. (i) 7070 m (ii) 3 km
(iii) $3x - 4y + 31 = 0$
(iv) $4x + 3y - 92 = 0$
(v) (11, 16)
(vi) Up North St. to Tangent St. and then follow Tangent St. directly to the museum; 21.5 km

Chapter 12: Ratio – Time – Speed

Exercise 12.1

1. (i) 1 : 3 (ii) 5 : 9 (iii) 2 : 7
(iv) 1 : 4 (v) 1 : 3 (vi) 1 : 8
(vii) 1 : 7 (viii) 2 : 9

2. (i) 2 : 1 (ii) 3 : 1 (iii) 2 : 3
(iv) 4 : 3 (v) 4 : 5 (vi) 6 : 7
(vii) 7 : 3 (viii) 1 : 3

3. Ann – €180, David – €108

4. €1600, €800, €400

5. €390, €910

6. €225

7. (i) B and C, A and E
(ii) One quarter of the class are girls OR The ratio of boys to girls is 3 : 1

8. 210

9. €5508

10. (i) 10 kg (ii) 15 kg

11. 250

12. (i) 15 apples, 125 g br. sugar, 1 kg flour, 250 g c. sugar, 5 tbsp water
(ii) 20 ppl

13. 3 : 7

14. $16\frac{1}{5}$ c

15. (i) 50 cm (ii) 16 m

16. €10

17. (i) Butter – 400 g, Flour – 600 g
(ii) 500 g (iii) 1875 g

18. 10 days

19. (i) 9 days (ii) 18

20. 1 : 2

21. 13 : 47

22. 3 : 2

23. 2 : 1

Exercise 12.2

1. (i) 8 hr 24 min (ii) 2 hr 36 min
(iii) 4 hr 58 min (iv) 1 hr 41 min

2. (i) 204 min (ii) 336 min
(iii) 474 min

3. (i) 1.25 am (ii) 10.30 pm
(iii) 6.50 am (iv) 4.45 pm

4. (i) 11.40 am (ii) 3.35 pm
(iii) 12.20 pm (iv) 12.30 am
(v) 10.15 pm

5. (i) 06.00 (ii) 10.45
(iii) 16.00 (iv) 22.12
(v) 12.00

6. (i) 4 hr 30 min (ii) 7 hr 5 min
(iii) 8 hr 15 min (iv) 8 hr 28 min

7. (i) 4 hr 10 min (ii) 3 hr 32 min
(iii) 8 hr 9 min

8. A and (i), B and (iv), C and (ii), D and (iii)

9. 36 hr 15 min **10.** 10.55 pm

11. 3 hr 48 min **12.** 14.26

13. (i) 3 hr 35 min (ii) 19 min
(iii) 1 hr 53 min (iv) Train 2
(v) 2 hr 55 min (vi) 2 min
(vii) 38 min (viii) Train 2

14. €27.23

Exercise 12.3

1. (i) 225 km (ii) 198 km

2. (i) 2 hr 30 min (ii) $\frac{3}{4}$ hr

3. (i) 60 km/hr (ii) 60 km/hr
(iii) 50 km/hr (iv) 135 km/hr

4. 180 km/hr **5.** 70 km/hr

6. $4\frac{1}{2}$ hours **7.** 72 km/hr

8. 5 hr 12 min **9.** $53\frac{1}{3}$ km/hr

10. 12 m/sec **11.** 42 km/hr

12. 72 km/hr

13. (i) 86 km/hr (ii) 67 ℓ

14. 8 km/hr

15. Cheetah is faster; 469.4 m/min

16. 8.35 am

17. Cheetah, Antelope, Racehorse, Deer