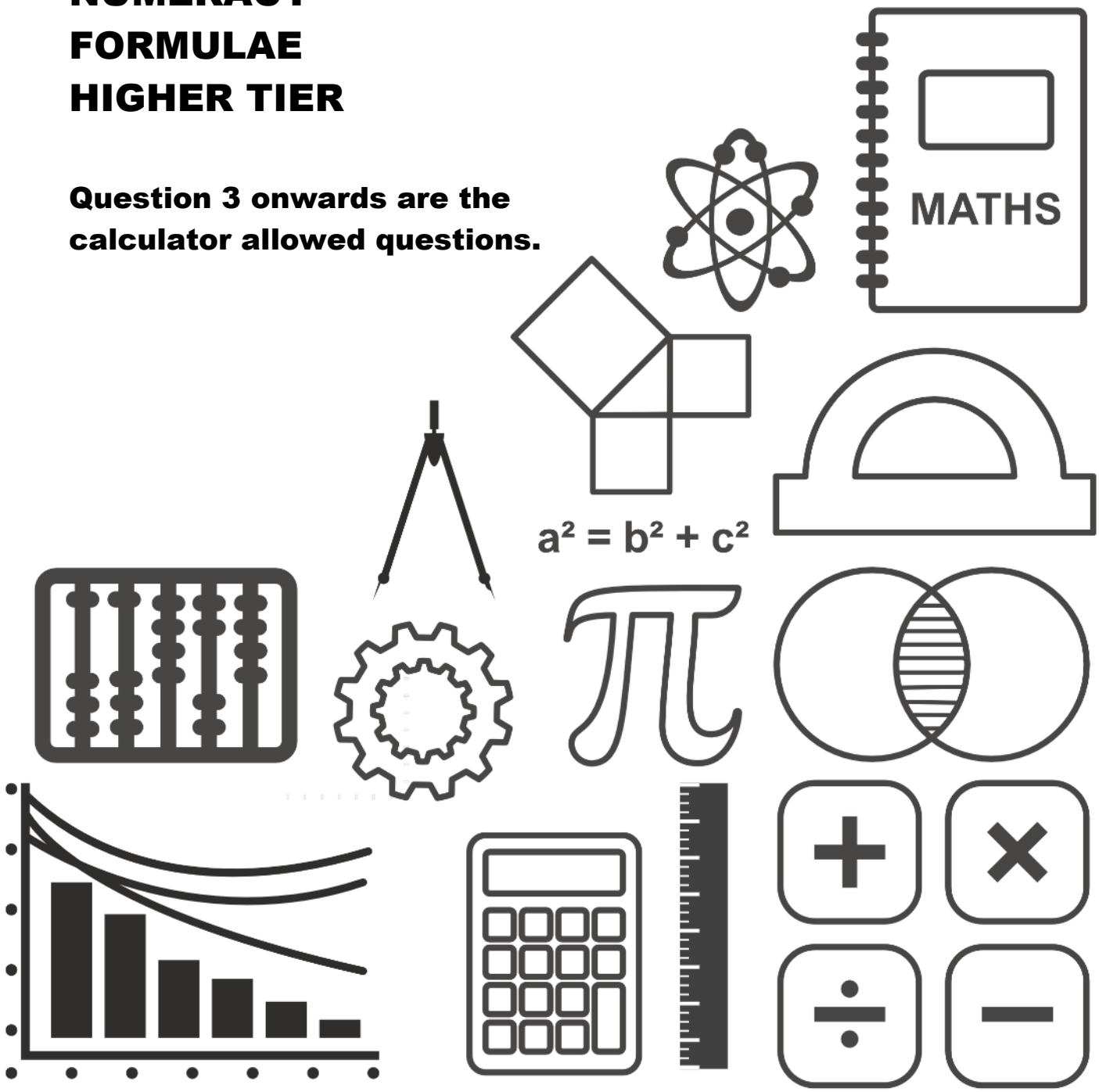
MATHSDIY

GCSE TOPIC BOOKLET
NUMERACY
FORMULAE
HIGHER TIER

Question 3 onwards are the calculator allowed questions.



1. Bronwen is investigating the increase in the growth of algae on the surface of a pond.
The surface area covered by the algae is measured in cm^2.
She finds the surface area covered by the algae t **days** after the start of her investigation is given by the following expression.

$$400 + 4^{\frac{t}{2}}$$

(a) What surface area was covered by algae at the start of her investigation?
Circle your answer. [1]

$404\,cm^2$ $401\,cm^2$ $4\,cm^2$ $402\,cm^2$ $400\,cm^2$

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(b) Bronwen calculated the surface area covered by the algae 5 days after the start of the investigation.
She also calculated the surface area 7 days after the start of the investigation.
By how much did the surface area covered by the algae increase between these two times? [3]

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2. During a chemistry experiment, it was found that a particle **lost** $\frac{3}{4}$ of its mass every second.

The initial mass of the particle was 160 mg.

(a) Calculate the mass of the particle after 4 seconds.
Circle your answer. [1]

2·5 mg 0·15625 mg 40 mg 0·625 mg 0·875 mg

(b) Write down a formula for the mass m, in milligrams, of the particle after t seconds. [3]

3. Dafydd has bought a new van.
To pay for the van, he has taken out a loan for £18 000.
The loan has an APR of 3%, and will be repaid by monthly payments of £237.84.

The amount that is still to be repaid on a loan is known as the *remaining balance*.
The formula below can be used to calculate the *remaining balance* on a loan after a period of time from the start date of the loan:

$$\textit{remaining balance} = L(1+r)^n - M\left(\frac{(1+r)^n - 1}{r}\right)$$

where,

r is the **monthly** interest rate written as a decimal,
L is the loan amount in pounds,
M is the monthly payment in pounds,
n is the number of months after the start date of the loan.

Dafydd plans to sell the van in 5 years' time for £5000.
Will he have enough money from the sale of the van to pay off the *remaining balance* on the loan?
You must show all your working. [4]

4. Laura and Matthew are buying a house priced at £150 000.
In order to buy the house, they will need to have a mortgage.

A mortgage is a loan that is paid back over a number of years.

They have saved a deposit of £15 000.
They need a mortgage of £135 000.

A bank has offered them a mortgage of £135 000 at an interest rate of 2·4% per annum, with interest added monthly.

To calculate the monthly payments needed in order to pay back the mortgage, they use the following formula:

$$M = \frac{r \times P}{1 - (1 + r)^{-12n}}$$

where:

M is the amount of each monthly payment,
P is the mortgage needed,
r is the **monthly** interest rate as a decimal,
n is the number of years taken to pay back the mortgage.

(a) The annual interest rate is 2·4%.
What is the monthly rate, as a decimal?
Circle your answer. [1]

0·24 0·024 0·00002 0·002 0·2

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(b) Laura and Matthew are considering whether to take out a mortgage over 25 years or 30 years.

They have correctly calculated their monthly payments to be £598.86 when paying back the mortgage over 25 years.

How much more will it cost **in total** to pay back the mortgage over 30 years than over 25 years? [5]

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