PEARSON

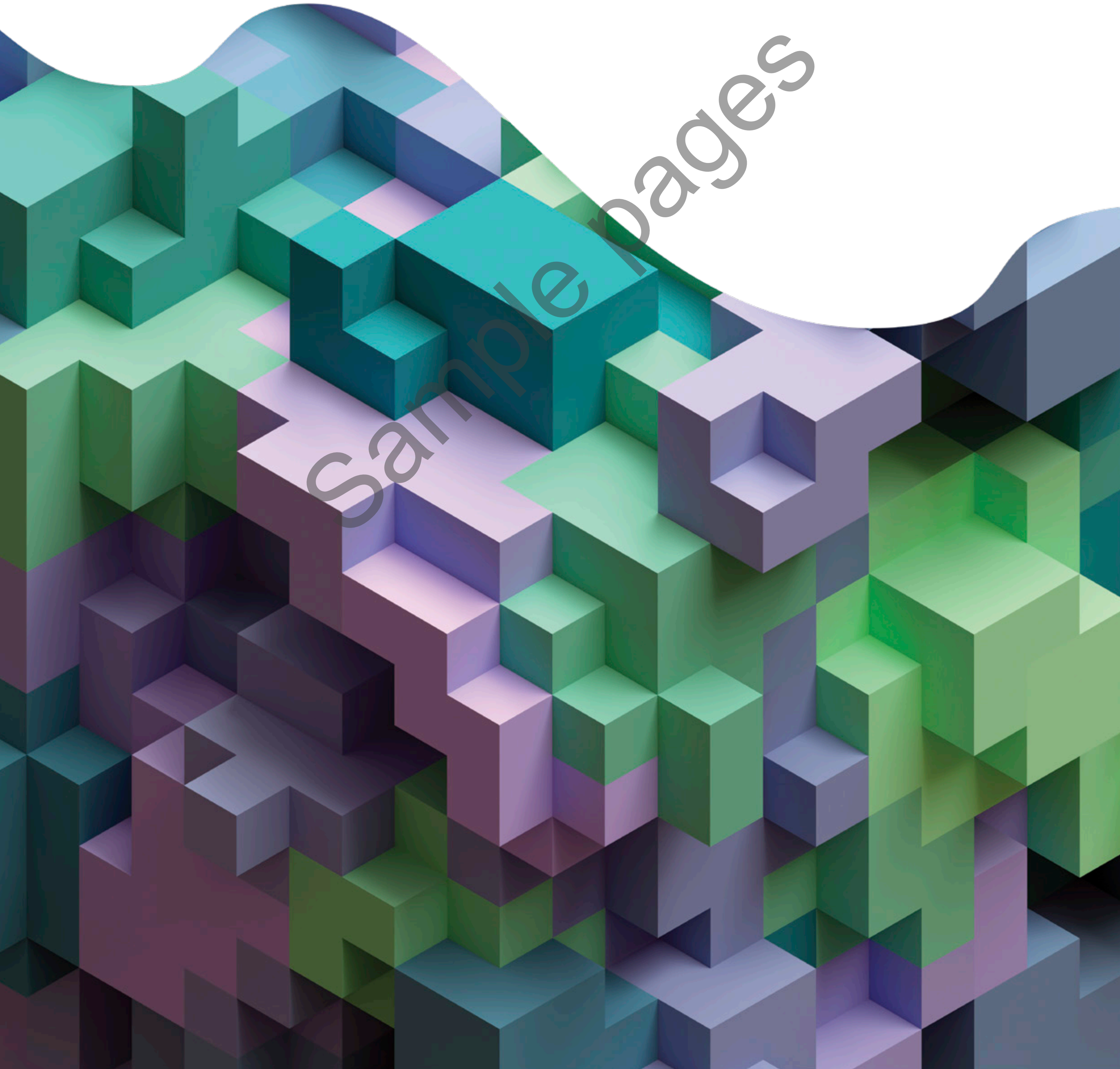
GENERAL MATHEMATICS

12

QUEENSLAND

UNITS 3 & 4

EXAM PREPARATION WORKBOOK



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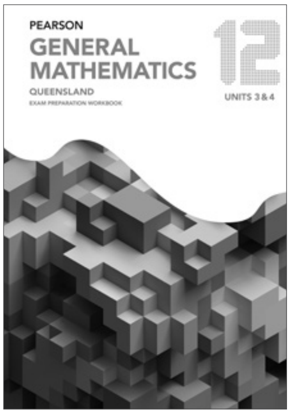

About this **Pearson General Mathematics 12 Exam Preparation Workbook**

The purpose of the **Pearson Exam Preparation Workbook** is to assist students in their preparation for the QCE external exams. Answering previous external exam questions is an effective way to do this, as it offers well-constructed questions at the appropriate level.

This **Pearson Exam Preparation Workbook** includes previous external exam questions from The Victorian Curriculum and Assessment Authority. Given that both the syllabuses and the access to allowed technologies varies across states, the author has reviewed questions from years 2000 to 2017 to select those questions that align with the QCAA syllabus.

These questions were then categorised using the QCAA three levels of difficulty: simple familiar, complex familiar and complex unfamiliar. This matches the QCAA external exam structure, which indicates that across Paper 1 and Paper 2, marks will be allocated in the following approximate proportions:

- 60% simple familiar
- 20% complex familiar
- 20% complex unfamiliar.

The source of each question in the **Pearson Exam Preparation Workbook** is referenced at the start of the question. At times, there may be some variation between the notation used in the questions and that used by the QCAA; the authors have made note of this within the worked solution as applicable.

Each worked solution has indicative mark allocations. As official marking schemes are not released by state examining bodies, the mark allocations in the **Pearson Exam Preparation Workbook** are based on the author's and reviewer's on-balance judgement and their teaching experience.

Writing and development team

We are grateful to the following people for their time and expertise in contributing to **Pearson General Mathematics 12 Exam Preparation Workbook**.

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How to use this workbook

Pearson General Mathematics 12 Queensland Exam Preparation Workbook, Units 3 & 4

This exam preparation workbook has been developed to assist students in their preparation for the QCAA external exams. It provides previous external exam questions from The Victorian Curriculum and Assessment Authority that align with the QCAA syllabus. All questions are categorised into the QCAA three levels of difficulty—simple familiar, complex familiar and complex unfamiliar—to match the QCAA external exam structure.

Questions have been grouped into convenient sets, with the intention that each question set is tackled in one sitting.

Levels of difficulty

Levels of difficulty are indicated using a three-striped label.

Simple familiar:

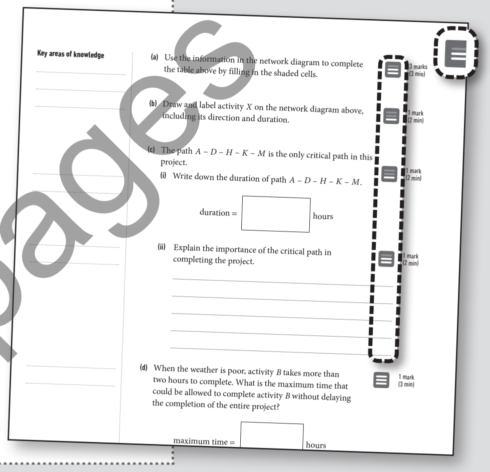
Complex familiar:

Complex unfamiliar:

These are used in two ways:

1 To show the level of difficulty for the whole question set

2 To show the level of difficulty of individual question parts when they differ from that of the question set level. In such cases, all parts of that question are labelled.



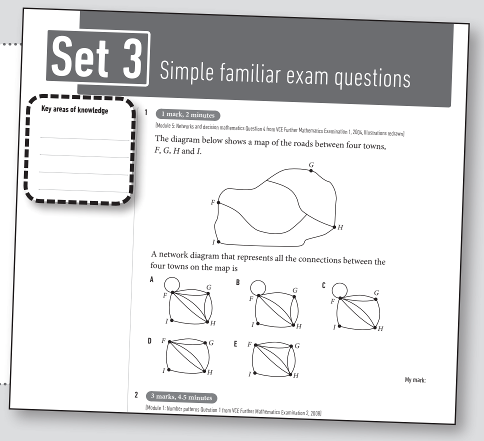
Get yourself exam ready using this 5-step preparation sequence

Step 1: Key areas of knowledge

The purpose of making these notes is to first identify ***what*** is required to be done, and ***how*** it might be done, ***without*** doing it at this stage.

For each question, note the topic(s) of mathematics it draws on, formulas you think will be needed, and any other comments you feel will help you work out the answer.

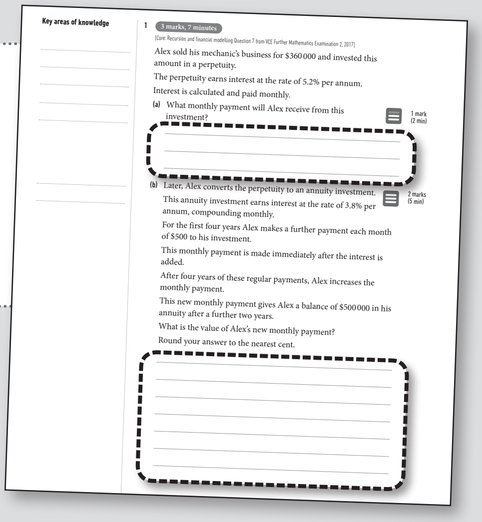
Then move on to the next question in that set.



Step 2: Complete questions

Complete all the questions within the question set using the space provided.

Question sets have been structured according to level of difficulty, with each question set covering a range of topics from the syllabus.


Key areas of knowledge

1 3 marks, 7 minutes

Alex sold his mechanic's business for $360 000 and invested this amount in a perpetuity.

The perpetuity earns interest at the rate of 5.2% per annum.

Interest is calculated and paid monthly.

(a) What monthly payment will Alex receive from this investment? 1 mark (2 min)

(b) Later, Alex converts the perpetuity to an annuity investment. 2 marks (5 min)

This annuity investment earns interest at the rate of 3.8% per annum, compounding monthly.

For the first four years Alex makes a further payment each month of $500 to his investment.

This monthly payment is made immediately after the interest is added.

After four years of these regular payments, Alex increases the monthly payment.

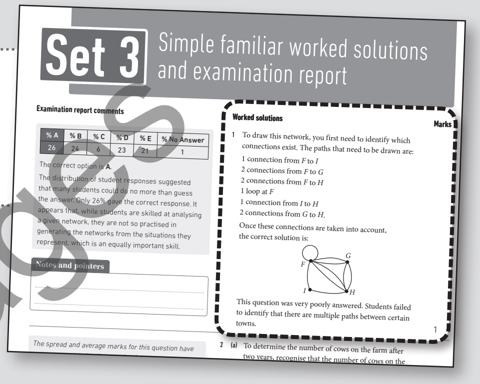
This new monthly payment gives Alex a balance of $500 000 in his annuity after a further two years.

What is the value of Alex's new monthly payment?

Round your answer to the nearest cent.

Step 3: Check your answer

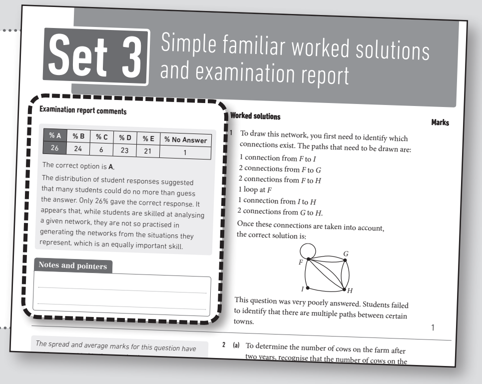
Review and mark your answers according to the solutions provided in the corresponding worked solutions.



Step 4: Examination report and reflection

Review the marks obtained from past students, read the information in the **Examination report** section (where available) and reflect on your own solution.

Use the **Notes and pointers** section to write down any relevant key reminders to yourself about common errors, key rules etc.

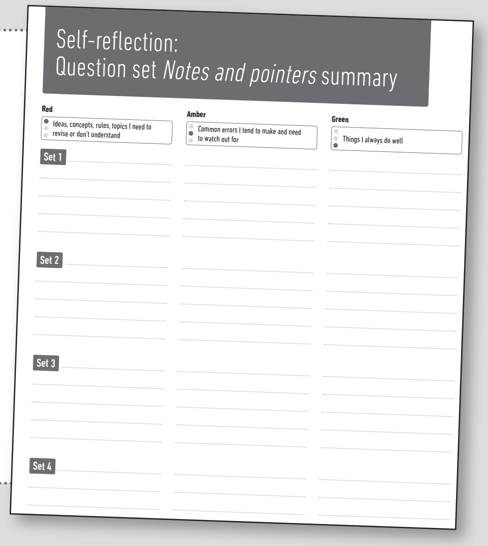


Step 5: Self-reflection: Question set notes and pointers summary

Reflect on all the questions within one set, review your comments in the individual Notes and pointers sections, and use these to complete a summary of the overall question set.

Use the **Red**, **Amber** and **Green** categories to note what you need to revise or don't understand, what you need to watch out for, and what you did well.

Once all sets are completed, these summaries will help in giving you direction on where to focus your further revision.



Contents

Self-reflection: Question set *Notes and pointers* summary

Red	Amber	Green
Ideas, concepts, rules, topics I need to revise or don't understand	Common errors I tend to make and need to watch out for	Things I always do well

Set 1

Set 2

Set 3

Set 4

Set 5

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Simple familiar worked solutions and examination report

Set 7

Examination report comments | **Worked solutions** | **Marks**

% A
82

Note, examiner reports from a few years ago did not include information about incorrect alternatives.

Notes and pointers

1 Substitute the birth rate of 60 into the least-squares equation to determine the average number of children per family.

$$\begin{aligned} \textit{average number of children} &= -0.48 + 0.146 \times \textit{birth rate} \\ &= -0.48 + 0.146 \times 60 \\ &= 8.28 \end{aligned}$$

1

% A	% B	% C	% D	% E	% No Answer
11	18	54	14	3	0

The correct option is **C**.

Notes and pointers

2 The maximum flow by inspection is $2 + 10 + 6 = 18$ litres per minute. 1

Marks	0	1	2	3	4	Average
%	26	25	21	9	19	1.69

This table shows the distribution of the total marks available for the question.

Most students got this answer. Several incorrect examples were seen of attempting to reduce 30 000 by 5% by calculating $\frac{5}{30000} \times \frac{100}{1}$

Notes and pointers

3 (a) Recognise that the sequence is geometric. To determine the amount of water available at the end of the first week, multiply the starting value by the common ratio. As the rate is decreasing, the common ratio will be less than 1.

$$\begin{aligned} r &= 1 - i \\ &= 1 - 0.05 \\ &= 0.95 \end{aligned}$$

$$\begin{aligned} t_1 &= t_0 \times r \\ &= 30\,000 \times 0.95 \\ &= 28\,500 \end{aligned}$$

1

There are 28 500 litres of water in the tank at the end of the first week.

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Examination report comments	Worked solutions	Marks

Many had little difficulty, although some regarded this as an arithmetic sequence. The answer was quite often completed by tabulation and a subsequent correct result was acceptable. Some incorrect applications of the formula included $t_5 = 30\,000 \times (0.95)^{(4-1)}$.

Notes and pointers

(b) To solve this problem, first determine the rule for the *n*th term in a geometric sequence. As you have been given t_0 use:

$$t_n = t_0 \times r^n$$
$$t_n = 30\,000 \times 0.95^n$$

At the end of the fourth week:

$$\begin{aligned} t_4 &= 30\,000 \times 0.95^4 \\ &= 24\,435.1875 \\ &\approx 24\,435 \end{aligned}$$

There are 24 435 litres of water in the tank at the end of the fourth week 1

One mark was given for a correct tabulation attempt or for writing an appropriate exponential equation. Many tabulated $30\,000 \times (0.95)^n$ to find their answer. Some may have used the Tables function on their graphics calculator and simply wrote an answer. Very few students tried to set up the equation $10\,000 = 30\,000 \times (0.95)^n$. Some solved this using logarithms.

1 mark for calculating the value of n where $t_n < 10\,000$

1 mark for correct interpretation of the result

Notes and pointers

(c) This can be solved by substituting different values into the rule found in part **(b)**. There is no need to start at zero and work through, as it is clear that it will take some time.

$$\begin{aligned} t_{20} &= 30\,000 \times (0.95)^{20} \\ &\approx 10\,754.6 \end{aligned}$$

$$\begin{aligned} t_{21} &= 30\,000 \times (0.95)^{21} \\ &\approx 10\,216.8 \end{aligned}$$

$$\begin{aligned} t_{22} &= 30\,000 \times (0.95)^{22} \\ &\approx 9706 \end{aligned}$$ 1

The first time the amount of water in the tank will be less than 10 000 litres is at the end of the 22nd week. 1

% A	% B	% C	% D	% E	% No Answer
4	14	10	65	7	0

The correct option is **D**.

The critical path analysis in Question 4 involved standard forward-scanning calculations. While there was some complexity of the activity network, students should be able to apply standard routine calculations to graphs such as this with care.

Notes and pointers

4 There are three paths to N from the start of the project. The paths and durations are:

$C - F - K$	duration 11 hours
$C - G - I - K$	duration 10 hours
$C - G - J$	duration 12 hours

The earliest starting time is determined by the path that will take the longest time to reach that point, which is 12 hours. 1

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Examination report comments	Worked solutions	Marks

The spread and average marks for this question have not been provided in the examination report.

A common incorrect answer was 1.09.

Notes and pointers

5 (a) The seasonal indices should sum to the number of seasons, four.

$$\begin{aligned} 0.78 + 1.05 + 1.07 + x &= 4 \\ 2.9 + x &= 4 \\ x &= 1.1 \end{aligned}$$

The seasonal index for spring is 1.1. This means the rainfall in spring is 10% higher than the 'average season'. 1

Notes and pointers

(b) To calculate the deseasonalised value, use the formula:

$$\begin{aligned} \text{deseasonalised value} &= \frac{\text{actual value}}{\text{seasonal index}} \\ &= \frac{188}{0.78} \\ &= 241.02\ldots \\ &\approx 241 \text{ (to the whole number)} \end{aligned}$$

The deseasonalised value for the summer rainfall in 2008 is 241 mm. 1

The autumn rainfall is 5% above the average for the four seasons of the year.

A common incorrect answer suggested that the autumn rainfall was 5% above the monthly average. Students are expected to be clear in their explanations. It was again evident that some students simply copied material from their bound reference notes and gave answers that referred to autumn 'sales'.

Notes and pointers

(c) A seasonal index of 1.05 tells us that the autumn rainfall is expected to be 5% above the 'average season'. 1

% A	% B	% C	% D	% E	% No Answer
91	3	1	4	0	0

The correct option is **A**.

Notes and pointers

6 This is an arithmetic sequence and you have been given the value of the first term (t_1). To solve this problem, start by determining the rule for the *n*th term in the sequence.

$$\begin{aligned} d &= t_2 - t_1 \\ &= 0.55 - 0.4 \\ &= 0.15 \end{aligned}$$

Substitute the known values into the rule:

$$\begin{aligned} t_n &= t_1 + (n-1) \times d \\ &= 0.40 + (n-1) \times 0.15 \end{aligned}$$

Now calculate the amount saved in week eight.

$$\begin{aligned} t_8 &= 0.40 + (8-1) \times 0.15 \\ &= 1.45 \end{aligned}$$

In week eight he will save \$1.45. 1

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Examination report comments | **Worked solutions** | **Marks**

% A	% B	% C	% D	% E	% No Answer
89	1	2	5	2	0

The correct option is **A**.

Notes and pointers

7 A Hamiltonian cycle visits every vertex once and only once, and finishes at the vertex it started at. By following the paths listed in each of the multiple choice options, the only Hamiltonian path is:

$K-J-I-H-G-L-F-E-D-K$. 1

Average score
3.64 / 5

This value represents the average mark achieved for the question.

The four parts of Question 8 were generally well done by those who attempted them.

Notes and pointers

8 **(a)** The length of road that is sealed every week is the value of the common difference for this arithmetic sequence.

$d = t_2 - t_1$
$= 13.9 - 13.45$
$= 0.45$

The length of road newly sealed each week is 0.45 km. 1

Notes and pointers

(b) To determine the value at the end of week 3, add the common difference to the value at the end of week 2.

$t_3 = t_2 + d$
$= 13.9 + 0.45$
$= 14.35$

The total length of sealed road at the end of week 3 is 14.35 km. 1

Notes and pointers

(c) To determine the value at the end of the eighth week, develop the rule for finding the nth term in the sequence. As you have been given t_1, use:

$t_n = t_1 + (n-1) \times d$
$t_n = 13.45 + (n-1) \times 0.45$
$t_8 = 13.45 + (8-1) \times 0.45$
$= 16.6$

At the end of the eighth week, the total length of sealed road between Amlin and Bonti is 16.6 km. 1

---

1 mark for correct rule

1 mark for correct answer

Notes and pointers

(d) The solution is the 33rd week.

Using the rule developed in part **(c)**, you can substitute in the amount of sealed road and solve for the number of weeks, n.

$t_n = 13.45 + (n-1) \times 0.45$
$27.5 = 13.45 + (n-1) \times 0.45$ 1
$14.05 = (n-1) \times 0.45$
$31.22 = n - 1$
$n = 32.22$ 1

The company would take 33 weeks to complete the sealing of this road.

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Examination report comments

Marks	0	1	2	3	4	5	Average
%	3	10	23	31	24	10	3

This table shows the distribution of the total marks available for the question.

This question was not answered well by many students.

Incorrect answers included $70 + 60 + 80 = 210$ and $50 + 40 + 60 + 80 = 230$.

Notes and pointers

Worked solutions — Marks

9 (a) (i) The shortest distance, via inspection, between the house and the pump is $70 + 90 = 160\,\text{m}$. — 1

A large number of incorrect responses ranged between 1 and 7 inclusive.

Notes and pointers

(ii) The degree of a vertex is the number of edges that are connected to that vertex. For this network there are two vertices of odd degree.

There are two vertices on the network diagram that have an odd degree. — 1

$1180 + 70 = 1250$

An Euler circuit would be an ideal solution but this is not possible due to the presence of two odd vertices: one at the house and one at the end of the edge marked 70, leading from the house. However, an 1180 metre long Euler path commencing at the house is possible, provided it ended at the other odd vertex. To return to the house, add 70 metres for the length of the shortest path between these two odd vertices.

This question was very poorly answered, with a common incorrect answer of 1180.

Some students wrote out all, or most of, the edge lengths and showed their (sometimes incorrect) total, despite this being given in the question.

Notes and pointers

(iii) An open Eulerian trail exists between the two vertices: the house and the vertex that is connected to the house by a weighted edge of 70.

Therefore, to travel along every edge and start and finish at the house is to complete the open Eulerian trail, starting at the house and finishing at the other vertex with an odd degree, and then travelling an extra 70 metres to get back to the house:

$1180 + 70 = 1250$.

The shortest distance travelled is 1250 metres. — 1

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Set 18 Complex unfamiliar exam questions

Key areas of knowledge

1 1 mark, 1.5 minutes

[Core: Data analysis Question 12 from VCE Further Mathematics Examination 1, 2011]

The seasonal index for headache tablet sales in summer is 0.80.

To correct for seasonality, how should the projected headache tablet sales figures be altered?

My mark:

2 1 mark, 2.5 minutes

[Core: Data analysis Question 13 from VCE Further Mathematics Examination 1, 2006]

The table shows the seasonal indices for the monthly unemployment numbers for workers in a regional town.

Month	Seasonal index
Jan	1.30
Feb	1.21
Mar	1.00
Apr	0.95
May	0.95
Jun	0.86
Jul	0.86
Aug	0.89
Sep	0.94

A trend line that can be used to forecast the **deseasonalised** number of unemployed workers in the regional town for the first nine months of the year is given by

$$\textit{deseasonliased number of unemployed} = 373.3 - 3.38 \times \textit{month number}$$

where month 1 is January, month 2 is February, and so on.

What is the **actual** number of unemployed for June predicted to be? Give your answer to 2 decimal places.

My mark:

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Key areas of knowledge

3 **3 marks, 5 minutes**

[Module 1: Number patterns Question 2 from VCE Further Mathematics Examination 2, 2010]

Two signposts are 100 km apart on the tollway.

There are six complete sections of road between these two signposts.

The lengths of the successive sections of road increase by 5%.

(a) Determine the length of the first section of road.
Write your answer in kilometres, correct to one decimal place.

2 marks (3 min)

(b) Let L_n be the length of the nth section of road between the two signposts.
Write a difference equation, in terms of L_n and L_{n+1}, that will generate the lengths of the six successive sections of road.

1 mark (2 min)

My total marks:

4 **1 mark, 3.5 minutes**

[Module 5: Networks and decision mathematics Question 9 from VCE Further Mathematics Examination 1, 2015]

The table below shows, in minutes, the duration, the earliest starting time (EST) and the latest starting time (LST) of eight activities needed to complete a project.

Activity	Duration	EST	LST
A	5	0	0
B	3	5	5
C	6	5	6
D	5	8	9
E	4	8	8
F	6	12	12
G	4	13	14
H	3	18	18

Draw a directed graph that shows the sequence of these activities.

My mark:

Key areas of knowledge

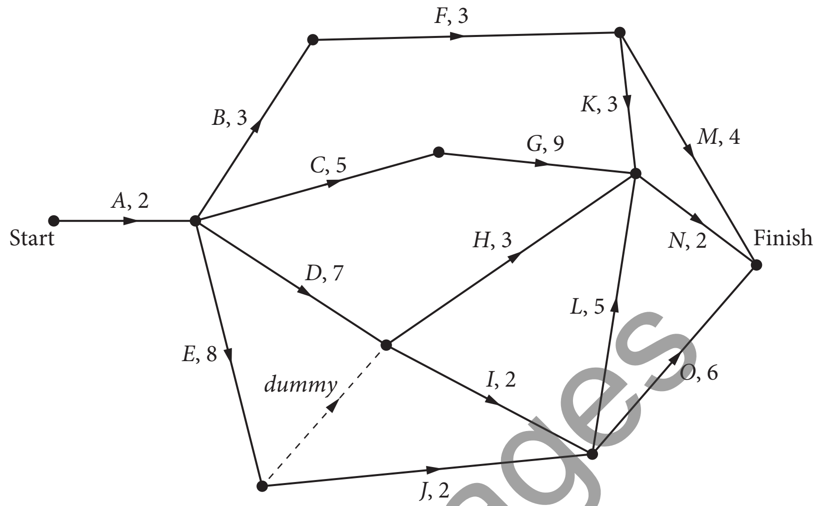
5 5 marks, 10 minutes

[Module 2: Networks and decision mathematics Question 4 from VCE Further Mathematics Examination 2, 2017, Illustration redrawn]

The rides at the theme park are set up at the beginning of each holiday season.

This project involves activities A to O.

The directed network below shows these activities and their completion times in days.



(a) Write down the two immediate predecessors of activity I. 1 mark (2 min)

(b) The minimum completion time for the project is 19 days.

(i) There are two critical paths. One of the critical paths is $A - E - J - L - N$. Write down the other critical path. 1 mark (2 min)

(ii) Determine the float time, in days, for activity F. 1 mark (2 min)

(c) The project could finish earlier if some of the activities were crashed (the duration was reduced). Six activities, B, D, G, I, J and L can all be reduced by one day. The cost of this crashing is \$1000 per activity.

(i) What is the minimum number of days in which the project could now be completed? 1 mark (2 min)

(ii) What is the minimum cost of completing the project in this time? 1 mark (2 min)

My total marks:

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Key areas of knowledge

6 5 marks, 11 minutes

[Module 1: Number patterns Question 3 from VCE Further Mathematics Examination 2, 2009]

The longer a performance season runs, the fewer people attend.

The difference equation below provides a model for predicting the weekly attendance at a variety concert.

$T_{n+1} = 0.8T_n + 1000$

$T_1 = 12\,000$ where T_n is the attendance in week n

(a) Use the difference equation to predict the attendance in week 3. 1 mark (2 min)

(b) Show that the sequence generated by this difference equation is not arithmetic. 1 mark (3 min)

(c) In which week will the attendance first fall below 6000 people? 1 mark (2 min)

(d) The performance season will continue as long as the weekly attendance is at least 5000 people. 2 marks (4 min)

What does the difference equation indicate about the long-term future of this variety concert?

Justify your answer by showing appropriate working.

My total marks:

Complex unfamiliar exam questions Set 20

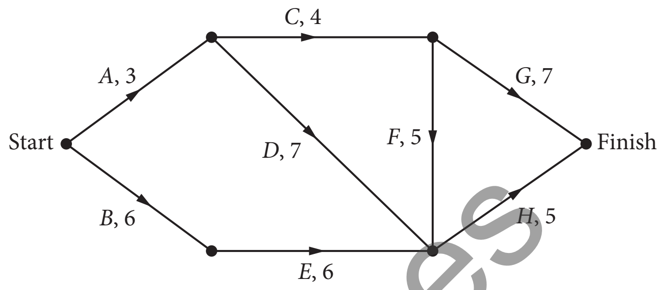
Key areas of knowledge

1 1 mark, 2.5 minutes

[Module 5: Networks and decision mathematics Question 9 from VCE Further Mathematics Examination 1, 2012, Illustration redrawn]

John, Ken and Lisa must work together to complete eight activities, *A*, *B*, *C*, *D*, *E*, *F*, *G* and *H* in minimum time.

The directed network below shows the activities, their completion times in days, and the order in which they must be completed.



Several activities need special skills. Each of these activities may be completed only by a specified person.

Activities *A* and *F* may only be completed by John.

Activities *B* and *C* may only be completed by Ken.

Activities *D* and *E* may only be completed by Lisa.

Activities *G* and *H* may be completed by any one of John, Ken or Lisa.

With these conditions, the minimum number of days required to complete these eight activities is

My mark:

Key areas of knowledge

2 7 marks, 16 minutes

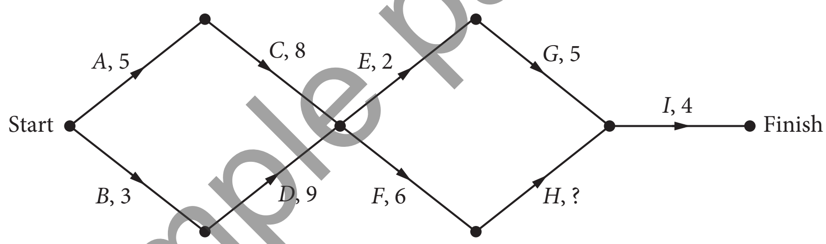
[Module 5: Networks and decision mathematics Question 3 from VCE Further Mathematics Examination 2, 2015, Illustrations redrawn]

Nine activities are needed to prepare a daily delivery of groceries from the factory to the towns.

The duration, in minutes, earliest starting time (EST) and immediate predecessors for these activities are shown in the table below.

Activity	Duration	EST	Predecessor(s)
A	5	0	–
B	3	0	–
C	8	5	*A*
D	9		*B*
E	2	13	*C*, *D*
F	6	13	*C*, *D*
G	5	15	*E*
H		19	*F*
I	4	22	*G*, *H*

The directed network that shows these activities is shown below.



All nine of these activities can be completed in a minimum time of 26 minutes.

(a) What is the EST of activity *D*? 1 mark (2 min)

(b) What is the latest starting time (LST) of activity *D*? 1 mark (2 min)

(c) Given that the EST of activity *I* is 22 minutes, what is the duration of activity *H*? 1 mark (3 min)

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Key areas of knowledge

(d) Write down, in order, the activities on the critical path.

1 mark (2 min)

(e) Activities C and D can only be completed by either Cassie or Donna.

1 mark (2 min)

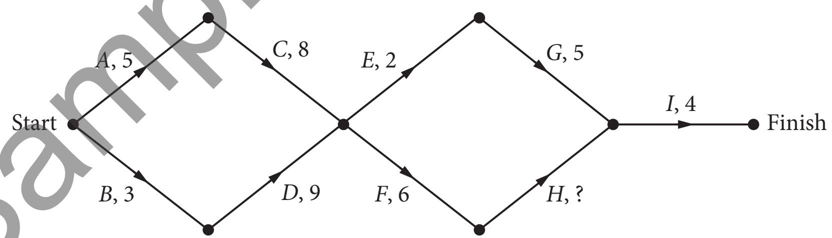
One Monday, Donna is sick and both activities C and D must be completed by Cassie. Cassie must complete one of these activities before starting the other.

What is the least effect of this on the usual minimum preparation time for the delivery of groceries from the factory to the five towns?

(f) Every Friday, a special delivery to the five towns includes fresh seafood. This causes a slight change to activity G, which then cannot start until activity F has been completed.

(i) On the directed graph below, show this change without duplicating any activity.

1 mark (2 min)



(ii) What effect does the inclusion of seafood on Fridays have on the usual minimum preparation time for deliveries from the factory to the five towns?

1 mark (3 min)

My total marks:

Key areas of knowledge

3 5 marks, 12.5 minutes

[Module 5: Networks and decision mathematics Question 3 from VCE Further Mathematics Examination 2, 2011]

A section of Farnham showgrounds has flooded due to a broken water pipe. The public will be stopped from entering the flooded area until repairs are made and the area has been cleaned up.

The table below shows the nine activities that need to be completed in order to repair the water pipe. Also shown are some of the durations, Earliest Start Times (EST) and the immediate predecessors for the activities.

Activity	Activity description	Duration (hours)	EST	Immediate predecessor(s)
A	Erect barriers to isolate the flooded areas	1	0	–
B	Turn off the water to the showgrounds		0	–
C	Pump water from the flooded area	1	2	*A*, *B*
D	Dig a hole to find the broken water pipe	1		*C*
E	Replace the broken water pipe	2	4	*D*
F	Fill in the hole	1	6	*E*
G	Clean up the entire affected area	4	6	*E*
H	Turn on the water to the showgrounds	1	6	*E*
I	Take down the barriers	1	10	*F*, *G*, *H*

(a) What is the duration of activity *B*? 1 mark (2 min)

(b) What is the Earliest Start Time (EST) of activity *D*? 1 mark (2 min)

(c) Once the water has been turned off (Activity *B*), which of the activities *C* to *I* could be delayed without affecting the shortest time to complete all activities? 1 mark (2.5 min)

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Key areas of knowledge

It is more complicated to replace the broken water pipe (Activity E) than expected. It will now take four hours to complete instead of two hours.

(d) Determine the shortest time in which activities A to I can now be completed.

1 mark (3 min)

Turning on the water to the showgrounds (Activity H) will also take more time than originally expected. It will now take five hours to complete instead of one hour.

(e) With the increased duration for Activity H and Activity E, determine the shortest time in which activities A to I can be completed.

1 mark (3 min)

My total marks:

4 1 mark, 2 minutes

[Core: Data analysis Question 13 from VCE Further Mathematics Examination 1, 2012]

A trend line was fitted to a deseasonalised set of quarterly sales data for 2012.

The seasonal indices for quarters 1, 2 and 3 are given in the table below. The seasonal index for quarter 4 is not shown.

Quarter number	1	2	3	4
Seasonal index	31.2	0.7	0.8	

The equation of the trend line is

$$\textit{deseasonalised sales} = 256\,000 + 15\,600 \times \textit{quarter number}$$

Using this trend line, what are the **actual** sales for quarter 4 in 2012 predicted to be?

My mark:

Key areas of knowledge

5 4 marks, 7 minutes

[Module 1: Number patterns Question 3 from VCE Further Mathematics Examination 2, 2006]

The water used in the orchard is stored in a tank.

Each afternoon, 10% of the volume of water in the tank is used.

Each evening, 2000 litres of water is added to the tank.

This pattern continues each day.

The volume of water, V_n, in the tank on the morning of the nth day is modelled by the difference equation

$V_{n+1} = rV_n + d$ where $V_1 = 45\,000$ litres

(a) Find r and d. 2 marks (3 min)

$r =$

$d =$

(b) Determine how many litres of water will be in the tank on the morning of the fourth day. 1 mark (2 min)

(c) On the morning of which day will the volume of water in the tank first be below 30 000 litres? 1 mark (2 min)

My total marks:

[Note: part **(d)** has been omitted]

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