EXCEL IN MATHSCI
HIGHER MATHEMATICS • TOPIC RESOURCE

2026–27
Portfolio 11

Recurrence Relations

PUPIL WORKSHEET

Skills covered: Percentage change; linear recurrence formulae; computing terms; fixed limiting values; finding coefficients; financial and population models.

Instructions: Attempt all questions. Show sufficient working to justify your answers. Give exact values unless a degree of accuracy is stated. Each section is separate for targeted revision.

Prerequisite core skills revise earlier learning; *topic practice* develops individual techniques; *exam-style and challenge* combines skills.

Pupil: _____ **Date:** _____

SECTION A | Prerequisite core skills

Question 1

[3 marks]

An investment of $£2500$ increases by 4% each year. Calculate its value after 3 years.

Question 2

[3 marks]

A machine valued at $£1200$ loses 8% of its value each year. Find its value after 4 years, to the nearest penny.

Question 3

[3 marks]

Given $u_0 = 5$ and $u_{n+1} = 2u_n - 3$, calculate u_1, u_2, u_3.

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Question 4

[3 marks]

Given $u_0 = 4$ and $u_{n+1} = \frac{1}{2}u_n + 6$, calculate u_1, u_2, u_3.

Question 5

[4 marks]

The first three terms of a linear recurrence relation $u_{n+1} = au_n + b$ are $6, 10, 18$. Find a and b.

Question 6

[3 marks]

The recurrence $u_{n+1} = 0.75u_n + 12$ approaches a limiting value L. Find L.

SECTION B | Topic practice

Question 7

[5 marks]

A savings account contains $£18000$. Interest of 3% is added each year before $£1000$ is withdrawn. Write down a recurrence relation for the balance u_n, and find the balance after 3 years.

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Question 8

[4 marks]

A patient is given 15 mg of a drug at the end of every day. During each day 40% of the drug already present is removed. Initially there is no drug in the bloodstream. Form a recurrence relation and calculate the amount immediately after the third dose.

Question 9

[5 marks]

A loan of $£4000$ is charged interest at 2% per month. A repayment of $£350$ is made at the end of every month. Write down a recurrence and find the amount outstanding after 3 payments.

Question 10

[4 marks]

A wildlife reserve contains 700 rabbits. Each month 30% of those present leave and 120 new rabbits arrive. Write down a recurrence relation and find its limiting population.

Question 11

[4 marks]

Given $u_0 = 10$ and $u_{n+1} = 0.4u_n + 9$, calculate u_1, u_2 and find the limiting value.

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Question 12

[4 marks]

Three consecutive terms of a linear recurrence $u_{n+1} = au_n + b$ are $4, 7, 13$. Determine a and b.

Question 13

[3 marks]

The recurrence $u_{n+1} = ku_n + 8$ has a limiting value of 40. Find k.

Question 14

[4 marks]

A recurrence is defined by $u_0 = 1000$ and $u_{n+1} = 0.9u_n + 50$. Find the limiting value. State whether the first three terms are above or below it.

SECTION C | Exam-style and challenge

Question 15

[4 marks]

The first three terms of a linear recurrence are $3, 8, 18$. Find the recurrence in the form $u_{n+1} = au_n + b$.

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Question 16

[5 marks]

A club has 200 members. At the start of each year 75% renew their membership and 60 new people join. Model the total just after enrolment with a recurrence relation and determine whether the membership will ever reach 250, assuming these rates remain constant.

Question 17

[5 marks]

Given $u_0 = 75$ and $u_{n+1} = 0.6u_n + 18$, find the first value of n for which $u_n < 50$.

Question 18

[6 marks]

A debt of $£1200$ attracts 5% interest monthly. A payment of $£200$ is made after the interest is added. Find the number of monthly payments needed to clear the debt, assuming a smaller final payment is allowed.

— End of pupil worksheet —

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