TRINITY COLLEGE

# Year 12 Applications Unit 3/4
# Test 2 2021

## Section 1 Calculator Free
**Sequences**

**STUDENT'S NAME** ________________________________________________

**DATE**: Friday 26th March **TIME:** 30 minutes **MARKS**: 30

**INSTRUCTIONS:**
Standard Items: Pens, pencils, drawing templates, eraser

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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1. (4 marks)

The first two terms of a sequence are $\frac{3}{2}$ and $3$ respectively.

(a) Given these terms begin an arithmetic sequence, write the recursive rule. [2]

(b) Given these terms begin a geometric sequence, write a rule for the $n^{th}$ term. [2]

2. (4 marks)

An arithmetic sequence entered into the sequence applet on the Classpad produced the following partial results.

| n | $a_n$ |
| --- | --- |
| 4 | 11.5 |
| 5 | 8 |
| 6 | |
| 7 | 1 |
| 8 | −2.5 |

(a) Determine the missing value for $n = 6$ in the table of values above. [2]

(b) State the recursive rule that was entered into the classpad to produce the table of values above. [2]

3. (5 marks)

Ms Wilson's car has an oil leak. Each Monday she checks the oil level and notices that it has decreased by 60% so she adds 660 mL of oil. The amount of oil in her car each Monday, in millilitres, can be modelled by the following sequence.

$$T_n = aT_{n-1} + b, \text{ where } T_0 = 140.$$

(a) State the value of both $a$ and $b$. [2]

(b) Given that Ms Wilson's oil tank has a maximum capacity of 1 Litre, can this model continue indefinitely? Justify your answer. [3]

4. (9 marks)

In December 2001 Mr Martin started a stamp collection after he was gifted a number of stamps, *a*. Each year in December he adds the same number of stamps, *d*, to his collection. The number of stamps in his collection at the end of each December forms an arithmetic sequence where December 2001 is $T_1$.

Mr Martin kept a record of the number of stamps in the table below, unfortunately he forgot to record values some years.

| Year (end of December) | 2001 | 2004 | 2011 | 2021 |
|---|---|---|---|---|
| Number of stamps | | 53 | 102 | |

(a) Using the two values given in the table above determine the value of both *a* and d. [3]

(b) How many stamps will Mr Martin have at the end of December 2021? [3]

(c) Can Mr Martin expect to ever have exactly 315 stamps in his collection when he records his data at the end of each December? Justify your answer. [3]

5. (8 marks)

Sequence A has the first four terms 2, 9, 16, 23,…

(a) State a recursive rule for sequence A in terms of $A_{n+1}$. [2]

Sequence B is defined by $B_n = B_{n-1} - 3,\ B_4 = 93$.

(b) Define sequence B using a simplified explicit rule. [3]

(c) Determine the value(s) of *n* for which sequence A = sequence B. [3]

Year 12 Applications Unit 3/4
Test 2021

Section 2 Calculator Assumed
**Sequences**

**STUDENT'S NAME** ________________________________________________

**DATE**: Friday 26th March **TIME:** 20 minutes **MARKS**: 20

**INSTRUCTIONS:**

| | |
|---|---|
| Standard Items: | Pens, pencils, drawing templates, eraser |
| Special Items: | Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment) |

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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6. (7 marks)

Construction on the new 220 km Hantzis Highway is to be completed in several stages. The distance of highway constructed during each stage, $D_n$, forms a sequence. The distances constructed in each of the first three stages is shown in the table below.

| Stage Number<br>$n$ | 1 | 2 | 3 |
|---|---|---|---|
| Distance constructed per stage<br>$D_n$ in km | 20 | 22 | 24.2 |

(a) Does the distance constructed in each stage form an arithmetic sequence, geometric sequence or neither. Justify your answer mathematically. [2]

(b) State the recursive rule that represents the distance of highway constructed per stage. [2]

(c) State the distance of highway constructed during the 5$^{th}$ stage. [1]

The state government has promised to complete the highway within two years.

(d) Given that it takes 3 months to complete each stage of the highway state, with reasoning, if the highway will be completed within the promised timeframe? [2]

7. (7 marks)

Mrs Pontré is growing money trees in the Field of Dreams orchard. Over time, some of the trees stop producing enough money and they are removed at the end of the year in which this first happens. Immediately afterwards a fixed number of new trees are planted.

The total number of money trees growing in the orchard at the end of the $n^{\text{th}}$ year, $A_n$, immediately after the planting of the new money trees for that year, is modelled by the first order linear recurrence relation, $A_{n+1} = 0.78A_n + k,\ A_1 = 18\ 000$.

(a) What does the variable $k$ represent in the equation? [1]

(b) What percentage of money trees will be removed at the end of each year? [1]

(c) If 100 new money trees are planted at the end of each year,

(i) How many trees will be growing in the orchard at the end of the third year? Round to the nearest 10 trees. [2]

(ii) Describe what would happen to the number of trees growing in the orchard in the long term. Why? [2]

(d) Determine the number of new money trees that needs to be planted at the end of each year so that there will always be 18 000 money trees growing in the orchard. [1]

8. (6 marks)

Ms Mallis is constructing an aluminium ladder to use while hanging ball decorations. It has 21 rungs and from the bottom to the top and each rung is shorter in length by a constant amount. The bottom rung is 400 mm long and the top rung is 320 mm.

(a) How much shorter is each rung than the one below it? [2]

(b) State a simplified rule to determine the length of each rung on the ladder, where $n$ = 1 represents the length of the bottom rung. [2]

(c) If the length of each aluminium side arm used to create the frame of the ladder is 5.2 m determine the total length of aluminium that is needed to construct the ladder. [2]