Applications of Arithmetic and Geometric patterns

Student name: _____ Score: _____

1. A hydraulic hammer drives a metal post vertically into the ground by striking the top of the post. The distance that the post is driven into the ground, by the nth strike of the hammer, is d_n.

The distances $d_1, d_2, d_3 \ldots, d_n$ form a geometric sequence.

The distance that the post is driven into the ground by the first strike of the hammer, d_1, is $64\,\text{cm}$.

The distance that the post is driven into the ground by the second strike of the hammer, d_2, is $48\,\text{cm}$.

(a) Find the value of the common ratio for this sequence. [2]

(b) Find the distance that the post is driven into the ground by the eighth strike of the hammer. [2]

(c) Find the **total depth** that the post has been driven into the ground after 10 strikes of the hammer. [2]

2. 512 competitors enter round 1 of a tennis tournament, in which each competitor plays a match against one other competitor.

The winning competitor progresses to the next round (round 2); the losing competitor leaves the tournament.

The tournament continues in this manner until there is a winner.

Find the number of competitors who play in round 6 of the tournament. *[3]*

Find the total number of matches played in the tournament. *[3]*

3. A comet orbits the Sun and is seen from Earth every 37 years. The comet was first seen from Earth in the year 1064.

(a) Find the year in which the comet was seen from Earth for the fifth time. [3]

(b) Determine how many times the comet has been seen from Earth up to the year 2014. [3]

4. Ramiro walks to work each morning. During the first minute he walks 80 metres. In each subsequent minute he walks 90 % of the distance walked during the previous minute. The distance between his house and work is 660 metres. Ramiro leaves his house at 08:00 and has to be at work by 08:15.

Explain why he will not be at work on time.

5. The population of big cats in Africa is increasing at a rate of 5 % per year. At the beginning of 2004 the population was 10 000.

(a) Write down the population of big cats at the beginning of 2005. *[1 mark]*

(b) Find the population of big cats at the beginning of 2010. *[2 marks]*

(c) Find the number of years, from the beginning of 2004, it will take the population of big cats to exceed 50 000. *[3 marks]*

6. The population of a city at the end of 1972 was 250 000. The population increases by 1.3 % per year.

(a) Write down the population at the end of 1973.

(b) Find the population at the end of 2002.

Applications of Arithmetic and Geometric patterns

Student name: ANSWERS Score: _____

1. A hydraulic hammer drives a metal post vertically into the ground by striking the top of the post. The distance that the post is driven into the ground, by the nth strike of the hammer, is d_n.

The distances $d_1, d_2, d_3 \ldots, d_n$ form a geometric sequence.

The distance that the post is driven into the ground by the first strike of the hammer, d_1, is $64\,\text{cm}$.

The distance that the post is driven into the ground by the second strike of the hammer, d_2, is $48\,\text{cm}$.

(a) Find the value of the common ratio for this sequence. $r = 0.75$ [2]

(b) Find the distance that the post is driven into the ground by the eighth strike of the hammer. 8.54 [2]

(c) Find the **total depth** that the post has been driven into the ground after 10 strikes of the hammer. 242 [2]

2.

512 competitors enter round 1 of a tennis tournament, in which each competitor plays a match against one other competitor.

The winning competitor progresses to the next round (round 2); the losing competitor leaves the tournament.

The tournament continues in this manner until there is a winner.

Find the number of competitors who play in round 6 of the tournament. 16 *[3]*

Find the total number of matches played in the tournament. 511 *[3]*

3. A comet orbits the Sun and is seen from Earth every 37 years. The comet was first seen from Earth in the year 1064.

(a) Find the year in which the comet was seen from Earth for the fifth time. 1212 [3]

(b) Determine how many times the comet has been seen from Earth up to the year 2014. 26 [3]

4. Ramiro walks to work each morning. During the first minute he walks 80 metres. In each subsequent minute he walks 90% of the distance walked during the previous minute. The distance between his house and work is 660 metres. Ramiro leaves his house at 08:00 and has to be at work by 08:15.

Explain why he will not be at work on time.

$n = 16.54290788$
since n > 15
he will be late

5. The population of big cats in Africa is increasing at a rate of 5 % per year. At the beginning of 2004 the population was 10 000.

(a) Write down the population of big cats at the beginning of 2005. 10 500 *[1 mark]*

(b) Find the population of big cats at the beginning of 2010. 13 400 *[2 marks]*

(c) Find the number of years, from the beginning of 2004, it will take the population of big cats to exceed 50 000. 33 *[3 marks]*

6. The population of a city at the end of 1972 was 250 000. The population increases by 1.3 % per year.

(a) Write down the population at the end of 1973. 253 250

(b) Find the population at the end of 2002. 368 318