

**A level Mathematics Practice Paper – Geometric sequences and series – Mark scheme**

| Question    | Scheme                                                                                                                                                                                                                                                                                                     | Marks            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>1(a)</b> | $\frac{a\left(1-\left(\frac{3}{4}\right)^4\right)}{1-\frac{3}{4}}$ or $\frac{a\left(1-\frac{3^4}{4}\right)}{1-\frac{3}{4}}$ or $\frac{a(1-0.75^4)}{1-0.75}$                                                                                                                                                | M1               |
|             | $175 = \frac{a\left(1-\left(\frac{3}{4}\right)^4\right)}{1-\frac{3}{4}} \Rightarrow a = \frac{175\left(1-\frac{3}{4}\right)}{\left(1-\left(\frac{3}{4}\right)^4\right)} \left\{ \Rightarrow a = \frac{\left(\frac{175}{4}\right)}{\left(\frac{175}{256}\right)} \Rightarrow \right\} \underline{a = 64^*}$ | A1*              |
|             |                                                                                                                                                                                                                                                                                                            | <b>(2)</b>       |
| <b>1(b)</b> | $\{S_{\infty}\} = \frac{64}{\left(1-\frac{3}{4}\right)}; = 256$                                                                                                                                                                                                                                            | M1               |
|             |                                                                                                                                                                                                                                                                                                            | A1 cao           |
|             |                                                                                                                                                                                                                                                                                                            | <b>(2)</b>       |
| <b>1(c)</b> | $\{D = T_9 - T_{10} = \} \quad 64\left(\frac{3}{4}\right)^8 - 64\left(\frac{3}{4}\right)^9$                                                                                                                                                                                                                | M1               |
|             |                                                                                                                                                                                                                                                                                                            | dM1              |
|             | $\left\{ = 64\left(\frac{3}{4}\right)^8 \left(\frac{1}{4}\right) = 1.6018066... \right\} = \underline{1.602} \text{ (3dp)}$                                                                                                                                                                                | A1 cao           |
|             |                                                                                                                                                                                                                                                                                                            | <b>(3)</b>       |
|             |                                                                                                                                                                                                                                                                                                            | <b>(7 marks)</b> |
| <b>2(a)</b> | Uses $360 \times \left(\frac{7}{8}\right)^{19}$ , to obtain 28.5                                                                                                                                                                                                                                           | M1 A1            |
|             |                                                                                                                                                                                                                                                                                                            | <b>(2)</b>       |
| <b>2(b)</b> | Uses $S = \frac{360(1-\left(\frac{7}{8}\right)^{20})}{1-\frac{7}{8}}$ , or $S = \frac{360((\frac{7}{8})^{20}-1)}{\frac{7}{8}-1}$ to obtain 2680                                                                                                                                                            | M1 A1            |
|             |                                                                                                                                                                                                                                                                                                            | <b>(2)</b>       |
| <b>2(c)</b> | Uses $S = \frac{360}{1-\frac{7}{8}}$ , to obtain 2880                                                                                                                                                                                                                                                      | M1 A1 cao        |
|             |                                                                                                                                                                                                                                                                                                            | <b>(2)</b>       |
|             |                                                                                                                                                                                                                                                                                                            | <b>(6 marks)</b> |

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| Question    | Scheme                                                                                            | Marks            |
|-------------|---------------------------------------------------------------------------------------------------|------------------|
| <b>3(a)</b> | $\frac{a}{1-r} = 6a$                                                                              | M1               |
|             | $\{\Rightarrow 1 = 6(1-r) \Rightarrow\} \quad r = \frac{5}{6}^*$                                  | A1*              |
|             |                                                                                                   | <b>(2)</b>       |
| <b>3(b)</b> | $\{T_4 = ar^3 = 62.5 \Rightarrow\} \quad a\left(\frac{5}{6}\right)^3 = 62.5$                      | M1               |
|             | $\Rightarrow a = 108$                                                                             | A1               |
|             |                                                                                                   | <b>(2)</b>       |
| <b>3(c)</b> | $S_{\infty} = 6(\text{their } a) \text{ or } \frac{\text{their } a}{1 - \frac{5}{6}} \{ = 648 \}$ | M1               |
|             | $\{S_{30} = \frac{108(1 - (\frac{5}{6})^{30})}{1 - \frac{5}{6}} \{ = 645.2701573... \}$           | M1 A1ft          |
|             | $\{S_{\infty} - S_{30}\} = 2.72984... \quad \text{awrt } 2.73$                                    | A1               |
|             |                                                                                                   | <b>(4)</b>       |
|             |                                                                                                   | <b>(8 marks)</b> |

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| Question    | Scheme                                                                                                                                      |                                                                                                                                                   | Marks            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>4(a)</b> | $120000 \times (1.05)^3 = 138915 *$                                                                                                         | Or $120000 \times 1.05 \times 1.05 \times 1.05 = 138915$<br>Or 120000, 126000, 132300, 138915<br>Or $a = 120000$ and $a \times (1.05)^3 = 138915$ | B1               |
|             |                                                                                                                                             |                                                                                                                                                   | <b>(1)</b>       |
| <b>4(b)</b> | $120000 \times (1.05)^{n-1} > 200000$                                                                                                       | Allow $n$ or $n - 1$ and “>”, “<”, or “=” etc.                                                                                                    | M1               |
|             | $\log 1.05^{n-1} > \log \left( \frac{5}{3} \right)$                                                                                         | Takes logs correctly<br>Allow $n$ or $n - 1$ and “>”, “<”, or “=” etc.                                                                            | M1               |
|             | $(n-1 >) \frac{\log \left( \frac{5}{3} \right)}{\log 1.05}$ or equivalent<br>e.g. $(n >) \frac{\log \left( \frac{7}{4} \right)}{\log 1.05}$ | Allow $n$ or $n - 1$ and “>”, “<”, or “=” etc. Allow $1.\dot{6}$ or awrt 1.67 for 5/3.                                                            | A1               |
|             | 2024                                                                                                                                        | M1: Identifies a calendar year using their value of $n$ or $n - 1$                                                                                | M1 A1            |
|             |                                                                                                                                             |                                                                                                                                                   | <b>(5)</b>       |
| <b>4(c)</b> | $\frac{a(1-r^n)}{1-r} = \frac{120000(1-1.05^{11})}{1-1.05}$                                                                                 | M1: Correct sum formula with $n = 10$ , 11 or 12                                                                                                  | M1 A1            |
|             |                                                                                                                                             | A1: Correct numerical expression with $n = 11$                                                                                                    |                  |
|             | 1704814                                                                                                                                     | Cao (Allow 1704814.00)                                                                                                                            | A1               |
|             |                                                                                                                                             |                                                                                                                                                   | <b>(3)</b>       |
|             |                                                                                                                                             |                                                                                                                                                   | <b>(9 marks)</b> |

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| Question    | Scheme                                                                                                    |                                                                                      | Marks            |
|-------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------|
| <b>5(a)</b> | $ar = 750$ and $ar^4 = -6$ (could be implied from later working in either (a) or (b)).                    |                                                                                      | B1               |
|             | $r^3 = \frac{-6}{750}$                                                                                    |                                                                                      | M1               |
|             | $r = -\frac{1}{5}$                                                                                        | Correct answer from no working, except for special case below gains all three marks. | A1               |
|             |                                                                                                           |                                                                                      | <b>(3)</b>       |
| <b>5(b)</b> | $a(-0.2) = 750$                                                                                           |                                                                                      | M1               |
|             | $a \left\{ = \frac{750}{-0.2} \right\} = -3750$                                                           |                                                                                      | A1 ft            |
|             |                                                                                                           |                                                                                      | <b>(2)</b>       |
| <b>5(c)</b> | Applies $\frac{a}{1-r}$ correctly using both their $a$ and their $ r  < 1$ . Eg. $\frac{-3750}{1 - -0.2}$ |                                                                                      | M1               |
|             | So, $S_{\infty} = -3125$                                                                                  |                                                                                      | A1               |
|             |                                                                                                           |                                                                                      | <b>(2)</b>       |
|             |                                                                                                           |                                                                                      | <b>(7 marks)</b> |

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| Question    | Scheme                                                                                  |                                                                                                          | Marks             |
|-------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------|
| <b>6(a)</b> | $\{ ar = 192 \text{ and } ar^2 = 144 \}$                                                |                                                                                                          |                   |
|             | $r = \frac{144}{192}$                                                                   | Attempt to eliminate $a$ .                                                                               | M1                |
|             | $r = \frac{3}{4}$ or 0.75                                                               | $\frac{3}{4}$ or 0.75                                                                                    | A1                |
|             |                                                                                         |                                                                                                          | <b>(2)</b>        |
| <b>6(b)</b> | $a(0.75) = 192$                                                                         |                                                                                                          | M1                |
|             | $a \left\{ = \frac{192}{0.75} \right\} = 256$                                           | 256                                                                                                      | A1                |
|             |                                                                                         |                                                                                                          | <b>(2)</b>        |
| <b>6(c)</b> | $S_{\infty} = \frac{256}{1-0.75}$                                                       | Applies $\frac{a}{1-r}$ correctly using both their $a$ <b>and</b> their $ r  < 1$ .                      | M1                |
|             | So, $\{S_{\infty} = \}$ 1024                                                            | 1024                                                                                                     | A1 <b>cao</b>     |
|             |                                                                                         |                                                                                                          | <b>(2)</b>        |
| <b>6(d)</b> | $\frac{256(1 - (0.75)^n)}{1 - 0.75} > 1000$                                             | Applies $S_n$ with their $a$ and $r$ and “uses” 1000 at any point in their working. (Allow with = or <). | M1                |
|             | $(0.75)^n < 1 - \frac{1000(0.25)}{256} \left\{ = \frac{6}{256} \right\}$                | Attempt to isolate $+(r)^n$ from $S_n$ formula. (Allow with = or >).                                     | M1                |
|             | $n \log(0.75) < \log\left(\frac{6}{256}\right)$                                         | Uses the power law of logarithms correctly. (Allow with = or >).                                         | M1                |
|             | $n > \frac{\log\left(\frac{6}{256}\right)}{\log(0.75)} = 13.0471042... \Rightarrow n =$ | $n = 14$                                                                                                 | A1 <b>cso</b>     |
|             |                                                                                         |                                                                                                          | <b>(4)</b>        |
|             |                                                                                         |                                                                                                          | <b>(10 marks)</b> |

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| Question    | Scheme                                                                                                                                                                                                                                         | Marks             |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>7(a)</b> | $a = 7k - 5, ar = 5k - 7$ and $ar^2 = 2k + 10$                                                                                                                                                                                                 | B1                |
|             | (So $r =$ ) $\frac{5k-7}{7k-5} = \frac{2k+10}{5k-7}$ or $(7k-5)(2k+10) = (5k-7)^2$ or<br>equivalent                                                                                                                                            | M1                |
|             | See $(5k-7)^2 = 25k^2 - 70k + 49$                                                                                                                                                                                                              | M1                |
|             | $14k^2 + 60k - 50 = 25k^2 - 70k + 49 \rightarrow 11k^2 - 130k + 99 = 0 *$                                                                                                                                                                      | A1cso *           |
|             |                                                                                                                                                                                                                                                | <b>(4)</b>        |
| <b>7(b)</b> | $(k-11)(11k-9)$ so $k =$                                                                                                                                                                                                                       | M1                |
|             | $k = 9/11$ only* (after rejecting 11)                                                                                                                                                                                                          | A1*               |
|             | <b><u>N.B. Special case <math>k = 9/11</math> can be verified in (b) (1 mark only)</u></b><br>$11 \times \left(\frac{9}{11}\right)^2 - 130 \times \left(\frac{9}{11}\right) + 99 = \frac{81}{11} - \frac{1170}{11} + \frac{1089}{11} = 0$ M1A0 |                   |
|             |                                                                                                                                                                                                                                                | <b>(2)</b>        |
| <b>7(c)</b> | $a = \frac{8}{11}$                                                                                                                                                                                                                             | B1                |
|             | $\frac{5 \times \frac{9}{11} - 7}{7 \times \frac{9}{11} - 5}$ or $\frac{2 \times \frac{9}{11} + 10}{5 \times \frac{9}{11} - 7}$ so $r = -4$                                                                                                    | B1                |
|             | (i) Fourth term = $ar^3 = -\frac{512}{11}$                                                                                                                                                                                                     | M1A1              |
|             | (ii) $S_{10} = \frac{a(1-r^{10})}{(1-r)} = \frac{\frac{8}{11}(1-(-4)^{10})}{(1-(-4))} = -152520$                                                                                                                                               | M1A1              |
|             |                                                                                                                                                                                                                                                | <b>(6)</b>        |
|             |                                                                                                                                                                                                                                                | <b>(12 marks)</b> |

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| Question    | Scheme                                                                                       |                                                                                                               | Marks             |
|-------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------|
| <b>8(a)</b> | $(S_n =) a + ar + (ar^2) + \dots + ar^{n-1}$ and<br>$rS_n = ar + ar^2 + (ar^3) \dots + ar^n$ |                                                                                                               | M1                |
|             | $S_n - rS_n = a - ar^n$                                                                      |                                                                                                               | M1                |
|             | $S_n(1-r) = a(1-r^n)$                                                                        |                                                                                                               | dM1               |
|             | And so result $S_n = \frac{a(1-r^n)}{(1-r)}$ *                                               |                                                                                                               | A1                |
|             |                                                                                              |                                                                                                               | <b>(4)</b>        |
| <b>8(b)</b> | Divides one term by other (either way) to give $r^2 = \dots$ then square roots to give $r =$ | <b>Or:</b> ( <i>Method 2</i> ) Finds geometric mean i.e 3.24 and divides one term by 3.24 or 3.24 by one term | M1                |
|             | $r^2 = \frac{1.944}{5.4}, \quad r = 0.6$ (ignore – 0.6)                                      | $r = 0.6$ (ignore – 0.6)                                                                                      | A1                |
|             |                                                                                              |                                                                                                               | <b>(2)</b>        |
| <b>8(c)</b> | Uses $5.4 \div r^2$ or $1.944 \div r^4$ , to give $a =$                                      |                                                                                                               | M1                |
|             | $a = 15$                                                                                     |                                                                                                               | A1ft              |
|             |                                                                                              |                                                                                                               | <b>(2)</b>        |
| <b>8(d)</b> | Uses $S = \frac{15}{1-0.6}$ , to obtain 37.5                                                 |                                                                                                               | M1 A1 A1          |
|             |                                                                                              |                                                                                                               | <b>(3)</b>        |
|             |                                                                                              |                                                                                                               | <b>(11 marks)</b> |

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|   | <b>Source paper</b> | <b>Question number</b> | <b>New spec references</b> | <b>Question description</b>    | <b>New AOs</b>     |
|---|---------------------|------------------------|----------------------------|--------------------------------|--------------------|
| 1 | C2 2016             | 1                      | 4.5                        | Sequences and series           | 1.1b and 2.1       |
| 2 | C2 Jan 2012         | 1                      | 4.5                        | Geometric sequences and series | 1.1b               |
| 3 | C2 June 2014R       | 2                      | 4.5                        | Geometric sequences and series | 1.1b               |
| 4 | C2 Jan 2013         | 3                      | 4.5, 6.3 and 6.5           | Geometric sequences and series | 1.1b, 2.2a and 2.4 |
| 5 | C2 Jan 2011         | 3                      | 4.5                        | Geometric sequences and series | 1.1b               |
| 6 | C2 2011             | 6                      | 4.5                        | Geometric sequences and series | 1.1b, 2.2a         |
| 7 | C2 2017             | 9                      | 4.5                        | Geometric sequence             | 1.1b, 2.1, 2.2a    |
| 8 | C2 2012             | 9                      | 4.5                        | Geometric sequences and series | 2.1, 1.1b          |