IB DP MATHEMATICS

AA Topic 1 · Number and Algebra

TOPICAL WORKSHEET

1.1 Arithmetic Sequences · 1.2 Geometric Sequences
1.3 Exponents, Logs & Binomial Thm · 1.4 Financial Applications

Standard and Higher Level · Syllabus 2025

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Original exam-style questions written for the IB Diploma Programme Mathematics course (first assessment 2025)

Section A — Multiple Choice (15 marks)

Circle the letter of the best answer to each question. Each question is worth 1 mark.

1. The nth term, u_n, of an arithmetic sequence with first term u_1 and common difference d is given by **[1]**

A $u_n = u_1 r^{n-1}$

B $u_n = u_1 + (n-1)d$

C $u_n = u_1 + nd$

D $u_n = nd + u_1 - 1$

2. An arithmetic sequence has first term $u_1 = 5$ and common difference $d = 3$. The 10th term, u_{10}, is **[1]**

A 27

B 30

C 32

D 35

3. The sum of the first n terms, S_n, of an arithmetic sequence can be calculated using **[1]**

A $S_n = u_1(1-r^n)\div(1-r)$

B $S_n = n\div 2 \times (2u_1 + (n-1)d)$

C $S_n = u_1 r^n$

D $S_n = n \times u_1$

4. Which of the following sequences is arithmetic? **[1]**

A 2, 4, 8, 16, ...

B 1, 4, 9, 16, ...

C 3, 7, 11, 15, ...

D 5, 3, 8, 2, ...

5. The nth term, u_n, of a geometric sequence with first term u_1 and common ratio r is given by **[1]**

A $u_n = u_1 + (n-1)r$

B $u_n = u_1 r^{n-1}$

C $u_n = u_1 r^n$

D $u_n = nu_1 r$

6. A geometric sequence has first term $u_1 = 4$ and common ratio $r = 2$. The 5th term, u_5, is **[1]**

A 16

B 32

C 64

D 128

7. For an infinite geometric series to converge to a finite sum, the common ratio r must satisfy **[1]**

A $r > 1$

B $r \geq 1$

C $|r| < 1$

D $r = 1$

8. For an infinite geometric series with $|r| < 1$, the sum to infinity, S_∞, is given by **[1]**

A $S_\infty = u_1 \div (1-r)$

B $S_\infty = u_1(1-r)$

C $S_\infty = u_1 \div r$

D $S_\infty = n \div (1-r)$

9. Which expression is equivalent to $\log_a(x) + \log_a(y)$? **[1]**

A $\log_a(x + y)$

B $\log_a(xy)$

C $\log_a(x \div y)$

D $\log_a(x) \times \log_a(y)$

10. The solution to $2^x = 8$ is **[1]**

A $x = 2$

B $x = 3$

C $x = 4$

D $x = 8$

11. In the binomial expansion of $(x + y)^n$, the general term is given by **[1]**

A ${}^nC_r\, x^r y^{n-r}$

B ${}^nC_r\, x^{n-r} y^r$

C $n \div r \times x^n y^r$

D ${}^nC_r\, (x+y)^r$

12. $\log_a(1)$ is equal to **[1]**

A a

B 1

C 0

D undefined

13. The future value, FV, of an investment of PV earning compound interest at a rate r per period for n periods is given by **[1]**

A $FV = PV(1 + rn)$

B $FV = PV(1 + r)^n$

C $FV = PV \times rn$

D $FV = PV + r^n$

14. An investment of $1000 earns compound interest at 5% per annum. Its value after 2 years is **[1]**

A $1050.00

B $1100.00

C $1102.50

D $1150.00

15. For the same principal and interest rate, over a long time period, compound interest compared with simple interest results in **[1]**

A exactly the same final value

B a smaller final value

C a greater final value, growing exponentially rather than linearly

D a final value that cannot be determined

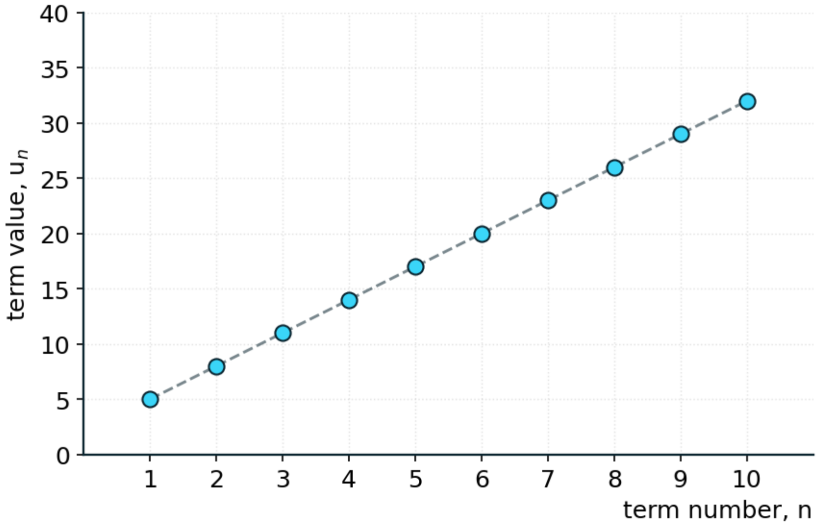
Section B — Structured Questions (65 marks)

Answer all questions in the space provided. Working must be shown for full marks.

1.1 Arithmetic Sequences

Question 1 [7 marks]

The graph shows the first 10 terms of an arithmetic sequence (computed).



Terms u_n of an arithmetic sequence for n = 1 to 10 (computed).

(a) Using the graph, write down the value of the first term u_1 and the common difference d of the sequence. **[2]**

(b) Using $u_n = u_1 + (n-1)d$, calculate u_{10}, the 10th term, and confirm this matches the graph. **[2]**

(c) The sequence is continued beyond the terms shown on the graph. Using the formula for the nth term, predict u_{15}, the 15th term. **[3]**

Question 2 [6 marks]

Arithmetic sequences and series can be described using standard formulas relating u_1, d, n, and S_n.

(a) State the formula for the nth term, u_n, of an arithmetic sequence, defining each symbol used. **[2]**

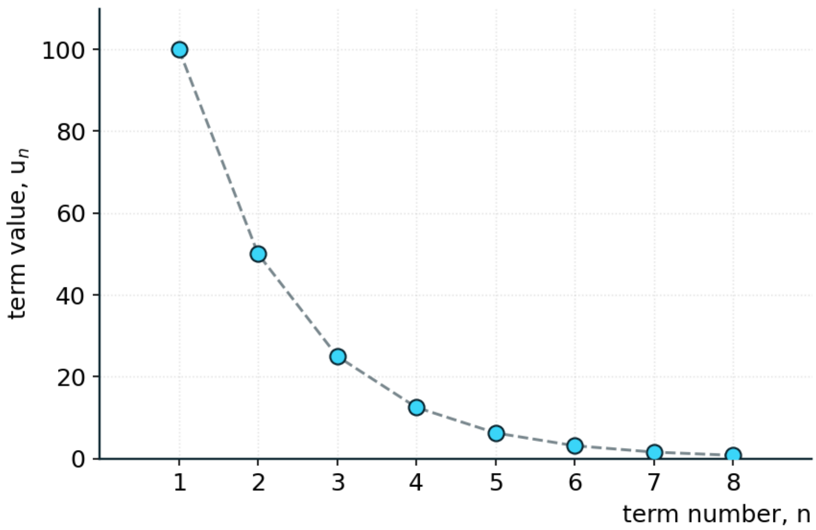
(b) State the formula for the sum of the first n terms, S_n, of an arithmetic sequence. **[2]**

(c) An arithmetic sequence has $u_1 = 8$ and $u_5 = 24$. Find the common difference, d. **[2]**

1.2 Geometric Sequences

Question 3 [7 marks]

The graph shows the first 8 terms of a geometric sequence (computed).



Terms u_n of a geometric sequence for n = 1 to 8 (computed).

(a) Using the graph, write down the value of u_1, and use two consecutive terms to determine the common ratio, r. **[2]**

(b) Using $u_n = u_1 r^{n-1}$, verify the value of u_4 shown on the graph. **[2]**

(c) Calculate u_9, the 9th term of the sequence (beyond the terms shown on the graph), giving your answer to 3 significant figures. **[3]**

Question 4 [6 marks]

Geometric sequences and series can also be described using standard formulas relating u_1, r, n, and S_n.

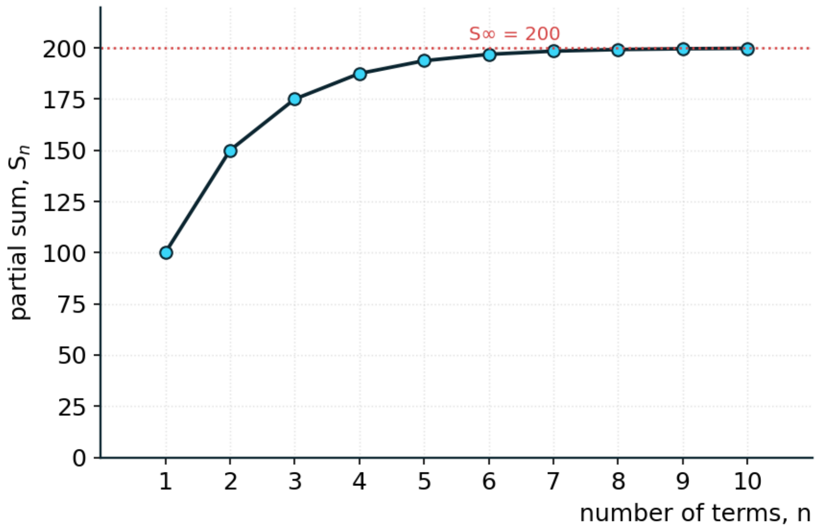
(a) State the formula for the nth term, u_n, of a geometric sequence, defining each symbol used. **[2]**

(b) State the formula for the sum of the first n terms, S_n, of a geometric sequence (for $r \neq 1$). **[2]**

(c) A geometric sequence has $u_1 = 6$ and $u_4 = 48$. Find the common ratio, r. **[2]**

Question 5 [7 marks]

The graph shows the partial sum S_n (the sum of the first n terms) of the same geometric sequence, $u_1 = 100$, $r = 0.5$, plotted against n (computed).



Partial sums S_n of a geometric series, $u_1 = 100$, $r = 0.5$ (computed).

(a) Using the graph, describe what happens to S_n as n increases, and estimate the value that S_n approaches. **[2]**

(b) State the condition on r required for an infinite geometric series to have a finite sum to infinity, and state whether this condition is satisfied here. **[2]**

(c) Using $S\infty = u_1 \div (1 - r)$, calculate the exact value of $S\infty$, and confirm it matches your estimate from the graph. **[3]**

1.3 Exponents & Logarithms

Question 6 [6 marks]

The laws of logarithms allow expressions involving logarithms to be simplified or combined.

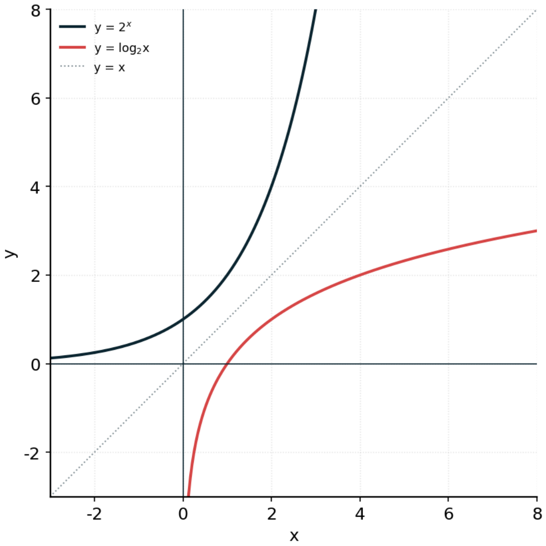
(a) State the law of logarithms for $\log_a(x) + \log_a(y)$, and for $\log_a(x) - \log_a(y)$. **[2]**

(b) Simplify $\log_a(x^3)$ in terms of $\log_a(x)$. **[2]**

(c) Solve for x: $\log_2(x) = 5$. **[2]**

Question 7 [7 marks]

The graph shows $y = 2^x$ and $y = \log_2 x$ plotted together with the line $y = x$ (computed).



$y = 2^x$ and $y = \log_2 x$, shown with the line $y = x$ (computed).

(a) Using the graph, describe the relationship between the graphs of $y = 2^x$ and $y = \log_2 x$. **[2]**

(b) Using the graph, estimate the solution to the equation $2^x = 6$. **[2]**

(c) Calculate $\log_2(6)$ algebraically, using the change-of-base formula, giving your answer to 3 significant figures. Confirm this is consistent with your estimate in part (b). **[3]**

Question 8 [6 marks]

The binomial theorem allows expressions of the form $(x+y)^n$ to be expanded without repeated multiplication.

(a) State the general term in the binomial expansion of $(x+y)^n$, in terms of n, r, x, and y. **[2]**

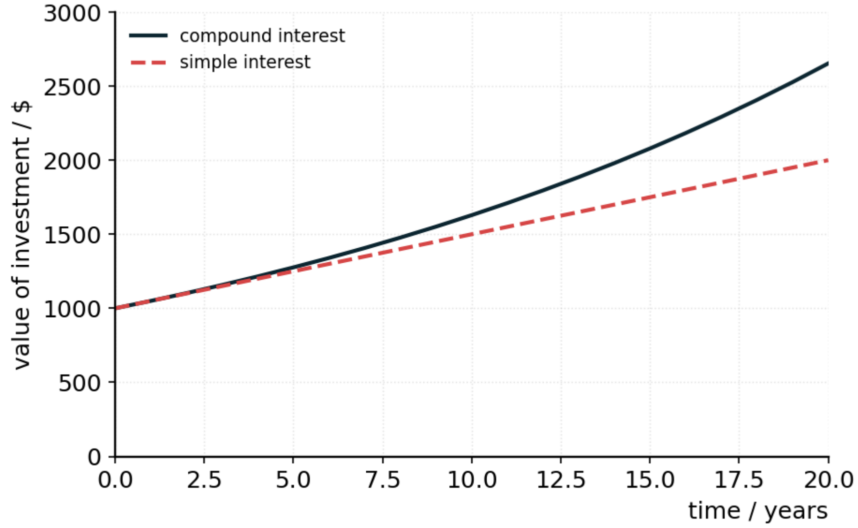
(b) Write out the full binomial expansion of $(x+2)^3$. **[2]**

(c) Hence state the coefficient of x^2 in this expansion. **[2]**

1.4 Financial Applications

Question 9 [7 marks]

The graph shows the value of a $1000 investment over 20 years, earning 5% per annum, under compound interest and under simple interest (computed).



Value of a $1000 investment at 5% per annum: compound interest vs simple interest (computed).

(a) Using the graph, compare how the value of the compound-interest investment changes over time with the value of the simple-interest investment. **[2]**

(b) Using $FV = PV(1+r)^n$, calculate the value of the compound-interest investment after 20 years, confirming it matches the graph. **[2]**

(c) Calculate the value of the simple-interest investment after 20 years, and hence find the difference between the two investments at that time. **[3]**

Question 10 [6 marks]

Compound interest is widely used in real-world financial applications, such as savings accounts, loans, and investments.

(a) Define 'compound interest', distinguishing it from simple interest. **[2]**

(b) Calculate the value of a $2000 investment after 3 years at 4% per annum compound interest. **[2]**

(c) Explain why compound interest results in a greater final value than simple interest over long time periods, for the same principal and rate. **[2]**