S4 Mathematics Module 1 Practice Paper 1 | Binomial, log equations, induction, series

Senior Secondary Mathematics (Module 1)

S4 Mathematics Module 1 practice paper with worked answers: binomial coefficients, log equations, induction, series and graph transformations.

1. Binomial expansion and coefficients (18 marks)

Find the coefficients only; no need to expand fully.

#	Question
1	(a) Find the coefficient of x^3 in the expansion of (1 + 2x)^5.
2	(b) Find the coefficient of x^2 in the expansion of (2 - x)^6.
3	(c) Find the sum of the constant term and the coefficient of x in the expansion of (1 + 3x)^7.
4	(d) Find the sum of all coefficients in the expansion of (1 + x)^10.

2. Exponential and logarithmic equations (16 marks)

Check the domain of the logarithm, and give a whole number of years in (d).

#	Question
5	(a) Solve 2^(x+1) = 32.
6	(b) Solve log base 3 of x plus log base 3 of (x - 2) equals 1.
7	(c) Simplify log 8 divided by log 2 plus log base 5 of 25.
8	(d) An amount grows at 6% per year, compounded yearly. Find the least whole number of years needed for the amount to double.

3. Mathematical induction (18 marks)

Write the basis step, the induction assumption and the induction step in order.

#	Question
9	(a) For the statement 1 + 3 + 5 + … + (2n - 1) = n^2, write the basis step for n = 1.
10	(b) From (a), assume the statement holds for n = k and write the step leading to n = k + 1.
11	(c) Use the formula to check the sum 1 + 3 + 5 + … + 19.
12	(d) Find the sum 1 + 3 + 5 + … + 99.

4. Sequences and series (16 marks)

The infinite geometric sum applies only when the common ratio has absolute value below 1.

#	Question
13	(a) An arithmetic sequence has first term 5 and common difference 4. Find the 12th term.
14	(b) From (a), find the sum of the first 12 terms.
15	(c) A geometric sequence has first term 3 and common ratio 2. Find the sum of the first 8 terms.
16	(d) An infinite geometric sequence has first term 8 and common ratio 1/4. Find its sum to infinity to 2 decimal places.

5. Transformations of graphs (16 marks)

Horizontal shifts change x; vertical shifts change the whole function value.

#	Question
17	(a) The graph of y = f(x) is shifted 3 units to the right and then 2 units up. Write the new function.
18	(b) From (a), if the original graph is y = x^2, find the vertex of the new graph.
19	(c) The graph of y = f(x) is stretched by a factor of 2 parallel to the y-axis and then reflected in the x-axis. Write the new function.
20	(d) After the graph of y = 2^x is shifted 2 units to the left, at which point does it cut the y-axis?

6. Modelling with functions (16 marks)

State the domain in your model; in (d) round to the nearest thousand.

#	Question
21	(a) A rectangle has perimeter 40 m. Let its width be x m. Express the area A in m² as a function of x and state the domain.
22	(b) From (a), find the greatest possible area.
23	(c) A spherical balloon is inflated from radius 3 cm to radius 6 cm. By what factor does its volume increase?
24	(d) A city population is modelled by P(t) = 500 000 x 1.02^t, where t is in years. Find the population at t = 10, correct to the nearest thousand.