S2 Mathematics Practice Paper: Laws of Indices and Scientific Notation, Polynomial Expansion and Factorisation, Simultaneous Linear Equations, Ratio and Variation, Pythagoras Theorem, Statistics and Probability

S2 | Mathematics | Time: 75 minutes | Total: 100 marks | 24 questions

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Part 1: Laws of Indices and Scientific Notation

Evaluate the following. Show your steps and give exact or reasonable decimal answers.

1. Find the value of 2^5 x 2^-3. [4]

Answer: Multiply powers of the same base by adding indices: 2^5 x 2^-3 = 2^(5-3) = 2^2 = 4.

2. Given x = 2, find (3x^2)^3. [4]

Answer: (3x^2)^3 = 27x^6; with x = 2 it is 27 x 64 = 1728, since 3 x 4 = 12 and 12 cubed is 1728.

3. Write 0.00045 in scientific notation, then multiply by 4 x 10^3. [4]

Answer: 0.00045 = 4.5 x 10^-4, so 4.5 x 10^-4 x 4 x 10^3 = 18 x 10^-1 = 1.8.

4. Find 6.4 x 10^5 / (3.2 x 10^2) and give the answer in scientific notation. [4]

Answer: 6.4 / 3.2 = 2 and 10^5 / 10^2 = 10^3, so the answer is 2 x 10^3 = 2000.

Part 2: Polynomial Expansion and Factorisation

Show full working; factorise completely.

5. Expand (2x + 3)(x - 5) and evaluate it when x = 2. [4]

Answer: = 2x^2 - 10x + 3x - 15 = 2x^2 - 7x - 15; at x = 2 it is 8 - 14 - 15 = -21, which matches 7 x (-3) = -21.

6. Expand (x + 4)^2 - (x - 4)^2 and evaluate it when x = 3. [4]

Answer: (x^2 + 8x + 16) - (x^2 - 8x + 16) = 16x; at x = 3 it is 48.

7. Factorise 12x^2 - 18x + 6 and check the result at x = 2. [5]

Answer: Take out 6 first: 6(2x^2 - 3x + 1) = 6(2x - 1)(x - 1); at x = 2 the original gives 18 and 6 x 3 x 1 = 18.

8. Factorise x^2 - 49 and 4x^2 - 20x + 25. [5]

Answer: Difference of squares: x^2 - 49 = (x + 7)(x - 7); perfect square: 4x^2 - 20x + 25 = (2x - 5)^2, which equals 25 at x = 5.

Part 3: Simultaneous Linear Equations

Use substitution or elimination; state both unknowns.

9. Solve x + y = 12 and x - y = 4. [4]

Answer: Adding gives 2x = 16, so x = 8 and y = 4.

10. Solve 2x + 3y = 19 and x - y = 2. [4]

Answer: From the second equation x = y + 2, so 2(y + 2) + 3y = 19, 5y = 15, y = 3 and x = 5.

11. A cage holds chickens and rabbits with 30 heads and 82 legs. Find the number of each. [4]

Answer: c + r = 30 and 2c + 4r = 82, giving r = 11 and c = 19; check 4 x 11 + 2 x 19 = 82.

12. Solve 3x + 2y = 16 and 5x - 2y = 8. [4]

Answer: Adding gives 8x = 24, so x = 3 and then y = 3.5.

Part 4: Ratio and Variation

State the constant or ratio first, then find the answer; money is in dollars.

13. y varies directly as x, and y = 15 when x = 6. Find y when x = 10. [4]

Answer: y = kx with k = 15 / 6 = 2.5, so y = 2.5 x 10 = 25 when x = 10.

14. y varies inversely as x, and y = 9 when x = 4. Find y when x = 3. [4]

Answer: xy = k with k = 4 x 9 = 36, so y = 36 / 3 = 12 when x = 3.

15. Divide $4,800 among three people in the ratio 3 : 4 : 5. [4]

Answer: The 12 parts are worth $4,800 / 12 = 400 each, so the shares are $1200, $1600 and $2000.

16. A map has a scale of 1 : 25,000 and two places are 6.4 cm apart on it. Find the real distance in km. [4]

Answer: Real distance = 6.4 x 25,000 = 160000 cm = 1.6 km.

Part 5: Pythagoras Theorem

Give non-integer answers to 1 decimal place and state the formula used.

17. A right-angled triangle has legs 9 cm and 12 cm. Find the hypotenuse. [4]

Answer: c^2 = 9^2 + 12^2 = 81 + 144 = 225, so c = 15 cm.

18. A right-angled triangle has hypotenuse 13 cm and one leg 5 cm. Find the other leg. [4]

Answer: b^2 = 13^2 - 5^2 = 169 - 25 = 144, so b = 12 cm.

19. Is a triangle with sides 7 cm, 24 cm and 25 cm right-angled? Explain. [4]

Answer: 7^2 + 24^2 = 49 + 576 = 625 = 25^2, so the square on the longest side equals the sum of the other two; the triangle is right-angled.

20. A 13 m ladder leans on a wall with its foot 5 m from the wall. If the foot slides to 6 m, how far does the top fall (1 d.p.)? [5]

Answer: Original height = sqrt(169 - 25) = 12 m; after sliding it is sqrt(169 - 36) = 11.5 m, so the top falls about 0.5 m.

Part 6: Statistics and Probability

Give probabilities as fractions and as decimals to 3 places; show the mean working.

21. For 12, 15, 15, 18, 20, 25 find the mean, median and mode. [4]

Answer: Mean = 105 / 6 = 17.5, median = (15 + 18) / 2 = 16.5 and mode = 15.

22. A bag holds 5 red, 3 blue and 2 green balls. One ball is drawn at random; find P(red) and P(not green). [4]

Answer: There are 10 balls, so P(red) = 5/10 = 0.5 and P(not green) = 8/10 = 0.8.

23. Three test scores are 70, 80 and 90 with weights 2 : 3 : 5. Find the weighted mean. [4]

Answer: Weighted mean = (70 x 2 + 80 x 3 + 90 x 5) / 10 = (140 + 240 + 450) / 10 = 83.

24. Two fair dice are thrown. Find the probability that the total is 7 and that it is 12 (fraction and 3 d.p.). [5]

Answer: There are 36 equally likely outcomes; six give a total of 7, so the probability is 6/36 = 1/6 = 0.167, while only (6,6) gives 12, so it is 1/36 = 0.028.
