S2 Mathematics Practice Paper I Index laws, factorisation, simultaneous equations, percentages, sectors, statistics

S2 Mathematics I Time allowed: 60 minutes I Total: 100 marks I 24 questions

Section A: Indices and algebraic expressions

Simplify the following. Give answers with positive indices.

1. Simplify (2a^3 b)^2 x 3a^-1 b^4. (4 marks)

> **Answer:** (2a^3 b)^2 = 4a^6 b^2; 4a^6 b^2 x 3a^-1 b^4 = 12 a^5 b^6.

2. Simplify x^5 y^-2 / (x^2 y^3). (4 marks)

> **Answer:** x^5 y^-2 / (x^2 y^3) = x^(5-2) y^(-2-3) = x^3 / y^5.

3. Evaluate 2^0 + 3^-2 x 9. (4 marks)

> **Answer:** 2^0 = 1; 3^-2 x 9 = (1/9) x 9 = 1; so the total is 1 + 1 = 2.

4. If 2^n = 32, find n. (4 marks)

> **Answer:** 32 = 2^5, so comparing indices gives n = 5.

Section B: Expansion and factorisation

Expand or factorise the following.

5. Expand (3x - 2)(x + 5). (4 marks)

> **Answer:** 3x(x) + 3x(5) - 2(x) - 2(5) = 3x^2 + 15x - 2x - 10 = 3x^2 + 13x - 10.

6. Expand (2a - 3b)^2. (4 marks)

> **Answer:** (2a)^2 - 2(2a)(3b) + (3b)^2 = 4a^2 - 12ab + 9b^2.

7. Factorise x^2 - 7x + 12. (4 marks)

> **Answer:** Two numbers with product 12 and sum -7 are -3 and -4, so x^2 - 7x + 12 = (x - 3)(x - 4).

8. Factorise 4y^2 - 25. (4 marks)

> **Answer:** 4y^2 - 25 = (2y)^2 - 5^2 = (2y + 5)(2y - 5).

Section C: Simultaneous linear equations

Solve the following and show a check.

9. Solve 2x + y = 11 and x - y = 1. (4 marks)

> **Answer:** Adding the two equations: 3x = 12, x = 4; then y = x - 1 = 3. Check: 2(4) + 3 = 11.

10. Solve 3x - 2y = 4 and x + 2y = 12. (4 marks)

> **Answer:** Adding: 4x = 16, x = 4; then 2y = 12 - 4 = 8, y = 4. Check: 3(4) - 2(4) = 4.

11. Two numbers have a sum of 30 and a difference of 8. Find them. (4 marks)

> **Answer:** Let x be the larger and y the smaller: x + y = 30, x - y = 8; adding gives 2x = 38, x = 19, so y = 11.

12. If 5x + 2y = 20 and x = 2, find y. (4 marks)

> **Answer:** Substitute x = 2: 10 + 2y = 20, 2y = 10, so y = 5.

Section D: Percentages

Show your working in each part.

13. An item marked at $480 is sold at 25% off. Find the selling price. (4 marks)

> **Answer:** 480 x 0.75 = $360.

14. The population of a district grows from 25 000 to 27 500. Find the percentage increase. (4 marks)

> **Answer:** (27 500 - 25 000) / 25 000 x 100% = 2 500 / 25 000 x 100% = 10%.

15. An item costs $120 and is sold at a 35% profit. Find the selling price. (4 marks)

> **Answer:** 120 x (1 + 35%) = 120 x 1.35 = $162.

16. After a 20% price increase an item sells for $600. Find the original price. (4 marks)

> **Answer:** Original price x 1.2 = 600, so original price = 600 / 1.2 = $500.

Section E: Circles and sectors (take pi = 22/7)

Take pi = 22/7 and give units in your answers.

17. A circle has radius 7 cm. Find its area. (5 marks)

> **Answer:** Area = (22/7) x 7^2 = (22/7) x 49 = 154 cm^2.

18. Find the circumference of the same circle. (5 marks)

> **Answer:** Circumference = 2 x (22/7) x 7 = 44 cm.

19. A sector has radius 7 cm and angle 120 degrees. Find its arc length. (4 marks)

> **Answer:** Arc length = 44 x 120/360 = 44/3 cm, about 14.7 cm.

20. Find the area of that sector. (4 marks)

> **Answer:** Sector area = 154 x 120/360 = 154/3 cm^2, about 51.3 cm^2.

Section F: Statistics

Use the data 12, 15, 15, 18, 20, 20, 20, 24 for the following.

21. Find the mean of the data. (5 marks)

> **Answer:** Sum = 12 + 15 + 15 + 18 + 20 + 20 + 20 + 24 = 144; mean = 144 / 8 = 18.

22. Find the median of the data. (5 marks)

> **Answer:** With 8 ordered values the middle two are 18 and 20, so median = (18 + 20) / 2 = 19.

23. Find the mode of the data. (4 marks)

> **Answer:** 20 appears 3 times, more than any other value, so the mode is 20.

24. Find the range of the data. (4 marks)

> **Answer:** Range = largest - smallest = 24 - 12 = 12.
