Power Play: Thinking Puzzles

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. Any non-zero number raised to the power 0 equals:

(a) the number itself **(b)** undefined
(c) 0 **(d)** 1

2. Which of these has the greatest value?

(a) 2^6 **(b)** 8^6 **(c)** 5^6 **(d)** 9^6

3. What comes next? 8, 20, 68, 260, ?

(a) 1,028 **(b)** 1,032 **(c)** 1,024 **(d)** 1,040

4. A uniform comes in 3 shirt colours, 7 trouser colours and 2 kinds of cap. How many different outfits of one shirt, one pair of trousers and one cap are there?

(a) 42 **(b)** 23 **(c)** 12 **(d)** 21

5. A water weed doubles its area every day and covers a whole pond on day 27. On which day did it cover half of the pond?

(a) 26 **(b)** 27 **(c)** 13 **(d)** 25

6. $8^3 \times 8^8 \div 8^{10} = 8^x$. What is x?

(a) 21 **(b)** 14 **(c)** 1 **(d)** 24

7. A lock has 6 dials, each showing one of 10 symbols. How many different settings are there?

(a) 1,000,000 **(b)** 1,000,010 **(c)** 60 **(d)** 999,999

8. What is the units digit of 8^{82}?

(a) 8 **(b)** 4 **(c)** 2 **(d)** 6

Section B — Short answer — 8 × 2 = 16 marks

9. Why is 5^0 equal to 1? Use a pattern.

10. Find the value of $(3^2)^2 \div 3^3$.

11. What is the units digit of $3^{35} \times 8^{14}$?

12. A team of 2 is chosen from 8 students A, B, C, D, E, F, G, H. B and F must be chosen together or not at all. How many different teams are possible?

13. One grain of rice is placed on day 1, and the number doubles each day. (a) How many grains are placed on day 20? (b) How many grains in all from day 1 to day 20?

14. $9{,}765{,}625 = 5^x$. Find x.

15. A 6-digit code uses the digits 0–9, and the last digit must be even. How many codes are possible?

16. Which is greater, 6^9 or 9^6? Write the value of the greater one.

Section C — Word problems — 4 × 4 = 16 marks

17. A culture starts with 18 cells and doubles every 4 hours. (a) How many cells are there after 24 hours? (b) After how many hours does the number first exceed 9,229?

18. Kabir saves ₹25 in month 1 and doubles the amount each month. (a) How much is saved in month 7? (b) What are the total savings after 7 months? (c) In which month does the amount saved first exceed ₹205?

19. A bag can carry at most 29 units. Each notebook weighs 3 units and earns 19 points; each dictionary weighs 5 units and earns 28 points; each atlas weighs 6 units and earns 41 points. At least one of each must go in. What is the greatest number of points possible?

20. A canteen offers 3 starters, 5 main dishes and 4 desserts. (a) How many different meals of one of each are there? (b) One starter cannot be served with one particular main dish. How many meals are possible now? (c) Without that rule, how many meals are possible if one more dessert is added?

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Answer key

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Q	Answer	Working
1	**(d) 1**	—
2	**(d) 9^6**	$2^6 = 64 < 5^6 = 15{,}625 < 8^6 = 262{,}144 < 9^6 = 531{,}441$
3	**(a) 1,028**	each term is $4^n + 4$: $4^5 + 4 = 1028$
4	**(a) 42**	3 × 7 × 2
5	**(a) 26**	go back one day for each halving: 27 − 1
6	**(c) 1**	add exponents when multiplying, subtract when dividing: 3 + 8 − 10
7	**(a) 1,000,000**	10 choices on each of 6 dials: 10^6
8	**(b) 4**	units digits of 8^1, 8^2, … repeat: 8, 4, 2, 6; 82 → position 2
9	**$5^3 = 125$, $5^2 = 25$, $5^1 = 5$: each step divides by 5, so the next is 5 ÷ 5 = 1.**	—
10	**3**	$3^4 \div 3^3 = 3^1$
11	**8**	units digits 7 and 4; 7 × 4 = 28
12	**16**	neither: 15; both: 1
13	**(a) 524,288; (b) 1,048,575**	day 20: 2^{19}; total $2^{20} - 1$
14	**x = 10**	divide by 5 repeatedly: 10 times
15	**500,000**	$10^5 \times 5$
16	**10,077,696**	$6^9 = 10{,}077{,}696$, $9^6 = 531{,}441$
17	**(a) 1,152; (b) 40 hours**	6 doublings: 18×2^6; 10 doublings: $18 \times 2^{10} = 18{,}432$
18	**(a) ₹1,600; (b) ₹3,175; (c) 5**	month k: 25 × 2^(k − 1); total $25 \times (2^7 - 1)$
19	**189 points**	best: 2 × notebook, 1 × dictionary, 3 × atlas (weight 29)
20	**(a) 60; (b) 56; (c) 75**	3 × 5 × 4; remove the 4 meals with the banned pair; 3 × 5 × 5

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