MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
35	55 minutes	3

Name: _____ Class: _____

Date: _____

MARK ____ / 35

INSTRUCTIONS AND INFORMATION

1. Answer **ALL** the questions in this question paper.
2. Answer QUESTION 1 by **circling** the letter (A–D) in the answer grid at the end of that section.
3. Show **ALL** calculations clearly.
4. Show all units where applicable.
5. Number the answers correctly according to the numbering system used in this question paper.
6. A non-programmable calculator may be used, unless stated otherwise.
7. Write neatly and legibly.

QUESTION 1 [10 MARKS]

Four options are given as possible answers to the following questions. Choose the correct answer and circle the letter (A–D) in the grid at the end of this section. If you want to change your choice, put a cross through the wrong letter and circle your new choice.

1.1 $2^{-3} = \ldots$ (1)

A) $\frac{1}{8}$ ✓ **B)** $\frac{-1}{8}$

C) -6 **D)** -8

Answer: A — A negative exponent means the RECIPROCAL: $2^{-3} = 1 \div 2^3 = \frac{1}{8}$.

- **B** — the base is positive, so the answer stays positive
- **C** — multiplied 2 by -3
- **D** — made the answer negative; a negative exponent flips the base instead

1.2 $16^{½} = \ldots$ (1)

A) $\frac{1}{16}$ **B)** 8

C) 32 **D)** 4 ✓

Answer: D — A power of ½ is the SQUARE ROOT, and $\sqrt{16} = 4$.

- **A** — treated the ½ as a negative exponent
- **B** — halved 16 instead of square-rooting it
- **C** — multiplied 16 by 2

1.3 $8^{\frac{2}{3}} = \ldots$ (1)

A) 512 **B)** 64

C) $\frac{16}{3}$ **D) 4 ✓**

> **Answer: D** — The denominator 3 is the CUBE root ($\sqrt[3]{8} = 2$) and the numerator 2 is the power: $2^2 = 4$.
> - **A** — cubed 8 instead of taking its CUBE ROOT
> - **B** — squared 8 and forgot the cube root
> - **C** — multiplied 8 by $\frac{2}{3}$ — an exponent is not a multiplier

1.4 $(3x^2)^3 = \ldots$ (1)

A) $9x^6$ **B)** $27x^5$

C) $\mathbf{27x^6}$ **✓** **D)** $3x^6$

> **Answer: C** — Everything inside the bracket is cubed: $3^3 = 27$ and $(x^2)^3 = x^6$.
> - **A** — squared the 3 instead of cubing it
> - **B** — ADDED the exponents 2 and 3 instead of multiplying them
> - **D** — never raised the 3 to the power at all

1.5 If $3^x = 81$, then $x = \ldots$ (1)

A) 5 **B)** 3

C) 4 ✓ **D)** 27

> **Answer: C** — $81 = 3^4$, so matching the bases gives $x = 4$.
> - **A** — counted 3, 9, 27, 81, 243 and stopped one step too late
> - **B** — read off the base instead of the exponent
> - **D** — divided 81 by 3 instead of matching the bases

1.6 If $2^{x+1} = 32$, then $x = \ldots$ (1)

A) 5 **B) 4 ✓**

C) 15 **D)** 16

> **Answer: B** — $32 = 2^5$, so $x + 1 = 5$ and $x = 4$.
> - **A** — solved $x + 1 = 5$ but forgot to subtract the 1
> - **C** — halved 32 and then subtracted 1
> - **D** — halved 32

1.7 $\frac{x^5 \times x^3}{x^2} = \ldots$ (1)

A) x^{15} **B)** $\mathbf{x^6}$ **✓**

C) x^{10} **D)** x^4

> **Answer: B** — Multiplying ADDS exponents ($5 + 3 = 8$) and dividing SUBTRACTS them ($8 - 2 = 6$).
> - **A** — multiplied the exponents 5 and 3 instead of adding them
> - **C** — added all three exponents instead of subtracting the last
> - **D** — divided 8 by 2 instead of subtracting the 2

1.8 $\sqrt[3]{x^5}$ written with a rational exponent is ... (1)

A) x^{15} **B)** x^2

C) $x^{\frac{3}{5}}$ **D)** $x^{\frac{5}{3}}$ ✓

> **Answer: D** — The ROOT becomes the denominator of the exponent and the power becomes the numerator.
>
> - **A** — multiplied 5 by 3 instead of writing a fraction
> - **B** — subtracted 3 from 5
> - **C** — put the root on top and the power underneath — they are the other way round

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1.9 $5^0 + 3^{-1} = \ldots$ (1)

A) $\frac{4}{3}$ ✓ **B)** 0

C) $\frac{1}{3}$ **D)** $\frac{1}{15}$

> **Answer: A** — Anything to the power 0 is 1, and $3^{-1} = \frac{1}{3}$, so the total is $1 + \frac{1}{3} = \frac{4}{3}$.
>
> - **B** — took 5^0 as 0 instead of 1, and 3^{-1} as 0 too
> - **C** — took 5^0 as 0 and kept only the $\frac{1}{3}$
> - **D** — read 5^0 as $\frac{1}{5}$ and then MULTIPLIED instead of adding

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1.10 A colony starts with 3 bacteria and DOUBLES every hour. After 6 hours there are ... (1)

A) 18 **B)** 64

C) 192 ✓ **D)** 36

> **Answer: C** — Doubling six times multiplies by $2^6 = 64$, and $3 \times 64 = 192$.
>
> - **A** — multiplied 3 by 6 — doubling is repeated multiplication, not addition
> - **B** — forgot the starting number of 3
> - **D** — worked out $3 \times 2 \times 6$ instead of 3×2^6

ANSWER GRID — MARKING GUIDELINE

1.1	(A)	B	C	D
1.2	A	B	C	(D)
1.3	A	B	C	(D)
1.4	A	B	(C)	D
1.5	A	B	(C)	D
1.6	A	(B)	C	D
1.7	A	(B)	C	D
1.8	A	B	C	(D)
1.9	(A)	B	C	D
1.10	A	B	(C)	D

QUESTION 2 [11 MARKS]

Simplify the following. Leave your answers with POSITIVE exponents.

2.1 $\dfrac{3^{x+1} - 3^x}{3^x}$ **(4)**

Factorise the numerator: $3^x(3 - 1)$ *(2)*

$= \dfrac{2 \times 3^x}{3^x}$ *(1)* $= \mathbf{2}$ *(1)*

2.2 $\dfrac{2^{x+3}}{2^x}$ **(3)**

$= 2^{(x+3)-x}$ *(2)* $= 2^3 = \mathbf{8}$ *(1)*

2.3 $\dfrac{12a^5b^2}{4a^2b^6}$ **(4)**

$12 \div 4 = 3$ *(1)*

$a^{5-2} = a^3$ *(1)*

$b^{2-6} = b^{-4}$ *(1)*

$= \dfrac{\mathbf{3a^3}}{\mathbf{b^4}}$ *(1)*

QUESTION 3 [14 MARKS]

Calculate the following WITHOUT a calculator, and solve the equations that follow.

3.1 $16^{-\frac{3}{4}}$ **(4)**

Deal with the negative first: $\dfrac{1}{16^{\frac{3}{4}}}$ *(1)*

$16^{\frac{3}{4}} = 2^3 = 8$ *(2)*

$= \mathbf{\dfrac{1}{8}}$ *(1)*

3.2 $27^{\frac{2}{3}}$ **(3)**

$= (\sqrt[3]{27})^2$ — the CUBE root first *(2)* $= 3^2 = \mathbf{9}$ *(1)*

3.3 Solve for x: $5^{2x} = 125$ **(3)**

$125 = 5^3$ *(1)*

$2x = 3$ *(1)*

$\boldsymbol{x = 1{,}5}$ *(1)*

3.4 Solve for x: $3^{3x-1} = 27$ **(4)**

$27 = 3^3$ *(1)*

$3x - 1 = 3$ *(2)*

$\boldsymbol{x = \dfrac{4}{3}}$ *(1)*

TOTAL: 35 marks

This question paper consists of 3 questions.

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