Name ANSWERS	Class

MATHS TEACHER HUB

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Indices

(9 – 1) Topic booklet

Higher

These questions have been collated from previous years GCSE Mathematics papers.

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.	Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Diagrams are NOT accurately drawn, unless otherwise indicated.
- You must **show all your working out.**
- If the question is a **1H** question you are not allowed to use a calculator.
- If the question is a **2H** or a **3H** question, you may use a calculator to help you answer.

Information

- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Answer ALL questions
Write your answers in the space provided.
You must write down all the stages in your working.

1 (a) Simplify $(x^3)^5$

x^{15}

(1)

June 2022 – Paper 2H

(Total for Question 1 is 5 marks)

1 (a) Simplify $n^3 \times n^5$

n^8

(1)

(b) Simplify $\dfrac{c^3d^4}{c^2d}$

cd^3

(2)

November 2020 – Paper 3H

(Total for Question 1 is 3 marks)

1 Work out the value of $\frac{3^7 \times 3^{-2}}{3^3}$ $= \frac{3^5}{3^3} = 3^2$

9

November 2018 – Paper 1H

(Total for Question 1 is 2 marks)

1 (a) Simplify $m^3 \times m^4$

m^7

(1)

(b) Simplify $(5np^3)^3$

$125n^3p^9$

(2)

(c) Simplify $\frac{32q^9r^4}{4q^3r}$

$8q^6r^3$

(2)

June 2018 – Paper 2H

(Total for Question 1 is 5 marks)

1 (a) Simplify $(t^3)^2$

t^6

(1)

(b) Simplify $\frac{w^9}{w^4}$

w^5

(1)

Specimen 2 – Paper 1H

(Total for Question 1 is 2 marks)

1 (a) Simplify $(m^2)^3$

m^6

(1)

(b) Simplify $x^5 \times x^8$

x^{13}

(1)

June 2023 – Paper 3H

(Total for Question 1 is 2 marks)

2 (a) (i) Write down the value of 5^0

1

(1)

(ii) Write down the value of 5^{-2}

$\frac{1}{25}$

(1)

(b) Write $\frac{2^5 \times 2^4}{2^3}$ in the form 2^n where n is an integer.

$\frac{2^9}{2^3} = 2^6$

2^6

(2)

November 2023 – Paper 1H

(Total for Question 2 is 4 marks)

3 Simplify $(2^{-5} \times 2^8)^2$

Give your answer as a power of 2

$(2^3)^2$

2^6

November 2022 – Paper 1H

(Total for Question 3 is 2 marks)

3 Simplify $5u^2w^4 \times 7uw^3$

$35u^3w^7$

Specimen 2 – Paper 2H

(Total for Question 3 is 1 mark)

6 $p^3 \times p^x = p^9$

(a) Find the value of x.

$x =$ 6

(1)

$(7^2)^y = 7^{10}$

(b) Find the value of y.

$y =$ 5

(1)

$100^a \times 1000^b$ can be written in the form 10^w

(c) Show that $w = 2a + 3b$

$100 = 10^2$

$1000 = 10^3$

$(10^2)^a \times (10^3)^b$

$= 10^{2a} \times 10^{3b} = 10^{2a+3b}$

(2)

November 2017 – Paper 2H

(Total for Question 6 is 4 marks)

8 (a) Work out an estimate for the value of $\sqrt{63.5 \times 101.7}$

$\sqrt{64 \times 100}$

$\sqrt{64} \times \sqrt{100}$

8×10

80

(2)

$(2.3)^6 = 148$ correct to 3 significant figures.

(b) Find the value of $(0.23)^6$ correct to 3 significant figures.

$0.23 \times 0.23 \times 0.23 \times 0.23 \times 0.23 \times 0.23$

0.000148

(1)

(c) Find the value of 5^{-2}

$\frac{1}{25}$

(1)

(Total for Question 8 is 4 marks)

9 (a) Express $\sqrt{\frac{10^{360}}{10^{150} \times 10^{90}}}$ as a power of 10

$= \sqrt{\frac{10^{360}}{10^{240}}}$

$= \sqrt{10^{120}}$

$= (10^{120})^{\frac{1}{2}}$

$= 10^{60}$

10^{60}

(3)

Liam was asked to express $(12^{50})^2$ as a power of 12

Liam wrote $(12^{50})^2 = 12^{50^2} = 12^{2500}$

Liam's method is wrong.

(b) Explain why.

Liam should have multiplied the power of 50 by 2 instead of squaring 50.

(1)

(Total for Question 9 is 4 marks)

9 (a) Write down the value of 7^0

1

(1)

(b) Find the value of $3 \times 3^6 \times 3^{-6}$

3

(1)

(c) Find the value of 2^{-4}

$\frac{1}{2^4}$

$\frac{1}{16}$

(1)

(d) Find the value of $27^{\frac{1}{3}}$

$\sqrt[3]{27} = 3$

3

(1)

(Total for Question 9 is 4 marks)

9

$$\frac{y^4 \times y^n}{y^2} = y^{-3}$$

Find the value of n.

$$\frac{y^{4+n}}{y^2} = y^{-3}$$

$n = -5$

(2)

November 2018 – Paper 3H

(Total for Question 9 is 8 marks)

9 (a) Write down the value of $36^{\frac{1}{2}}$

$\sqrt{36}$

± 6

(1)

(b) Write down the value of 23^0

1

(1)

(c) Work out the value of $27^{-\frac{2}{3}}$

$$\frac{1}{27^{2/3}} = \frac{1}{(3)^2} = \frac{1}{9}$$

$\frac{1}{9}$

(2)

June 2018 – Paper 1H

(Total for Question 9 is 4 marks)

10 (a) Write down the value of $100^{\frac{1}{2}}$

$\sqrt{100}$

± 10

(1)

(b) Find the value of $125^{\frac{2}{3}}$

$(\sqrt[3]{125})^2 = (5)^2$

25

(2)

November 2017 – Paper 1H

(Total for Question 10 is 3 marks)

10 (a) Write down the value of $64^{\frac{1}{2}}$

$\sqrt{64}$

± 8

(1)

(b) Find the value of $\left(\frac{8}{125}\right)^{-\frac{2}{3}}$

$\frac{1}{4/25} = \frac{25}{4}$

$6\frac{1}{4}$

(2)

Sample 1 – Paper 1H

(Total for Question 10 is 3 marks)

11 (a) Find the value of $\sqrt[4]{81 \times 10^8}$

$= \sqrt[4]{81} \times \sqrt[4]{10^8}$

$= 3 \times (10^8)^{\frac{1}{4}}$

$= 3 \times 10^2$

$= 300$

300

(2)

(b) Find the value of $64^{-\frac{1}{2}}$

$\frac{1}{\sqrt{64}} = \frac{1}{8}$

$\frac{1}{8}$

(2)

(c) Write $\frac{3^n}{9^{n-1}}$ as a power of 3

$\frac{3^n}{(3^2)^{n-1}}$

$\frac{3^n}{3^{2n-2}}$

$n - (2n-1) = -n+2$

3^{2-n}

(2)

(Total for Question 11 is 6 marks)

11 Write down the value of $125^{\frac{2}{3}}$

$(\sqrt[3]{125})^2$

25

Specimen 1 – Paper 1H

(Total for Question 11 is 1 mark)

11 Write $\dfrac{(6x^5y^3)^2}{3x^2y^7 \times 4xy^{-3}}$ in the form ax^by^c where a, b and c are integers.

$\dfrac{36x^{10}y^6}{12x^3y^4} = 3x^7y^2$

$3x^7y^2$

June 2023 – Paper 1H

(Total for Question 11 is 3 marks)

12 $(ax^6)^{\frac{1}{n}} = 7x^3$

Work out the value of a and the value of n.

$a^{\frac{1}{n}} = 7$

$a^{\frac{1}{2}} = 7$

$a = 49$

$6 \times \frac{1}{n} = 3$

$\frac{1}{n} = \frac{3}{6} = \frac{1}{2}$ $n = 2$

$a =$ 49

$n =$ 2

November 2021 – Paper 3H

(Total for Question 12 is 2 marks)

12 Patrick has to work out the exact value of $64^{\frac{1}{4}}$

Patrick says,

"$\frac{1}{4}$ of 64 is 16 so $64^{\frac{1}{4}} = 16$"

Explain what is wrong with what Patrick says.

Patric has done $\frac{1}{4}$ of 64 instead of the fourth root of 64.

June 2019 – Paper 3H

(Total for Question 12 is 1 mark)

12 (a) Find the value of $81^{-\frac{1}{2}}$

$\frac{1}{\sqrt{81}}$

$\frac{1}{9}$

(2)

(b) Find the value of $\left(\frac{64}{125}\right)^{\frac{2}{3}}$

$\frac{(\sqrt[3]{64})^2}{(\sqrt[3]{125})^2} = \frac{16}{25}$

$\frac{16}{25}$

(2)

May 2017 – Paper 1H

(Total for Question 12 is 4 marks)

14 Work out the value of $27^{\frac{2}{3}} + \left(\frac{1}{2}\right)^{-3}$

$(3\sqrt{27})^2 + \frac{1}{1/8}$

$9 + \frac{8}{1}$

17

November 2023 – Paper 1H

(Total for Question 14 is 3 marks)

14 Simplify fully $(3x^5y^6)^4$

$81x^{20}y^{24}$

(2)

November 2022 – Paper 3H

(Total for Question 14 is 2 marks)

14 (a) Work out the value of $\left(\frac{16}{81}\right)^{\frac{3}{4}}$

$$\frac{(\sqrt[4]{16})^3}{(\sqrt[4]{81})^3} = \frac{2^3}{3^3} = \frac{8}{27}$$

$\frac{8}{27}$

(2)

$3^a = \frac{1}{9}$ $\quad 3^b = 9\sqrt{3}$ $\quad 3^c = \frac{1}{\sqrt{3}}$

(b) Work out the value of $a + b + c$

$3^{-2} = \frac{1}{9}$ $\quad 9\sqrt{3}$ $\quad \frac{1}{\sqrt{3}} = \frac{1}{3^{\frac{1}{2}}} = 3^{-\frac{1}{2}}$

$a = -2$ $\quad 3^2 \times 3^{\frac{1}{2}} = 3^{2.5}$ $\quad b = 2.5$ $\quad c = -\frac{1}{2}$

$a + b + c$

$-2 + 2.5 + -0.5$

0

(2)

(Total for Question 14 is 4 marks)

17 Work out the value of $\left(\frac{8}{27}\right)^{\frac{4}{3}}$

$$\frac{\left(\sqrt[3]{8}\right)^4}{\left(\sqrt[3]{27}\right)^4} = \frac{2^4}{3^4} = \frac{16}{81}$$

$\frac{16}{81}$

November 2022 – Paper 1H

(Total for Question 17 is 2 marks)

14 (a) Write $\frac{1}{16}$ in the form 4^n where n is an integer.

$$\frac{1}{16} = \frac{1}{4^2} = 4^{-2}$$

4^{-2}

(1)

(b) Work out the value of $8^{\frac{5}{3}} - 9^{\frac{3}{2}}$

$$\left(\sqrt[3]{8}\right)^5 - \left(\sqrt{9}\right)^3$$

$$2^5 - 3^3$$

$$32 - 27$$

5

(3)

June 2023 – Paper 1H

(Total for Question 14 is 4 marks)

15 (a) Find the value of $\sqrt[3]{8 \times 10^6}$

$\sqrt[3]{8} \times \sqrt[3]{10^6}$

$2 \times (10^6)^{\frac{1}{3}}$

2×10^2

200

(1)

(b) Find the value of $144^{\frac{1}{2}} \times 64^{-\frac{1}{3}}$

$\sqrt{144} \times \frac{1}{\sqrt[3]{64}}$

$12 \times \frac{1}{4}$

3

(2)

(c) Solve $3^{2x} = \frac{1}{81}$

$\frac{1}{81} = \frac{1}{3^4} = 3^{-4}$

$2x = -4$

$x = -2$

$x =$ -2

(2)

(Total for Question 15 is 5 marks)

18 Work out the value of $\dfrac{\left(5\frac{4}{9}\right)^{-\frac{1}{2}} \times \left(4\frac{2}{3}\right)}{2^{-3}}$

You must show all your working.

$= \left(\frac{49}{9}\right)^{-\frac{1}{2}} \times \left(\frac{14}{3}\right)$

$= \left(\frac{9}{49}\right)^{\frac{1}{2}} \times \frac{14}{3}$

$= \frac{3}{7} \times \frac{14}{3}$

$= \frac{14}{7}$

$= 2$

$\frac{2}{2^{-3}} = \frac{2}{1/8} = 16$

16

June 2022 – Paper 1H

(Total for Question 18 is 4 marks)

18 $16^{\frac{1}{5}} \times 2^x = 8^{\frac{3}{4}}$

Work out the exact value of x.

$(2^4)^{\frac{1}{5}} \times 2^x = (2^3)^{\frac{3}{4}}$

$2^{\frac{4}{5}} \times 2^x = 2^{\frac{9}{4}}$

$\therefore \frac{4}{5} + \boxed{x} = \frac{9}{4}$

$\frac{9}{4} - \frac{4}{5} = \frac{29}{20}$

$= 1\frac{9}{20}$

$= 1.45$

or

$= 1\frac{9}{20}$

June 2017 – Paper 2H

(Total for Question 18 is 3 marks)

19 Given that $9^{-\frac{1}{2}} = 27^{\frac{1}{4}} \div 3^{x+1}$
find the exact value of x.

$$\frac{1}{\sqrt{9}} = (3^3)^{\frac{1}{4}} \div 3^{x+1}$$

$$\frac{1}{3} = 3^{\frac{3}{4}} \div 3^{x+1}$$

$$3^{-1} = 3^{\frac{3}{4}} \div 3^{x+1}$$

$$-1 + x + 1 = \frac{3}{4}$$

$$x = \frac{3}{4}$$

$x =$ $\frac{3}{4}$

November 2019 – Paper 1H **(Total for Question 19 is 3 marks)**

20 Here is a list of five numbers.

98^{53} 98^{64} 98^{73} 98^{88} 98^{91}

Find the lowest common multiple of these five numbers.

98^{91}

November 2020 – Paper 3H **(Total for Question 20 is 1 mark)**

20 $2^x = \dfrac{2^n}{\sqrt[3]{2}}$ $\quad 2^y = \left(\sqrt{2}\right)^5$

Given that $x + y = 8$

work out the value of n.

$2^x = \dfrac{2^n}{2^{\frac{1}{3}}} = 2^{n-\frac{1}{3}}$

$2^y = \left(2^{\frac{1}{2}}\right)^5 = 2^{\frac{5}{2}}$

$\boxed{x = n - \frac{1}{3}}$

$\boxed{y = \frac{5}{2}}$

$x + y = 8$

$n - \frac{1}{3} + \frac{5}{2} = 8$

$n - \frac{1}{3} = 5.5$

$n = 5.5 + \frac{1}{3}$ $\quad n =$ $5.8\dot{3}$

May 2024 – Paper 1H **(Total for Question 20 is 3 marks)**

$n = 5.5 + 0.\dot{3}$