HIGHER

6.2 Fractional and Negative Indices: Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

Key Index Laws to Recall

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Before you start: a^0 = 1 for any non-zero a. A negative index flips the base into a fraction: a^-n = 1/a^n. A fractional index is a root: a^(1/n) = nth root of a, and a^(m/n) = (nth root of a)^m. When multiplying powers of the same base, add the indices: a^m * a^n = a^(m+n). When dividing powers of the same base, subtract the indices: a^m / a^n = a^(m-n). When raising a power to a power, multiply the indices: (a^m)^n = a^(m*n). These rules still apply when m and n are fractions or negative numbers.

1 Write down the value of:

(a) 6^0 **(1)**

(b) 2^{-3} **(1)**

(c) 5^{-1} **(1)**

(Total for Question 1 is 3 marks)

2 Which of the following is equal to 5^{-2}?

- ☐ A) 25
- ☐ B) -25
- ☐ C) 1/25
- ☐ D) -1/25

(Total for Question 2 is 1 mark)

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3 The number of bacteria, P, in a culture is modelled by $P = 200 \times 3^t$, where t is the time in hours after the culture begins.

(a) Work out the number of bacteria when t = 0. **(1)**

.....

(b) Work out the number of bacteria after 4 hours. **(2)**

.....

(Total for Question 3 is 3 marks)

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4 The mass, M grams, of a radioactive sample after t years is given by $M = 80 \times 2^{-t/12}$.

(a) Find the mass after 12 years. **(2)**

.....

(b) Find the mass after 24 years. **(1)**

.....

(c) State what the number 80 represents in this context. **(1)**

(Total for Question 4 is 4 marks)

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5 Given that $y = x^{-3/2}$, find the value of y when x = 4.

(Total for Question 5 is 2 marks)

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6 Write $1/x^2$ in the form x^n, where n is a fraction or integer.

(Total for Question 6 is 2 marks)

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7 Work out the value of $32^{1/5}$.

(Total for Question 7 is 1 mark)

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8 Simplify each expression. Give each answer as a single power of x.

(a) $x^{1/2} * x^{3/2}$ **(2)**

(b) x^5 / x^{-2} **(2)**

(c) $(x^{2/3})^3$ **(2)**

(Total for Question 8 is 6 marks)

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9 A population of bacteria is modelled by $N = 800 * 4^{-t/2}$, where N is the number of bacteria and t is the time in hours after the population is first measured.

(a) Work out N when t = 1 **(2)**

(b) Find the value of t for which N = 100 **(3)**

(Total for Question 9 is 5 marks)

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10 Work out the value of each expression. Give each answer as a fraction.

(a) $4^{-1/2}$ **(2)**

(b) $27^{-2/3}$ **(2)**

(c) $16^{-3/4}$ **(2)**

(Total for Question 10 is 6 marks)

11 Show that $4^{-3/2} \times 8^{2/3} = 1/2$

(Total for Question 11 is 3 marks)

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12 Solve $8^{x+1} = 4^{2x-1}$

(Total for Question 12 is 4 marks)

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13 Solve the equation $9^{x} - 3^{x+1} = 0$

(Total for Question 13 is 4 marks)

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Mark scheme · 6.2 Fractional and Negative Indices: Test Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

(a) 1 cao **B1**

(a) Answer: 1

(b) 1/8 oe (0.125) **B1**

(b) Answer: 1/8 (0.125)

(c) 1/5 oe (0.2) **B1**

(c) Answer: 1/5 (0.2)

Question 2

C (1/25) cao **B1**

Answer: C) 1/25

Question 3

(a) 200 cao **B1**

(a) Answer: 200

(b) 200 x 3^4 with 3^4 = 81 seen, or correct substitution **M1**

(b) 16200 cao **A1**

(b) Answer: 16200

Question 4

(a) correct substitution t = 12 giving 80 x 2^{-1}, or 2^{-1} = 0.5 seen **M1**

(a) 40 (g) cao **A1**

(a) Answer: 40 grams

(b) 20 (g) cao, ft from correct method in (a) **B1**

(b) Answer: 20 grams

(c) the initial mass of the sample / the mass when t = 0 oe **B1**

(c) Answer: The initial mass of the sample (the mass at t = 0), which is 80 grams.

Question 5

$4^{1/2}$ = 2 and/or $4^{3/2}$ = 8 seen **M1**

y = 1/8 oe cao **A1**

Answer: y = 1/8

Question 6

correct use of a fractional or negative index **M1**

x^{-2} oe **A1**

Answer: x^{-2}

Question 7

2 cao **B1**

Answer: 2

Question 8

(a) indices added: 1/2 + 3/2 **M1**

(a) x^2 cao **A1**

(a) Answer: x^2

(b) indices subtracted: 5 - (-2) **M1**

(b) x^7 cao **A1**

(b) Answer: x^7

(c) indices multiplied: (2/3) x 3 **M1**

(c) x^2 cao **A1**

(c) Answer: x^2

Question 9

(a) $4^{-1/2}$ = 1/2 found **M1**

(a) N = 400 cao **A1**

(a) Answer: N = 400

(b) equation set up: 800 * $4^{-t/2}$ = 100, or $4^{-t/2}$ = 1/8 **M1**

(b) both sides written as powers of 2 and indices equated **M1**

(b) t = 3 cao **A1**

(b) Answer: t = 3

Question 10

(a) $4^{1/2}$ = 2 found (or equivalent unit-fraction set up) **M1**

(a) 1/2 cao **A1**

(a) Answer: 1/2

(b) $27^{2/3}$ = 9 found **M1**

(b) 1/9 cao **A1**

(b) Answer: 1/9

(c) $16^{3/4}$ = 8 found **M1**

(c) 1/8 cao **A1**

(c) Answer: 1/8

Question 11

$4^{-3/2}$ = 1/8 oe (from $4^{1/2}$ = 2, 2^3 = 8) **M1**

$8^{2/3}$ = 4 oe (from $8^{1/3}$ = 2, 2^2 = 4) **M1**

cso: (1/8) x 4 = 1/2 shown, dependent on both method marks **A1**

Answer: 1/2 (shown)

Question 12

8^{x+1} written as 2^{3x+3} **M1**

4^{2x-1} written as 2^{4x-2} **M1**

indices equated and rearranged: 3x + 3 = 4x - 2 (dependent on both previous M marks) **dM1**

x = 5 cao **A1**

Answer: x = 5

Question 13

9^x written as 3^{2x}, or $(3^x)^2$ **M1**

3^{x+1} written as 3 * 3^x **M1**

expression factorised to $3^x(3^x - 3) = 0$ and $3^x = 0$ rejected as impossible (dependent on both previous M marks) **dM1**

x = 1 cao **A1**

Answer: x = 1

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