

CHAPTER 3

EM

Indices & Standard Form

Compound interest

Singular : index
Plural : indices
("power")

Eg: 7³
base

1)

Same base laws

Same power laws

Laws of Indices		Examples	
1)	$a^m \times a^n = a^{m+n}$	$2^3 \times 2^{-7} =$	
2)	$a^m \div a^n = a^{m-n} = \frac{a^m}{a^n}$	$\frac{4^{-2}}{4^{-8}} =$	
3)	$(a^m)^n = a^{mn}$	$(5^{\frac{1}{3}})^{-2} =$	
4)	$a^n \times b^n = (ab)^n = a^n b^n$	$(-3)^4 \times (-\frac{5}{3})^4 =$	
5)	$a^n \div b^n = (\frac{a}{b})^n = \frac{a^n}{b^n}$	$\frac{27^{-3}}{9^{-3}} =$	
6)	$a^0 = 1$	$(10^{-2} \times 5^{-3} \times \frac{1}{2})^0 =$	
7)	$a^{-n} = \frac{1}{a^n}$	$5^{-3} =$	$\frac{5a^{-3}}{1} =$
		$\frac{(5a)^{-3}}{1} =$	
8)	$(\frac{a}{b})^{-n} = (\frac{b}{a})^n$ $\frac{a^{-n}}{b^{-n}} = \frac{b^n}{a^n}$	$(\frac{7^{-2}a^3}{b^5})^{-4} =$	
9)	$\sqrt[n]{a} = a^{\frac{1}{n}}$	empty = 2 $\sqrt[]{9a} =$	$\sqrt[5]{a^2c} =$
10)	$\sqrt[n]{a^m} = (\sqrt[n]{a})^m = a^{\frac{m}{n}}$	$\sqrt[7]{(a^{-2}b^5)^3} =$	

The power '-3' belongs to 'a' only. So only 'a' will switch to the bottom and change to positive index.

eg. Simplify the following, express your answer in positive index notation.

(a) $\sqrt[3]{x^3 y^{-2}} =$

TIPS

- ✓ Remove roots
- ✓ Remove negative
- ✓ Remove bracket
- ✓ Combine fractions
- * If there's $\div$, need to Keep, Change, Flip
- ✓ Simplify

$$(b) \left(\frac{b^{-4}}{ac^{-3}} \right)^3 \div \left(\frac{\sqrt{a}}{c^3} \right)^{-2}$$

$$(c) \frac{-a^2}{27ab^0} \div \frac{12b^{-3}}{\sqrt{81a^4b^3}}$$

2) Solving equations

• "Solve" means to find _____.

• Method: Convert to the same _____
and compare the _____

$$\begin{array}{l} a^x = a^n \\ \Rightarrow = \end{array}$$

where $a \neq -1, 0$ or 1

Type 1: Change to same base directly

$$\text{eg. } 16^{1-x} = 8(2^{2x})$$

Type 2: Same powers, combine the bases first

$$\text{eg. } 3^{x+5} \times 2^{x+5} = \frac{1}{36}$$

TIP Check your answer by substituting your solution to the LHS and RHS of the question separately.

c) Factorise, change base, combine base, compare powers.

- Factorise when you see addition / subtraction of same / common terms.

eg. Solve $8^2 + 8^2 + 8^2 + 8^2 = 8^n$

eg. Show that $2^{15} + 2^{13}$ is divisible by 5.

3) Other types of questions involving indices

eg. Express $81^4 \times 9^{2p}$ as a power of 3.

↑ Means that the base is 3.

eg. (a) Solve $3x^2 - 28x + 9 = 0$

(b) Hence, solve the equation $3(3^{2x}) - 28(3^x) + 9 = 0$

4) Standard form

✓ Format .



×

10power must be
an _____

· can only have _____ digit

· _____ < digit < _____

Remaining digits

Not in standard form	Standard form
6 789 000	
0.0000000000358	
0.284×10^3	
10×10^{-8}	
800×10^{-1}	

Calculate and give your answers in standard form, correct to 3 significant figures.

Examples	Standard form
3581×0.15 =	
$45 \times 10^{-2} \times 5.874 \times 10^8$ =	
$6.8 \times 10^{-7} - 3.79 \times 10^5$ =	
4×2189 =	
$(92.108 \times 10^3 + 4.8 \times 10^{-7}) \times (3.72 \times 10^4)$ =	
$9.6 \times 10^5 - 3.2 \times 10^5 = (9.6 - 3.2) \times 10^5$ =	
$\frac{3.111 \times 10^7 \div (4.29 \times 10^{-3} - 3 \times 10^6)}{-5.5 \times 10^4 - 2 \times 10^{-1}}$ =	
$\frac{\sqrt{\frac{3}{4} \times 841 + (3^2 - 4)} - 90.81^3}{(2.5 \times 10^{-2} - 8) + 33} + \sqrt[3]{\frac{181}{197}}$ =	

✓ use calculator to check



Shift → menu →

FYI: To choose the
significant figure

How to set calculator back to normal mode:

Shift → menu → 3: Number format → 3: Norm → 2

✓ SI Prefix

power of 10	SI Prefix	Symbol	English word
	tera -		
	giga -		
	mega -		
	kilo -	k	thousand
	milli -	m	thousandth
	micro -	μ	millionth
	nano -	n	billionth
	pico -	p	trillionth

Should know

usually given

$$\begin{aligned}
 &58 \text{ mm} \\
 &= 58 \text{ millimetres} \\
 &= 58 \times \text{---} \text{ m}
 \end{aligned}$$

Express $458 \mu\text{m}$ in km in standard form.

$$458 \mu\text{m} =$$

Eg: Light travels 1 metre in 3.33 nanoseconds. Find the speed of light in m/s.

Give your answer in standard form. (1 nanosecond = 10^{-9} second)

$$3.33 \text{ nanoseconds} = \text{---} \text{ seconds}$$

$$\text{Speed of light} =$$

Eg: A high-resolution photograph has a file size of 4.8×10^6 bytes.

(a) A solid-state drive (SSD) has a capacity of 512 gigabytes. Given that 1 gigabyte = 1×10^9 bytes, express the capacity of the SSD in bytes in standard form.

(b) Calculate the maximum number of these photographs that can be stored on the SSD.

Express your answer in standard form, correct to 2 significant figures.

5) Simple Interest (Refer to Financial Math Notes for related topics).

Interest =

P :

R :

T :

Total amount =

* per annum means _____.

Eg 1: Hui Xin took a car loan of \$45 000 from a bank which charges a simple interest of 3.5% per annum. The loan is to be repaid over 30 months.

(a) Calculate the total amount of interest Hui Xin has to pay back at the end of 30 months.

(b) How much is the monthly instalment?

Eg 2: Sarah received \$562.50 in simple interest after 18 months from an investment at 2.5% per annum. What was her initial investment?

* Form an equation

Eg 3: Jenny deposited \$3000 in the bank for 5 years. Find the interest rate if her deposit grew to \$3750 after 5 years.

6) Compound Interest

$$\text{Total amount} = P \left(1 + \frac{r}{100}\right)^n$$

Given in math formula

P :

r :

n :

$$\text{Interest} =$$

→ annually : compounded _____ a year

→ half-yearly : compounded _____ a year

→ quarterly : compounded _____ times a year

→ monthly : compounded _____ times a year

Eg 1 : Mrs Lee deposited \$15 000 in an account that pays 2.68% compound interest per annum. Find the total amount in the account after 5 years if the interest is compounded **monthly**.

[inside divide, outside times]

Eg 2 : Li Ya places \$6000 in a bank that offers an interest compounded **quarterly**. At the end of 3 years, she received \$964.53 in interest. Find the interest rate offered by the bank.
