

13

Mass

By studying this lesson you will be able to

- identify milligramme as a unit used to measure masses,
- identify the relationship between the units gramme and milligramme,
- add and subtract masses expressed in grammes and milligrammes, and
- multiply and divide masses expressed in milligrammes, grammes, and kilogrammes by a whole number.

13.1 Units used to measure mass

You have learnt before that gramme and kilogramme are units used to measure masses. Now let us identify another unit which is used to measure masses.

The masses of the nutrients included in a 100 grammes packet of food for children, “Thriposha”, are indicated as below.

Protein 20.0 g

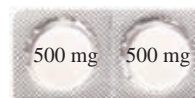
Carbohydrate 61.9 g

Fat 7.8 g

Iron 18 mg



The mass of paracetamol in each of the paracetamol tablets shown in the figure is indicated as 500 mg.



Based on the above information, you will notice that in addition to kilogramme (kg) and gramme (g), the unit milligramme which is smaller than the other two units is also used to measure a mass more precisely. “Milligramme” is denoted by mg.

1 gramme is 1000 milligrammes. That is, $1 \text{ g} = 1000 \text{ mg}$

13.2 The relationship between grammes and milligrammes

• Expressing a mass given in grammes in milligrammes

Now let us consider how a mass given in grammes is expressed in milligrammes.

$$\begin{aligned}\text{Since } 1 \text{ g} &= 1000 \text{ mg}, \\ 2 \text{ g} &= 2 \times 1000 \text{ mg} = 2000 \text{ mg} \\ 3 \text{ g} &= 3 \times 1000 \text{ mg} = 3000 \text{ mg}\end{aligned}$$

Therefore, to express a mass given in grammes, in terms of milligrammes, the given number of grammes should be multiplied by 1000.

Example 1

Express 7.656 g in milligrammes.

$$\begin{aligned}7.656 \text{ g} &= 7.656 \times 1000 \text{ mg} \\ &= 7656 \text{ mg}\end{aligned}$$

Example 3

Express 7.656 g in grammes and milligrammes.

$$\begin{aligned}7.656 \text{ g} &= 7 \text{ g} + 0.656 \text{ g} \\ &= 7 \text{ g} + 0.656 \times 1000 \text{ mg} \\ &= 7 \text{ g} + 656 \text{ mg} \\ &= 7 \text{ g } 656 \text{ mg}\end{aligned}$$

Example 2

Express 2 g 650 mg in milligrammes.

$$\begin{aligned}2 \text{ g } 650 \text{ mg} &= 2 \times 1000 \text{ mg} + 650 \text{ mg} \\ &= 2000 \text{ mg} + 650 \text{ mg} \\ &= 2650 \text{ mg}\end{aligned}$$

Example 4

Express $3\frac{1}{2}$ g in milligrammes.

$$\begin{aligned}3\frac{1}{2} \text{ g} &= 3 \text{ g} + \frac{1}{2} \text{ g} \\ &= 3 \times 1000 \text{ mg} + 500 \text{ mg} \\ &= 3000 \text{ mg} + 500 \text{ mg} \\ &= 3500 \text{ mg}\end{aligned}$$

• Expressing a mass given in milligrammes in terms of grammes

Next let us consider how a mass given in milligrammes can be expressed in grammes.

$$\begin{aligned}\text{Since } 1000 \text{ mg} &= 1 \text{ g}, \\ 2000 \text{ mg} &= \frac{2000}{1000} \text{ g} = 2 \text{ g} \\ 3000 \text{ mg} &= \frac{3000}{1000} \text{ g} = 3 \text{ g}\end{aligned}$$

Therefore, to express a mass given in milligrammes in terms of grammes, the given number of milligrammes should be divided by 1000.

Example 1

Express 2758 mg in grammes.

$$\begin{aligned} 2758 \text{ mg} &= \frac{2758}{1000} \text{ g} \\ &= 2.758 \text{ g} \end{aligned}$$

Example 2

Express 2225 mg in grammes and milligrammes.

$$\begin{aligned} 2225 \text{ mg} &= 2000 \text{ mg} + 225 \text{ mg} \\ &= \frac{2000}{1000} \text{ g} + 225 \text{ mg} \\ &= 2 \text{ g} + 225 \text{ mg} \\ &= 2 \text{ g } 225 \text{ mg} \end{aligned}$$

Accordingly, when an amount of 1000 mg or more, is expressed in terms of grammes and milligrammes, care should be taken to ensure that the amount of milligrammes written is less than 1000.

Example 3

Express 3 g 675 mg in grammes.

$$\begin{aligned} 3 \text{ g } 675 \text{ mg} &= 3 \text{ g} + 675 \text{ mg} \\ &= 3 \text{ g} + \frac{675}{1000} \text{ g} \\ &= 3 \text{ g} + 0.675 \text{ g} \\ &= 3.675 \text{ g} \end{aligned}$$

Exercise 13.1

(1) Fill in the blanks.

- | | |
|--|--|
| (i) $8 \text{ g } 42 \text{ mg} = 8 \text{ g} + \dots \text{ mg}$
$= \dots \text{ mg} + \dots \text{ mg}$
$= \dots \text{ mg}$ | (ii) $3750 \text{ mg} = \frac{3750}{1000} \text{ g}$
$= \dots \text{ g}$ |
| (iii) $1.275 \text{ g} = 1 \text{ g} + \dots \text{ mg}$
$= \dots \text{ mg} + \dots \text{ mg}$
$= \dots \text{ mg}$ | (iv) $1.275 \text{ g} = 1.275 \times \dots \text{ mg}$
$= \dots \text{ mg}$ |

(2) Express the following masses in grammes.

- (i) 1245 mg (ii) 1475 mg (iii) 2 g 875 mg (iv) 12 g 8 mg

(3) Express the following masses in milligrammes.

- (i) 8 g (ii) 15 g (iii) 3 g 750 mg (iv) 2 g 75 mg
 (v) 2.5 g (vi) 3.005 g (vii) 3.61 g (viii) $1\frac{3}{4} \text{ g}$

(4) Express each of the following masses in terms of grammes and milligrammes.

(i) 2350 mg

(ii) 3.75 g

(iii) 12.05 g

(iv) 1.005 g

(5) Complete the following table.

g	g mg	mg
1.4 g	1 g 400 mg	1400 mg
3.65 g	.....	.....
5.005 g	.....	.....
.....	1 g 975 mg	.....
.....	5 g 5 mg	.....
.....	.....	6007 mg
.....	.....	12 535 mg

13.3 Addition of masses expressed in grammes and milligrammes

The mass of the chocolates in a box of mass 15 g 350 mg, is 750 g 800 mg. Let us find the total mass of the box of chocolates.

To do this, let us add the mass of the box and the mass of the chocolates.



Method I

$$\begin{array}{r}
 \text{g} \qquad \text{mg} \\
 15 \qquad 350 \\
 + 750 \qquad 800 \\
 \hline
 766 \qquad 150
 \end{array}$$

Let us add the quantities in the milligrammes column.

$$350 \text{ mg} + 800 \text{ mg} = 1150 \text{ mg}$$

$$1150 \text{ mg} = 1000 \text{ mg} + 150 \text{ mg}$$

$$= 1 \text{ g} + 150 \text{ mg}$$

Let us write 150 mg in the milligrammes column.

Let us carry the 1 g to the grammes column and add the amounts in the grammes column.

$$1 \text{ g} + 15 \text{ g} + 750 \text{ g} = 766 \text{ g}$$

Let us write 766 g, in the grammes column.

Total mass of the box of chocolates is 766 g 150 mg.

Method II

Let us express each of the masses in grammes, and then simplify.

$$15 \text{ g } 350 \text{ mg} = 15.350 \text{ g}$$

$$750 \text{ g } 800 \text{ mg} = 750.800 \text{ g}$$

$$766.150 \text{ g} = 766 \text{ g} + 150 \text{ mg}$$

$$\begin{array}{r}
 \text{g} \\
 15.350 \\
 + 750.800 \\
 \hline
 766.150
 \end{array}$$

Exercise 13.2

(1) Simplify the following.

(i)	g	mg	(ii)	g	mg	(iii)	10 g	255 mg	+	5 g	805 mg
	250	170		15	150						
+	35	630		20	675	(iv)	150 g	750 mg	+	50 g	360 mg
	<u> </u>	<u> </u>	+	<u>30</u>	<u>265</u>						
	<u> </u>	<u> </u>		<u> </u>	<u> </u>						

(2) The mass of the sweetmeats in a box of mass 19 g 750 mg, is 480 g 250 mg. Find the total mass of the box of sweetmeats.



(3) The masses of three letters received by a post office are 10 g 150 mg, 5 g 975 mg and 8 g 900 mg respectively. Show that the total mass of all three letters exceeds 25 g.



13.4 Subtraction of masses expressed in grammes and milligrammes

The total mass of a box of sweetmeats is 500 g 250 mg. The mass of the empty box is 100 g 750 mg. Accordingly, let us find the mass of the sweetmeats in the box.



To find the mass of the sweetmeats, the mass of the empty box needs to be subtracted from the total mass.

Method I

	g	mg
	500	250
-	100	750
	<u>399</u>	<u>500</u>

Since 750 mg cannot be subtracted from 250 mg, let us carry 1 g, that is 1000 mg, from the 500 g in the grammes column to the milligrammes column and add it to the 250 mg in the milligrammes column.

Then, 1000 mg + 250 mg = 1250 mg.

1250 mg - 750 mg = 500 mg

Let us write the 500 mg in the milligrammes column.

Let us subtract 100 g from the 499 g remaining in the grammes column.

Then, 499 g - 100 g = 399 g

Let us write the 399 g, in the grammes column.

The mass of the sweetmeats in the box is 399 g 500 mg.

Method II

Let us express each of the masses in grammes, and then simplify.

$$\begin{array}{r} 500 \text{ g } 250 \text{ mg} = 500.250 \text{ g} \\ 100 \text{ g } 750 \text{ mg} = 100.750 \text{ g} \\ \hline 399.500 \text{ g} = 399 \text{ g } 500 \text{ mg} \end{array}$$

The mass of the sweetmeats in the box is 399 g 500 mg.

Exercise 13.3

(1) Simplify the following.

$$\begin{array}{r} \text{(i) } \begin{array}{r} \text{g} \quad \text{mg} \\ 50 \quad 750 \\ - 20 \quad 250 \\ \hline \hline \end{array} \quad \text{(ii) } \begin{array}{r} \text{g} \quad \text{mg} \\ 150 \quad 200 \\ - 75 \quad 300 \\ \hline \hline \end{array} \quad \text{(iii) } 250 \text{ g } 550 \text{ mg} - 150 \text{ g } 105 \text{ mg} \\ \text{(iv) } 60 \text{ g} - 25 \text{ g } 150 \text{ mg} \end{array}$$

(2) The total mass of a biscuit packet with biscuits is 210 g 150 mg. The mass of the empty packet is 2 g 300 mg. What is the mass of the biscuits in the biscuit packet?



(3) When a certain amount was used from a quantity of margarine of mass 150 g, the remaining mass was 105 g 350 mg. Find the mass of the margarine that was used.



(4) A mass of 160 g 450 mg of gold was left over after making jewellery from a block of gold of mass 205 g 375 mg. Find the mass of the gold that was used to make the jewellery.

13.5 Multiplication of a mass by a whole number

➤ The mass of gold used to produce a particular pendent is 6 g 500 mg. Let us find the total mass of gold required to produce 5 such pendants.

To produce 5 pendants, 5 portions of gold of mass 6 g 500 mg each are required. Therefore, to find the total mass of gold that is required, 6 g 500 mg should be multiplied by 5.



Method I

Let us express 6 g 500 mg in milligrammes and then multiple by 5.



$$\begin{aligned}6 \text{ g } 500 \text{ mg} &= 6500 \text{ mg} \\6500 \text{ mg} \times 5 &= 32\,500 \text{ mg}\end{aligned}$$

$$\begin{array}{r} \text{mg} \\ 6500 \\ \times 5 \\ \hline \hline 32\,500 \end{array}$$

$$32\,500 \text{ mg} = 32 \text{ g } 500 \text{ mg}$$

That is, the total mass required to produce 5 pendants is 32 g 500 mg.

Method II

$$\begin{array}{r} \text{g} \quad \text{mg} \\ 6 \quad 500 \\ \times 5 \\ \hline \hline 32 \quad 500 \end{array}$$

First, let us multiply 500 mg by 5.

$$500 \times 5 \text{ mg} = 2500 \text{ mg}$$

$$2500 \text{ mg} = 2000 \text{ mg} + 500 \text{ mg} = 2 \text{ g} + 500 \text{ mg}$$

Let us write 500 mg in the milligrammes column.

Let us multiply 6 g by 5. $6 \text{ g} \times 5 = 30 \text{ g}$

Now let us add the 2 g obtained from the multiplication done in the milligrammes column, to 30 g.

$$30 \text{ g} + 2 \text{ g} = 32 \text{ g}$$

Let us write 32 g in the grammes column.

➤ Let us simplify 5 kg 120 g $\times 12$.

Method I

$$\begin{array}{r} \text{kg} \quad \text{g} \\ 5 \quad 120 \\ \times 12 \\ \hline \hline 61 \quad 440 \end{array}$$

First multiply 120 g by 12.

$$120 \text{ g} \times 12 = 1440 \text{ g} = 1 \text{ kg } 440 \text{ g}$$

Let us multiply 5 kg, by 12.

$$5 \text{ kg} \times 12 = 60 \text{ kg}$$

$$\begin{aligned}5 \text{ kg } 120 \text{ g} \times 12 &= 60 \text{ kg} + 1 \text{ kg } 440 \text{ g} \\ &= 60 \text{ kg} + 1 \text{ kg} + 440 \text{ g} \\ &= 61 \text{ kg } 440 \text{ g}\end{aligned}$$



$$5 \text{ kg } 120 \text{ g} \times 12 = 61 \text{ kg } 440 \text{ g}$$

Method II

Let us express 5 kg 120 g in grammes and then multiply by 12.

$$5 \text{ kg } 120 \text{ g} = 5120 \text{ g}$$

Let us multiply 5120 g by 12.

$$61\,440 \text{ g} = 61 \text{ kg } 440 \text{ g}$$

$$\begin{array}{r} \text{g} \\ 5120 \\ \times 12 \\ \hline 10240 \\ 5120 \\ \hline 61440 \end{array}$$

Example 1

The mass of a lorry which transports goods is 2250 kg. It is loaded with 60 cement bags of mass 50 kg each. When entering an old bridge, the driver sees a notice which indicates that a mass greater than 5300 kg cannot be transported across the bridge. The mass of the driver and his assistant is 140 kg. Is this vehicle allowed to cross the bridge?

$$\text{Mass of vehicle} = 2250 \text{ kg}$$

$$\text{Mass of cement} = 50 \text{ kg} \times 60 = 3000 \text{ kg}$$

$$\text{Mass of two passengers} = 140 \text{ kg}$$

$$\begin{aligned} \text{Therefore the total mass of the vehicle} &= 2250 \text{ kg} + 3000 \text{ kg} + 140 \text{ kg} \\ &= 5390 \text{ kg} \end{aligned}$$

Since the total mass of the vehicle is more than 5300 kg, it is not allowed to cross the bridge.

Exercise 13.4

(1) Simplify the following.

$$\begin{array}{r} \text{(i) g} \quad \text{mg} \\ 150 \quad 100 \\ \times 5 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{(ii) g} \quad \text{mg} \\ 175 \quad 375 \\ \times 4 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{(iii) kg} \quad \text{g} \\ 12 \quad 100 \\ \times 8 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{(iv) kg} \quad \text{g} \\ 5 \quad 250 \\ \times 4 \\ \hline \hline \end{array}$$

$$\text{(v) } 12 \text{ g } 150 \text{ mg} \times 12$$

$$\text{(vi) } 16 \text{ g } 650 \text{ mg} \times 13$$

$$\text{(vii) } 10 \text{ kg } 375 \text{ g} \times 15$$

$$\text{(viii) } 5 \text{ kg } 650 \text{ g} \times 25$$

(2) Find the quantity of rice that needs to be purchased for a week for a household that requires 1 kg 750 g of rice daily.



- (3) The mass of a certain type of biscuit is 3 g 750 mg. Packets containing 25 of these biscuits each are issued to the market. Find the total mass of the biscuits in one packet.



- (4) Four gunny bags of mass 760 g each are filled with 40 kg of sugar per bag. Find the total mass of the 4 gunny bags filled with sugar.

- (5) 20 incense sticks of mass 650 mg per stick are in a packet of mass 2 g.



- Find the mass of the incense sticks in one packet.
- Find the total mass of one packet of incense sticks.
- Find the total mass of 12 such packets.

13.6 Division of a mass by a whole number

- The mass of 5 tablets is 1 g 750 mg. Let us find the mass of one tablet. To do this, 1 g 750 mg should be divided by 5.



Method I

g	mg
0	350
5	1 750
	0
	1 → 1000
	1750
	1750
	0000

Let us divide the gramme quantity first.

Since there are no 5s in 1, let us write '0' in the place where the answer is to be written in the grammes column and carry the remaining 1 g as 1000 mg to the milligrammes column.

Then let us find the amount of milligrammes in the milligrammes column.

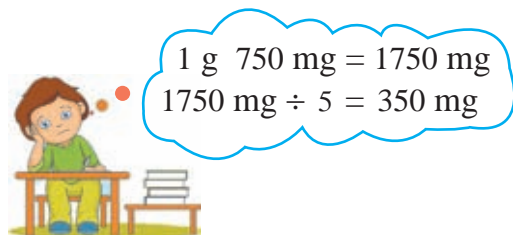
$$1000 \text{ mg} + 750 \text{ mg} = 1750 \text{ mg}$$

Let us divide 1750 mg by 5. $1750 \text{ mg} \div 5 = 350 \text{ mg}$

The mass of one tablet is 350 mg.

Method II

Express 1 g 750 mg in milligrammes and then divide by 5.



	mg
	350
5	1750
	15
	25
	25
	00
	00
	00

The mass of one tablet is 350 mg.

- A mass of 16 kg 200 g of sugar is stored in three bags in equal quantities. Let us find the mass of sugar in one of these bags.

To do this, 16 kg 200 g should be divided by 3.



Method I

	kg	g
	5	400
3	16	200
	15	
	1 →	1000
		1200
		1200
		0000

Let us divide 16 kg in the kilogrammes column by 3.
 Let us carry the remaining 1 kg to the grammes column as 1000 g
 Next let us find the amount of grammes in the grammes column
 $1000 \text{ g} + 200 \text{ g} = 1200 \text{ g}$
 Let us divide 1200 g by 3.
 $1200 \text{ g} \div 3 = 400 \text{ g}$

The mass of sugar in one bag is 5 kg 400 g.

Method II

Let us express 16 kg 200 g in grammes and divide by 3.



$$\begin{aligned}
 16 \text{ kg } 200 \text{ g} &= 16 \text{ kg} + 200 \text{ g} \\
 &= 16\,000 \text{ g} + 200 \text{ g} \\
 &= 16\,200 \text{ g} \\
 16\,200 \text{ g} \div 3 &= 5400 \text{ g}
 \end{aligned}$$

	g
	5400
3	16200
	15
	12
	12
	00
	00
	00
	00

The mass of sugar in one bag is 5 kg 400 g.

Example 1

A quantity of 19.2 kg of a particular type of sweetmeat is purchased and stored in equal quantities in 6 boxes. Find the mass of the sweetmeats contained in one box.

	kg
	3.2
6	19.2
	18
	12
	12
	0

Mass of sweetmeats in 6 boxes = 19.2 kg

Mass of sweetmeats in one box = $19.2 \text{ kg} \div 6$

= 3.2 kg

Exercise 13.5

(1) Simplify the following.

- (i) $8\text{ g } 160\text{ mg} \div 8$ (ii) $1\text{ g } 575\text{ mg} \div 3$ (iii) $6\text{ g } 125\text{ mg} \div 5$
(iv) $7\text{ g } 140\text{ mg} \div 3$ (v) $10\text{ g } 400\text{ mg} \div 4$

(2) Simplify the following.

- (i) $4\text{ kg } 800\text{ g} \div 4$ (ii) $4\text{ kg } 230\text{ g} \div 3$ (iii) $8\text{ kg } 350\text{ g} \div 5$
(iv) $12\text{ kg } 600\text{ g} \div 7$

(3) A quantity of 1.6 kg of fertilizer from a quantity of 4 kg is used on a coconut plant. If the remaining amount is used on 8 orange plants in equal quantities, find the amount of fertilizer used on one orange plant in grammes.

(4) The mass of the biscuits in a biscuit packet is indicated as 75 g. If the packet contains 12 biscuits, find the mass of one biscuit.

(5) The total mass of 306 biscuits of the same type is 3 kg 978 g.

- (i) Find the mass of one biscuit.
(ii) If these biscuits are put into packets such that each packet contains 34 biscuits, find the mass of the biscuits in one packet.
(iii) Find the total mass of the biscuits in 5 such packets.

13.7 Mass Estimation

The mass of an olive obtained from a stack of olive fruits is about 5 g. Estimate the total mass of 100 olives.



The total mass of 100 olives is approximately $5 \times 100\text{ g}$; that is, 500 g.

Exercise 13.6

- (1) The mass of 10 nelli fruits obtained from a stack of fruits is 27 g 225 mg. Estimate the total mass of 100 nelli fruits.
- (2) A household having only 4 adults and no children eat rice for all 3 meals in a day. An adult usually consumes 125 g of rice for breakfast, 100 g for lunch and 75 g for dinner.
 - (i) Estimate the amount of rice that is required for one adult of this household for one day.
 - (ii) Estimate the number of kilogrammes of rice that is required for this household for a week.
 - (iii) Estimate the amount of rice that is required for all 4 adults for a month.
- (3) Information on the quantities of the nutrients included in a 100 g packet of “Thripasha” which is given to children with malnutrition is given below.

Protein 20.0 g

Carbohydrate 61.9 g

Fat 7.8 g

Iron 18 mg



If a child is given 50 g of ‘Thripasha’ per day, estimate the mass of each of the nutrients that can be expected to be consumed by a child in a month.

(i) Protein


(ii) Fat

(iii) Iron

(iv) Carbohydrate

Miscellaneous Exercise

- (1) The amount of paracetamol in a paracetamol tablet is 375 mg. If the amount of paracetamol taken by an adult should be less than 2 g per day, what is the maximum number of tablets that an adult can take in a day?
- (2) A mass of 100 g of cheese is issued to the market in a box of mass 2 g 500 mg. Find the mass of 100 such boxes of cheese.

- 
- (3) If 60 equal sized sesame balls are made from a mixture containing 500 g of sesame seeds and 250 g of jaggery, find the mass of one sesame ball in grammes and milligrammes.
- (4) The total mass of a box containing 80 tea bags is 276 g. The mass of the empty box is 26 g. Find the mass of one tea bag and express it in grammes and milligrammes.
- (5) When passengers flying overseas travel in a group, if the average mass of their bags does not exceed 30 kg, there are no extra charges for overweight bags. However, if the average mass of the bags exceeds 30 kg, then those with bags that exceed 30 kg have to pay overweight charges. The following are the masses of the bags of 5 passengers who are travelling in a group.

Hasintha - 20 kg 250 g Mangala - 29 kg 750 g Sithumini - 32 kg

Dileepa - 32 kg 150 g Sashika - 28 kg 70 g

Based on the above information, show with reasons whether Dileepa and Sithumini have to pay overweight charges.

$$\text{Average mass of the bags} = \frac{\text{total mass of the bags of all the group members}}{\text{number of group members}}$$

Summary

- Milligramme (mg), gramme (g) and kilogramme (kg) are a few units used to measure mass.
 $1 \text{ kg} = 1000 \text{ g}$ $1 \text{ g} = 1000 \text{ mg}$
- To express a mass given in grammes, in terms of milligrammes, the given number of grammes should be multiplied by 1000.
- To express a mass given in milligrammes in terms of grammes, the given number of milligrammes should be divided by 1000.