

# COMBINED PAN & BUCKET BALANCE



**IP 152459**

**PRODUCT GUIDE**

## INVICTA'S COMBINED PAN AND BUCKET BALANCE SET

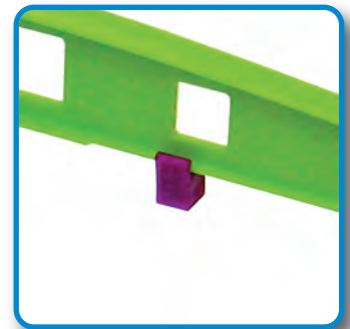


Invicta's Combined Pan and Bucket Balance contained within this set is a precision beam balance set that can be used for measuring liquids, solids or a combination of both. By combining different sized buckets with removable pans children need only to use a single piece of equipment to show many maths and science concepts, meaning there is no need to keep introducing new equipment. Included within the set are enough materials for whole class use.



← The spirit level in the centre of the balance provides a very quick visual confirmation on whether the items compared are balanced or not.

→ By adjusting the balancing compensators on the underside of the balance children can put liquid into the bucket on one side whilst balancing weights on a pan the other side.



### WHAT'S INCLUDED?

Included within Invicta's Combined Pan and Bucket Balance set;

- 1 set of clear 2500 ml/cm<sup>3</sup> buckets (x2)
- 1 set of clear pans (x2)
- 1 set of large lids (for use with the buckets)
- Set of coloured weights (1 g x 20, 5 g x 20 & 10 g x 20) →



### WHAT IS A BUCKET BALANCE USED FOR?

Bucket balances, frequently called scales are designed for easy and accurate measurement of loose fill materials or liquids such as sand or water. Both sets of 'buckets' in this set are made from clear wipeable plastic with volumes marked on the outside enabling children too easily see and record exactly what is in the bucket.



## WHAT IS A PAN BALANCE USED FOR?

Pan balances are probably the most recognisable of scales, so recognisable they are used almost uniformly as the symbol for 'justice' or 'balance'. Pan balances are used to determine the mass of a solid object by balancing it with a known mass.

By combining a pan and bucket on a single balance you can determine the mass, volume or density of a given object easily.

## ITEMS AROUND THE CLASSROOM WHICH COULD BE WEIGHED WITH THE COMBINED ROCKER SCALES:-

Items are only suggestions and similar items can be used instead

- Small black canisters/containers
- Cotton reels
- Dice
- Coloured Small balls or counters

### QUICK CONVERSION CHART

1000 g (gram)	= 1 kg (kilogram)
1 ml (millilitre)	= 1 cm <sup>3</sup> (centimetre cubed)
10 ml	= 1 cl (centilitre)
1000 ml	= 1 ltr (litre)
1 ltr of water	= 1 kg (kilogram)

### QUICK DEFINITIONS

**What is volume?**

Volume in short is the amount of space an object takes up. 1 kg of apples and 1 kg of cotton wool have the same mass - 1 kg, but would fill very different sized bags. Volume is measured in millilitres (ml) for liquids and gases and centimetres cubed (cm<sup>3</sup> for solids).

**What is mass?**

Isaac Newton called mass the 'quantity of matter'; put simply mass is how much stuff is in something. For example the amount of grams in an apple. Mass is measured in kilograms and grams.

**What is density?**

When talking of 'density' we usually mean mass density. This is the amount of mass you can put into a given volume. Using our apples and cotton wool example you could probably get over 100 g of apples into a 125 cm<sup>3</sup> container but only 50 g of cotton wool into the same container, therefore the apples are denser. Density is usually measured in grams per cm<sup>3</sup> (g/cm<sup>3</sup>) or grams per millilitre (g/ml)

### CALCULATING VOLUME, MASS OR DENSITY.

Density in g/ml	= Mass g divided by Volume ml
Mass in g	= Density in g or ml multiplied by Volume ml
Volume in ml	= Mass g divided by Density ml

## WHAT THE COMBINED PAN AND BUCKET BALANCE CAN BE USED TO DEMONSTRATE

- Measuring and comparing mass
- Measuring and comparing volume
- Formulae and equations
- Equality and balance in algebra
- Calculating density
- Comparing mass / densities of liquids
- Comparing mass / densities of solids

### INTRODUCTION

Prior to introducing children to the balance set for the first time it may be useful to explain that the balance works like a see saw.

Get children to visualise what would happen if a cow sat on one side of the see saw and a chicken sat on the other side, by running through a few combinations of common farm animals in this way, children quickly grasp that the larger animal will stay on the ground whilst the smaller animal will rise up.

Next ask what would happen if two cows sat on a see saw one on either side.

Note: With older children you may wish to explain that a see saw and a bucket balance are both examples of class one levers.

The purpose of a pan balance is to measure how 'heavy' something is. For younger children this is often referred to as 'weight' but for older children the term 'mass' is used. This guide uses the terms 'mass' or 'masses'.

Throughout the guide the activities vary in difficulty with the easiest activities presented first and the most difficult last, some suggestions have been given for extension activities or varying difficulty.

Many young children believe that = is an operation and makes something, it is important that they understand that = means 'is equal to' or 'balances with'. In short  $2 + 3$  does not make 5 it is equal to 5. Children can investigate this using a pan balance.

### ACTIVITY 1. PAIRING TREASURE HUNT

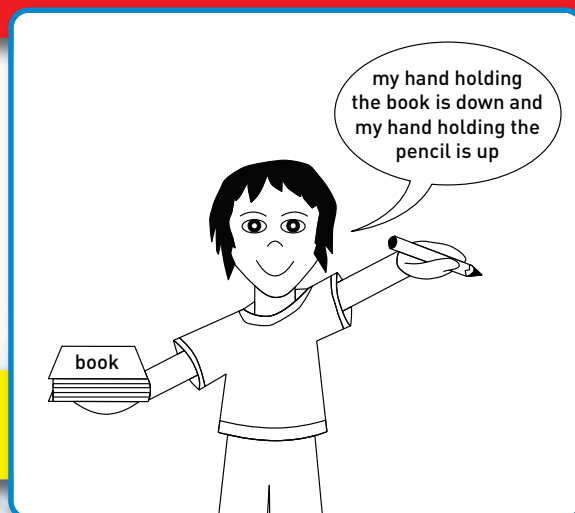
Year group: Reception – Year 2

Resources Required:

A selection of small everyday items within the classroom for children to find such as pens, books, crayons etc.

Time needed: 30 - 60 mins

**Objective:** For children to understand that some objects have a greater or lesser mass than others.



This exercise uses estimating and can be used as a standalone activity or as an introduction to activity 2.

Ask each child to 'hunt' around the room and find 2 small objects, once they each have 2 objects ask them to place one item in each hand and standing with arms out level to demonstrate what they think would happen if their items were placed on a pan balance. One at a time ask each child to explain what they are showing and why e.g. "my hand holding the book is down and my hand holding the pencil is up because the book is heavier".

## ACTIVITY 2. ESTIMATING VERSES ACCURACY

Year groups: Year 1 - 3

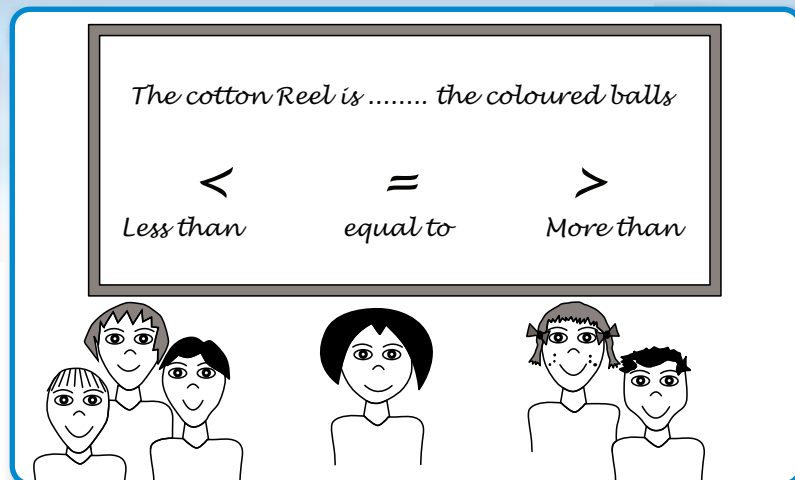
Resources Required - Items are only suggestions and similar items can be used instead:

1 Combined Pan & Bucket Balance set up and zeroed

5 small coloured balls

1 cotton reel

Wipe board and a dry wipe marker.



Setting up Required:

Prior to starting the activity put the pan balance where everyone can see it. At the top of the wipe board write 'The cotton reel is ..... the coloured balls' (This could be substituted with other items in the classroom which would have different masses).

To the left-hand side of the board draw a large < sign and underneath it write 'less than'. In the centre of the board draw a large = sign and underneath write 'equal to' and to the right-hand side of the board draw a large > symbol and underneath it write 'greater than'.

Time needed: 30 – 60 mins.

**Objective:** For children to understand the meaning of the mathematical signs <, > and =.

To show that estimating is only correct some of the time and that you must check answers for accuracy.

Invite children one at a time to stand up with their arms held up apart and level to their shoulders.

Place the cotton reel in one of the child's hands and the 5 small coloured balls/counters in the other, then ask them to demonstrate what they think would happen if these items were to be placed on the balance.

If the child believes that the cotton reel (or similar item) has a lesser mass than the coloured balls ask them to stand to the left side of the board. If they believe it has a greater mass then to go and stand to the right side of the board and if they believe the masses are equal, stand in front of the board.

Explain that whilst some of the children did estimate correctly it is difficult to compare objects of a differing shape or size (volume) accurately and this is why we use instruments like balances.



### ACTIVITY 3. COMPARING MASS

Year groups: Years 2 - 3

Resources Required:

A selection of small items from the balance kit and around the room such as crayons, pencils and erasers.  
1 Combined Pan & Bucket Balance (zeroed) for each group of children  
Set of stackable weight

Setting up required: Collecting of small items

Time needed: 45 - 60 mins

**Objective:** To use logical thinking to show that different items have different masses.

Arrange the children into small groups giving each group a balance and each child a small item, but ensure that no group has two of the same item. Ask each group to sort their items from least mass to greatest mass using the scales. Once each group has sorted out their items get them to check the order using the stackable weights.

### ACTIVITY 4. BALANCING EQUATIONS – COTTON REEL CHALLENGE

Year groups: Years 3 - 5

Resources Required - Items are only suggestions and similar items can be used instead:

Cotton reels  
Dice  
Coloured balls/Counters  
1 Combined Pan & Bucket Balance (zeroed) for each group of children  
1 activity sheet for each group (from page 10)  
Pencils for writing

Time needed: 30 - 60 mins

**Objective:** This activity introduces children to writing and exploring simple abstract formulae in preparation for algebra.

Organise the children into small groups and give each group 4 cotton reels a combined rocker scale, 20 coloured balls/counters, several dice and an activity sheet.

Nominate 1 child from each group as note taker and get each group to choose a group name which the note taker should write at the top of their blank page.

Ask one child from each group to put the 4 cotton reels into one of the balance. Explain that they are going to investigate how many ways they can find of balancing the 4 cotton reels).

Before starting the activity explain that it is faster and easier to refer to the cotton reels as 'C', the dice as 'D', and the balls as 'B'.

Challenge each group to find as many combinations of objects as they can that balance in 30 minutes. Each time they have a sum that balances the note taker needs to write it down.

After 30 minutes ask each group to stop weighing and writing and swap sheets with another group. Once each group has swapped sheets get them to test the sums on the sheet using the scale. If a sum balances, draw a smiley face next to it, if it doesn't balance draw a sad face.

The group with the most smiley faces is the winner.

## ACTIVITY 5. MAKING YOUR OWN MASS SET

Year groups: Years 3 - 5

Resources Required - items are only suggestions and similar items can be used instead:  
Selection of dry fill objects such as sand, rice, lentils, popping corn and cotton wool  
Black canisters or containers where the contents cannot be seen (5 for each group)  
Blank Labels  
Activity sheet (from page 11)  
Pencils or pens  
Funnels (not essential but helpful)  
1 Combined Pan & Bucket Balance (zeroed) for each group of children  
Stackable Weight set from balance set for demonstration  
Adhesive tape to secure the canister/container lids (e.g. sellotape)

Setting up required:  
Arrange the dry fill items at the front of the room and next to them put out some funnels to aid filling the canisters.

Time needed: 45 - 90 mins

**Objective:** To show objects of the same volume can have a different mass.

Arrange the children into groups and explain that they are going to be making their own mass sets. Give each group a balance, 5 black canisters/containers, 5 blank labels for their canisters/containers, an activity sheet, a pencil and some tape.

Before starting the activity show the children the weights set from the balance set explaining that each weight has a different mass.

Ask each group to label their canisters/containers 1 - 5 and explain that they are going to fill each canister/container with one or more materials from the front of the class.

They can choose whether to fill the canisters/container all the way to the top or not, but what is important is that each canister/container in a set has a different mass (no two canisters/containers in a single group can have the same mass).

Get the children to fill each of their canisters/containers with different material/s.

On the activity sheet make a note of the material contained in each canister/container (e.g. canister 1 = rice) and seal the canisters using sticky tape.

Using the balances weigh each canister/container noting the mass on the activity sheet.

Once the canisters/containers have been filled and sealed each group is to arrange them in order of least mass to greatest mass and write the order on their activity sheet.



## ACTIVITY 6. CALCULATING DENSITY OF SOLIDS

Year groups: Years 4 - 6

Resources Required - items are only suggestions and similar items can be used instead:  
Selection of dry fill objects such as sand, rice, lentils, popping corn and cotton wool at the front of the class  
Activity Sheet (from page 12)  
Pencils or pens  
1 Combined Pan & Bucket Balance (zeroed) for each group of children set up with the smaller buckets as a combination balance  
Stackable Weights for each group

Setting up required: Arrange the dry fill items at the front of the room.

Time needed: 60 – 90 mins (Introduction to density takes approx 5 - 10 mins and can be used as a standalone demonstration in science).

**Objective:** For children to understand that different solids have different properties.

Children are required to measure the mass of a given volume of material and to calculate the volume.

Before children perform the activity it is important that they understand what density is.

A quick and simple way of explaining density is to show them the items set out at the front of the room and explain that the denser something is, the more tightly packed it is, in other words there are fewer spaces for air in the material.

Most children will be able to see that cotton wool isn't very tightly packed and is pretty squishy so has a lot of air sacks. What is harder to see is that items such as sand also have a lot of air spaces.

To prove this measure out 100 cm<sup>3</sup> of sand into one of the buckets and balance it with the weights, asking the children if they think anything else can fit in the bucket without it measuring more than 100 cm<sup>3</sup>.

Then slowly add water on top (ensure it doesn't go over 100 cm<sup>3</sup>. The water will go into the air spaces and until the sand is saturated, the volume will not change however the mass will.

### ACTIVITY

Organise the children into small groups and give each group a balance, weights, an activity sheet for each child and something to write with.

Get the children to set up the balances as a combination balance and zero them.

Have the children take turns in measuring out 100 cm<sup>3</sup> of material into the bucket and then balancing it using weights on the lid i.e. if there are 6 children in a group they will need to need to measure at least 6 items, each time recording the results on the activity sheet and filling in the material measured column and the mass column.

Once each child has taken a turn explain that they are going to calculate the densities of these materials using the information they have gathered and fill in the density column.

To work out the density of each material take the mass of the material and divide it by 100 (the volume we have used) and you will see that the first line has been completed on the sheet to show water. Explain that if a material has a density less than water it will float and if it has a greater density than water it will sink.

You can demonstrate this by asking for a material the children believe will float based on their results (e.g. lentils) then filling one of the small buckets with water and dropping (slowly and carefully otherwise the force of the fall will interfere with the result) some of the material on top of the water.



## ACTIVITY 7. SINKING SHIPS

Year groups: Years 4 - 6

Resources Required - items are only suggestions and similar items can be used instead:  
Selection of liquids and solids at the front of the class such as sand, cooking oil, salt, washing powder or washing up liquid (the more concentrated the better). Try to ensure that the majority of the materials have a density greater than  $1 \text{ g/cm}^3$   
Activity sheet for each group (from page 12)  
Pencils or pens  
1 Combined Pan & Bucket Balance (zeroed) for each group of children set up with the smaller buckets as a combination balance  
Weights for each group  
5 canisters/containers per group  
1 large bowl of water for each group

Setting up required: Arrange the dry fill items at the front of the room

Time needed 60 – 90 mins

**Objective:** For children to understand that by changing the mass in a given volume you can manipulate the properties, this is how steel ships float.

Children are required to measure the mass of a given volume of material and to calculate the volume.

During this activity children will calculate the densities of 5 different materials as in activity 6 and fill in the sheet.

Once each group has worked out the densities of 5 materials explain that each group is a merchant shipping company owning 5 ships (canisters/containers).

In order for the company to be successful they need to ship as much material at a time as the ship will hold without any of the material getting wet or worse still, the ship sinking.

Using the information recorded on the sheets children have to work out how much material can be loaded into a canister and for it to still float.

The aim is to get all 5 canisters/containers floating in the water and none of the material wet.

The first group to get their whole fleet loaded and on the water safely is the winner.



**WARNING!** NOT SUITABLE FOR CHILDREN UNDER 36 MONTHS BECAUSE SMALL PARTS MAY CAUSE A CHOKING HAZARD. TO BE USED ONLY UNDER ADULT SUPERVISION.

Please retain the information from this product guide for future reference. We reserve the right to alter designs and specifications (including colours and materials) when such changes are unavoidable. This product conforms to the safety requirements of EN71, ASTM, 16 CFR and The Canadian Hazardous Products (Toys) Regulations.



MADE IN CHINA

Spirit levels contain 0.7cc decane. Do not expose to a source of ignition. If breakage occurs, do not allow ingestion or contact with eyes. In case of accidental ingestion, provide copious amounts of water and consult a medical practitioner. In case of accidental contact with eyes, rinse with copious amounts of water and consult a medical practitioner. Avoid breathing vapours. In case of spillage, collect with absorbent material and remove to a well ventilated location. Do not expose to a source of ignition.





Group Name:

Dry fill material used	Canister number	Mass in grams

Least Mass

Greatest Mass

Name: \_\_\_\_\_

Material Measured	Mass (grams)	Volume (cl or ml)	Density (gram/ml)
<i>Water</i>	<i>100 grams</i>	<i>100 ml</i>	<i>1.0</i>
		<i>100 ml</i>	
		<i>100 ml</i>	
		<i>100 ml</i>	
		<i>100 ml</i>	
		<i>100 ml</i>	
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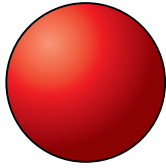


EXTENSION ACTIVITIES

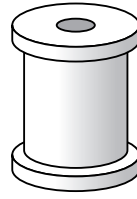
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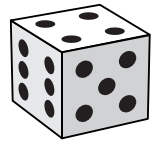
Black Canister  
(A)



Coloured Ball  
(B)

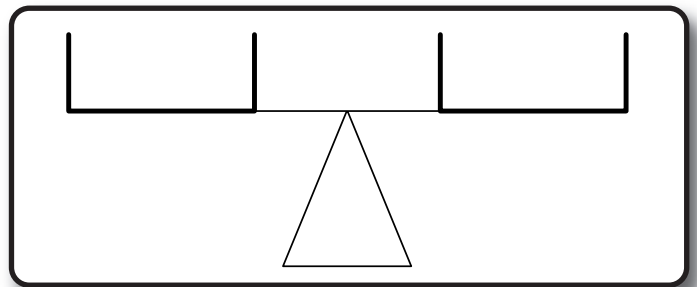
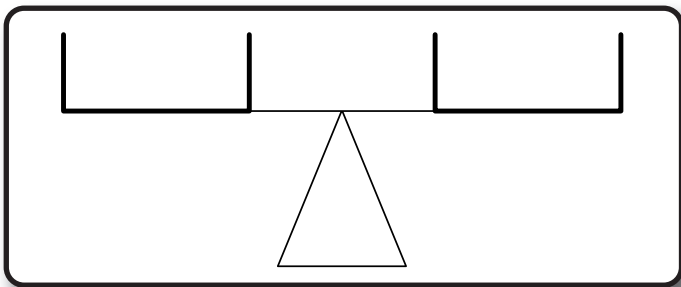
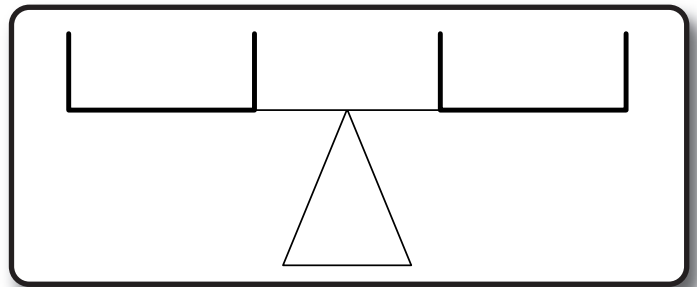
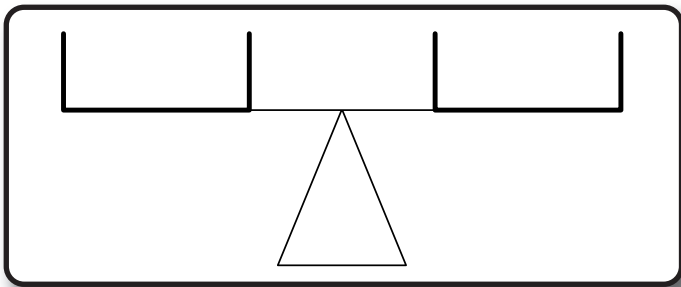
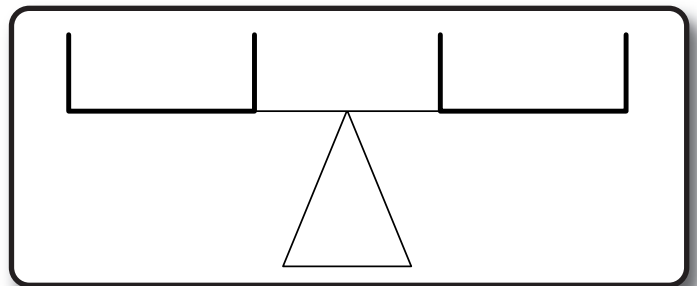
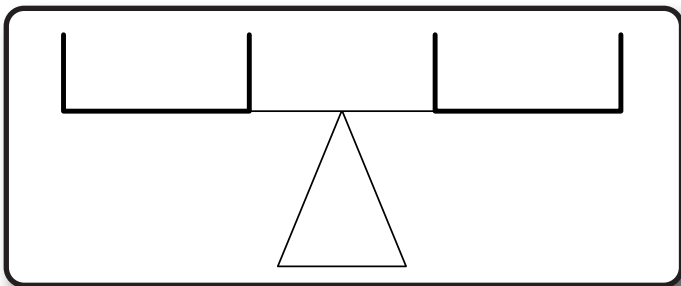


Cotton Reel  
(C)



Dice  
(D)

Using the symbols above, design some equations to test on a partner



Other products associated with the Combined Pan and Bucket Balance are listed below. For more information about any of these, click on the relevant link, or see our web site for the full range of Invicta Education products.

16 mm Counters	Ref No. 075059
Balance Kit	Ref No. 050559
Bucket Balance	Ref No. 050459
Capacity Measures	Ref No. 034359
Combined Rocker Scales	Ref No. 152359
Cotton Reels	Ref No. 012659
Litre Extension Set	Ref No. 051939
Litre Set	Ref No. 120559
Maths Balance	Ref No. 050359
Mk3 Maths Balance	Ref No. 152559
Rocker Scales (0.5 l)	Ref No. 152259
Rocker Scales (1 l)	Ref No. 090559
Simple Scales	Ref No. 050259
Stackable Weights	Ref No. 150759
Storage Box	Ref No. 014059
Storage Tubs	Ref No. 098159

[Invicta Education Web Site](#)

Invicta ensures that all products designed and manufactured conform with our Clients' requirements. We wholeheartedly support both environmental and ethical trading practices.

The polymers we use are all heavy metal free.

We are able to manufacture in recyclable plastics, water soluble bio-polymers (hot and cold), fully biodegradable bio-polymers and degradable polymers with the aim of contributing to a 'sustainable' future for plastics in the developing world.

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