Brien Holden Vision Institute

TRIAL SETS AND TRIAL FRAMES

THINK

A person's spectacles contain lenses of a certain power to correct their refractive error. It is rare for two people to have exactly the same refractive error.

During an eye examination we use a specially designed adjustable spectacle frame (called a "trial frame") into which we place various temporary lenses (called "trial lenses"). This lets us change the power of the lenses in front of the person's eyes quickly and accurately, in order to determine their refractive error and the most suitable spectacle prescription.

AIM

This unit introduces you to the features of trial lens sets and trial frames.

LEARNING OUTCOMES

When you have worked through this unit you should be able to:

- identify and locate spheres, cylinders, prisms and accessories in a trial lens set
- tell the difference between plus and minus lenses
- adjust a trial frame correctly.

REVIEW: TRIAL SETS AND TRIAL FRAMES

REFRACTIVE ERROR	A person who has a refractive error will need to wear spectacles (glasses) or contact lenses so that they can see clearly and comfortably. This is because their eye is not the correct size and shape. There are four main types of refractive error: myopia, hyperopia, astigmatism and presbyopia. An eye examination that tests for refractive error is called a refraction.
LENSES	Lenses refract light to form a focus. Spherical lenses can be plus or minus lenses. Astigmatic lenses can be cylindrical or sphero-cylindrical lenses.
PRISMS	A prism makes light rays change direction by bending them. A prism has a base and an apex, and light is bent away from the apex.
OPTICAL CENTRE	A light ray will not bend if it travels through the optical centre of a lens.
INTERPUPILLARY DISTANCE (PD)	PD is the distance (in mm) between a person's pupils. Distance PD is the distance between a person's pupils when they are looking at something far away. Near PD is the distance between a person's pupils when they are looking at something close. The distance between the optical centres of the lenses in a person's spectacles should be the same as their PD.

TRIAL LENS SETS

A trial lens set (also called a trial lens case) is a collection of lenses that is used to measure a person's refractive error.

Trial lens sets usually contain:

- spherical trial lenses (plus and minus)
- cylindrical trial lenses (minus and sometimes plus)
- prism trial lenses
- accessory lenses.

Figure 8.1: *A trial lens set*

Trial lens sets come in different designs and colours, but they all contain the same basic lenses that are needed to do a refraction (examine the eyes for refractive error).

TRIAL LENS SETS (cont.)

TRIAL LENSES

The lenses contained in a trial lens set are called trial lenses.
Each lens is labelled so that its power can be identified easily.

The power of a spherical lens is measured in dioptres (D).
The power of a cylindrical lens is measured in dioptres cylinder (DC).
The power of a prism lens is measured in prism dioptres ($^{\Delta}$).

The rim (outside edge) of a trial lens can be made of plastic or metal. Sometimes the plastic rims of plus and minus lenses are coloured differently, to make it easier to tell them apart.
Each lens in a trial lens set has a particular place where it must be stored. The different types of lenses are kept in groups and in order of power. This makes it easier to find each lens, and also helps to avoid us accidentally using the wrong lens during a refractive examination.

If a trial lens is not kept in its correct place in the trial case, it will be confusing the next time the trial lens set is used, and can lead to mistakes in the refractive examination.

Every trial set is different, but usually:

- plus spherical trial lenses are on the right side of the trial lens set
- minus spherical trial lenses are on the left side of the trial lens set
- cylindrical trial lenses are in the centre (between the plus and minus spherical trial lenses)
- prism trial lenses are in the centre (near the cylindrical trial lenses)
- accessory trial lenses are in the centre (near the cylindrical trial lenses).

Spherical, cylindrical and prism trial lenses come in many different powers.

Usually, the powers of trial lenses between:

- ±0.25 and ±4.00 D increase in power in 0.25 D steps
- ±4.00 and ±6.00 D increase in power in 0.50 D steps
- ±6.00 and ±20.00 D increase in power in 1.00 D steps

Each trial lens set has two trial lenses for every spherical and cylindrical lens power.

This is because sometimes the same lens power is required for both the right eye and the left eye.

TRIAL LENS SETS (cont.)

SPHERICAL TRIAL LENSES

Spherical trial lenses are also called spherical lenses, or spheres.

Spherical lenses can be either plus or minus lenses.

There are two ways to tell the difference between a plus and a minus lens, namely the sign marking on the rim and the colour of the rim:

- Plus lenses
  - have a "+" sign on the rim
  - *usually* have a black or green coloured rim

- Minus lenses
  - have a "–" sign on the rim
  - *usually* have a red coloured rim.

Warning:

Some trial lens sets use colours that are the opposite from what is normal (*some* trial sets use black rims for minus lenses, and red rims for plus lenses).

Other trial sets might even use other colours altogether.

Always check which colour means plus and which means minus before you use a trial set for the first time.

Figure 8.2: *A plastic rimmed spherical trial lens. The black colour tells you that it is a plus lens, and the number tells you the power. This is a +1.50 D trial lens.*

Figure 8.3: *A metal rimmed spherical trial lens. The power of the lens is written on the lens. This is a −1.50 D trial lens.*

Sometimes a trial lens will not have a "+" or "–" sign on its rim. If this happens, you can tell the difference between the plus and minus lenses by looking at the shape of the high powered (stronger) trial lenses.

TRIAL LENS SETS (cont.)

SPHERICAL TRIAL LENSES (cont.)

A plus trial lens will be thick in the middle of the lens, and thin near the rim of the lens.

The higher the power of the plus lens, the thicker it will be in the middle.

A minus trial lens will be thin in the middle of the lens, and thick near the rim of the lens.

The higher the power of the minus lens, the thicker it will be near the rim.

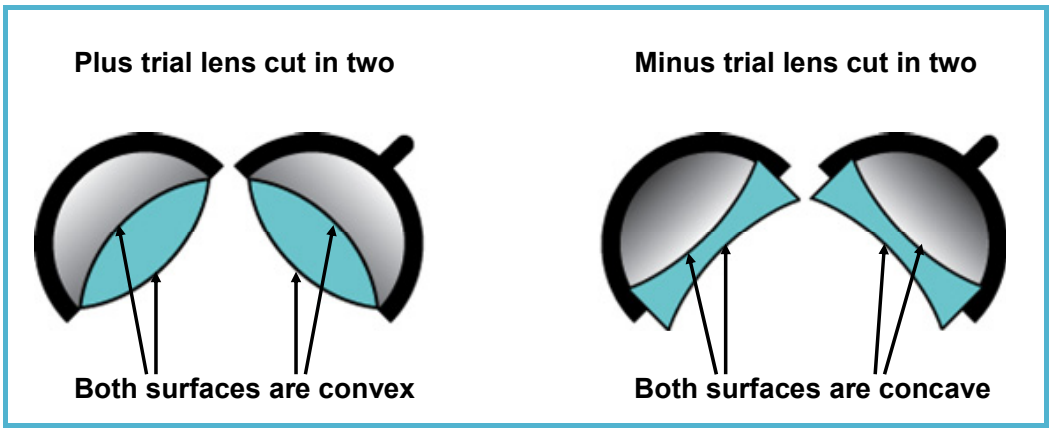


Figure 8.4: *Plus trial lenses are thicker in the middle and minus trial lenses are thinner in the middle*

Unlike spectacle lenses, the optical centre of a trial lens is always in the exact centre of the trial lens.

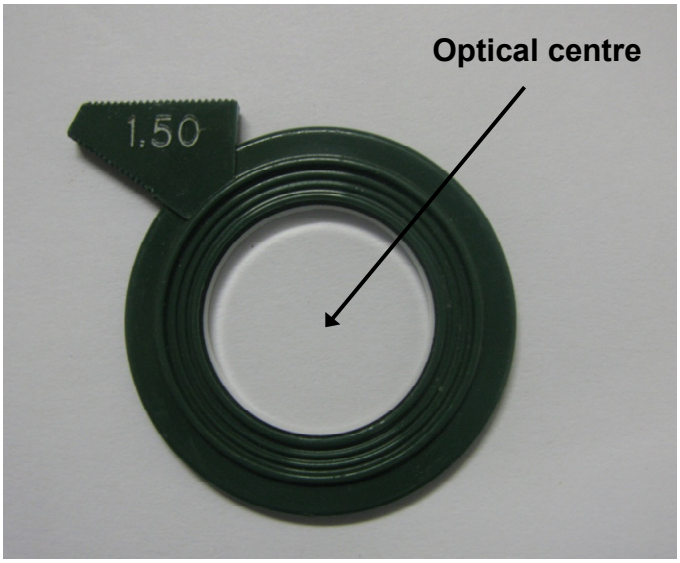


Figure 8.5: *Optical centre of trial lens*

TRIAL LENS SETS (cont.)

CYLINDRICAL TRIAL LENSES

Cylindrical trial lenses come in plus and minus powers, but usually it is only necessary to use the minus cylindrical lenses to do a refraction. In fact, some trial lens sets do not have plus cylinders, they only have minus cylinders.

Cylindrical lenses are also called cylinder lenses, or cyls.

Like sphere lenses, cylindrical trial lenses are labelled so that they can be identified. They may have a "+" or "–" sign on the rim, or they may have a coloured rim.

Cylindrical lenses also have two small axis marks, which can either be located on the rim, or engraved (carved into) the edge of the lens. These small lines show the direction of the axis of the cylinder.

Sometimes these small axis marks on a cylindrical trial lens are the only things that make it look different from a spherical lens. You must look very carefully for the axis marks – this is the best way to tell the difference!

Cylindrical trial lenses can be confused with spherical trial lenses, so it is important to look for the axis marks.

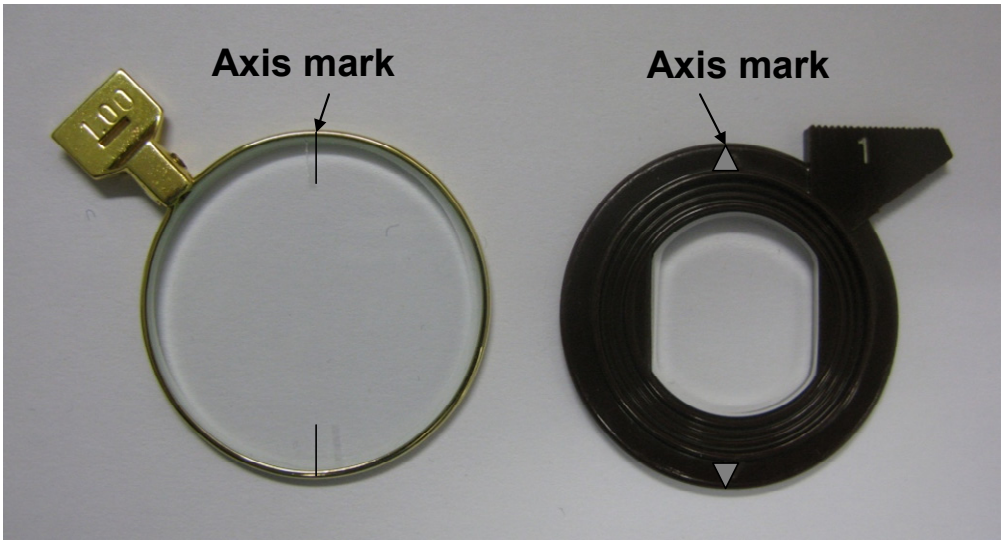


Figure 8.6: *Metal rimmed cylindrical lens and plastic rimmed cylindrical trial lens*

PRISM TRIAL LENSES

Prism trial lenses are also called prism lenses, or prisms.

Unlike spheres and cylinders, prisms do not have plus or minus powers.
This means that prism lenses are not coloured differently, and they do not have "+" or "–" signs on their rims.

Like cylinder lenses, prism trial lenses usually have a small line on the rim or on the edge of the lens. A prism usually only has one line, and a cylinder usually has two lines – but this is not always the case. If the prism has only one line, this line shows the location of the apex of the prism.

Prism lenses are thin at the apex (near the small line), and thick at the base (furthest away from the small line). The higher the power of the prism, the thicker the base will be.

TRIAL LENS SETS (cont.)

Figure 8.7: *Plastic rimmed prism trial lens. This lens is a 3$^{\Delta}$ prism. It is thinner at the apex of the prism, and thicker at its base.*

Figure 8.8: *Metal rimmed prism trial lens. This lens is a 3$^{\Delta}$ prism. It has a small line at the apex of the prism, and a longer line at its base. You must be extremely careful not to confuse prism and cylindrical trial lenses.*

ACCESSORY TRIAL LENSES

Accessory trial lenses are also called accessory lenses, or accessories.
Accessory lenses can be thought of as tools that help with the refraction. Each accessory lens has a special purpose.
Some trial lens sets have more accessories than others, but all trial lens sets should have:

- **Occluder** – This accessory is simply a piece of black plastic inside a lens rim. It is used to cover the eye that is not being examined.

Figure 8.9: *An occluder*

- **Pinhole** – This accessory looks similar to an occluder, but it has one or more small holes in it. It is used to conduct the pinhole test, to find out whether poor VA is caused by uncorrected refractive error or by an eye health problem.

Figure 8.10: *A pinhole*

TRIAL LENS SETS (cont.)

ACCESSORY TRIAL LENSES (cont.)

- **Cross cylinder** (also called a “cross cyl”, “Jackson cross cylinder”, or “JCC”). This is a special accessory lens with a longer handle than the other trial lenses.

  It also has several lines and markings on the lens. Cross cyls are used to measure astigmatism.

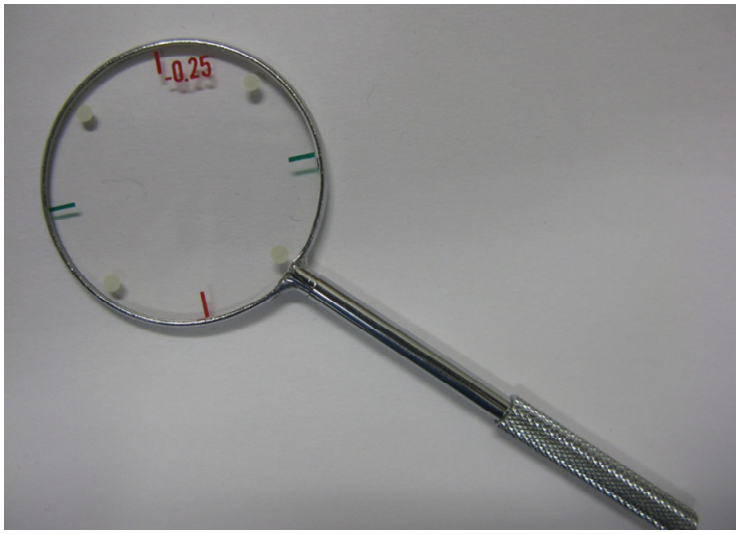


Figure 8.11: *A cross cylinder*

When you have finished using a trial lens, you should make sure the lens is clean (with no fingerprints!), and put it back in its correct position in the trial lens set.

TRIAL FRAMES

A trial frame is an adjustable spectacle frame that is used to hold trial lenses in front of a person's eyes. It is especially useful when performing a refraction, because it makes it easy to change the lenses.

Figure 8.12: *A woman wearing a trial frame with plastic rimmed trial lenses in it*

Figure 8.13: *A man wearing a trial frame with metal rimmed trial lenses in it*

LENS CELLS	The places where trial lenses are inserted into a trial frame are called lens cells. There are lens cells in front of the trial frame apertures (openings where the eyes will look through), and more lens cells at the back of the trial frame. It is better to place higher powered spherical lenses in the back lens cells of the trial frame. Lenses that are placed in the front cells can be rotated (turned). This is useful because cylindrical lenses need to be rotated during a refraction to determine the amount and axis of a person's astigmatism. It also allows the axis of the cylindrical trial lens to be accurately placed against the axis scale marked on the trial frame.
AXIS SCALE	The axis scale is painted on the trial frame. It has markings from 0° to 180° which increase in 5° steps. The axis scale is used for cylindrical lenses when testing for astigmatism. Cylindrical lenses can be rotated in the lens cells by using the front cell rotation knob.

TRIAL FRAMES (cont.)

AXIS SCALE (cont.)

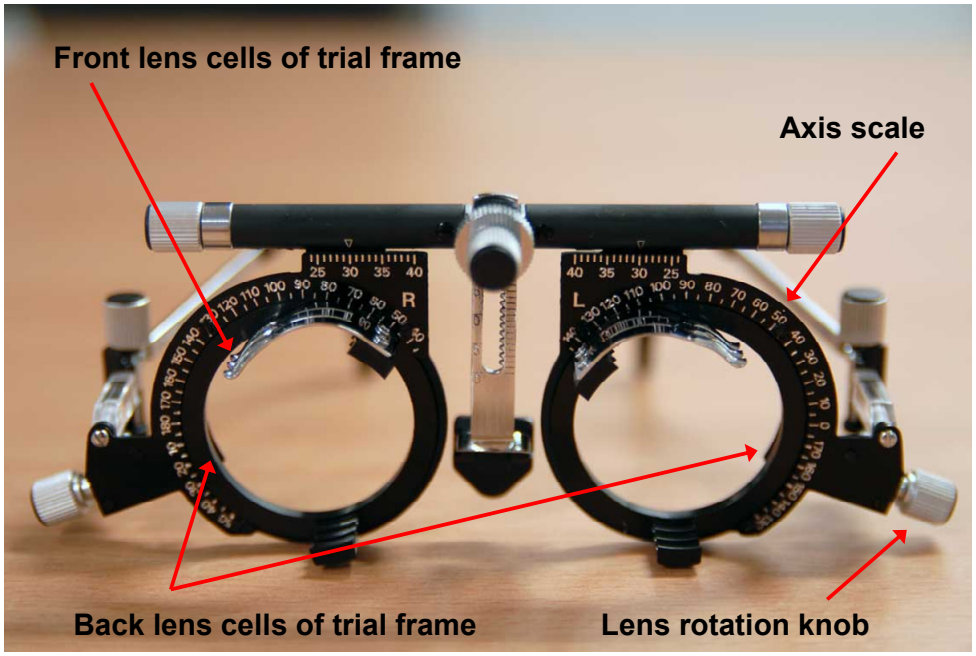


Figure 8.14: *A trial frame is an adjustable spectacle frame for holding trial lenses*

ADJUSTING THE TRIAL FRAME

Trial frames are adjustable so that they will fit every person's face properly.
An accurate refraction depends on correct fitting of the trial frame.

Adjustable parts include:

- **temples** (or **ear pieces**) – These are the side arms of the trial frame. They can be made longer or shorter so that the trial frame fits firmly yet comfortably, and at the right distance from the person's eyes.
- **nose pad** – This is the part of the trial frame that sits on the bridge (top) of the person's nose. The nose pad can be made higher or lower so that the person's eyes are in the centre of the trial frame apertures (holes that the person looks through).
- **temple angle** (or **angle** on the **ear piece**) – These parts of the trial frame are located near the hinge of the temples. They can be adjusted so that the trial frame apertures sit vertically on the person's face.
- **interpupillary distance (PD)** – These knobs on each side of the trial frame move the trial frame apertures closer or further away from each other. They should be adjusted to the person's PD, so that their eyes are in the centre of the trial frame apertures.

Be gentle and careful when making adjustments to the trial frame – especially when it is on the person's face.

It can be uncomfortable for the person when trial lenses are put into and taken out of the trial frame.

It is best to hold the trial frame with one hand when inserting or removing lenses. This stops the trial frame from pressing on the person's face.

TRIAL FRAMES (cont.)

ADJUSTING THE TRIAL FRAME (cont.)

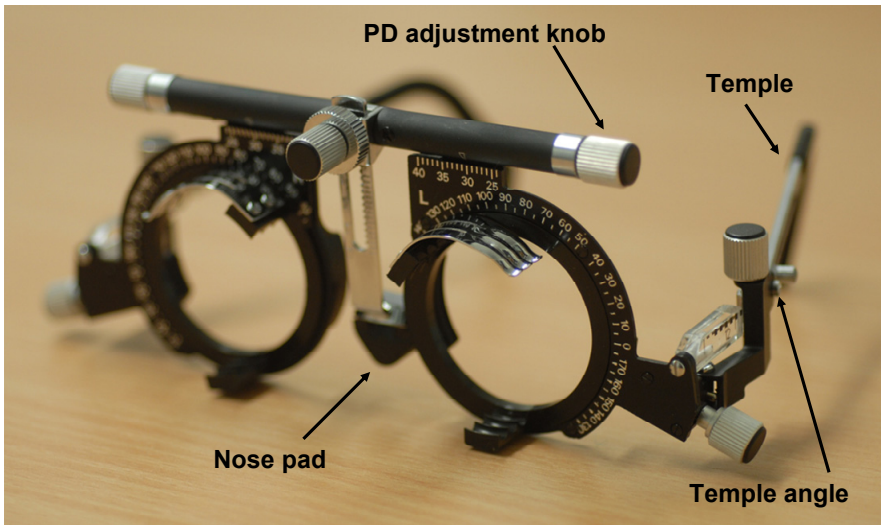


Figure 8.15: *Adjustable parts of the trial frame*

SETTING INTERPUPILLARY DISTANCE (PD)

Before you put a trial frame on a person, you must first measure the person's PD and then adjust the trial frame so that the PD setting on the trial frame is correct.

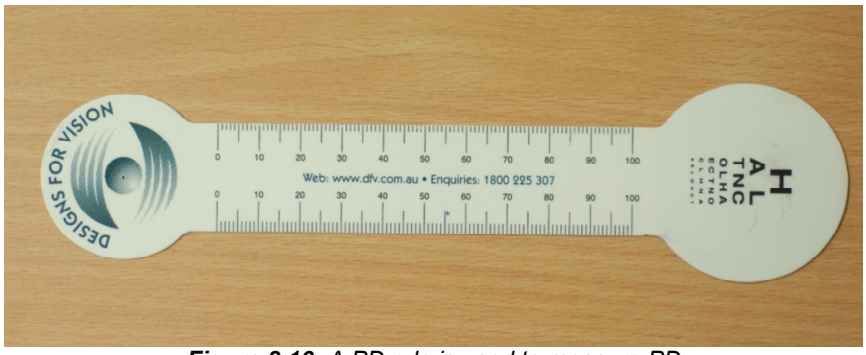


Figure 8.16: *A PD rule is used to measure PD*

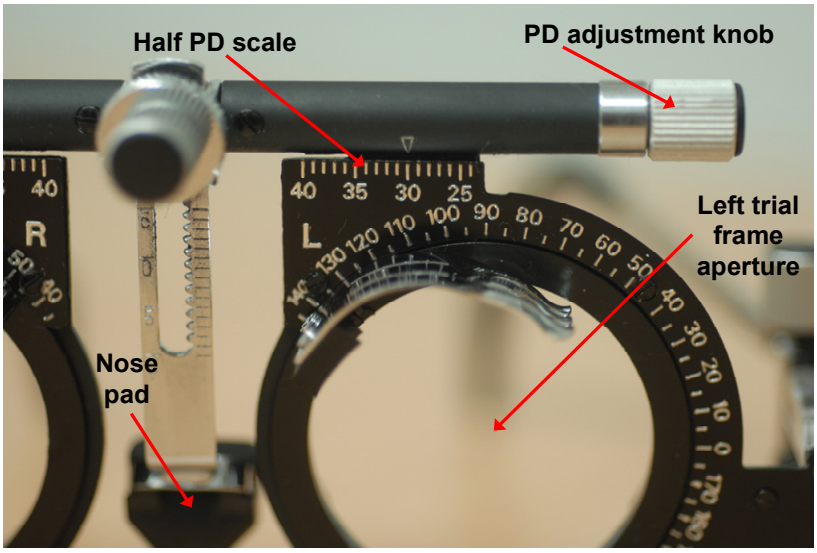
Setting the correct PD on a trial frame is important – especially when using higher powered trial lenses.

Trial frames usually have two PD adjustment knobs (one for each trial frame aperture) and two half PD scales. Turning one of these knobs in one direction will make the trial frame aperture on that side move closer to the other trial frame aperture and closer to the nose pad; turning it in the other direction will make it move it further away.

After a person's PD has been measured with a PD rule, half of the total PD needs to be set on one half of the trial frame, and the other half needs to be set on the other half of the trial frame.

When an adjustment knob is turned, an arrow will move along the half PD scale. The number that it points to needs to be equal to half the person's PD.

TRIAL FRAMES (cont.)

SETTING INTERPUPILLARY DISTANCE (PD) (cont.)	If the trial frame has been adjusted properly, each eye should be exactly in the centre of each trial frame aperture. This means that when lenses are inserted into the trial frame, the eyes will look through the optical centres of the trial lenses.  ***Figure 8.17:*** *Half PD scale and adjustment knob for left trial frame aperture*
EXAMPLE 1:	You measure a person's distance PD as 64 mm. Step 1: Find half of the person's PD: 64 mm ÷ 2 = 32 mm. Step 2: Turn the PD adjustment knob on one side until the arrow points to the number 32. Step 3: Turn the PD adjustment knob on the other side until the arrow points to the number 32.
EXAMPLE 2	You measure a person's distance PD as 67 mm. Step 1: Find half of the person's PD: 67 mm ÷ 2 = 33.5 mm. Step 2: Trial frames do not have 0.5 settings on the scale, so you just set one side to 33 mm and the other side to 34 mm.
USING A TRIAL FRAME TO TEST NEAR VISION	When the trial frame is being used for near vision tests, the PD adjustment of the trial frame must be set for the near PD.
EXAMPLE 3	A person's near PD is 58 mm. Step 1: Find half of the person's PD: 58 mm ÷ 2 = 29 mm. Step 2: Turn the PD adjustment knob on one side until the arrow points to the number 29. Step 3: Turn the PD adjustment knob on the other side until the arrow points to the number 29.

SUMMARY: TRIAL SETS AND TRIAL FRAMES

TRIAL SET

- A trial set is a collection of spherical, cylindrical and prism lenses, as well as some accessory lenses, usually contained in a specially designed box.
- These lenses are used to measure a person's refractive error.

SPHERICAL TRIAL LENSES

- Plus and minus trial lenses are either:
  - labelled with a "+" or "–" sign; or
  - surrounded by a coloured rim.

  Usually plus lenses are black (or green) and minus lenses are red.
- Plus trial lenses are thickest in the centre of the lens.
- Minus trial lenses are thickest at the edge of the lens (near the rim).
- Unlike spectacle lenses, the optical centre of a trial lens is always in the centre of the trial lens.

CYLINDRICAL TRIAL LENSES

- Cylindrical trial lenses come in plus and minus powers, but usually we only use the minus cylinders to do a refraction.
- Cylindrical lenses have two small axis marks that show the direction of the axis of the cylinder.

PRISM TRIAL LENSES

- Prism lenses usually have one small line on the rim or edge of the lens. This line shows the apex of the prism.
- Prisms are thin at the apex and thicker at the base.

ACCESSORY TRIAL LENSES

Occluder: used to cover the eye that is not being examined.
Pinhole: used to check for refractive error.
Cross cylinder: used to measure astigmatism.

TRIAL FRAME

- A trial frame holds trial lenses in front of a person's eyes.
- It must be adjusted to fit each person individually.
- The adjustable parts include: temples, nose pad, temple angle, interpupillary distance (PD).
- The person's PD must be measured before a trial frame can be adjusted.

TEST YOURSELF QUESTIONS

1. **What is interpupillary distance (PD)?**

_____

_____

2. **What types of lenses does a trial lens set usually contain?**

_____

_____

3. **How can you tell the difference between a plus and minus spherical trial lens?**

_____

_____

_____

4. **How can you tell the difference between a cylindrical and a spherical trial lens?**

_____

_____

5. **How can you tell the difference between a prism and a cylindrical trial lens?**

_____

_____

6. **Complete the following table:**

Accessory Lens:	Used for:
Occluder	
Pinhole	
Cross Cylinder	

7. **Which parts of a trial frame can be adjusted?**

_____

_____

8. **In which cells of the trial frame should you place higher powered spherical lenses?**

_____

9. **What is this person's PD?** _____

NOTES