

3 A student investigates reflections in a plane mirror.

A ray-trace sheet is shown in Fig. 3.1.

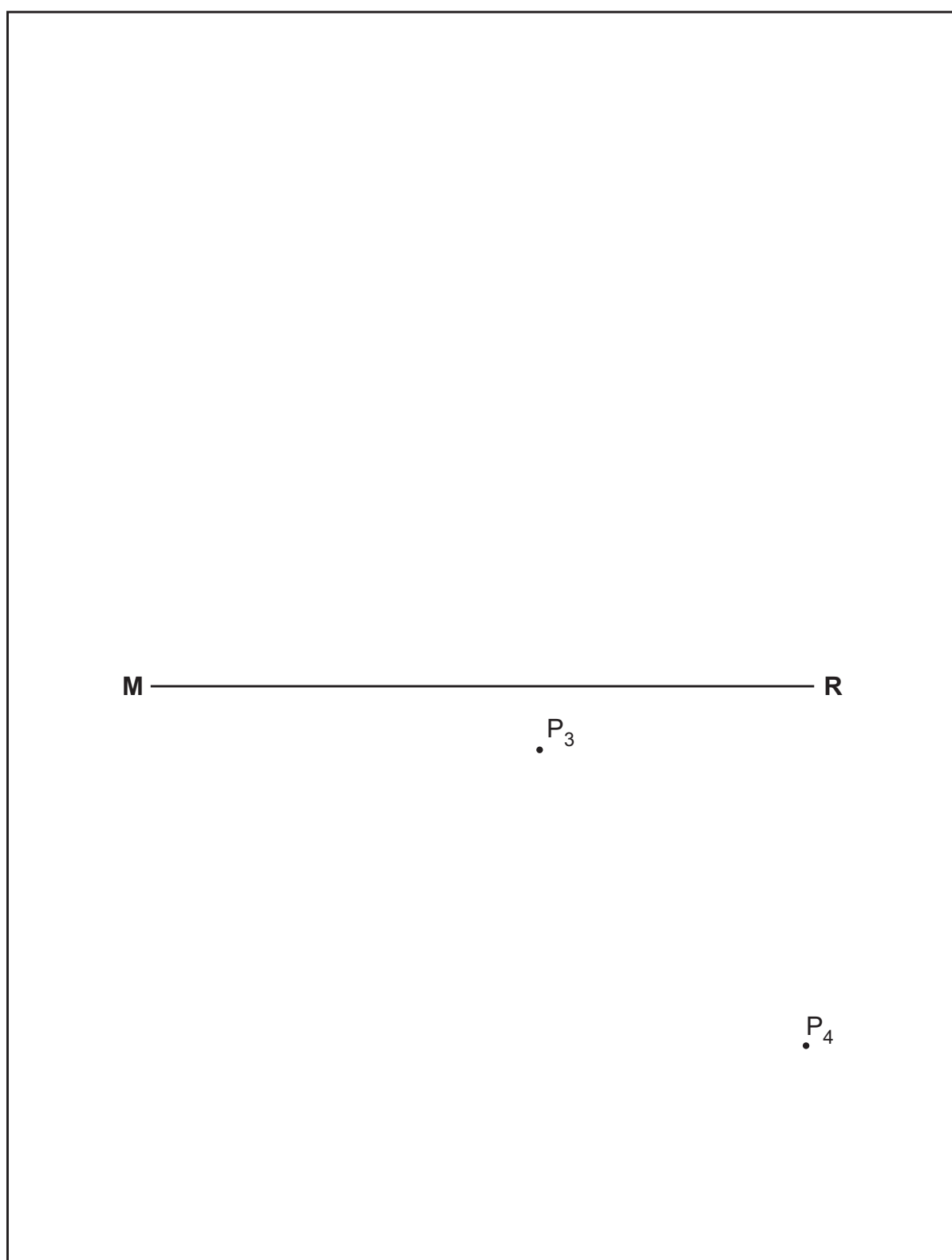


Fig. 3.1

- (a) • Draw a normal to the line **MR** that passes through the centre of **MR**. Label the normal **NL**.  
 • Label the point at which **NL** crosses **MR** with the letter **B**.  
 • Draw a line 10.0 cm long from **B** at an angle of incidence  $i = 40^\circ$  to the normal below **MR** and to the left of the normal. Label the end of this line **A**.

[1]

- (b) The student places the reflecting face of the mirror vertically on the line **MR**.

He places **two** pins,  $P_1$  and  $P_2$ , on line **AB**.

Mark the positions of  $P_1$  and  $P_2$  with crosses (X) on line **AB** at a suitable distance apart for this type of ray-trace experiment. Label the positions of  $P_1$  and  $P_2$ . [1]

- (c) The student views the images of pins  $P_1$  and  $P_2$  from the direction indicated by the eye in Fig. 3.1. He places two pins,  $P_3$  and  $P_4$ , so that pins  $P_3$  and  $P_4$  and the images of  $P_2$  and  $P_1$  all appear exactly one behind the other. The positions of  $P_3$  and  $P_4$  are shown on Fig. 3.1.

- (i) Draw a line through the positions of  $P_3$  and  $P_4$ . Continue the line until it meets **MR**. [1]  
 (ii) Measure the acute angle  $\alpha$  between this line and the horizontal line **MR**. An acute angle is an angle less than  $90^\circ$ .

$\alpha = \dots\dots\dots^\circ$  [1]

- (d) The student turns the mirror through  $180^\circ$ . He draws a new incident ray at an angle of incidence  $i = 50^\circ$  to the normal above **MR** and to the left of the normal.

He labels the end of this line **C**. This line is **not** shown on Fig. 3.1. You may draw the line on Fig. 3.1.

He places two pins on the line **CB** and views the images of the two pins from near the top right-hand corner of the ray-trace sheet.

On Fig. 3.1, draw a reflected ray 10.0 cm long from **B** with an angle of reflection  $\beta$  equal to the angle of incidence. Label the end of the line **D**. [2]

- (e) Suggest a relationship between  $\alpha$  and  $\beta$ . Justify your answer by reference to the results.

relationship .....  
 justification .....  
 .....  
 ..... [2]

- (f) State **two** techniques that you use in this type of experiment to obtain an accurate ray trace.

1 .....  
 .....  
 2 .....  
 ..... [2]