1 A student investigates the reflection of light by a plane mirror.
The student's ray-trace is shown full-size in Fig. 1.1.

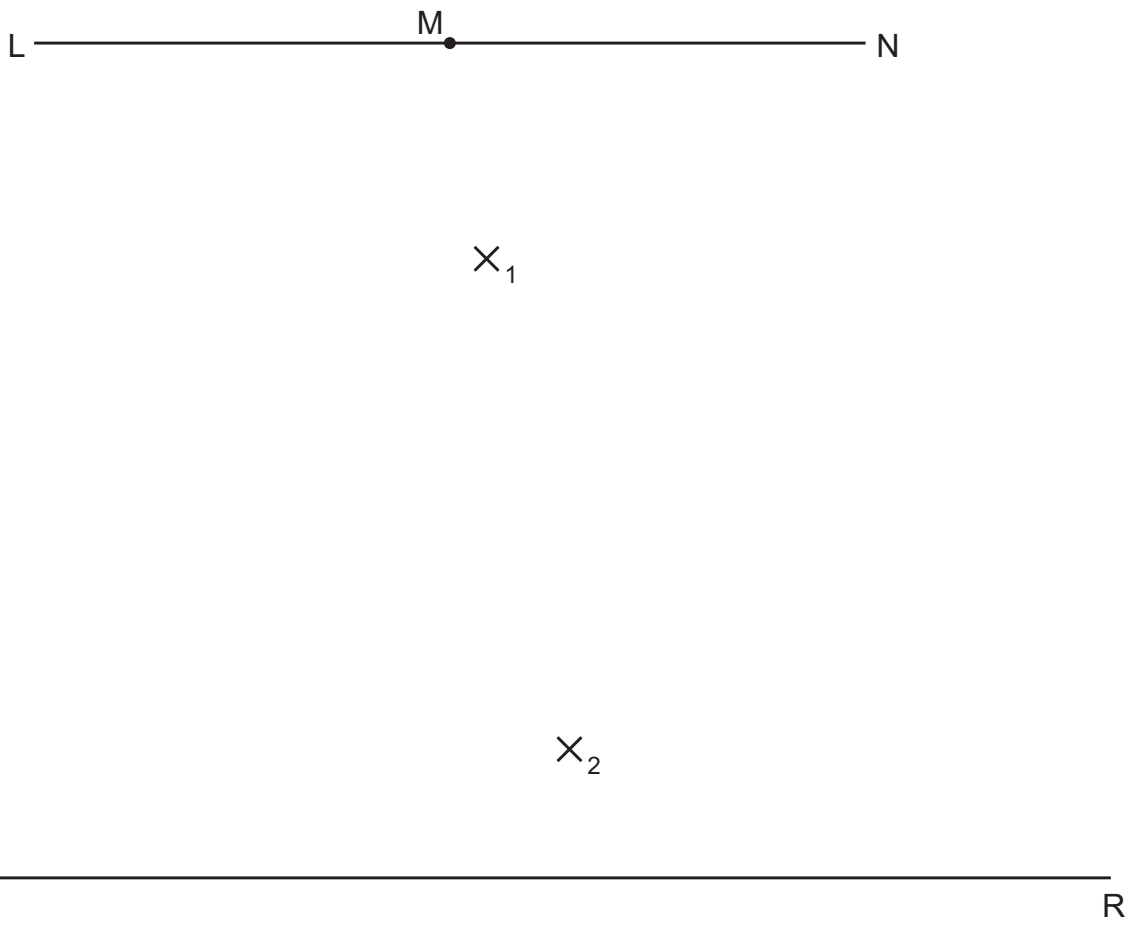

Fig. 1.1

(a) The student:

- draws line **LN**
- labels the mid-point of **LN** with the letter **M**
- draws a line **PR** parallel to **LN** and 10.0 cm below it

On Fig. 1.1, draw a normal to **LN** at the point **M**. Extend the normal downwards until it crosses the line **PR**. Label the point at which the normal crosses **PR** with the letter **Q**. [1]

(b) On Fig. 1.1, draw a line 14.0 cm long from point **M** at an angle $\theta = 10°$, as shown in Fig. 1.2.
Label the other end of the line **O**. [2]

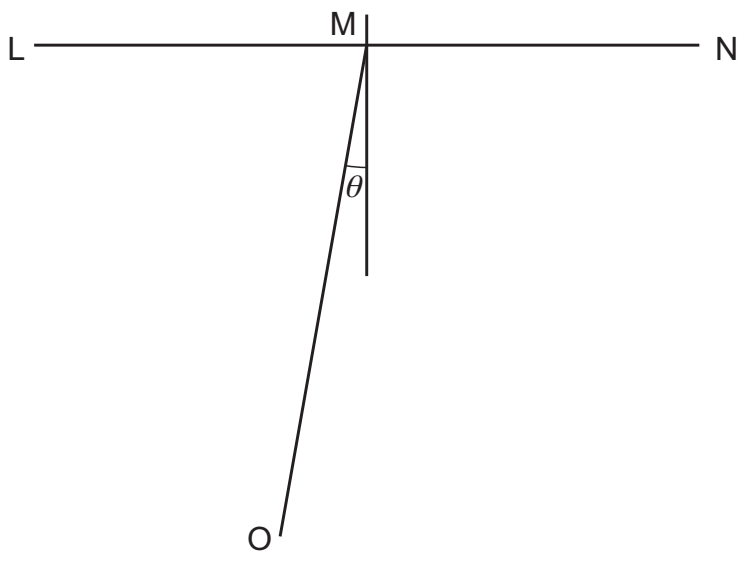

Fig. 1.2

(c) The student:

- places the reflecting surface of a mirror along the line **LN**, with its reflecting surface facing the bottom of the page, and with the centre of the mirror at **M**
- positions a light source and slit so that a ray of light passes along the line **OM** towards **M**
- marks two small crosses X_1 and X_2, a suitable distance apart on the ray reflected from the mirror
- removes the mirror and the illuminated slit.

(i) On Fig. 1.1, draw a line joining **M** to X_1 and X_2.

Continue the line until it crosses the line **PR** and label the point where it crosses **PR** with the letter **T**. [1]

(ii) Measure the length *a* of the line **QT** in centimetres to the nearest millimetre and the length *b* of the line **MT** in centimetres to the nearest millimetre. Record your measurements below and in Table 1.1.

a = ... cm

b = ... cm
[1]

(d) Calculate the ratio $r = \frac{a}{b}$. Record your answer in Table 1.1.

Give your answer to 2 significant figures.

Table 1.1

θ/°	*a*/cm	*b*/cm	$r = \frac{a}{b}$
10			
20	4.2	12.8	0.33
30	6.8	13.7	0.50

[2]

(e) The student repeats the procedure in **(b)** and **(c)** for values of $\theta = 20°$ and $\theta = 30°$.

The student's results are recorded in Table 1.1.

The student states that *r* is directly proportional to θ.

State if you agree with the student.

Use values from Table 1.1 to justify your answer.

statement .....

justification .....

.....

.....
[2]

(f) Suggest what the student can do to have more confidence in their answer to part **(e)**.

.....

.....

..... [1]

(g) Suggest **one** source of inaccuracy in this experiment, even if it is carried out very carefully.

.....

..... [1]

[Total: 11]