17 **(a)**

$$\mathbf{r} = \begin{pmatrix} 3 \\ -2 \end{pmatrix} + \begin{pmatrix} -5 \\ -2 \end{pmatrix}$$

(i) Write down **r** as a single vector.

Answer(a)(i) **r** = $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(ii) The point *G*(3, 2) is translated by the vector **r** to the point *H*.

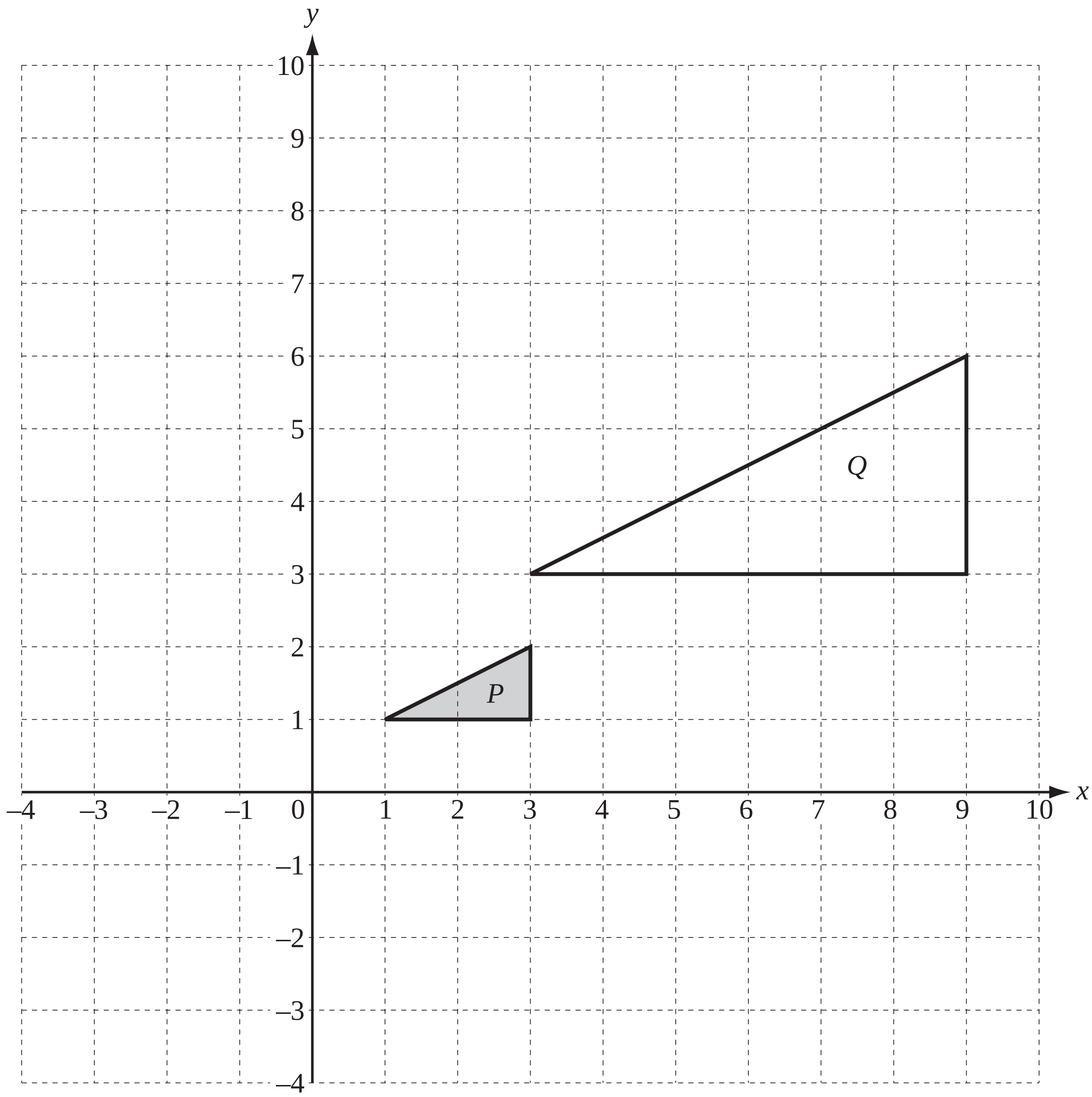
Find the co-ordinates of *H*.

Answer(a)(ii) (.............. , ...) [1]

(iii) Write down the vector of the translation that maps *H* onto *G*.

Answer(a)(iii) $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(b)



The diagram shows two triangles P and Q.

(i) Describe fully the **single** transformation which maps P onto Q.

Answer(b)(i) .... [3]

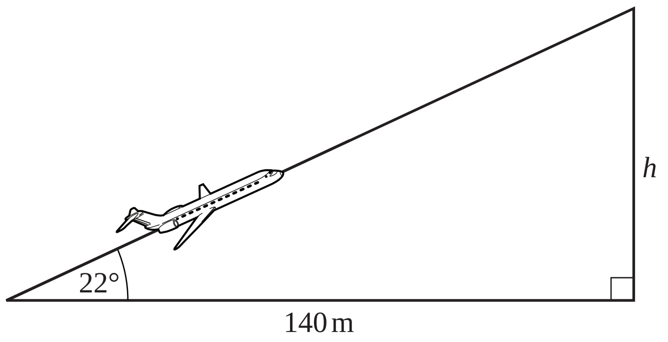
(ii) On the grid, draw the reflection of P in the line $x = 0$. Label this image R. [2]

(iii) On the grid, rotate P through 180° about (0, 0). Label this image S. [2]

(iv) Describe fully the **single** transformation which maps triangle S onto triangle R.

Answer(b)(iv) .... [2]

18 **(a)** An aeroplane takes off 140 metres before reaching the end of the runway.
It climbs at an angle of 22° to the horizontal ground.



NOT TO
SCALE

Calculate the height of the aeroplane, *h*, when it is vertically above the end of the runway.

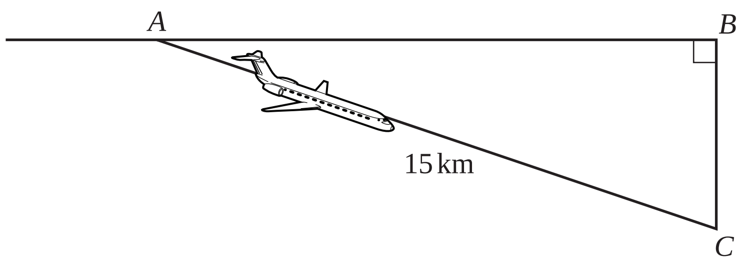
Answer(a) h = ... m [2]

(b) After 3 hours 30 minutes the aeroplane has travelled 1850 km.

Calculate the average speed of the aeroplane.

Answer(b) .... km/h [2]

(c)



NOT TO
SCALE

The aeroplane descends from *A*, at a height of 12 000 metres, to *C*, at a height of 8 300 metres.

(i) Work out the vertical distance, *BC*, that the aeroplane descends.

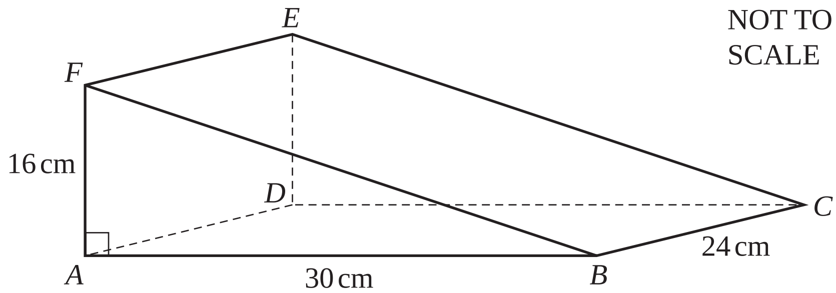
Answer(c)(i) .... m [1]

(ii) The distance *AC* is 15 **kilometres**.

Calculate angle *BAC*.

Answer(c)(ii) Angle *BAC* = ... [2]

19



The diagram shows a wedge in the shape of a triangular prism.

AB = 30 cm, *AF* = 16 cm and *BC* = 24 cm. Angle *BAF* = 90°.

(a) Calculate

(i) the area of triangle *ABF*,

Answer(a)(i) .... cm^2 [2]

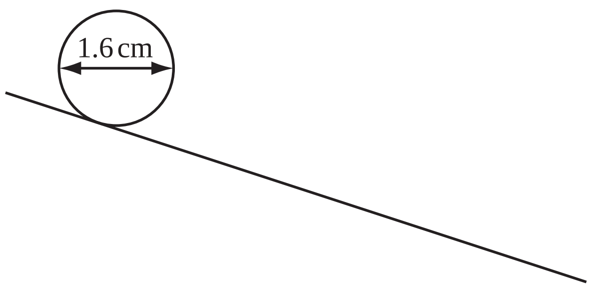
(ii) the volume of the wedge.

Answer(a)(ii) .... cm^3 [1]

(b) **(i)** Calculate *BF*.

Answer(b)(i) .... cm [2]

(ii)



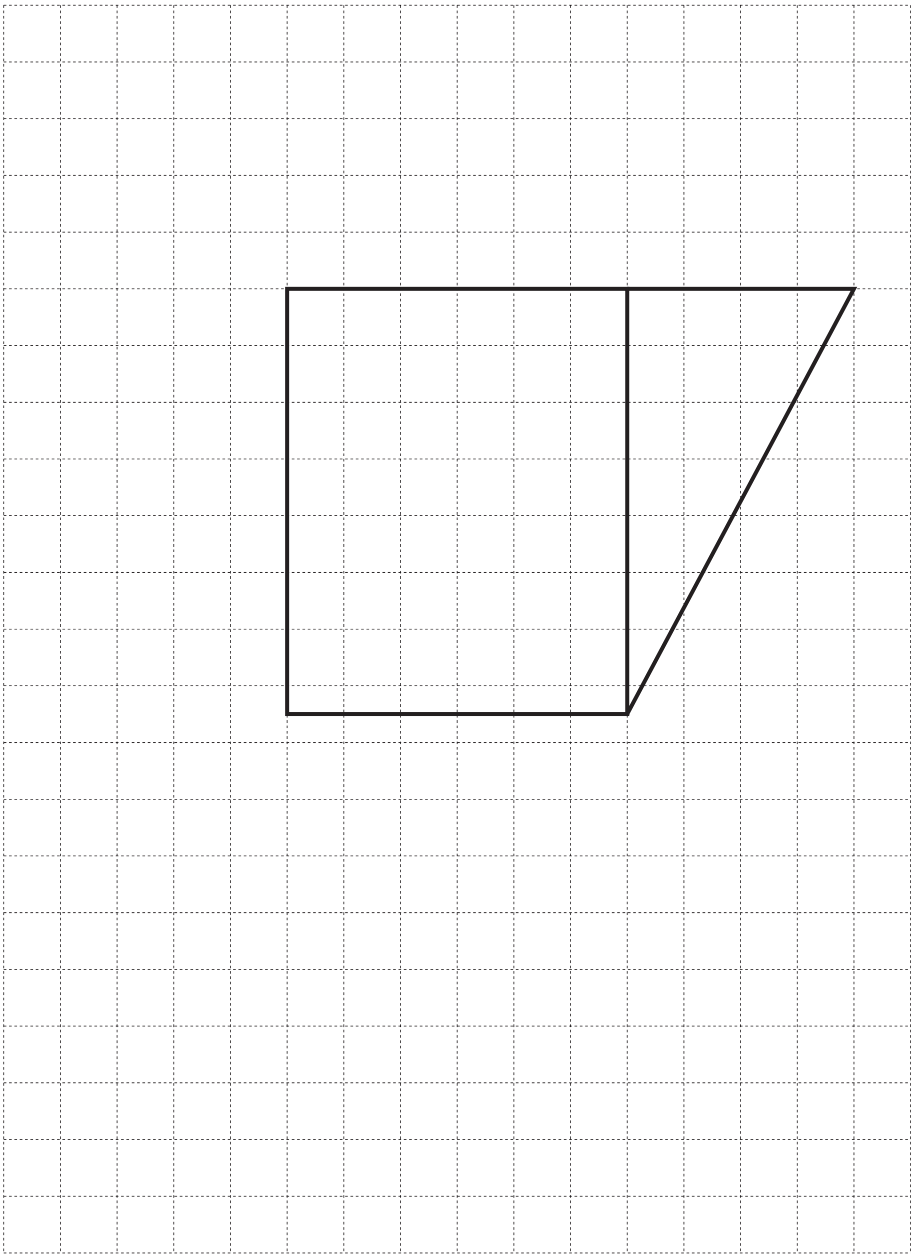
A coin with diameter 1.6 cm is rolled down the sloping surface of the wedge.
It travels in a straight line parallel to *BF*, starting on *FE* and ending on *BC*.

Calculate the number of **complete** turns it makes.

Answer(b)(ii) .... [3]

(c) On the grid, complete the net of the wedge.
The base and one of the triangles have been drawn for you.

Each square on the grid represents a square of side 4 centimetres.



[3]

(d) Calculate the surface area of the wedge.

Answer(d) .... cm^2 [3]

20 On the scale drawing opposite, point *A* is a port.
B and *C* are two buoys in the sea and *L* is a lighthouse.

The scale is 1 cm = 3 km.

(a) A boat leaves port *A* and follows a straight line course that bisects angle *BAC*.

Using a straight edge and compasses only, construct the bisector of angle *BAC* on the scale drawing. [2]

(b) When the boat reaches a point that is equidistant from *B* and from *C*, it changes course.
It then follows a course that is equidistant from *B* and from *C*.

(i) Using a straight edge and compasses only, construct the locus of points that are equidistant from *B* and from *C*.
Mark the point *P* where the boat changes course. [2]

(ii) Measure the distance *AP* in centimetres.

Answer(b)(ii) .... cm [1]

(iii) Work out the actual distance *AP*.

Answer(b)(iii) .... km [1]

(iv) Measure the **obtuse** angle between the directions of the two courses.

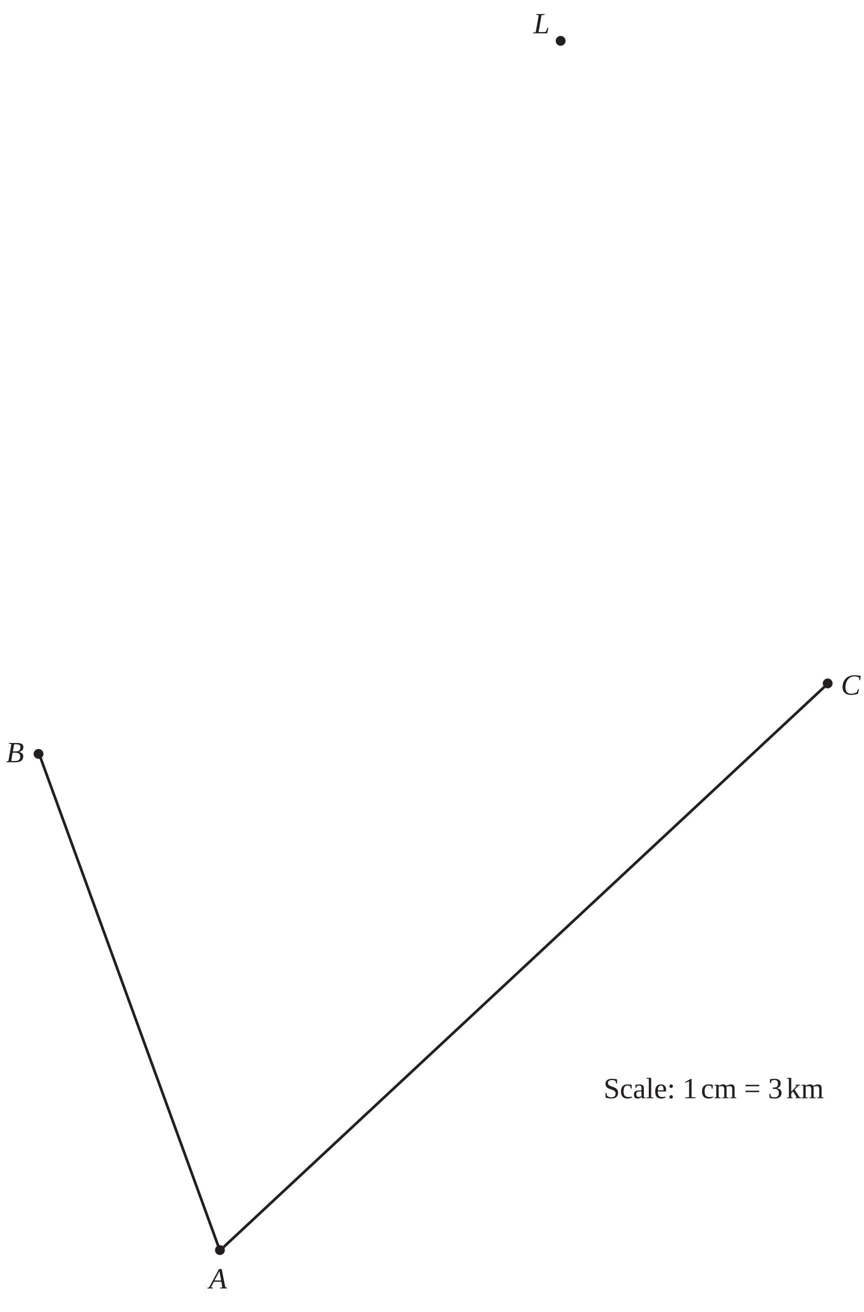
Answer(b)(iv) .... [1]

(c) Boats must be more than 9 kilometres from the lighthouse, *L*.

(i) Construct the locus of points that are 9 kilometres from *L*. [2]

(ii) Mark the point *R* where the course of the boat meets this locus.
Work out the actual straight line distance, *AR*, in kilometres.

Answer(c)(ii) .... km [1]


L
C
B
A
Scale: 1 cm = 3 km