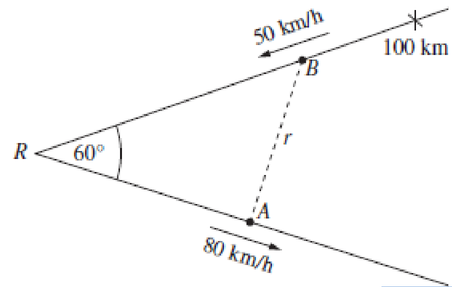
Want more revision exercises? Get **MathsFit** - *New from projectmaths.*

13	**14 b**	Two straight roads meet at R at an angle of 60°. At time $t = 0$ car A leaves R on one road, and car B is 100 km from R on the other road. Car A travels away from R at a speed of 80 km/h, and car B travels towards R at a speed of 50 km/h. The distance between the cars at time t hours is r km. (i) Show that $r^2 = 12\,900t^2 - 18\,000t + 10\,000$. (ii) Find the minimum distance between the cars. 	**2** **3**

State Mean:
0.52/2
0.80/3

(i) As $D = ST$, then:

Car A travels $80t$ km; car B travels $50t$ km.

$\therefore\ AR = 80t$

$BR = 100 - 50t$

Using cosine rule:

$r^2 = (100 - 50t)^2 + (80t)^2$

$\quad - 2(100 - 50t)(80t) \times \cos 60^\circ$

$= 10\,000 - 10\,000t + 2500t^2$

$\quad + 6400t^2 - 8000t + 4000t^2$

$\therefore r^2 = 12\,900t^2 - 18\,000t + 10\,000$

(ii) Min when $\dfrac{d(r^2)}{dt} = 0$

$\dfrac{d(r^2)}{dt} = 25\,800t - 18\,000 = 0$

$t = \dfrac{18000}{25800}$

$= \dfrac{30}{43}$

Consider nature:

$\dfrac{d^2(r^2)}{dt^2} = 25\,800 > 0 \quad \therefore$ Minimum

Subs in r^2:

$r^2 = 12\,900\left(\dfrac{30}{43}\right)^2 - 18\,000\left(\dfrac{30}{43}\right) + 10\,000$

$r = 60.99942813\ \ldots$

$= 61$ (nearest whole)

$\therefore$ minimum distance is 61 km

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by the Board of Studies

Board of Studies: Notes from the Marking Centre

(i) A significant number of candidates could not establish that $RB = 100 - 50t$ and $RA = 80t$. Most candidates correctly identified the cosine rule.

Common problems were:

- not substituting correct values into the cosine rule
- making algebraic and simplification errors, as more than one algebraic step was required to prove the given result.

(ii) Finding the derivative of r^2 (rather than making r the subject) made the algebra much easier.

Common problems were:

- when making r the subject, finding the second derivative posed a problem
- not testing the value found to justify a minimum.

Source: http://www.boardofstudies.nsw.edu.au/hsc_exams/