**1** The line *l* has equation



A circle *C* has centre (−2, −2, 2) and radius .

Given that *C* intersects *l* at two points, *A* and *B*, find the coordinates of *A* and *B*. **(6 marks)**

**2** Given that **a** = 3**i** + **j** − **k** and **b** = −**i** + 5**j** + 3**k**, find a vector which is perpendicular   
to both **a** and **b**. **(4 marks)**

**3** The points *A*, *B* and *C* have coordinates *A*(3, −4, 6), *B*(−1, 7, 2) and *C*(8, 0, −5).

Find the area of triangle *ABC*. **(6 marks)**

**4** The line with vector equation



is perpendicular to the line with vector equation



**a** Find the value of *p*. **(2 marks)**

**b** Find the coordinates of the point of intersection of the lines. **(4 marks)**

**5** The line  has equation



The plane  has equation

2*x* – *y* + 4*z* = 4

The line  is a reflection of the line  in the plane 

Find an exact vector equation of the line . **(9 marks)**

**6** A plane passes through three points *P*, *Q* and *R*, whose position vectors, referred to an origin *O*,   
are ,  and 

**a** Find, in the form , a unit vector normal to this plane. **(5 marks)**

**b** Find a Cartesian equation for the plane. **(2 marks)**

**c** Find the acute angle between the plane in part **b** and the plane with vector equation  **(4 marks)**

**7** Sumarine A wishes to move from point *P*(6, −13, 14) to point *Q*(16, −9, 12) where   
the unit of distance is kilometres.

An enemy, submarine B, is located at a fixed point *O*. Submarine B has a radar that   
can detect motion within 15 km.

**a** Can submarine A move from *P* to *Q* undetected by the radar of submarine B? **(7 marks)**

**b** State one limitation of the model. **(1 mark)**