**1.** ***a***•***b*** = │***a***││***b***│cos *θ* (M1)  
***a*** • ***b*** =  = 7 *+* 3*m* A1  
 A1  
  
7 *+* 3*m* =  cos 30° A1  
*m* = 2*.*27, *m* = 25*.*7 A1A1

[6]

**2.** (a)  = ***b*** – ***a*** A1  
 = ***a*** + ***b*** A1

(b)  = (***b*** – ***a***)•(***b*** + ***a***) M1  
 = │***b***│2–│***a***│2 A1  
 = 0 since │***b***│=│***a***│ R1

**Note:** Only award the A1 and R1 if working indicates that they  
understand that they are working with vectors.

so  is perpendicular to  i.e.  is a right angle AG

[5]

**3.** (***a*** *+* ***b***)•(***a*** *–* ***b***) = ***a*** • ***a*** *+* ***b***•***a*** *–* ***a*** • ***b*** *–* ***b***•***b*** M1= ***a*** • ***a*** *–* ***b*** • ***b*** A1  
= |***a***|2 – |***b***|2 = 0 since |***a***| = |***b***| A1  
the **diagonals** are perpendicular R1

**Note:** Accept geometric proof, awarding M1 for recognizing OACB is a  
rhombus, R1 for a clear indication that (***a*** *+* ***b***) and (***a*** – ***b***) are the  
diagonals, A1 for stating that diagonals cross at right angles and  
A1 for “hence dot product is zero”.

Accept solutions using components in 2 or 3 dimensions.

[4]

**4.** (a) cos *θ* =  M1A1

(b) ***a********b***  cos *θ* = 0 M1  
sin 2*α* cos *α* + sin *α* cos 2*α* – 1 = 0  
*α* = 0.524  A1

(c) **METHOD 1**

 (M1)  
assuming *α* = 

**Note:** Allow substitution at any stage.

 A1  
=   
= 0 A1  
***a*** and ***b*** are parallel R1

**Note:** Accept decimal equivalents.

**METHOD 2**

from (a) cos *θ* = –1 (and sin *θ* = 0) M1A1  
***a*** × ***b*** = 0 A1  
***a*** and ***b*** are parallel R1

[8]

**5.** (a) 2*y* *+* 8*x* = 4 M1  
–3*x* + 2*y* = *–*7 A1  
2*x* + 6 – 2*x* = 6

**Note:** Award M1 for attempt at components, A1 for two correct equations.  
No penalty for not checking the third equation.

solving : *x* = 1, *y* = *–*2 A1

(b) │***a*** *+* 2***b***│=  
=   
 (M1)  
=  A1

[5]

**6.** (a) (i) use of ***a*** • ***b*** = │***a***││***b***│cos *θ* (M1)  
***a*** • ***b*** = –1 (A1)  
│***a***│ = 7, │***b***│ = 5 (A1)  
cos *θ* =  A1

(ii) the required cross product is  
 = 18***i*** – 24***j*** – 18***k*** M1A1

(iii) using ***r*** • ***n*** = ***p*** • ***n*** the equation of the plane is (M1)  
18*x* – 24*y* – 18*z* = 12 (3*x* *–* 4*y* *–* 3*z* = 2) A1

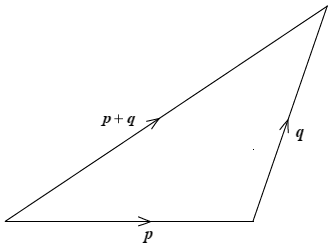
(iv) recognizing that *z* = 0 (M1)  
*x-*intercept = , *y-*intercept =  (A1)  
area =  A1

(b) (i) ***p*** • ***p*** = │***p***││***p***│cos 0 M1A1  
= │***p***│2 AG

(ii) consider the LHS, and use of result from part (i)  
│***p*** *+* ***q***│2 = (***p*** *+* ***q***)•(***p*** *+* ***q***) M1  
= ***p***• ***p*** *+* ***p*** • ***q*** *+* ***q*** *•* ***p*** *+* ***q*** *•* ***q*** (A1)= ***p*** *•* ***p*** *+* 2***p*** *•* ***q*** *+* ***q*** *•* ***q*** A1  
= │***p***│2 *+* 2***p*** *•* ***q*** *+* │***q***│2 AG

(iii) **EITHER**use of ***p***• ***q*** ≤ │***p***││***q***│ M1  
so 0 ≤ *|****p*** *+* ***q****|*2 = │***p***│2 + 2***p*** • ***q*** + │***q***│2 ≤ │***p***│2 + 2│***p***││***q***│+│***q***│2 A1  
take square root (of these positive quantities) to establish A1  
│***p*** + ***q***│≤│***p***│+│***q***│ AG

**OR**

 M1M1

**Note:** Award M1 for correct diagram and M1 for correct labelling  
of vectors including arrows.

since the sum of any two sides of a triangle is greater than the third side,  
│***p***│ + │***q***│ > │***p*** + ***q***│ A1  
when *p* and *q* are collinear │***p***│ + │***q***│ = │***p*** + ***q***│  
 │***p*** + ***q***│ ≤ │***p***│ + │***q***│ AG

[19]

**7.** **METHOD 1**

Use of | ***a***  ***b*** | = | ***a*** | | ***b*** | sin** (M1)

| ***a***  ***b*** |2 = | ***a*** |2 | ***b*** |2 sin2** (A1)

**Note:** Only one of the first two marks canbe implied.

= | ***a*** |2 | ***b*** |2 (1  cos2**) A1

= | ***a*** |2 | ***b*** |2  | ***a*** |2 | ***b*** |2 cos2** (A1)

= | ***a*** |2 | ***b*** |2  (| ***a*** | | ***b*** | cos**)2 (A1)

**Note:** Only one of the above two A1 marks canbe implied.

= | ***a*** |2 | ***b*** |2  (***a*** • ***b***)2 A1

Hence LHS = RHS AG N0

**METHOD 2**

Use of ***a*** • ***b*** = | ***a*** | | ***b*** | cos** (M1)

| ***a*** |2 | ***b*** |2  (***a*** • ***b***)2 = | ***a*** |2 | ***b*** |2  (| ***a*** | | ***b*** | cos**)2 (A1)

= | ***a*** |2 | ***b*** |2  | ***a*** |2 | ***b*** |2 cos2** (A1)

**Note:**Only one of the above two A1 markscan be implied.

= | ***a*** |2 | ***b*** |2 (1  cos2**) A1

= | ***a*** |2 | ***b*** |2 sin2** A1

= | ***a***  ***b*** |2 A1

Hence LHS = RHS AG N0

**Notes:**Candidates who independently correctlysimplify both sides  
 and show that LHS = RHS should be awarded full marks.  
 If the candidate starts off with expressionthat they are trying to  
 prove and concludes that sin2 = (1  cos2) awardM1A1A1A1A0A0.  
 If the candidate uses two general 3D vectorsand explicitly finds  
 the expressions correctly award full marks. Use of 2D vectors  
 gains a maximum of 2 marks.  
 If two specific vectors are used no marks are gained.

[6]

**8.** (a)  A1A1A1

(b)  A1A1  
 (M1)A1

(c) (i) area of MNP =  M1  
 =   
 =  A1

(ii)   
 A1  
since  AG is perpendicular to MNP R1

(iii) ***r***  M1A1  
***r***  = 3 (accept – *x* *+* *y* *+* *z* = 3) A1

(d) ***r*** =  A1  
 = 3 M1A1  
–2 + 2*λ* + 2*λ* + 2*λ* = 3  
*λ* =  A1  
***r*** =  M1  
coordinates of point  A1

[20]