# **Topic 11**

# **Vectors**

# Bronze, Silver, Gold and

# Platinum Worksheets for

# AS Level Mathematics

# Teacher Notes

These Bronze, Silver and Gold worksheets are designed to be used either straight after the content has been taught or as part of a skills gap analysis, especially as students move into year 13.

They are drawn from the latest specification questions and legacy questions. The papers are between 25 and 35 marks.

The topic number on this worksheet relates to the corresponding chapter number in the ‘Pearson Edexcel AS and A Level Mathematics: Pure Mathematics Year 1/AS’ textbook.

# Non-Calculator Questions

The new specification allows calculators to be used in all papers. **We have, however, put these questions together with the intention that students can complete them without a calculator.** It’s important for pupils to be able to maintain their non-calculator skills, especially on topics such as surds or indices, to support question that use the keywords “show that” or “prove”. If you wish to ease the difficulty slightly then you can, of course, allow students to attempt them with the support of a calculator.

# Quick Links

(Press Ctrl, as you click with your mouse to follow these links)

* [Bronze Questions](#BrQue)
* [Bronze Mark Scheme](#BrMS)
* [Silver Questions](#SiQue)
* [Silver Mark Scheme](#SiMS)
* [Gold Questions](#GoQu)
* [Gold Mark Scheme](#GoMS)

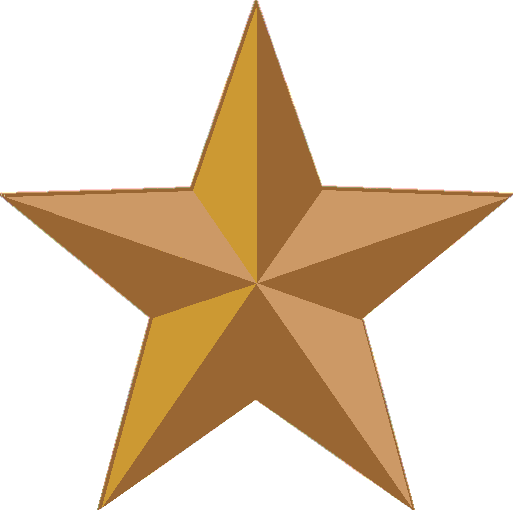
The Platinum Questions below are taken from the Advanced Extension Award. You can use these in class as high level problem solving questions, either with individual students or as group problem solving exercises. On the Advanced Extension Award students, typically, need to get around 50% to get a Merit and around 70% to get a distinction.

* [Platinum Questions](#PlQu)
* [Platinum Mark Schemes](#PlMS)

# Extension and Enrichment

If you have students that have enjoyed the challenge of the Gold questions, then they should have a go at the more challenging question from our Advanced Extension Award (AEA) papers. The Mathematics AEA is a single, 3 hour non-calculator paper, taken at the end of year 13. It helps students to develop high level problem solving and proof skills. It is entirely based on the content of the A Level Mathematics Course. No extra material needs to be covered to take the AEA in Mathematics. A second important difference is that marks are awarded for the clarity and quality of their solution. Developing this key skill, alongside the extra problem-solving experience, can pay dividends in the way they approach A Level Mathematics and Further Mathematics problems.

More information about the Advanced Extension Award can be found [here](https://qualifications.pearson.com/en/qualifications/edexcel-a-levels/advanced-extension-award-mathematics-2018.html) on the Pearson Edexcel Website, or [here](https://www.mathsemporium.com/category/advanced-extension-award-mathematics/) on the Maths Emporium

**Bronze Questions**

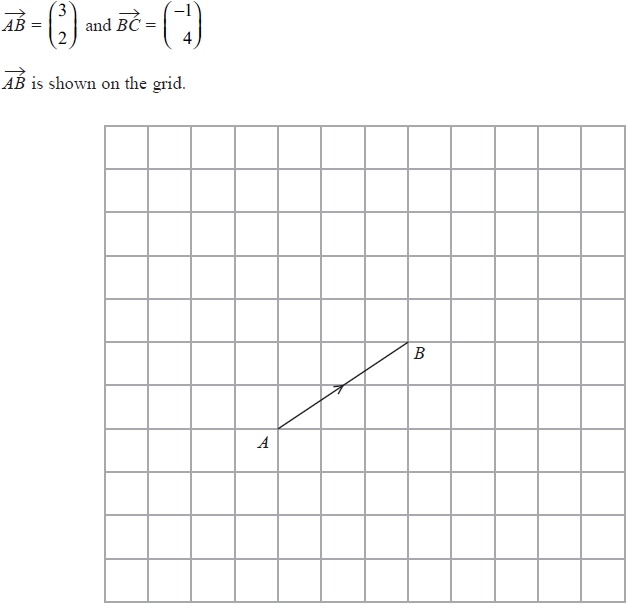
**Calculators may not be used**

The total mark for this section is 27

**1**

****

 is shown on the grid



(a) On the grid, draw .

**(1)**



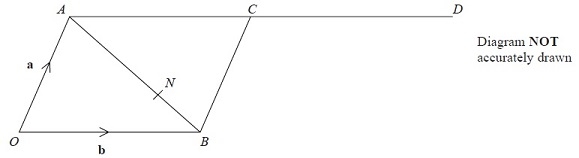
(b) On the grid, mark with a cross the position of *D*.

Label this point *D*.

**(2)**

**(Total for Question 1 is 3 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q2**

****

*D* is the point such that ****

The point *N* divides *AB* in the ratio 2:1

(a) Write an expression for **** in terms of **a** and **b**.

**(3)**

(b) Prove that *OND* is a straight line.

**(3)**

**(Total for Question 2 is 6 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q3**

Given that the point *A* has position vector 4**i** – 5**j** and the point *B* has position vector –5**i** –2**j**,

(a) find the vector .

**(2)**

(b) Find .

Give your answer as a simplified surd.

**(2)**

**(Total for Question 2 is 4 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q4**

A particle *P* is moving with constant velocity (−3**i** + 2**j**) m s−1. At time *t* = 6 s *P* is at the point with position vector (−4**i** − 7**j**) m. Find the distance of *P* from the origin at time *t* = 2 s.

**(Total for Question 4 is 5 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q5**

*[In this question, the unit vectors* **i** *and* **j** *are due east and due north respectively. Position vectors are relative to a fixed origin O.]*

A boat *P* is moving with constant velocity (−4**i** + 8**j**) km h−1.

(a) Calculate the speed of *P*, giving your answer as a simplified surd.

**(2)**

When *t* = 0, the boat *P* has position vector (2**i** − 8**j**) km. At time *t* hours, the position vector of *P* is **p** km.

(b) Write down **p** in terms of *t*.

**(1)**

A second boat *Q* is also moving with constant velocity. At time *t* hours, the position vector of *Q* is **q** km, where

**q** = 18**i** + 12**j** − *t* (6**i** + 8**j**)

Find

(c) the value of *t* when *P* is due west of *Q*,

**(3)**

(d) the distance between *P* and *Q* when *P* is due west of *Q*.

**(3)**

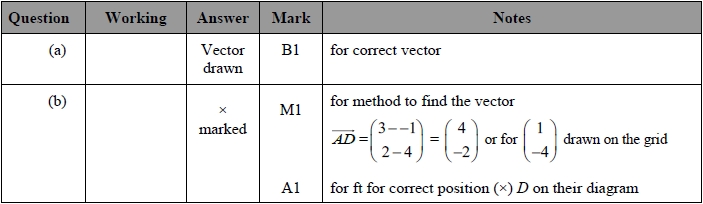
**(Total for Question 5 is 9 marks)**

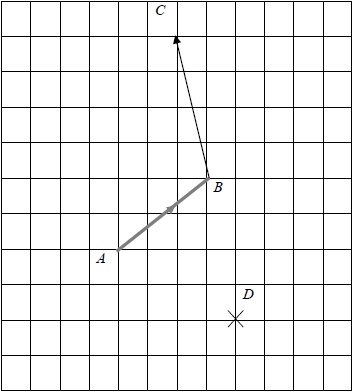
**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**End of Questions**

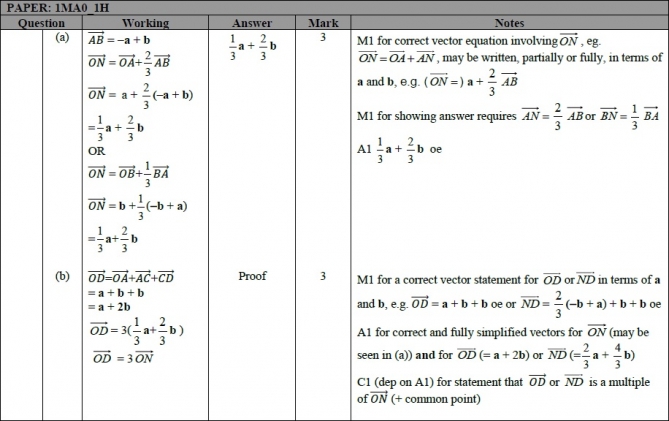
**Bronze Mark Scheme**

**Q1**

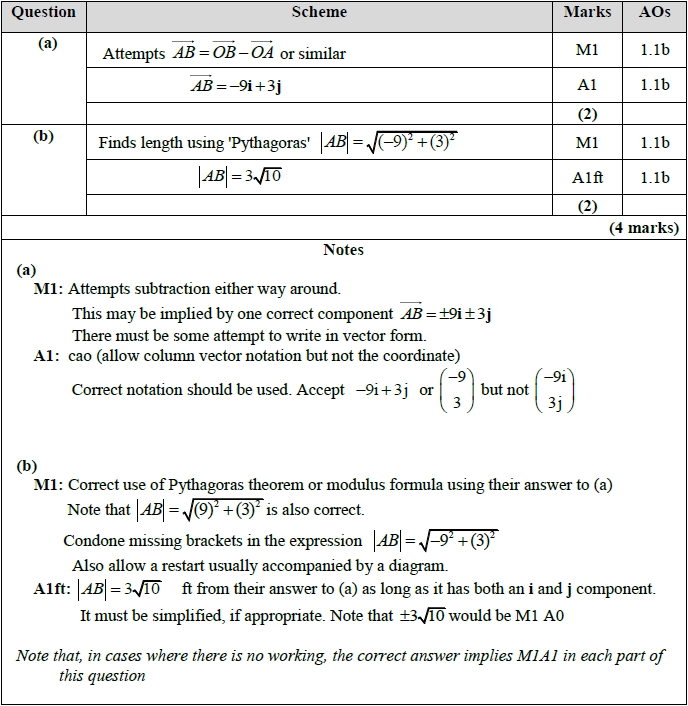




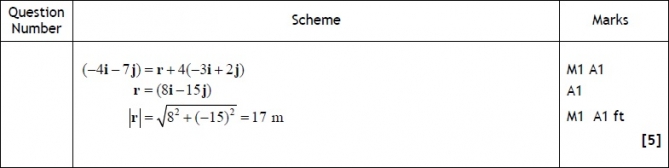
**Q2**



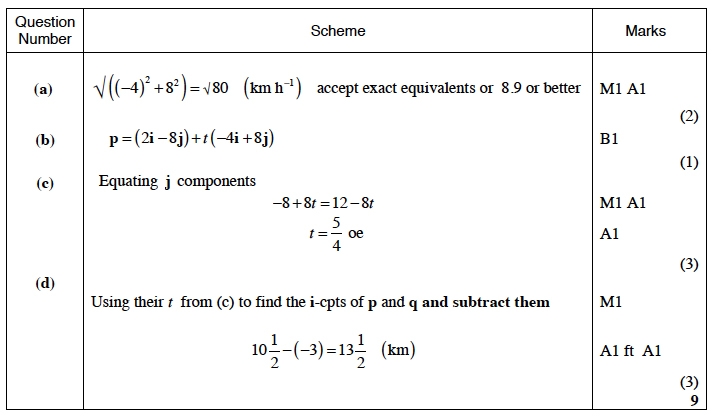
**Q3.**



**Q4.**



**Q5.**

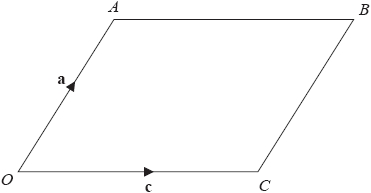


**Silver Questions **

**Calculators may not be used**

The total mark for this section is 25

**Q1**



*OABC* is a parallelogram.

****

*X* is the midpoint of the line *AC*.   
*OCD* is a straight line so that *OC* : *CD* = *k* : 1

Given that ****

find the value of *k*.

**(Total for Question 1 is 4 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q2**

Given that the point *A* has position vector 3**i** – 7**j** and the point *B* has position vector 8**i** + 3**j**,

(a) find the vector **.**

**(2)**

(b) Find. Give your answer as a simplified surd.

**(2)**

**(Total for Question 2 is 4 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q3**

Three forces, (15**i** + **j**) N, (5*q***i** − *p***j**) N and (−3*p***i** − *q***j**) N, where *p* and *q* are constants, act on a particle. Given that the particle is in equilibrium, find the value of *p* and the value of *q*.

**(Total for Question 3 is 6 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q4**

*[In this question, the horizontal unit vectors* ***i*** *and* ***j*** *are directed due east and due north respectively.]*

The velocity, **v** m s−1, of a particle *P* at time *t* seconds is given by

**v** = (1 − 2*t*)**i** + (3*t* − 3)**j**

(a) Find the speed of *P* when *t* = 0

**(3)**

(b) Find the bearing on which *P* is moving when *t* = 2

**(2)**

(c) Find the value of *t* when *P* is moving

(i) parallel to **j**,

(ii) parallel to (− **i** − 3**j**).

**(6)**

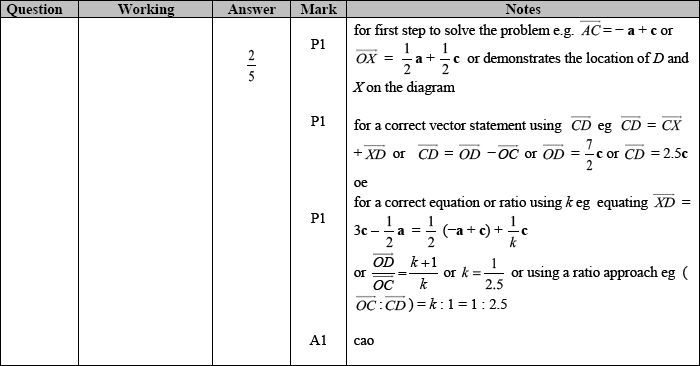
**(Total for Question 4 is 11 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

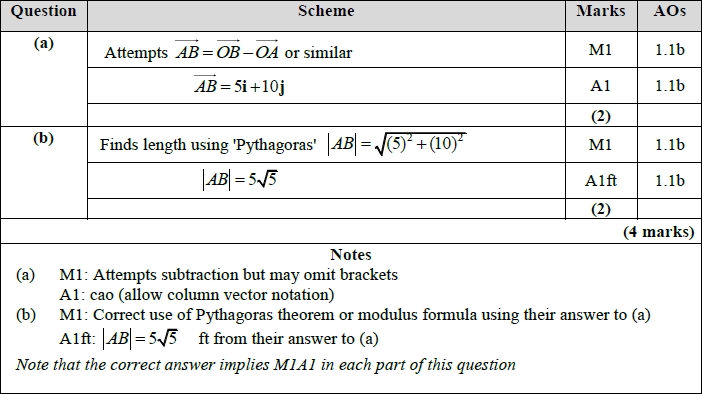
**End of Questions**

**Silver Mark Scheme**

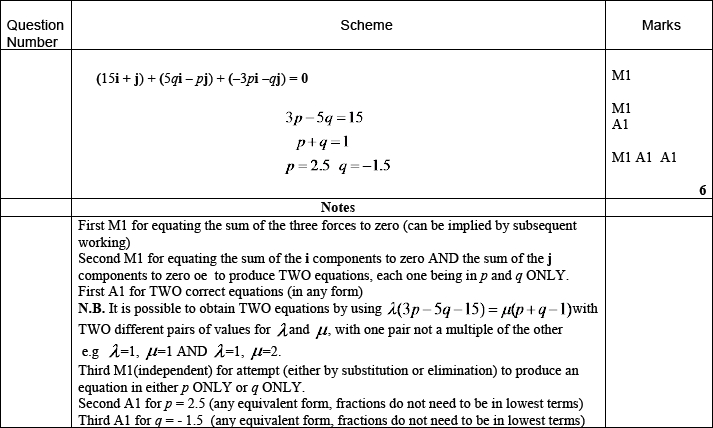
**Q1.**

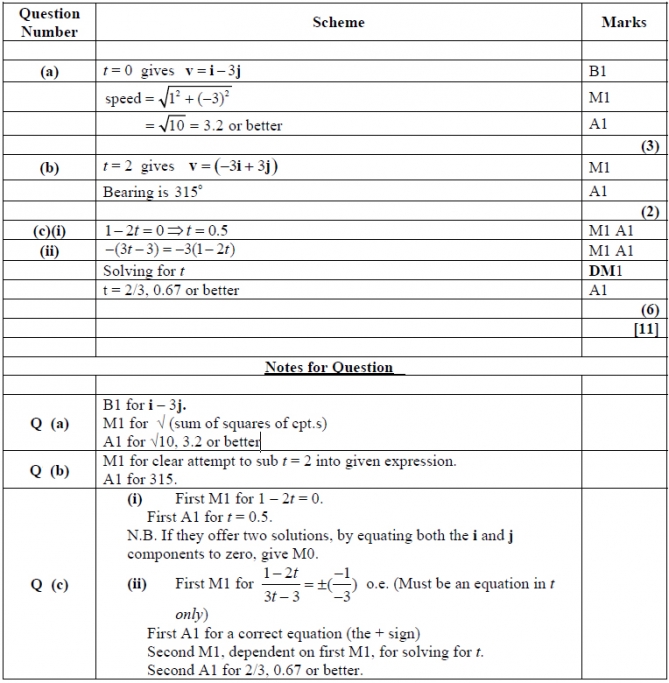


**Q2**



**Q3.**



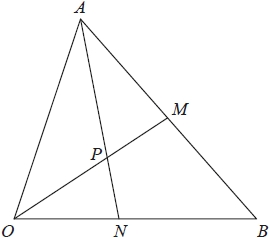
**Q4.**

**Gold Questions **

**Calculators may not be used**

The total mark for this section is 29

**Q1**



*OAB* is a triangle.   
*OPM* and *APN* are straight lines.   
*M* is the midpoint of *AB*.

****

*OP* : *PM* = 3 : 2

Work out the ratio *ON* : *NB*

**(Total for Question 1 is 5 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q2**

[*In this question,***i***and***j***are horizontal unit vectors due east and due north respectively and position vectors are given with respect to a fixed origin.*]

A ship sets sail at 9 am from a port *P* and moves with constant velocity. The position vector of *P* is (4**i** − 8**j**) km. At 9.30 am the ship is at the point with position vector (**i** − 4**j**) km.

(a) Find the speed of the ship in km h−1.

**(4)**

(b) Show that the position vector **r** km of the ship, *t* hours after 9 am, is given by

**r** = (4 − 6*t*)**i** + (8*t* − 8)**j**.

**(2)**

At 10 am, a passenger on the ship observes that a lighthouse *L* is due west of the ship. At 10.30 am, the passenger observes that *L* is now south-west of the ship.

(c) Find the position vector of *L*.

**(5)**

**(Total for Question 2 is 11 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

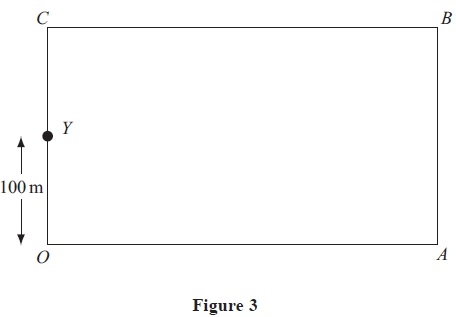
**Q3**

[*In this question* **I** *and* **j** *are horizontal unit vectors due east and due north respectively.*]

A hiker *H* is walking with constant velocity (1.2**i** − 0.9**j**) m s−1.

(a) Find the speed of *H*.

**(2)**



A horizontal field *OABC* is rectangular with *OA* due east and *OC* due north, as shown in Figure 3. At twelve noon hiker *H* is at the point *Y* with position vector 100 **j** m, relative to the fixed origin *O*.

(b) Write down the position vector of *H* at time *t* seconds after noon.

**(2)**

At noon, another hiker *K* is at the point with position vector (9**i** + 46**j**) m. Hiker *K* is moving with constant velocity (0.75**i** + 1.8**j**) m s−1.

(c) Show that, at time *t* seconds after noon,

 = [(9 − 0.45*t*) **i** + (2.7*t* − 54) **j**]metres.

**(4)**

Hence,

(d) show that the two hikers meet and find the position vector of the point where they meet.

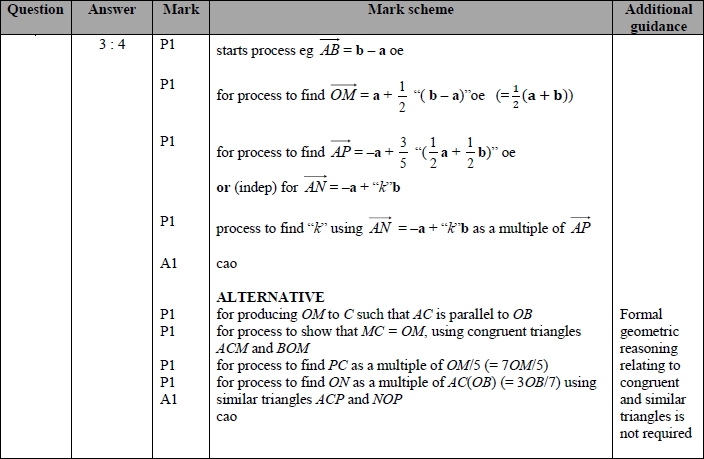
**(5)**

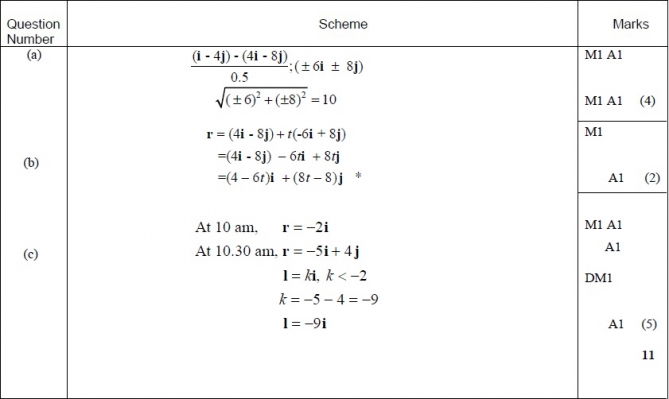
**(Total for Question 3 is 13 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

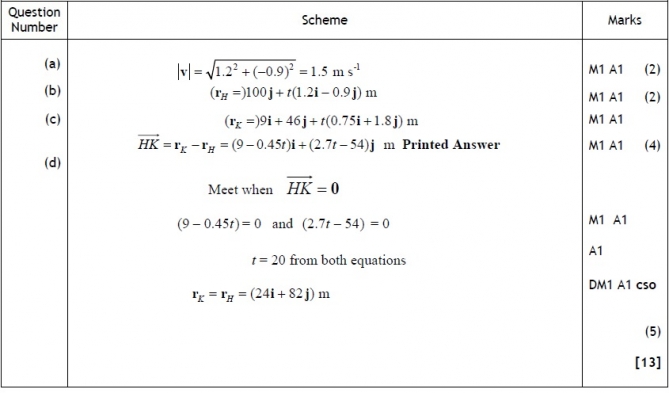
**Gold Mark Scheme**

**Q1**



**Q2**

**Q3**



**Platinum Questions **

**Calculators may not be used**

The total mark for this section is 16

**1** Points *A* and *B* have position vectors **a** and **b**, respectively, relative to an origin *O*, and

are such that *OAB* is a triangle with *OA* = *a* and *OB* = *b*.

The point *C*, with position vector **c**, lies on the line through *O* that bisects the angle *AOB*.

(*a*)Prove that the vector *b***a** − *a***b** is perpendicular to **c**.

**(4)**

The point *D*, with position vector **d**, lies on the line *AB* between *A* and *B*.

(*b*)Explain why **d** can be expressed in the form **d** = (1 – 𝜆)**a** + 𝜆**b** for some scalar 𝜆

with 0 < 𝜆< 1

**(2)**

(*c*)Given that *D* is also on the line *OC*, find an expression for *λ* in terms of *a* and *b* only

and hence show that

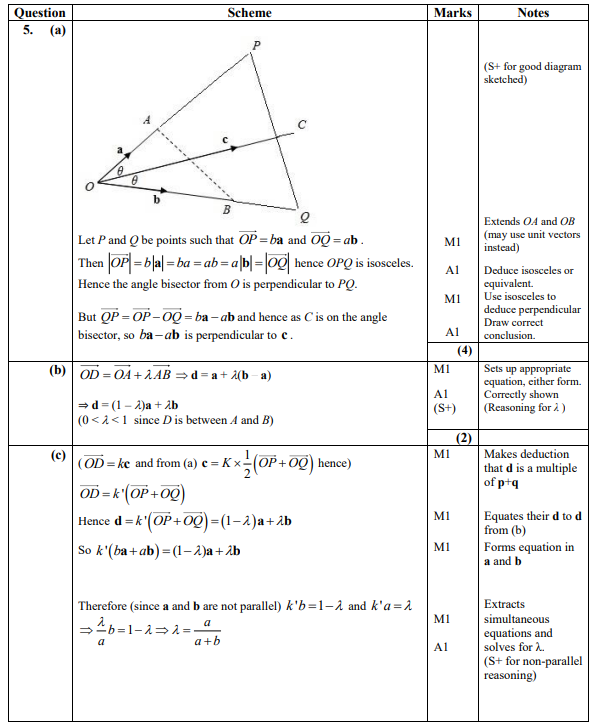
*DA* : *DB* = *OA* : *OB*

**(8)**

**(+S2)**

**(Total for Question 1 is 16 marks)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Platinum Mark Scheme**

**1.**

