# **Topic 6**

# **Circles**

# 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)

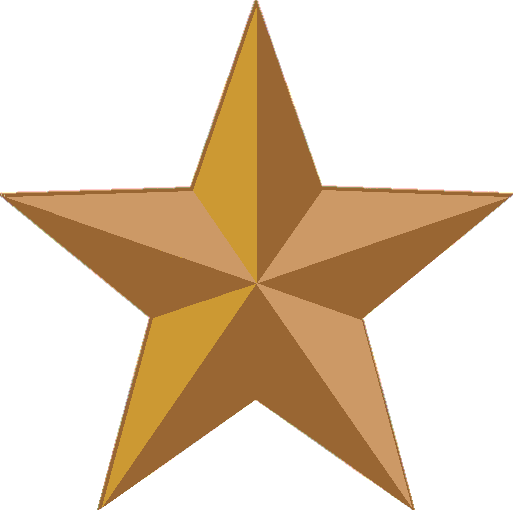
The Platinum Questions below are taken from the Advanced Extension Award. You can use these in class as high level problem solving questions, either with individual students or as group problem solving exercises. On the Advanced Extension Award students, typically, need to get around 50% to get a Merit 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 29

**Q1**

A circle *C* has centre (−1, 7) and passes through the point (0, 0). Find an equation for *C*

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

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**Q2**

The circle *C* has equation 

Find

(a)  the coordinates of the centre of *C*,

**(2)**

(b)  the radius of *C*,

**(2)**

(c)  the coordinates of the points where *C* crosses the *y*-axis,

giving your answers as simplified surds.

**(4)**

**(Total for Question 2 is 8 marks)**

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

**Q3**

The points *A* and *B* have coordinates (−2, 11) and (8, 1) respectively.

Given that *AB* is a diameter of the circle *C*,

(a) show that the centre of *C* has coordinates (3, 6),

**(1)**

(b) find an equation for *C*.

**(4)**

(c) Verify that the point (10, 7) lies on *C*.

**(1)**

(d) Find an equation of the tangent to *C* at the point (10, 7), giving your answer in the form *y* = *mx* + *c*, where *m* and *c* are constants.

**(4)**

**(Total for Question 3 is 10 marks)**

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**Q4**

The circle *C*, with centre *A*, passes through the point *P* with coordinates (−9, 8) and the point *Q* with coordinates (15, −10).

Given that *PQ* is a diameter of the circle *C*,

(a) find the coordinates of *A*

**(2)**

(b) find an equation for *C*

**(3)**

A point *R* also lies on the circle *C*.   
Given that the length of the chord *PR* is 20 units,

(c) find the length of the shortest distance from *A* to the chord *PR*.   
Give your answer as a surd in its simplest form.

**(2)**

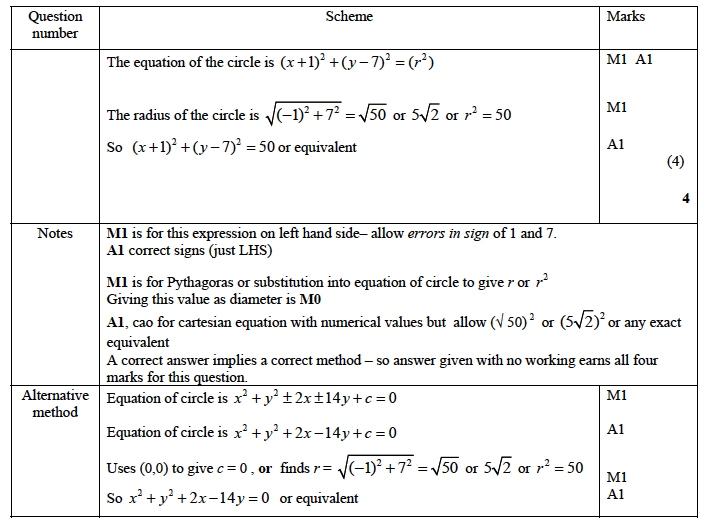
**(Total for Question 4 is 7 marks)**

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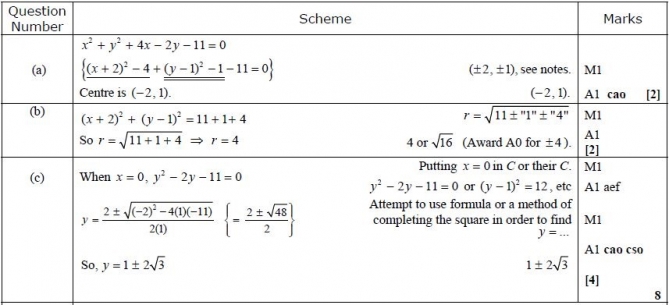
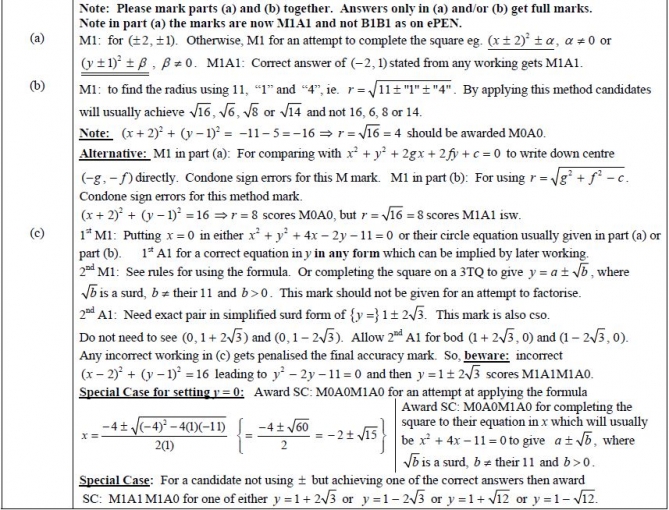
**End of Questions**

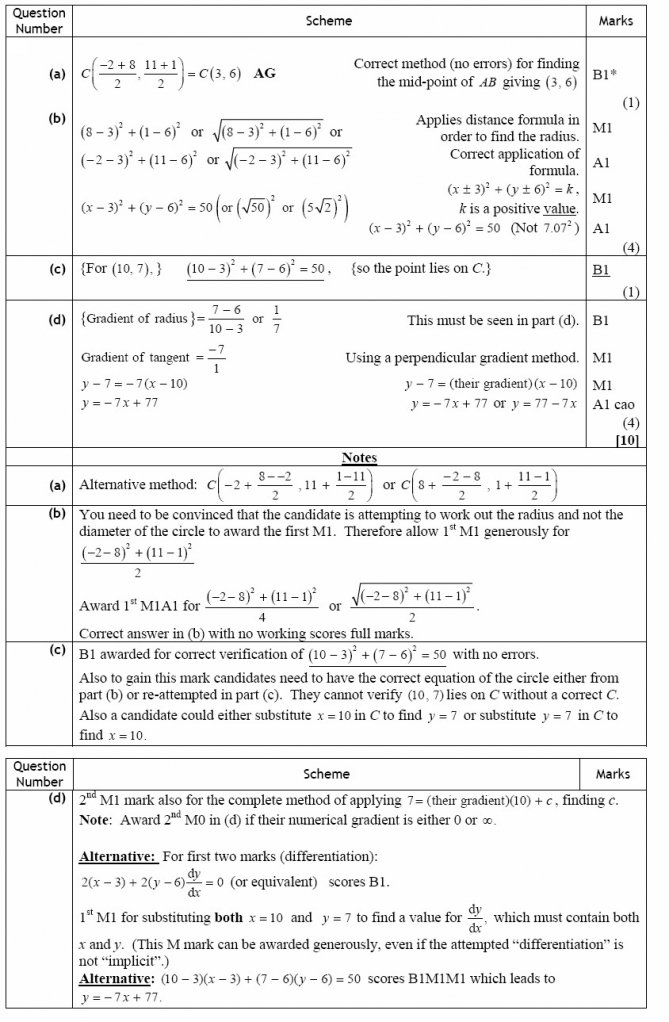
**Bronze Mark Scheme**

Q1

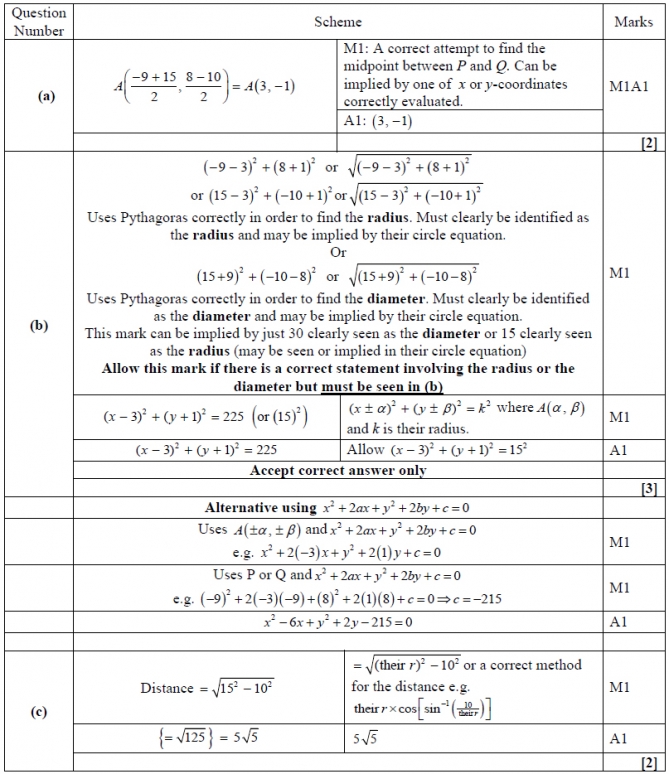


**Q2**

**Q3** 

**Q4**



**Silver Questions **

**Calculators may not be used**

The total mark for this section is 33

**Q1**

The circle *C* has equation

*x*2 + *y*2 − 20*x* − 24*y* + 195 = 0

The centre of *C* is at the point *M*

(a)  Find

      (i)  the coordinates of the point *M*

      (ii)  the radius of the circle *C*

**(5)**

*N* is the point with coordinates (25, 32)

(b)  Find the length of the line *MN*

**(2)**

The tangent to *C* at a point *P* on the circle passes through point *N*

(c)  Find the length of the line *NP*

**(2)**

**(Total for Question 1 is 9 marks)**

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

**Q2**

The circle *C* has centre (3, 1) and passes through the point *P*(8, 3).

(a)  Find an equation for *C*.

**(4)**

(b)  Find an equation for the tangent to *C* at *P*, giving your answer in the form

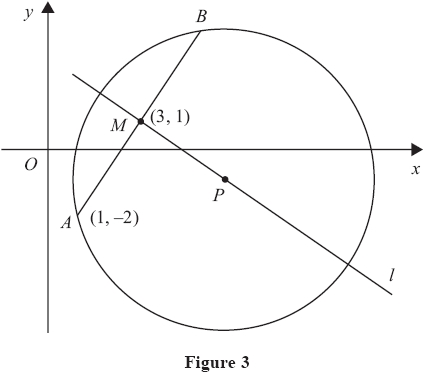
*ax* + *by* + *c* = 0, where *a*, *b* and *c* are integers.

**(5)**

**(Total for Question 2 is 9 marks)**

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

**Q3**



The points *A* and *B* lie on a circle with centre *P*, as shown in Figure 3.   
The point *A* has coordinates (1, –2) and the mid-point *M* of *AB* has coordinates (3, 1).   
The line *l* passes through the points *M* and *P*.

(a)  Find an equation for *l*.

**(4)**

Given that the *x*-coordinate of *P* is 6,

(b)  use your answer to part (a)  to show that the *y*-coordinate of *P* is –1,

**(1)**

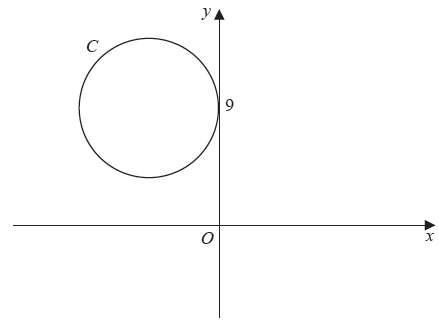
(c)  find an equation for the circle.

**(4)**

**(Total for Question 3 is 9 marks)**

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

**Q4**



**Figure 4**

The circle *C* has radius 5 and touches the *y*-axis at the point (0, 9), as shown in Figure 4.

(a)    Write down an equation for the circle *C*, that is shown in Figure 4.

**(3)**

A line through the point *P*(8, − 7) is a tangent to the circle *C* at the point *T*

(b) Find the length of *PT*

**(3)**

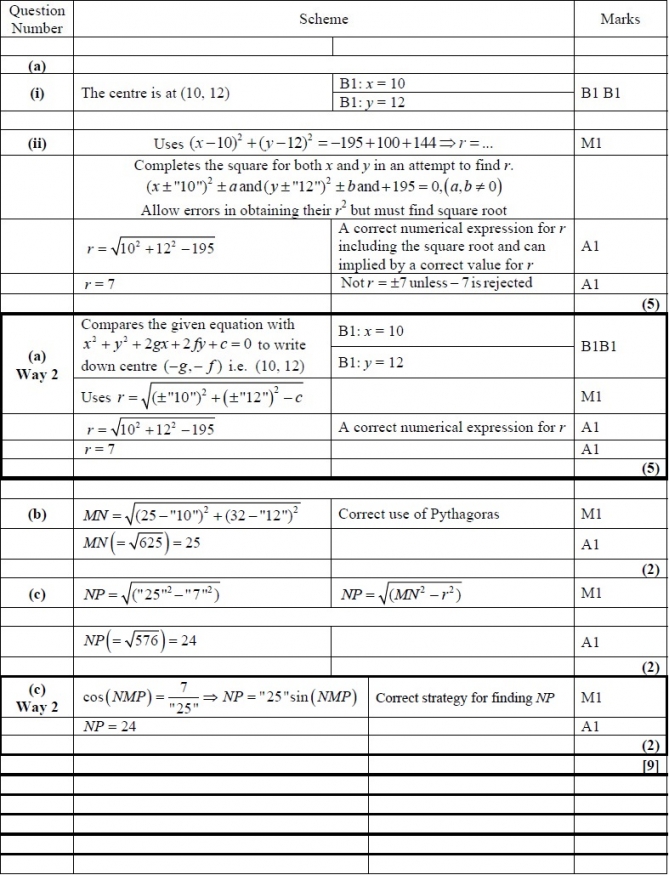
**(Total for Question 4 is 6 marks)**

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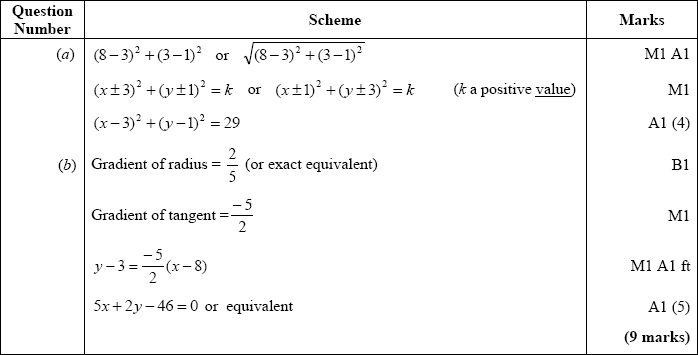
**End of Questions**

**Silver Mark Scheme**

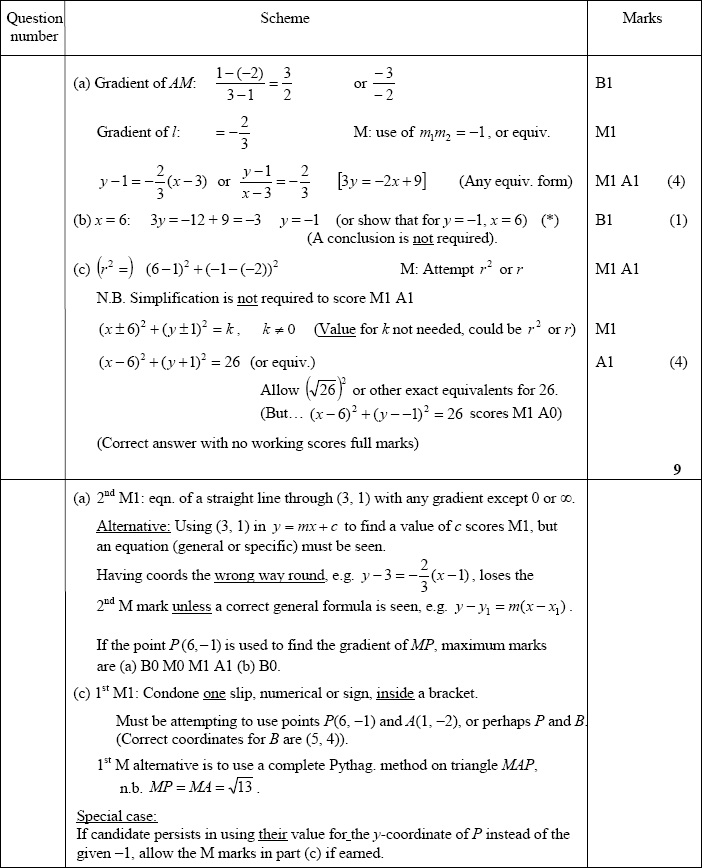
**Q1**



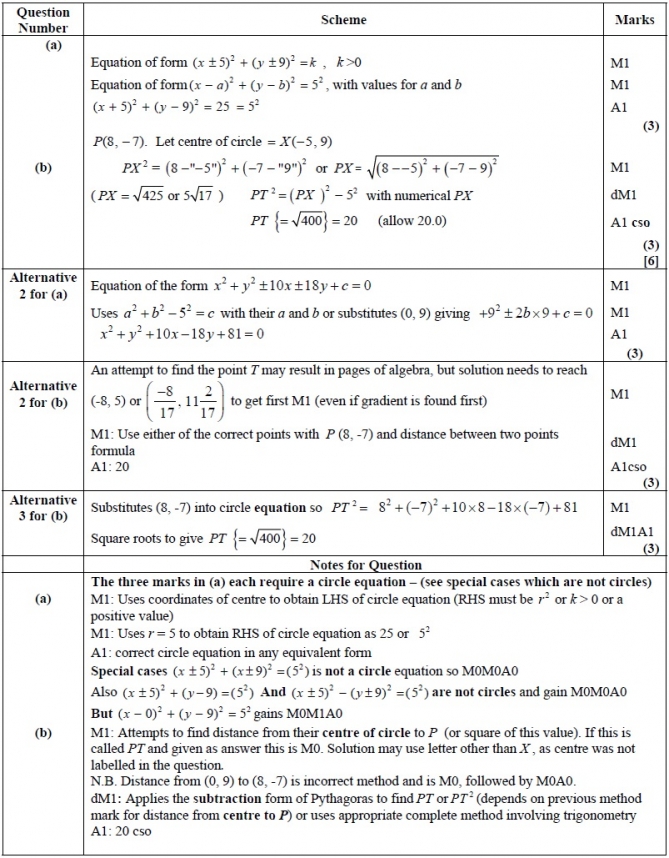
**Q2**



**Q3**



**Q4**

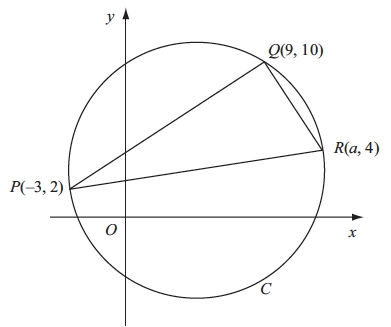


**Gold Questions **

**Calculators may not be used**

The total mark for this section is 35

**Q1**



**Figure 2**

The points P(−3, 2), *Q*(9, 10) and *R*(a, 4) lie on the circle *C*, as shown in Figure 2. Given that *PR* is a diameter of *C*,

(a) show that *a* = 13

**(3)**

(b) find an equation for *C*

**(5)**

**(2)**

**(Total for Question 1 is 10 marks)**

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

**Q2**

The circle *C* has centre *A*(2,1) and passes through the point *B*(10, 7)

(a)   Find an equation for *C*

**(4)**

The line *l*1 is the tangent to *C* at the point *B*

(b)   Find an equation for *l*1

**(4)**

The line *l*2 is parallel to *l*1 and passes through the mid-point of *AB*

Given that *l*2 intersects *C* at the points *P* and *Q*,

(c)   find the length of *PQ*, giving your answer in its simplest surd form.

**(3)**

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

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

**Q3**

The circle *C* has equation

*x*2 + *y*2 – 6*x* + 10*y* + 9 = 0

(a)  Find

(i)  the coordinates of the centre of *C*

(ii)  the radius of *C*

**(3)**

The line with equation *y* = *kx*, where *k* is a constant, cuts *C* at two distinct points.

(b)  Find the range of values for *k*

**(6)**

**(Total for Question 3 is 9 marks)**

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

**Q4**

A circle *C* with centre at (– 2, 6) passes through the point (10, 11).

The circle *C* also passes through the point (10, 1) and has the equation

The tangent to the circle *C* at the point (10, 11) meets the *y* axis at the point *P*

and the tangent to the circle *C* at the point (10, 1) meets the *y* axis at the point *Q*.

Show that the distance *PQ* is 58 explaining your method clearly.

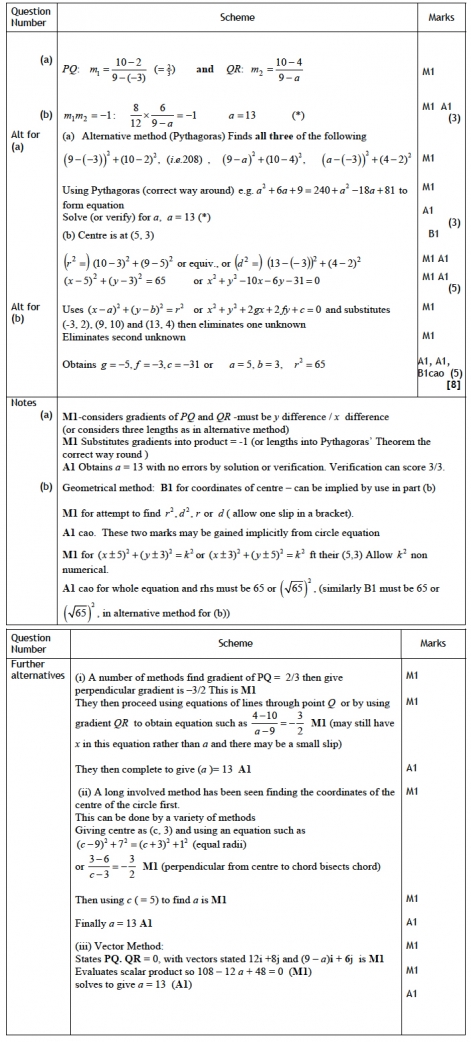
**(Total for Question 4 is 7 marks)**

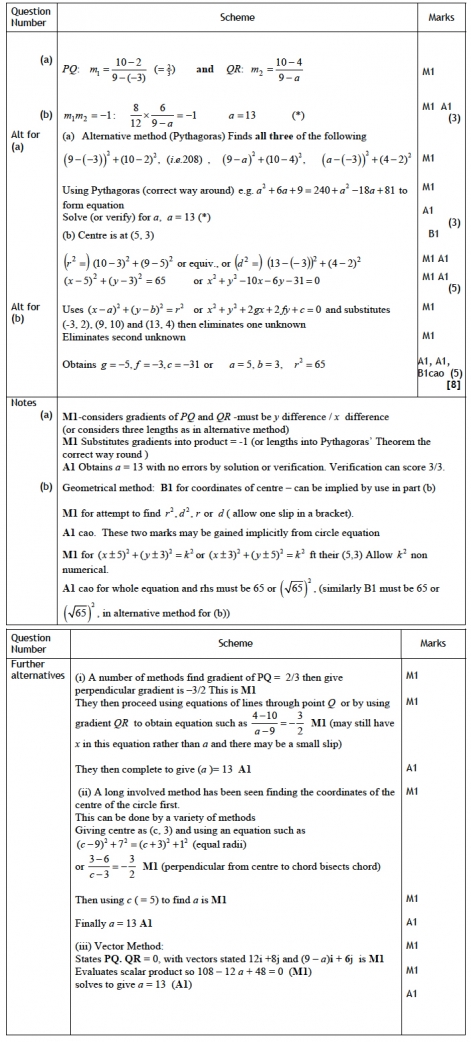
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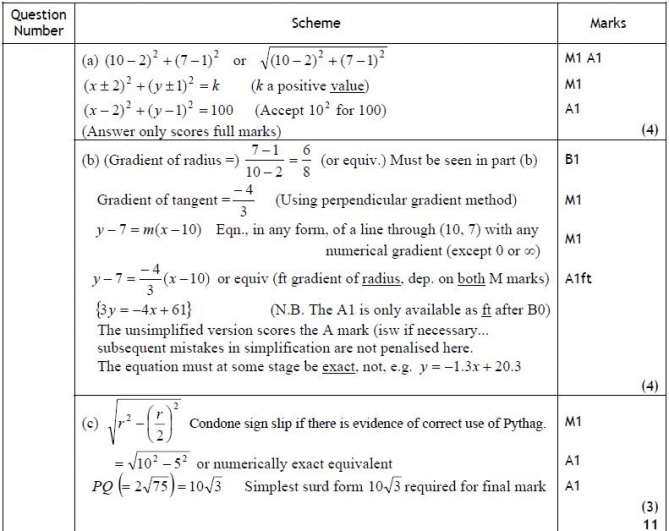
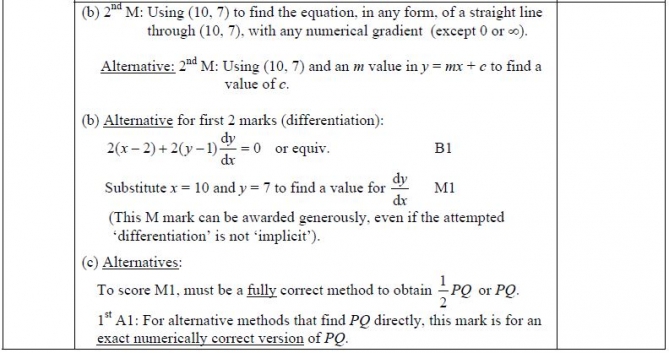
**End of Questions**

**Gold Mark Scheme**

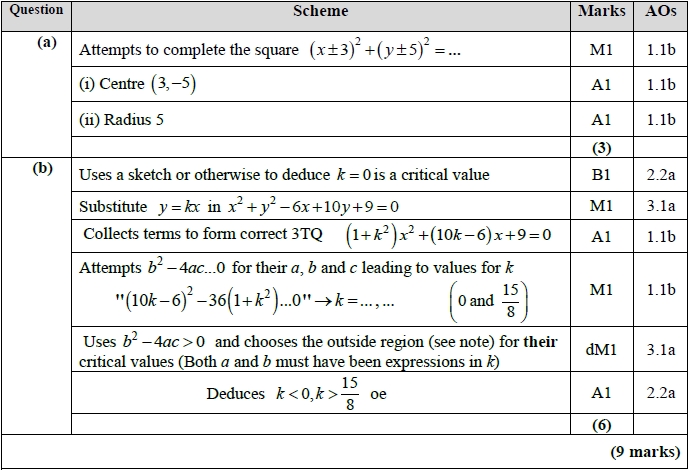
**Q1**

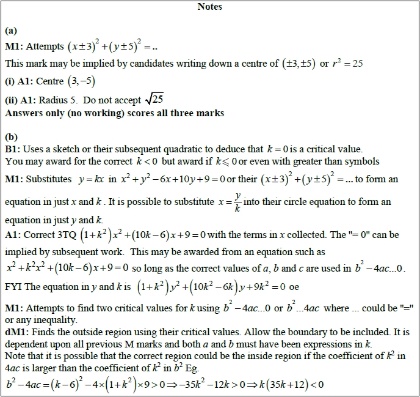




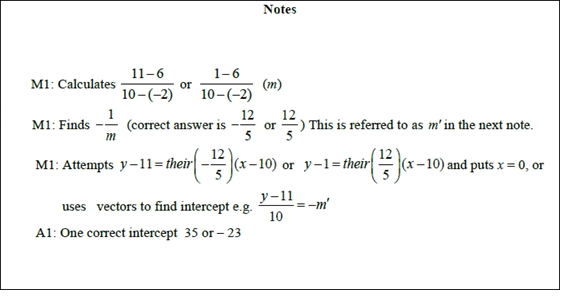
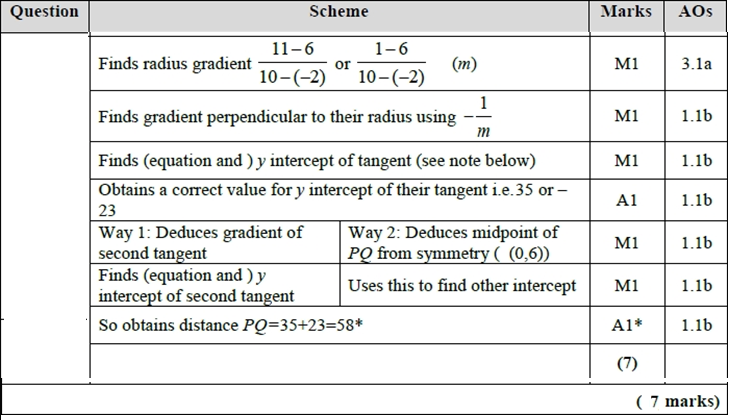
**Q2**  


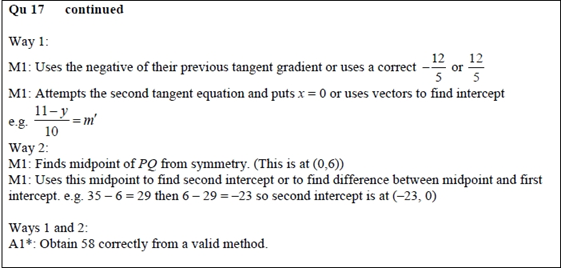
**Q3**





**Q4**



**Platinum Questions **

**Calculators may not be used**

The total mark for this section is 20

**1** A point *P* lies on the curve with equation

*x*2 + *y*2 – 6*x* + 8*y* = 24.

Find the greatest and least possible values of the length *OP*, where *O* is the origin.

**(6)**

**(Total for Question 1 is 6 marks)**

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**2** The line with equation*y* = *mx* is a tangent to the circle *C*1 with equation

(*x* + 4)2 + (*y* – 7)2 = 13.

(a) Show that *m* satisfies the equation

3*m*2 + 56*m* + 36 = 0.

**(4)**

The tangents from the origin *O* to *C*1 touch *C*1 at the points *A* and *B*.

(b) Find the coordinates of the points *A* and *B*.

**(8)**

Another circle *C*2 has equation *x*2 + *y*2 = 13. The tangents from the point (4, –7) to *C*2touch it at the points *P* and *Q*.

(c) Find the coordinates of either the point *P* or the point *Q*.

**(2)**

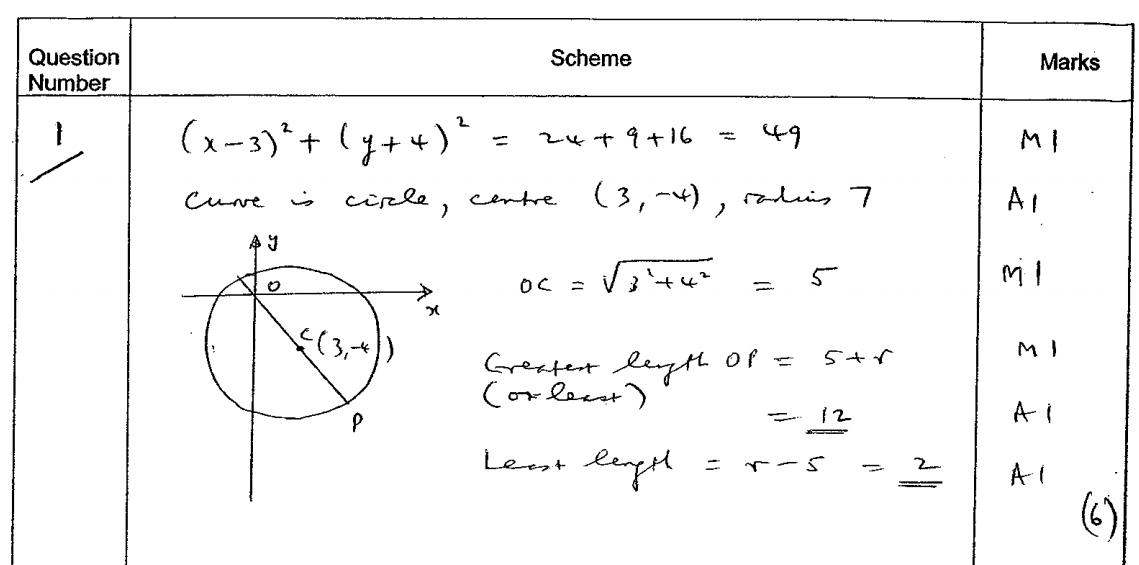
**(Total for Question 2 is 20 marks)**

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**End of Questions**

**Platinum Mark Scheme**

1.



2. 