# **Topic 3**

# **Equations and Inequalities**

# 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)

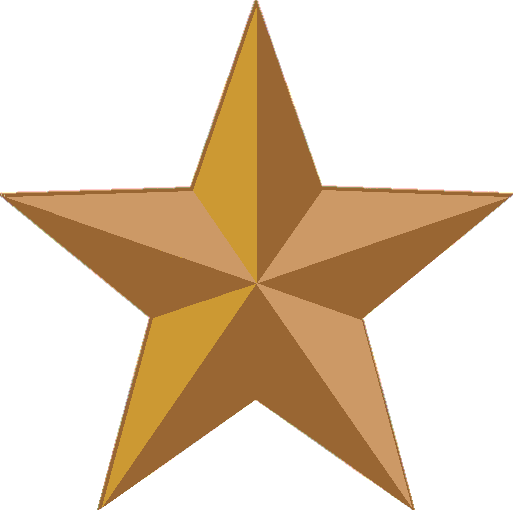
The Platinum Questions below are taken from the Advanced Extension Award. You can use these in class as high level problem solving questions, either with individual students or as group problem solving exercises. On the Advanced Extension Award students, typically, need to get around 50% to get a Merit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

Find the set of values of *x* for which

(a)   3(*x* − 2) < 8 − 2*x*

**(2)**

(b)   (2*x* − 7)(1 + *x*) < 0

**(3)**

(c)   both 3(*x* − 2) < 8 − 2*x***and** (2*x* − 7)(1 + *x*) < 0

**(1)**

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

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

**Q2**

Find the set of values of *x* for which

(a)  2(3*x* + 4) > 1 − *x*

**(2)**

(b)  3*x*2 + 8*x* − 3 < 0

**(4)**

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

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

**Q3**

Solve the simultaneous equations

*y* − 3*x* + 2 = 0

*y*2 − *x* − 6*x*2 = 0

**(Total for Question 3 is 7 marks)**

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

**Q4**

A rectangular room has a width of *x* m.

The length of the room is 4 m longer than its width.

Given that the perimeter of the room is greater than 19.2 m,

(a)  show that *x* > 2.8

**(3)**

Given also that the area of the room is less than 21 m2,

(b) (i)   write down an inequality, in terms of *x*, for the area of the room.

(ii)   Solve this inequality.

**(4)**

(c)  Hence find the range of possible values for *x*.

**(1)**

**(Total for Question 4 is 8 marks)**

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

**End of Questions**

**Bronze Mark Scheme**

**Q1.**

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**Q2.**

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**Q3.**

Table

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**Q4.**

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**Silver Questions **

**Calculators may not be used**

The total mark for this section is 34

**Q1**

Find the set of values of *x* for which

(a)   4*x* − 3 > 7 − *x*

**(2)**

(b)   2*x*2 − 5*x* − 12 < 0

**(4)**

(c)   **both** 4*x* − 3 > 7 − *x*  **and**  2*x*2 − 5*x* − 12 < 0

**(1)**

**Q2**

Given the simultaneous equations

2*x* + *y* = 1

*x*2 − 4*ky* + 5*k* = 0

where *k* is a non zero constant,

(a)  show that

*x*2 + 8*kx* + *k* = 0

**(2)**

Given that *x*2 + 8*kx* + *k* = 0 has equal roots,

(b)  find the value of *k*.

**(3)**

(c)  For this value of *k*, find the solution of the simultaneous equations.

**(3)**

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

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**Q3**

Solve the simultaneous equations



**(Total for Question 3 is 7 marks)**

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**Q4**

The equation

(*k* + 3) *x*2 + 6*x* + *k* = 5, where *k* is a constant,

has two distinct real solutions for *x*.

(a)  Show that *k* satisfies

*k*2 − 2*k* − 24

**(4)**

(b)  Hence find the set of possible values of *k*.

**(3)**

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

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

**Q5**

(i)  Show that *x*2 – 8*x* + 17 > 0 for all real values of *x*

**(3)**

(ii)  "If I add 3 to a number and square the sum, the result is greater than the square of the original number."

State, giving a reason, if the above statement is always true, sometimes true or never true.

**(2)**

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

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**End of Questions**

**Silver Mark Scheme**

**Q1**

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**Q2.**

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**Q3.**

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**Q4.**

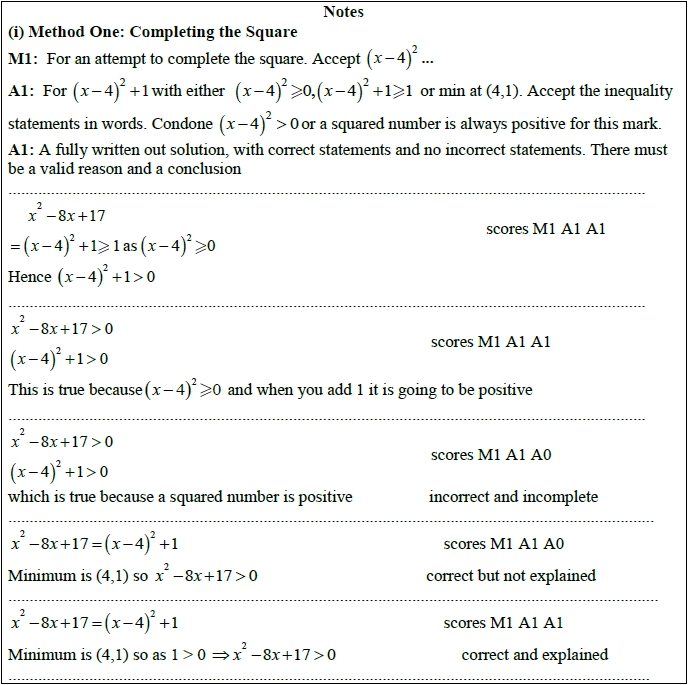
Table

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**Q5.**

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**Gold Questions **

**Calculators may not be used**

The total mark for this section is 27

**Q1**

The equation

*x*2 + *kx* + 8 = *k*

has no real solutions for *x*.

(a)  Show that *k* satisfies *k*2 + 4*k* – 32 < 0.

**(3)**

(b)  Hence find the set of possible values of *k*.

**(4)**

**(Total for Question 1 is 7 marks)**

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

**Q2**

Given that the equation 2*qx*2 + *qx* – 1 = 0, where *q* is a constant, has no real roots,

(a)  show that *q*2 + 8*q* < 0.

**(2)**

(b)  Hence find the set of possible values of *q*.

**(3)**

**(Total for Question 2 is 5 marks)**

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

**Q3**

The equation 20*x*2 = 4*kx* – 13*kx*2 + 2, where *k* is a constant, has no real roots.

(a)  Show that *k* satisfies the inequality

2*k*2 + 13*k* + 20 < 0

**(4)**

(b)  Find the set of possible values for *k*.

**(4)**

**(Total for Question 3 is 8 marks)**

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

**Q4**

(a)  By eliminating *y* from the equations

*y* = *x* − 4

2*x*2 − *xy* = 8,

show that

*x*2 + 4*x* − 8 = 0

**(2)**

(b)  Hence, or otherwise, solve the simultaneous equations

*y* = *x* − 4,

2*x*2 − *xy* = 8,

giving your answers in the form *a* ± *b*√3, where *a* and *b* are integers.

**(5)**

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

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

**End of Questions**

**Gold Mark Scheme**

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**Q2.**

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**Q3.**

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**Q4.**

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**Platinum Questions **

**Calculators may not be used**

The total mark for this section is 13

**1** (*a*)Find the set of values of *k* for which the equation



has no real roots.

**(6)**



Figure 3 shows a sketch of the curve *C*1 with equation *y* = f(*x*) where f(*x*) = 

The curve has asymptotes *x* = *a*, *x* = *b* and *y* = *c*, where *a*, *b* and *c* are integers.

(*b*)Find the value of *a*, the value of *b* and the value of *c*.

**(4)**

(*c*)Find the coordinates of the points of intersection of *C*1 with the line *y* = 2

**(3)**

**(Total for Question 1 is 13 marks)**

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

**Platinum Mark Scheme**

|  |  |  |
| --- | --- | --- |
| **Qu** | **Scheme** | **Mark** |
| **7 (a)** |  | M1 |
|  | No real roots so “” | M1 |
|  | So | M1A1 |
|  |  | M1 |
|  | so  (o.e.) | A1cso |
|  |  | (6) |
| **(b)** |  | M1 |
|  |  | A1A1 |
|  | Division or limits of *x* *y* = 1 or *c* = 1 | B1 |
|  |  | (4) |
| **(c)** | f(*x*) = 2 | M1 |
|  | i.e.  so | M1 |
|  | Coordinates are **(3, 2)** and **(4, 2)** | A1 |
|  |  | (3) |