Dear A-Level Mathematics Student,

If you are reading this, then you are hoping to study A-Level Mathematics at Berkhamsted……a wise but challenging choice!

The summer work outlined below is intended to set you up for success in your A-Level Mathematics, so let's outline briefly what makes a successful student:

1) Your algebra needs to be ruthlessly accurate! At GCSE you will have already learnt how to manipulate algebra, including factorising, completing the square, dealing with indices and solving any type of equations. Algebraic excellence is the central element of the summer work program.

2) You cannot be working to deadlines. You have to be working in advance, spreading your work out over a longer period of time. If you are reading this page for the first time in the final week of September, having ignored it all summer, then that is the first red flag.

3) You will need to dedicate time to your work. A-Level Mathematics is not about doing work in your head and writing down an answer. You must be writing down clear working. And you need to accept that sometimes, you'll need to go back and improve your work to reinforce your understanding, even if your answers were right the first time. A-Level is not GCSE; showing a clear method is everything.

N.B. The terms GCSE and IGCSE are used interchangeably in this documentation.

Instructions for Summer work

If you are working from an electronic version of this document, you will be expected write your answers on lined paper and bring them at the beginning of term. You must not squash your answers in beside the questions.

If you attended induction then you will have been given a printed version of this document, you should answer in the spaces provided.

Your summer work is as follows:

- **Exercises from the Early Chapters based on GCSE prior knowledge**
- **For Further Mathematicians only: One Edexcel Level 3 Algebra Paper**

All compulsory questions are included in this document. Optional questions and videos, are found via the links provided.

You will be expected to **answer and mark all compulsory questions in this document**!

1) Exercises from the Early Chapters

The A-Level course is divided into two parts: Pure and Applied in a ratio of 2:1.

The Pure part of the course is split between two textbooks, called P1 and P2. Each textbook is split into chapters.

The P1 textbook is split into 14 chapters. The content of chapters 1, 2, 3, 4 and 9 has already been taught as part of your GCSE course and is prior knowledge for the AL course. To this end, you are required to complete a set of questions based on the content of each of these chapters. Work through these five chapters independently over the summer. The content should all be familiar to you, so the work should just be consolidation and revision.

If you are needing help with these chapters?

If you need some help with any of these five chapters, you should visit

https://www.pearson.com/en-gb/schools/subject-resources/mathematics/unrivalled-support/support-from-pearson/gcse-maths-transition-to-a-level.html

For each chapter, there are around 15 short videos explaining each of the techniques. There are also some examples and questions that you should work through as per the instructions on the page. At the end of each of these chapters, there are a set of "end of chapter exam questions". We have used a subset of these questions for your summer work, and they are included in this document. However, if you are looking for extra practice, then feel free to work through the remainder from here.

YOU WILL BE EXPECTED TO PRESENT YOUR **WRITTEN SOLUTIONS** WHICH SHOULD BE **MARKED TO ALL FIVE** OF THESE "**Exercises from Early Chapters**" WHEN YOU ARRIVE IN **SEPTEMBER**.

Please note, QR codes and "tiny URLs" for each individual video are given at the end of this document.

2) For Further Mathematicians only: One Edexcel Level 3 Algebra Paper

This is a past paper that focuses entirely of algebra skills that you have learnt as part of your GCSE course. These should be straight forward skills-based questions and being able to answer the types of questions in this paper is paramount to your success at A-Level.

Over the summer, you should complete the paper, from Jan 2020. This is included in this document. Set yourself the challenge to complete it by the fourth week of the holiday. (If you are already thinking about leaving them until a bit later, then that is your next red flag!)

Your solutions to each question must be presented clearly.

ONCE COMPLETED, THE PAPER SHOULD BE MARKED ACCORDING TO THE MARK SCHEME PROVIDED.

If you find these three papers difficult, then the key is practice, practice, practice. You may choose to attempt some additional papers, which can be downloaded using the links below:

Jan 2017 Paper

- https://qualifications.pearson.com/content/dam/pdf/Edexcel-Awards-in-mathematics/Algebra/2012/Exam-materials/AAL30_01_que_20170113.pdf

Jan 2017 Mark Scheme

- https://qualifications.pearson.com/content/dam/pdf/Edexcel-Awards-in-mathematics/Algebra/2012/Exam-materials/AAL30_01_rms_20170301.pdf

Jan 2018 Paper

- https://qualifications.pearson.com/content/dam/pdf/Edexcel-Awards-in-mathematics/Algebra/2012/Exam-materials/AAL30_01_que_20180111.pdf

Jan 2018 Mark Scheme

- https://qualifications.pearson.com/content/dam/pdf/Edexcel-Awards-in-mathematics/Algebra/2012/Exam-materials/AAL30_01_rms_20180308.pdf

Jan 2019 Paper

- https://qualifications.pearson.com/content/dam/pdf/Edexcel-Awards-in-mathematics/Algebra/2012/Exam-materials/AAL30_01_que_20190111.pdf

Jan 2019 Mark Scheme

- https://qualifications.pearson.com/content/dam/pdf/Edexcel-Awards-in-mathematics/Algebra/2012/Exam-materials/AAL30_01_msc_20190307.pdf

Good luck with the summer work and we look forward to seeing you in the Maths classroom in September.

Berkhamsted Maths Department

YOU MUST ANSWER THESE QUESTIONS ON LINED PAPER

THEY SHOULD NOT BE WRITTEN ON THESE QUESTION SHEETS.

Chapter 1: Algebraic Expressions

Calculators may NOT be used to answer these questions. Answers should be written on lined paper. They should not be written on these question sheets.

1. (*a*) Expand and simplify $(x-y)(x+2y)$

(2)

(*b*) Factorise $12u^2t^2 + 18ut^3$

(2)

(4 marks)

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2. (*a*) Simplify

$$\sqrt{50} - \sqrt{18}$$

giving your answer in the form $a\sqrt{2}$, where a is an integer.

(2)

(*b*) Hence, or otherwise, simplify

$$\frac{12\sqrt{2}}{\sqrt{\quad}\sqrt{\quad}}$$

giving your answer in the form $b\sqrt{\quad}$, where b and c are integers and $b \neq 1$.

(3)

(5 marks)

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3. Simplify

$$\frac{7 \quad 15}{\quad},$$

giving your answer in the form $a + b\sqrt{5}$, where a and b are integers.

(4 marks)

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4. (*a*) Simplify $\left(3\sqrt{7}\right)^2$

(1)

(*b*) Simplify

$$\frac{\sqrt{3}}{5\sqrt{3}+6\sqrt{2}}$$

giving your answer in the form $a+b\sqrt{c}$, where *a*, *b* and *c* are integers and $b \neq -1$

(4)

(5 marks)

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5. (*a*) Find the value of $8^{\frac{5}{3}}$.

(2)

(*b*) Simplify fully $\frac{(2x^{\frac{1}{2}})^3}{4x^2}$.

(3)

(5 marks)

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6. (*a*) Simplify $\left(9x^4\right)^{\frac{1}{2}}$

(1)

(*b*) Simplify $a^7 \div a^{-3}$

(1)

(*c*) Simplify $(x^{-2})^{-3}$

(1)

$\frac{(2q)^2 - q^{\frac{7}{2}}}{q^2}$ can be written in the form $d - q^f$

(*d*) Work out the value of *d* and the value of *f*.

(3)

(6 marks)

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7. Show that $\frac{2}{\sqrt{12}-\sqrt{8}}$ can be written in the form $\sqrt{a} + \sqrt{b}$, where *a* and *b* are integers.

(5 marks)

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8. Simplify $\sqrt[3]{(8x)^6}$

(2 marks)

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9. (*a*) Simplify $\left(\frac{x^5}{x^7}\right)^{-1}$

(1)

(*b*) Simplify $\left(4y^{\frac{2}{3}}\right)^3$

(2)

$6x^{-2}\left(\frac{1}{2}x^6 - \frac{1}{3}x^2\right)$ can be written in the form $ax^n + b$

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

(2)

(*d*) Expand and simplify $(3y + 2)^2 - (3y - 2)^2$

(2)

(7 marks)

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10. (i) Simplify

$$\sqrt{48} - \frac{6}{\sqrt{3}}$$

Write your answer in the form $a\sqrt{3}$, where *a* is an integer to be found.

(2)

(ii) Solve the equation

$$3^{6x-3} = 81$$

Write your answer as a rational number.

(3)

(5 marks)

Chapter 1: Algebraic Expressions – Mark Scheme

Question	Scheme	Marks
1(a)	for expanding bracket to obtain 4 terms with all 4 correct without considering signs or for 3 terms out of 4 correct with correct signs	M1
	$x^2 + xy - 2y^2$	A1
		(2)
(b)	for correct factorisation (B1 for a partial correct factorisation which shows a product of 3 or 4 factors) $6ut^2(2u + 3t)$	B2
		(2)
		(4 marks)

Question	Scheme	Marks
2(a)	$\sqrt{50} - \sqrt{18} = 5\sqrt{2} - 3\sqrt{2}$	M1
	$= 2\sqrt{2}$	A1
		(2)
(b)	$\frac{12\sqrt{3}}{\sqrt{50} - \sqrt{18}} = \frac{12\sqrt{3}}{"2"\sqrt{2}}$	M1
	$= \frac{12\sqrt{3}}{"2"\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{12\sqrt{6}}{4}$	dM1
	$= 3\sqrt{6}$ or $b = 3$, $c = 6$	A1
		(3)
		(5 marks)

Question	Scheme	Marks
3	$\frac{7 + \sqrt{5}}{\sqrt{5} - 1} \times \frac{(\sqrt{5} + 1)}{(\sqrt{5} + 1)}$	M1

Question	Scheme	Marks
	$=\frac{\ldots}{4}$	A1 cso
	$(7+\sqrt{5})(\sqrt{5}+1)=7\sqrt{5}+5+7+\sqrt{5}$	M1
	$3+2\sqrt{5}$	A1 cso
		(4 marks)

Question	Scheme		Marks
4(a)	$\left(3\sqrt{7}\right)^2 = 63$	Cao	B1
			(1)
(b)	$\frac{\sqrt{3}}{5\sqrt{3}+6\sqrt{2}}\times\frac{5\sqrt{3}-6\sqrt{2}}{5\sqrt{3}-6\sqrt{2}}$	For rationalising the denominator by a correct method (i.e. multiply numerator and denominator by $5\sqrt{3}-6\sqrt{2}$). This statement is sufficient.	M1
	$=\frac{15-6\sqrt{6}}{\ldots}$ **or** $=\frac{\ldots}{75-72}$	For $15-6\sqrt{6}$ (or $3\times5-6\sqrt{6}$) in the numerator **or** 75 – 72 (or 3 from correct work) in the denominator seen at some point i.e. apply isw	A1
	$=\frac{15-6\sqrt{6}}{\ldots}$ **and** $=\frac{\ldots}{75-72}$	For $15-6\sqrt{6}$ (or $3\times5-6\sqrt{6}$) in the numerator **and** 75 – 72 (or 3 from correct work) in the denominator seen at some point i.e. apply isw	A1
	$5-2\sqrt{6}$	Fully correct expression. Allow $a = 5$ $b = -2$, $c = 6$ but apply isw e.g. $5-2\sqrt{6}$ followed by $a = 5$ $b = 2$, $c = 6$	A1
			(4)
			(5 marks)

Question	Scheme	Marks
5(a)	$8^{\frac{1}{3}} = 2 \quad \text{or} \quad 8^5 = 32768$	M1
	$\left(8^{\frac{5}{3}} =\right) \ 32$	A1 cao
		(2)
(b)	$\left(2x^{\frac{1}{2}}\right)^3 = 2^3 x^{\frac{3}{2}}$	M1
	$\frac{8x^{\frac{3}{2}}}{4x^2} = 2x^{-\frac{1}{2}}$ or $\frac{2}{\sqrt{x}}$	dM1A1
		(3)
		(5 marks)

Question	Scheme	Marks
6(a)	$3x^2$	B1cao
		(1)
(b)	a^{10}	B1cao
		(1)
(c)	x^6	B1cao
		(1)
(d)	a correct first step eg $4q^2$ or $\frac{7}{2} - 2$	M1oe
	for $d = 4$	A1
	for $f = \frac{3}{2}$ oe	A1oe
		(3)
		(6 marks)

Question	Scheme	Marks
7	$\left\{\dfrac{2}{\sqrt{12}-\sqrt{8}}\right\} = \dfrac{2}{\left(\sqrt{12}-\sqrt{8}\right)} \times \dfrac{\left(\sqrt{12}+\sqrt{8}\right)}{\left(\sqrt{12}+\sqrt{8}\right)}$ Writing this is sufficient for M1.	M1
	$= \dfrac{\left\{2\left(\sqrt{12}+\sqrt{8}\right)\right\}}{12-8}$ For $12-8$. This mark can be implied.	A1
	$= \dfrac{2\left(2\sqrt{3}+2\sqrt{2}\right)}{12-8}$	B1 B1
	$= \sqrt{3}+\sqrt{2}$	A1 cso
		(5 marks)

Question	Scheme	Marks
8	$64x^2$ for $64x^2$ (B1 for 64 or x^2)	B2
		(2 marks)

Question	Scheme	Marks
9(a)	x^2	B1cao
		(1)
(b)	for $4^3(=64)$ or $y^3 \times \frac{2}{3}$ $(= y^2)$	M1
	$64y^2$	A1cao
		(2)
(c)	$a = 3, b = -2, n = 4$ for all 3 correct values (B1 for 2 correct values)	B2
		(2)
(d)	for one correct expansion or use of difference of 2 squares	M1
	$24y$	A1cao
		(2)
		(7 marks)

Question	Scheme		Marks
10(i) Way 1	$\sqrt{48}=\sqrt{16}\sqrt{3}$ or $\frac{6}{\sqrt{3}}=6\frac{\sqrt{3}}{3}$	Writes one of the terms of the given expression correctly in terms of $\sqrt{3}$	M1
	$\Rightarrow \sqrt{48}-\frac{6}{\sqrt{3}}=2\sqrt{3}$	A correct answer of $2\sqrt{3}$. A correct answer with **no** working implies both marks.	A1
			(2)
(i) Way 2	$\sqrt{48}=2\sqrt{12}$ or $\frac{6}{\sqrt{3}}=\sqrt{12}$	Writes one of the terms of the given expression correctly in terms of $\sqrt{12}$	M1
	$2\sqrt{12}-\sqrt{12}=\sqrt{12}=2\sqrt{3}$	A correct answer of $2\sqrt{3}$. A correct answer with **no** working implies both marks.	A1
			(2)
(i) Way 3	$\sqrt{48}=\frac{12}{\sqrt{3}}$ or $\sqrt{48}=\frac{\sqrt{144}}{\sqrt{3}}$	Writes $\sqrt{48}$ correctly as $\frac{12}{\sqrt{3}}$ or $\frac{\sqrt{144}}{\sqrt{3}}$	M1
	$\frac{12}{\sqrt{3}}-\frac{6}{\sqrt{3}}=\frac{6}{\sqrt{3}}=2\sqrt{3}$	A correct answer of $2\sqrt{3}$. A correct answer with **no** working implies both marks.	A1
			(2)
(i) Way 4	$\sqrt{48}-\frac{6}{\sqrt{3}}=\frac{\sqrt{3}\sqrt{48}-...}{\sqrt{3}}=\frac{12-...}{\sqrt{3}}$ or $\sqrt{48}-\frac{6}{\sqrt{3}}=\frac{\sqrt{3}\sqrt{48}-...}{\sqrt{3}}=\frac{\sqrt{144}-...}{\sqrt{3}}$	Writes $\sqrt{48}$ correctly as $\frac{12}{\sqrt{3}}$ or $\frac{\sqrt{144}}{\sqrt{3}}$	M1
	$\frac{12-6}{\sqrt{3}}=\frac{6}{\sqrt{3}}=2\sqrt{3}$	A correct answer of $2\sqrt{3}$. A correct answer with **no** working implies both marks.	A1
			(2)

Question	Scheme		Marks
(ii) **Way 1**	$81=3^4$ or $\log_3 81=6x-3$	For $81=3^4$ or $\log_3 81=6x-3$. This may be implied by subsequent work.	B1
	$3^{6x-3}=3^4$ or $\log_3 81=6x-3$ $\Rightarrow 4=6x-3\Rightarrow x=...$	Solves an equation of the form $6x-3=k$ where k is their power of 3.	M1
	$\Rightarrow x=\frac{4+3}{6}=\frac{7}{6}$	$\frac{7}{6}$ or $1\frac{1}{6}$ or 1.16 with a dot over the 6	A1
			(3)
Way 2	$3=81^{\frac{1}{4}}$	For $3=81^{\frac{1}{4}}$. This may be implied by subsequent work.	B1
	$81^{\frac{6x-3}{4}}=81\Rightarrow\frac{6x-3}{4}=1\Rightarrow x=...$	Solves an equation of the form $k(6x-3)=1$ where k is their power of 81.	M1
	$\Rightarrow x=\frac{4+3}{6}=\frac{7}{6}$	$\frac{7}{6}$ or $1\frac{1}{6}$ or 1.16 with a dot over the 6	A1
			(3)
Way 3	$81=9^2$ **and** $3=9^{\frac{1}{2}}$	For $81=9^2$ **and** $3=9^{\frac{1}{2}}$. This may be implied by subsequent work.	B1
	$9^{\frac{6x-3}{2}}=9^2\Rightarrow\frac{6x-3}{2}=2\Rightarrow x=...$	Solves an equation of the form $p(6x-3)=q$ where p is their power of 9 for the 3 and q is their power of 9 for the 81.	M1
	$\Rightarrow x=\frac{4+3}{6}=\frac{7}{6}$	$\frac{7}{6}$ or $1\frac{1}{6}$ or 1.16 with a dot over the 6	A1
			(3)
Way 4	$3^{6x-3}=3^{6x}\times 3^{-3}$	For writing 3^{6x-3} correctly in terms of 3^{6x}	B1
	$3^{6x}=81\times 3^3=3^7$ $\Rightarrow 6x=7\Rightarrow x=...$	Solves an equation of the form $6x=k$ where k is their $3^3\times 81$ written as a power of 3.	M1

	$\Rightarrow x = \frac{7}{6}$	$\frac{7}{6}$ or $1\frac{1}{6}$ or 1.16 with a dot over the 6	A1
			(3)
Way 5	$\log 3^{6x-3} = \log 81$	Takes logs of both sides	B1
	$6x-3 = \frac{\log 81}{\log 3}$ $6x-3 = 4 \Rightarrow x = \ldots$	Solves an equation of the form $6x - 3 = k$ where k is their $\frac{\log 81}{\log 3}$	M1
	$\Rightarrow x = \frac{7}{6}$	$\frac{7}{6}$ or $1\frac{1}{6}$ or 1.16 with a dot over the 6	A1
			(3)
			(5 marks)

Chapter 2: Quadratics

Calculators may NOT be used to answer these questions unless a calculator symbol is shown next to the question.

1. (i) Show that $x^2 - 8x + 17 > 0$ 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)

(5 marks)

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2. $$f(x) = x^2 - 10x + 23$$

(a) Express f (x) in the form $(x + a)^2 + b$, where a and b are constants to be found.

(2)

(b) Hence, or otherwise, find the exact solutions to the equation

$$x^2 - 10x + 23 = 0$$

(2)

(4 marks)

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3. Factorise completely $x - 4x^3$.

(3)

(3 marks)

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4. The equation $kx^2 + 4kx + 3 = 0$, where k is a constant, has no real roots.

Prove that $0 \leq k < \frac{3}{4}$

(4)

(4 marks)

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5. The curve C has equation

$$y = \frac{k^2}{x} + 1 \qquad x \in \mathbb{R},\ x \neq 0$$

where k is a constant.

The line l has equation $y = -2x + 5$

(a) Show that the x coordinate of any point of intersection of l with C is given by a solution of the equation

$$2x^2 - 4x + k^2 = 0$$

(2)

(b) Hence find the exact values of k for which l is a tangent to C.

(3)

(5 marks)

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6. Find, using algebra, all real solutions to the equation $b^4 + 7b^2 - 18 = 0$

(4)

(4 marks)

Chapter 2: Quadratics – Mark Scheme

Mark Scheme

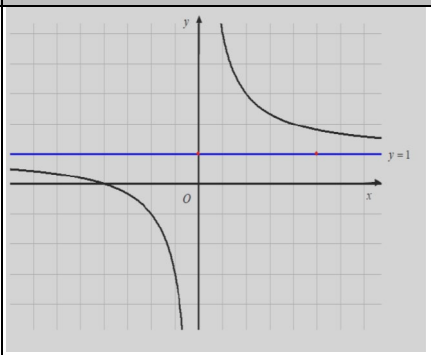
Question	Scheme	Marks
1(i)	$x^2-8x+17=(x-4)^2-16+17$	M1
	$=(x-4)^2+1$ with comment (see notes)	A1
	As $(x-4)^2 \ldots 0 \Rightarrow (x-4)^2+1 \ldots 1$ hence $x^2-8x+17>0$ for all x	A1
		(3)
(ii)	For an explanation that it may not always be true Tests say $x=-5 \quad (-5+3)^2=4$ whereas $(-5)^2=25$	M1
	States sometimes true and gives reasons Eg. when x=5 $(5+3)^2=64$ whereas $(5)^2=25$ True When $x=-5 \quad (-5+3)^2=4$ whereas $(-5)^2=25$ Not true	A1
		(2)
		(5 marks)

Question	Scheme	Marks
2(a)	$x^2-10x+23=(x\pm5)^2\pm A$	M1
	$(x-5)^2-2$	A1
		(2)
(b)	$(x\pm5)^2-A\Rightarrow x=\ldots$ or $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}\Rightarrow x=\ldots$ $\left(x=\dfrac{10\pm\sqrt{10^2-4(1)(23)}}{2}\right)$	M1

	$x = 5 \pm \sqrt{2}$	A1
		(2)
		(5 marks)

Question	Scheme	Marks
3	$x(1-4x^2)$	B1
	Accept $x(-4x^2+1)$ or $-x(4x^2-1)$ or $-x(-1+4x^2)$ or even $4x(\frac{1}{4}-x^2)$ or equivalent quadratic (or initial cubic) into two brackets	M1
	$x(1-2x)(1+2x)$ or $-x(2x-1)(2x+1)$ or $x(2x-1)(-2x-1)$	A1
		(3)
		(3 marks)

Question	Scheme	Marks
4	Realises that $k = 0$ will give no real roots as equation becomes $3 = 0$ (proof by contradiction)	B1
	$(\text{For } k \neq 0)\,\text{quadratic has no real roots provided}$ $b^2 < 4ac \text{ so } 16k^2 < 12k$	M1
	$4k(4k-3) < 0$ with attempt at solution	M1
	So $0 < k < \frac{3}{4}$, which together with $k = 0$ gives $0 \leq k < \frac{3}{4}$ (*)	A1
		4(3)
		(4 marks)

Question	Scheme	Marks
5(a)	 $\frac{1}{x}$ shape in 1st quadrant	M1
		A1
	Correct Asymptote $y=1$	B1
		(3)
(b)	Combines equations $\Rightarrow \frac{k^2}{x}+1=-2x+5$	M1
	$(\times x) \Rightarrow k^2+1x=-2x^2+5x \Rightarrow 2x^2-4x+k^2=0$ *	A1*
		(2)
(c)	Attempts to set $b^2-4ac=0$	M1
	$8k^2=16$	A1
	$k=\pm\sqrt{2}$	A1
		(3)
		(8 marks)

Question	Scheme		Marks
6(i)	$16a^2 = 2\sqrt{a} \Rightarrow a^{\frac{3}{2}} = \frac{1}{8}$	$16a^2 - 2\sqrt{a} = 0$ $\Rightarrow 2a^{\frac{1}{2}}\left(8a^{\frac{3}{2}} - 1\right) = 0$ $\Rightarrow a^{\frac{3}{2}} = \frac{1}{8}$	M1
	$\Rightarrow a = \left(\frac{1}{8}\right)^{\frac{2}{3}}$	$\Rightarrow a = \left(\frac{1}{8}\right)^{\frac{2}{3}}$	M1
	$\Rightarrow a = \frac{1}{4}$	$\Rightarrow a = \frac{1}{4}$	A1
	Deduces that $a = 0$ is a solution		B1
			(4)
(ii)	$b^4 + 7b^2 - 18 = 0 \Rightarrow \left(b^2 + 9\right)\left(b^2 - 2\right) = 0$		M1
	$b^2 = -9, 2$		A1
	$b^2 = k \Rightarrow b = \sqrt{k}, k > 0$		dM1
	$b = \sqrt{2}$, $-\sqrt{2}$ only		A1
			(4)
			(8 marks)

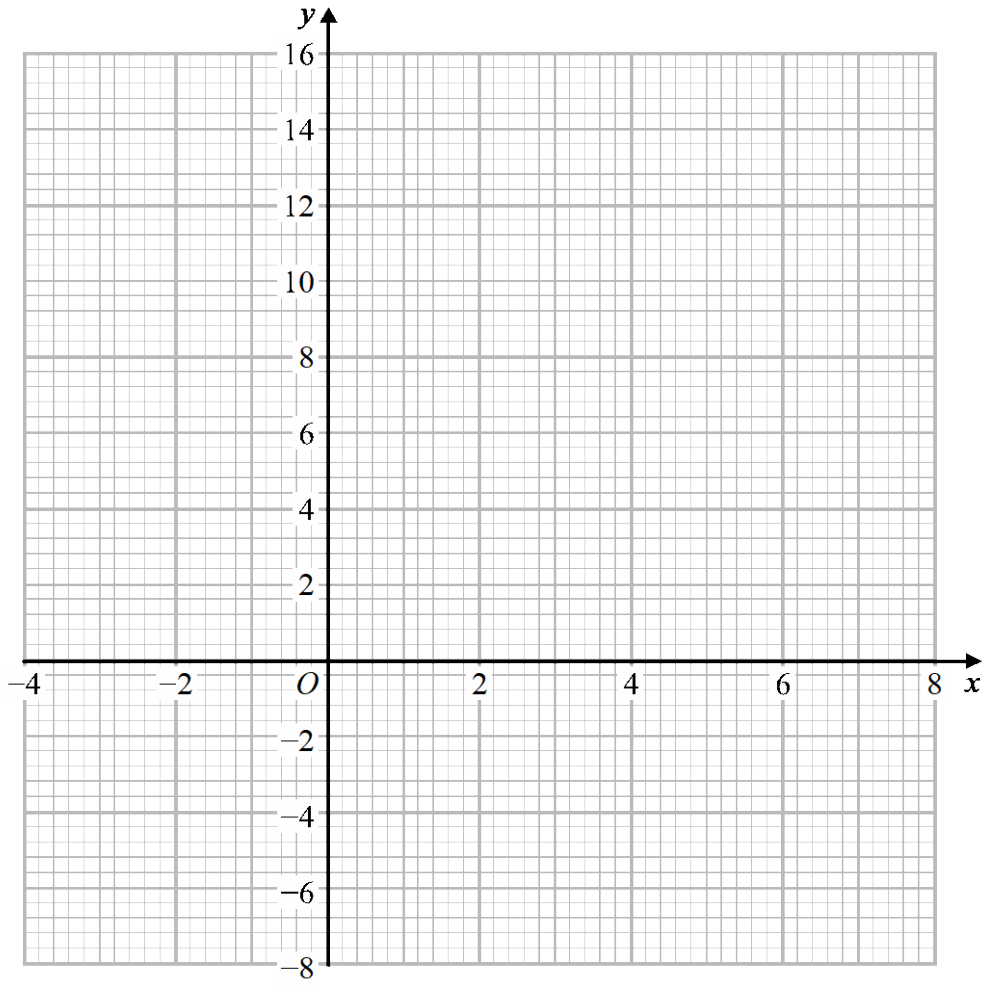
Chapter 3: Inequalities and Equations

Calculators may NOT be used to answer these questions unless a calculator symbol is shown next to the question.

1. On the grid, shade the region that satisfies all these inequalities.

$x > 0$ $y > 0$ $y > 3x - 6$ $2x + y < 12$

Label the region **R**.



(4 marks)

2. Solve $6(2 - 3x) < 5(x + 1)$

(3 marks)

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3. (*a*) Solve $x^2 \geq 4x + 5$

(3)

(*b*) For what range of values of b has the equation $25x^2 + bx + 16 = 0$ no real roots?

(2)

(5 marks)

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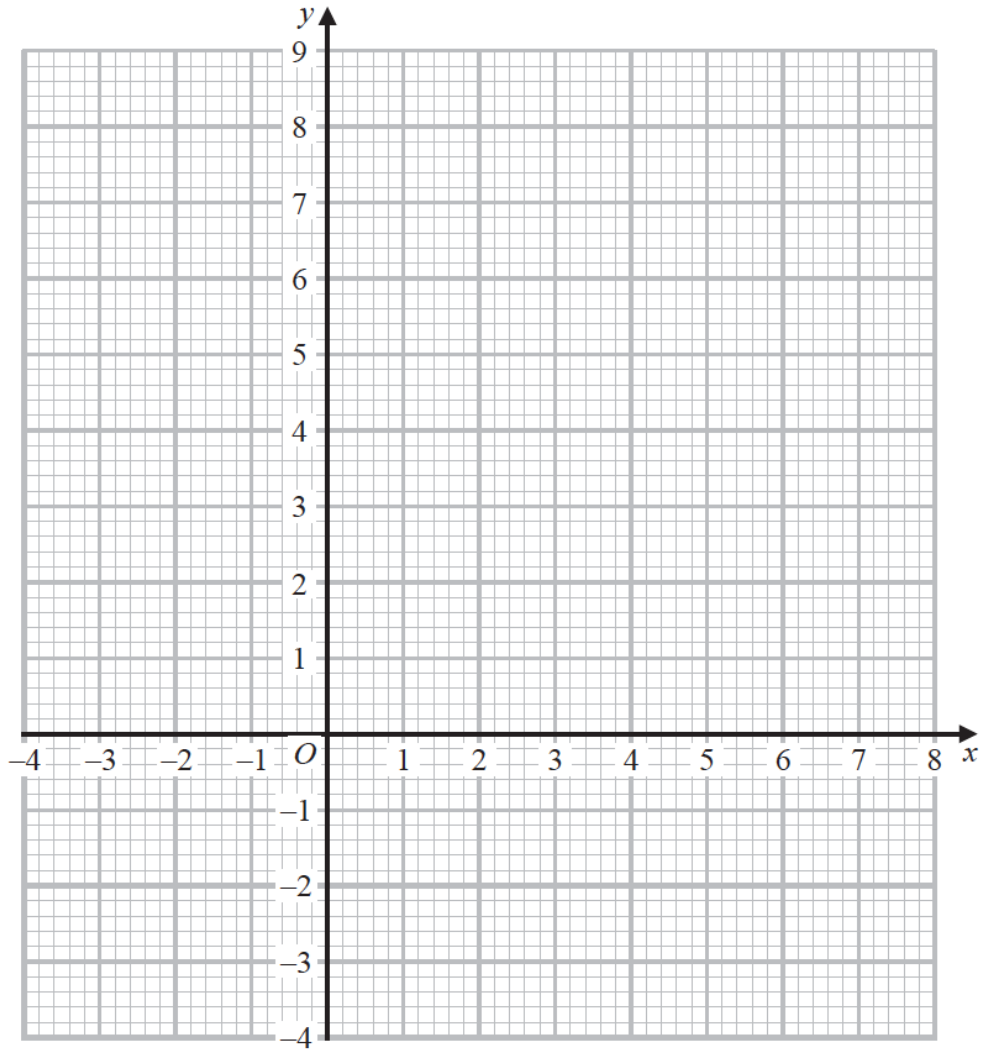
4. (*a*) On the grid, shade the region that satisfies all these inequalities.

$$x < 3 \quad y - x < 5 \qquad 7x + 5y > 35$$

Label the region **R**



(5)

(*b*) Write down the coordinates of each of the points, with integer coordinates, that satisfy

$x < 3$ $y - x < 5$ $7x + 5y > 35$

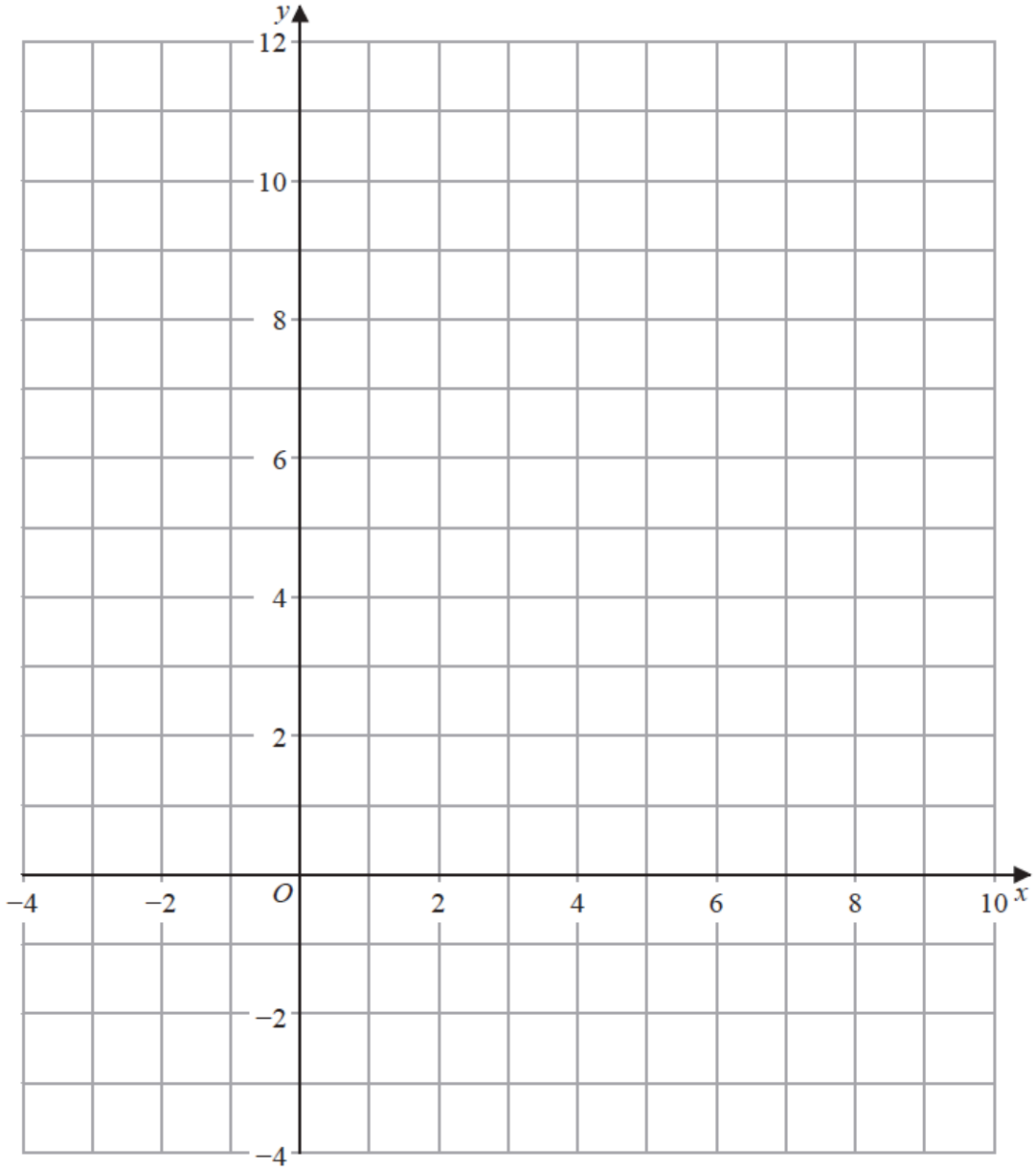
(1)

(6 marks)

5. On the grid, shade the region that satisfies all these inequalities.

$$4x + 3y < 24 \quad x > -2 \quad 3y > 9 - x$$

Label the region **R**.

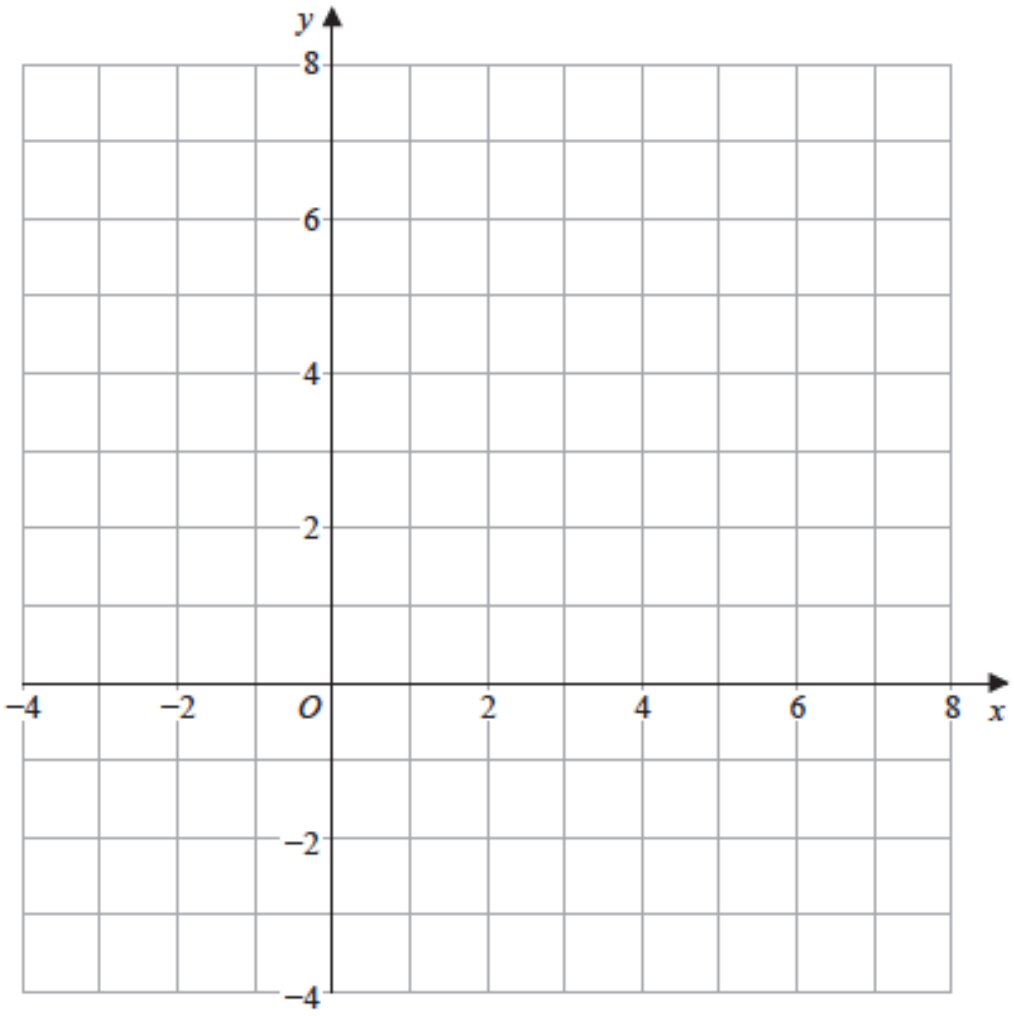


(5 marks)

6. On the grid, shade the region that satisfies all these inequalities.

$x > -1$ $\quad$ $2x + y < 6$ $\quad$ $y < 4 - x$

Label the region **R**.



(5 marks)

7. Solve, algebraically, the simultaneous equations

$$2x + y = 7$$

$$4x^2 + 3y^2 = 43$$

(5 marks)

---

9. Find the set of values of x for which

(*a*) $4x - 5 > 15 - x$,

(2)

(*b*) $x(x - 4) > 12$.

(4)

(6 marks)

---

10. The curve C has equation $y = x(5 - x)$ and the line L has equation $2y = 5x + 4$.

(*a*) Use algebra to show that C and L do not intersect.

(4)

(*b*) Sketch C and L on the same diagram, showing the coordinates of the points at which C and L meet the axes.

(4)

(8 marks)

---

11. (i) Show that $x^2 - 8x + 17 > 0$ 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)

(5 marks)

Chapter 3: Inequalities and Equations – Mark Scheme

Question	Scheme	Marks
1	drawing $y = 3x - 6$	M1
		M1
	drawing $2x + y = 12$	A1
	Correct region indicated	A1
		(4 marks)

Notes

M1 for drawing $y = 3x - 6$

M1 for drawing $2x + y = 12$

A2 for correctly indicating required region

(A1 for correctly indicating region satisfying 3 of the inequalities)

Question	Scheme	Marks
2	correct expansion of both brackets or expansion of $\frac{6}{5}(2 - 3x)$ or $\frac{5}{6}(x + 1)$	M1
	isolating terms in x, eg $7 < 23x$	M1
	$x > \frac{7}{23}$	A1
		(3 marks)

Question	Scheme	Marks
3(a)	writing in form $x^2 - 4x - 5$ (≥ 0) or $-x^2 + 4x + 5$ (≤ 0)	M1
	establishing critical values, 5 and -1	M1
	$x \leq -1, x \geq 5$	A1
		(3)
(b)	use of $b^2 - 4ac < 0$ or $b^2 < 4ac$ or $b < 40$ or $-40 < b$	M1
	$-40 < b < 40$	A1
		(2)
		(5 marks)

Question	Scheme	Marks
4(a)	drawing $x = 3$ correctly	M1
	drawing $y - x = 5$ correctly	M1
	drawing $7x + 5y = 35$ correctly	M1
		A1
	Correct region indicated	A1
		(5)
(b)	(2, 5) (2, 6)	B1
		(2)
		(5 marks)

Notes

M1 for drawing $x = 3$ correctly

M1 for drawing $y - x = 5$ correctly

M1 for drawing $7x + 5y = 35$ correctly

A2 for correctly shading required region

(A1 for correct shading for 2 inequalities)

B1 for both correct and no extras

Question	Scheme	Marks
5	drawing $4x + 3y = 24$ correctly	M1
	drawing $x = -2$ correctly	M1
	drawing $3y = 9 - x$ correctly	M1
		A1
	Correct region indicated	A1
		(5 marks)

Notes

M3 for drawing $4x + 3y = 24$, $x = -2$ and $3y = 9 - x$ correctly

(M2 for drawing 2 lines correctly

M1 for drawing 1 line correctly)

A2 for correctly shading required region

(A1 for correct shading for 2 inequalities)

Question	Scheme	Marks
6	drawing $x = -1$ correctly	M1
	drawing $2x + y = 6$ correctly	M1
	drawing $y = 4 - x$ correctly	M1
		A1
	Correct region indicated	A1
		(5 marks)

Notes

M1 for drawing $x = -1$ correctly

M1 for drawing $2x + y = 6$ correctly

M1 for drawing $y = 4 - x$ correctly

A2 for correctly shading required region

(A1 for correct shading for 2 inequalities)

Question	Scheme		Marks
7	$49 - 28x + 4x^2$ $147 - 84x + 12x^2 + 4x^2 = 43$	$49 - 14y + y^2$ $49 - 14y + y^2 + 3y^2 = 43$	M1
	$104 - 84x + 16x^2 = 0$ $4x^2 - 21x + 26 = 0$	$2y^2 - 7y + 3 = 0$	M1
	$(4x - 13)(x - 2) = 0$	$(2y - 1)(y - 3) = 0$	M1
	$x = 2, 3.25$ oe or $y = 3, 0.5$ oe		A1
	$x = 2, y = 3$ and $x = 3.25, y = 0.5$		A1
			(5 marks)

Notes

M1 for substitution of $y = 7 - 2x$ or $2x = 7 - y$ oe into the quadratic equation to eliminate one variable

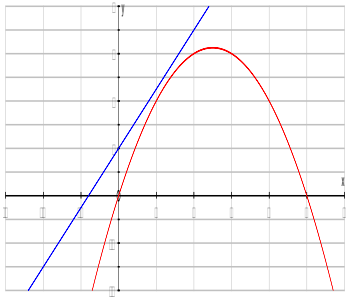
M1 (dep on M1) for expansion of brackets within the quadratic

M1 (dep on M2) for equation of the form $ax^2 + bx + c$ (= 0)

A1 $x = 2, 3.25$ oe or $y = 3, 0.5$ oe

A1 for $x = 2, y = 3$ and $x = 3.25, y = 0.5$

Question	Scheme	Marks
9(a)	$5x > 20$	M1
	$x > 4$	A1
		(2)
(b)	$x^2 - 4x - 12 = 0$ $(x+2)(x-6)$ [= 0]	M1
	$x = 6, -2$	A1
		M1
	$x < -2$, $x > 6$	A1ft
		(4)
		(6 marks)

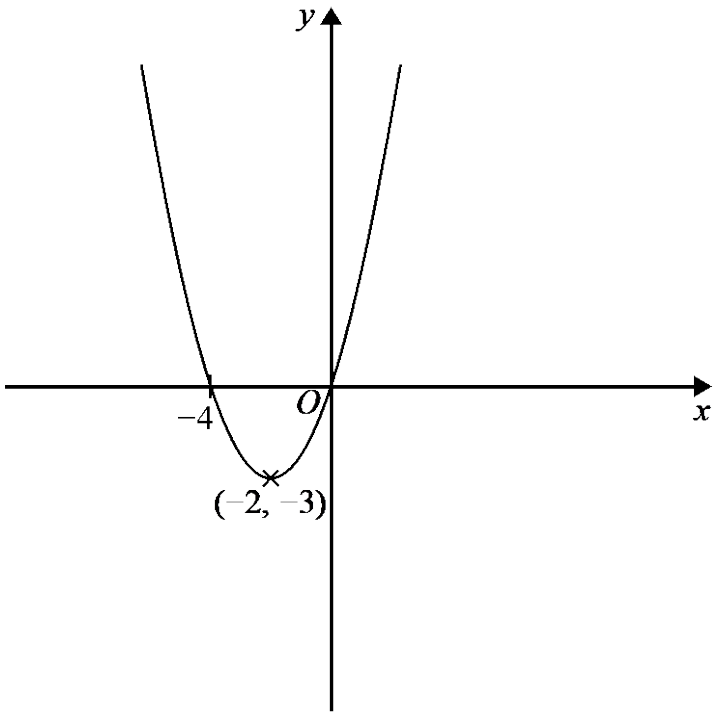
Question	Scheme	Marks
10(a)	$x(5-x)=\frac{1}{2}(5x+4)$ (o.e.)	M1
	$2x^2-5x+4(=0)$ (o.e.) e.g. $x^2-2.5x+2(=0)$	A1
	$b^2-4ac=(-5)^2-4\times2\times4$	M1
	$=25-32$ <0, so no roots or no intersections or no solutions	A1
		(4)
(b)	 Curve: ∩ shape and passing through (0, 0)	B1
	Curve: ∩ shape and passing through (5, 0)	B1
	Line : +ve gradient and no intersections with *C*. If no *C* drawn score B0	B1
	Line : Line passing through (0, 2) and (-0.8, 0) marked on axes	B1
		(4)
		(8 marks)

Question	Scheme	Marks
11(i)	$x^2-8x+17=(x-4)^2-16+17$	M1
	$=(x-4)^2+1$ with comment (see notes)	A1
	As $(x-4)^2..0 \Rightarrow (x-4)^2+1..1$ hence $x^2-8x+17>0$ for all x	A1
		(3)
(ii)	For an explanation that it may not always be true Tests say $x=-5 \quad (-5+3)^2=4$ whereas $(-5)^2=25$	M1
	States sometimes true and gives reasons Eg. when x=5 $(5+3)^2=64$ whereas $(5)^2=25$ True When $x=-5 \quad (-5+3)^2=4$ whereas $(-5)^2=25$ Not true	A1
		(2)
		(5 marks)
Alternative methods may be accepted		

Chapter 4: Graphs and Transformations

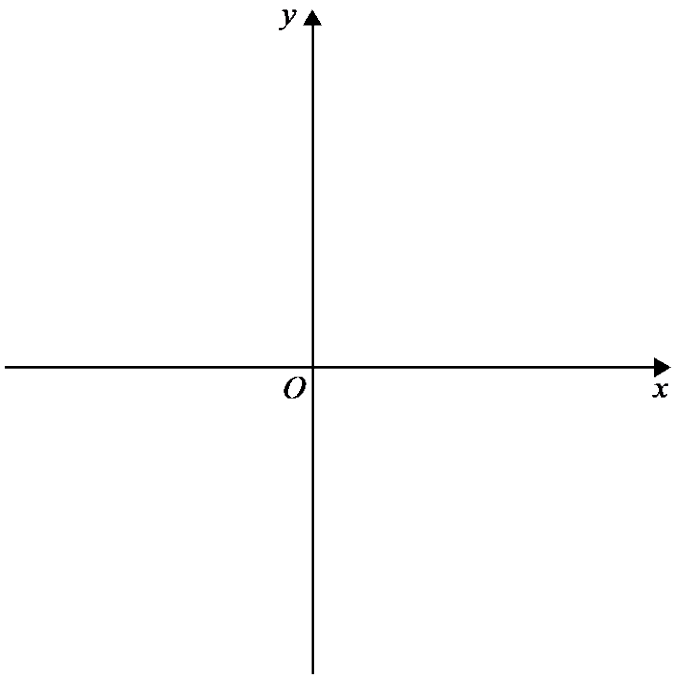
Calculators may NOT be used to answer these questions unless a calculator symbol is shown next to the question.

1. Here is the graph of $y = f(x)$



(*a*) On the axes below, sketch the graph of $y = -f(x)$

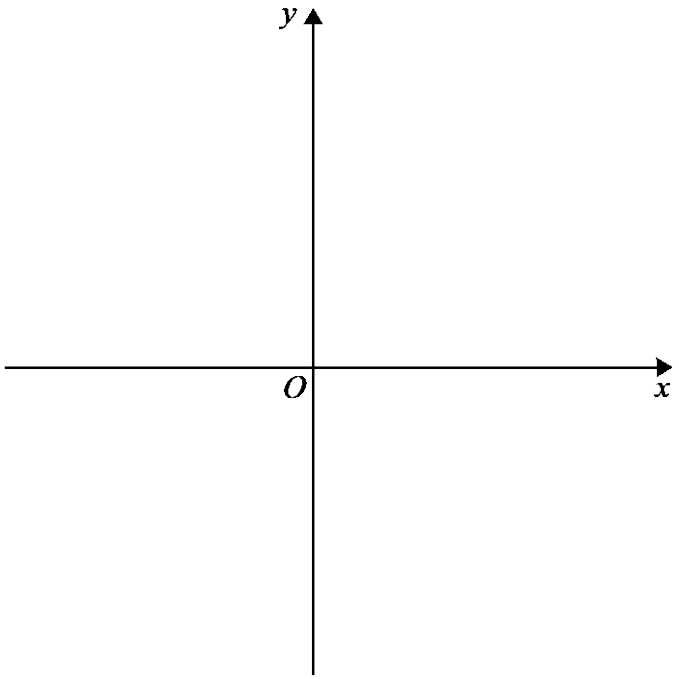
On your sketch, show the coordinates of any points where the graph intersects the x-axis and show the coordinates of any turning points.



(2)

(*b*) On the axes below, sketch the graph of $y = \frac{1}{2}f(x)$

On your sketch, show the coordinates of any points where the graph intersects the *x*-axis and show the coordinates of any turning points.



(2)

(4 marks)

2. (*a*) Factorise completely $9x - 4x^3$.

(3)

(*b*) Sketch the curve *C* with equation

$$y = 9x - 4x^3.$$

Show on your sketch the coordinates at which the curve meets the *x*-axis.

(3)

The points *A* and *B* lie on *C* and have *x* coordinates of –2 and 1 respectively.

(*c*) Show that the length of *AB* is $k\sqrt{10}$, where *k* is a constant to be found.

(4)

(10 marks)

3. $f(x) = x^2 - 8x + 19$

(*a*) Express $f(x)$ in the form $(x + a)^2 + b$, where a and b are constants.

(2)

The curve C with equation $y = f(x)$ crosses the y-axis at the point P and has a minimum point at the point Q.

(*b*) Sketch the graph of C showing the coordinates of point P and the coordinates of point Q.

(3)

(*c*) Find the distance PQ, writing your answer as a simplified surd.

(3)

(8 marks)

4.

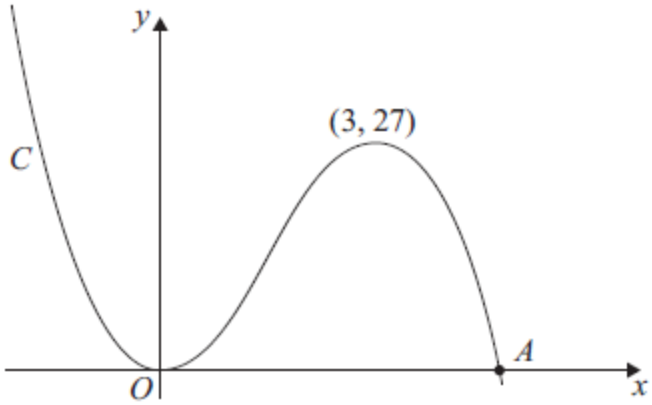


Figure 4

Figure 4 shows a sketch of the curve C with equation $y = f(x)$, where

$$f(x) = x^2(9 - 2x).$$

There is a minimum at the origin, a maximum at the point (3, 27) and C cuts the x-axis at the point A.

(a) Write down the coordinates of the point A.

(1)

(b) On separate diagrams sketch the curve with equation

(i) $y = f(x + 3)$,

(ii) $y = f(3x)$.

On each sketch you should indicate clearly the coordinates of the maximum point and any points where the curves cross or meet the coordinate axes.

(6)

The curve with equation $y = f(x) + k$, where k is a constant, has a maximum point at (3, 10).

(c) Write down the value of k.

(1)

(8 marks)

5.

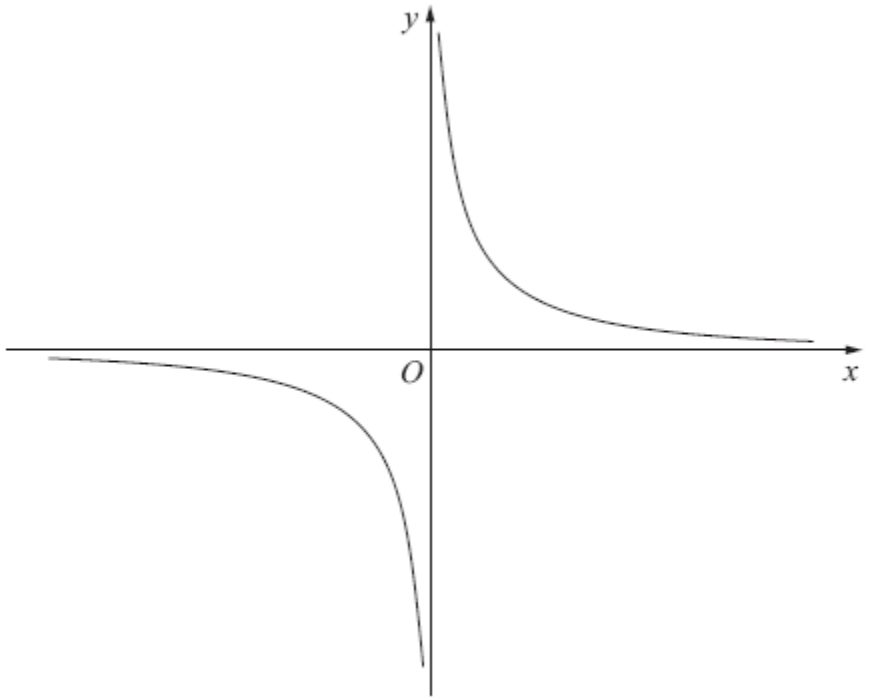


Figure 6

Figure 6 shows a sketch of the curve with equation $y = \frac{2}{x}$, $x \neq 0$.

The curve C has equation $y = \frac{2}{x} - 5$, $x \neq 0$, and the line l has equation $y = 4x + 2$.

(a) Sketch and clearly label the graphs of C and l on a single diagram.

On your diagram, show clearly the coordinates of the points where C and l cross the coordinate axes.

(5)

(b) Write down the equations of the asymptotes of the curve C.

(2)

(c) Find the coordinates of the points of intersection of $y = \frac{2}{x} - 5$ and $y = 4x + 2$.

(5)

(12 marks)

6. The curve C has equation $y = x(5 - x)$ and the line L has equation $2y = 5x + 4$.

(a) Use algebra to show that C and L do not intersect.

(4)

(b) Sketch C and L on the same diagram, showing the coordinates of the points at which C and L meet the axes.

(4)

(8 marks)

7.

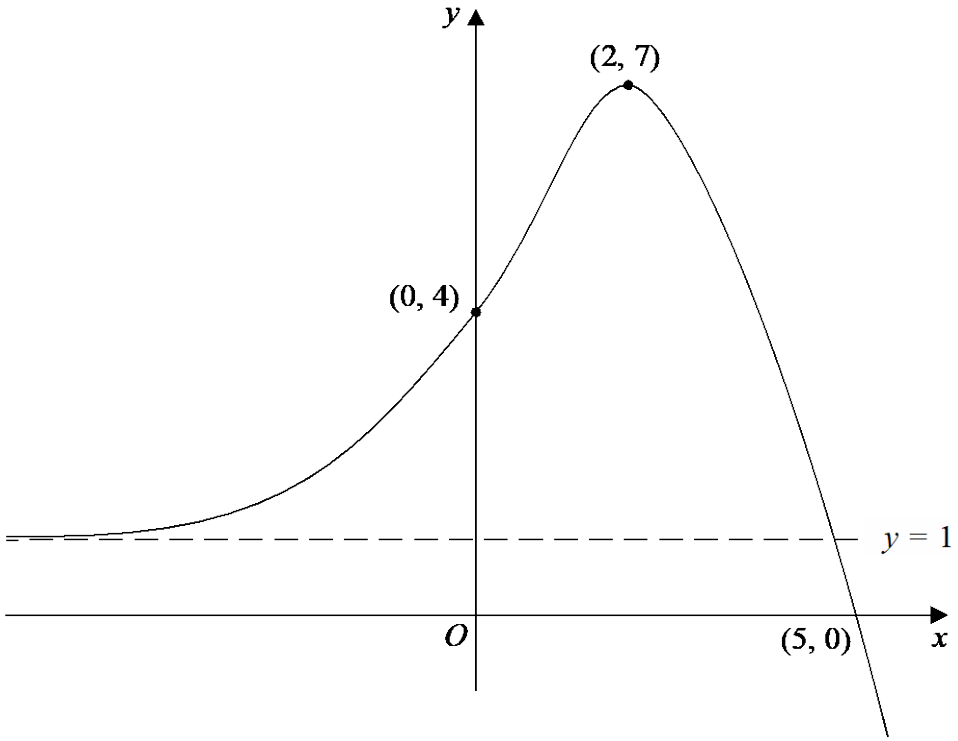


Figure 8

Figure 8 shows the sketch of a curve with equation $y = f(x)$, $x \in \mathbb{R}$.

The curve crosses the y-axis at (0, 4) and crosses the x-axis at (5, 0).

The curve has a single turning point, a maximum, at (2, 7).

The line with equation $y = 1$ is the only asymptote to the curve.

(a) State the coordinates of the turning point on the curve with equation $y = f(x - 2)$.

(1)

(b) State the solution of the equation $f(2x) = 0$

(1)

(c) State the equation of the asymptote to the curve with equation $y = f(-x)$.

(1)

Given that the line with equation $y = k$, where k is a constant, meets the curve
$y = f(x)$ at only one point,

(d) state the set of possible values for k.

(2)

(5 marks)

8.

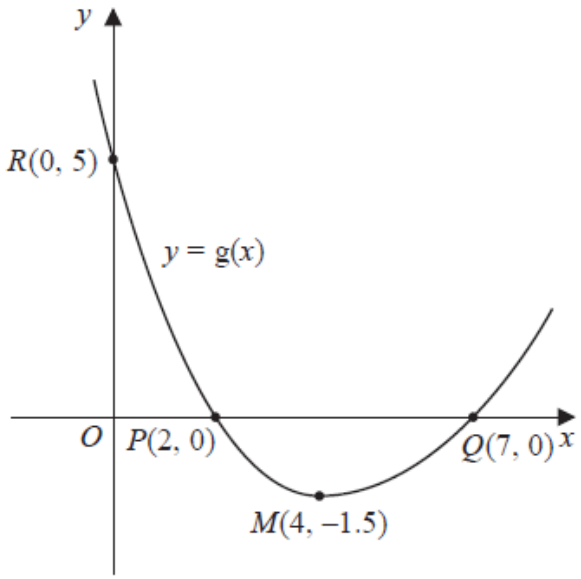


Figure 9

Figure 9 shows a sketch of the curve with equation $y = g(x)$.

The curve has a single turning point, a minimum, at the point $M(4, -1.5)$.

The curve crosses the x-axis at two points, $P(2, 0)$ and $Q(7, 0)$.

The curve crosses the y-axis at a single point $R(0, 5)$.

(a) State the coordinates of the turning point on the curve with equation $y = 2g(x)$.

(1)

(b) State the largest root of the equation $g(x + 1) = 0$.

(1)

(c) State the range of values of x for which $g'(x) \leq 0$.

(1)

Given that the equation $g(x) + k = 0$, where k is a constant, has no real roots,

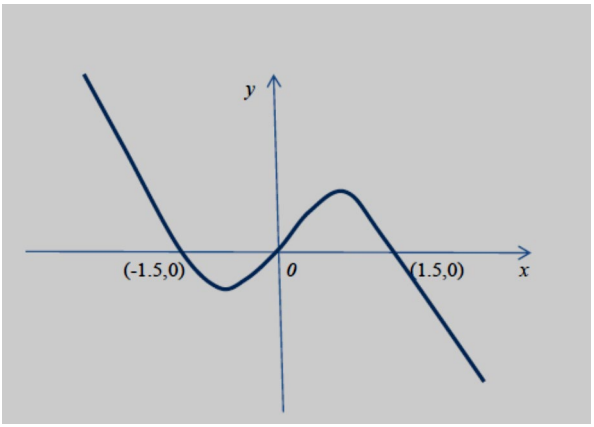
(d) state the range of possible values for k.

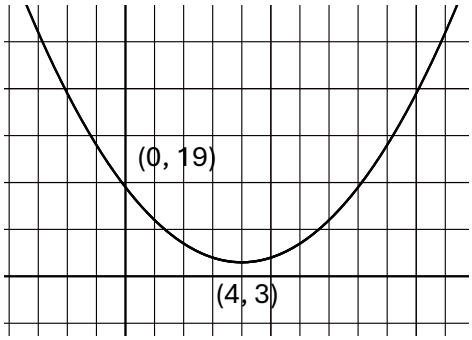
(1)

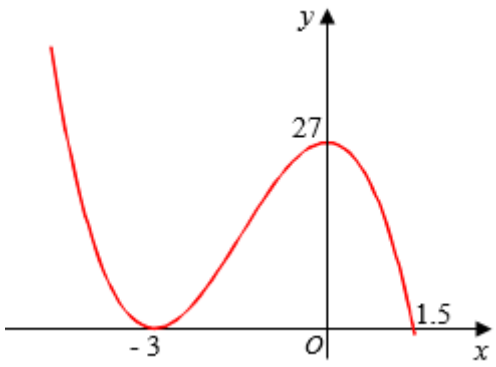
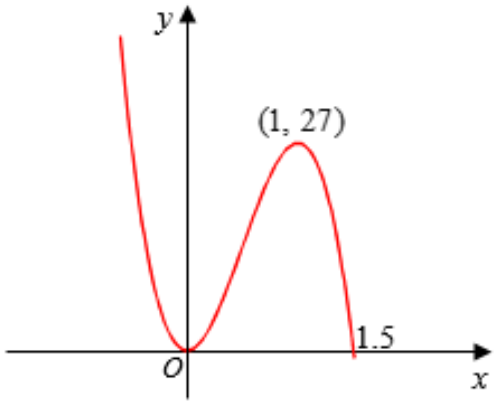
(4 marks)

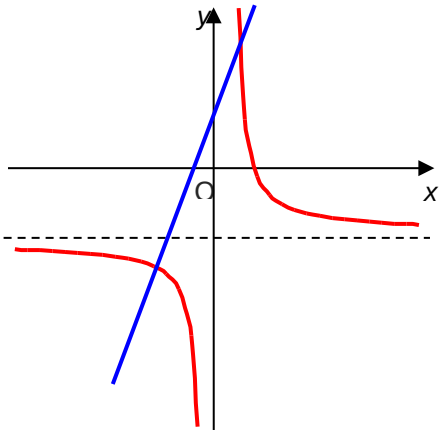
Chapter 4: Graphs and Transformations – Mark Scheme

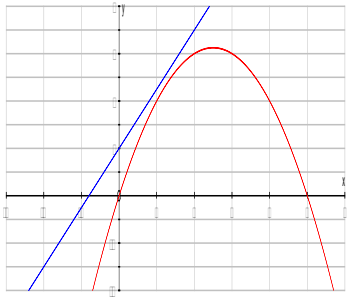
Question	Scheme		Marks
1(a)	For reflection in *x*-axis	Correct graph	M1
	For curve drawn with (−4, 0), (0, 0) and (−2, 3) labelled		A1
			(2)
(b)	for stretch in direction of *y*-axis	Correct graph	M1
	for curve drawn with (– 4, 0), (0, 0) and (–2, $-\frac{3}{2}$) labelled		A1
			(2)
			(4 marks)

Question	Scheme	Marks
2(a)	$9x-4x^3=x(9-4x^2)$ or $-x(4x^2-9)$	B1
	$9-4x^2=(3+2x)(3-2x)$ or $4x^2-9=(2x-3)(2x+3)$	M1
	$9x-4x^3=x(3+2x)(3-2x)$	A1
		(3)
(b)		M1 B1 A1
		(3)
(c)	$A=(-2,\ 14),\quad B=(1,\ 5)$	B1 B1
	$(AB=)\sqrt{(-2-1)^2+(14-5)^2}\ \left(=\sqrt{90}\right)$	M1
	$(AB=)3\sqrt{10}$ cao	A1
		(4)
		(10 marks)

Question	Scheme	Marks
3(a)	$f(x) = (x-4)^2 + 3$	M1A1
		(2)
(b)		B1 B1 B1
		(3)
(c)	$PQ^2 = (0-4)^2 + (19-3)^2$	M1
	$PQ = \sqrt{4^2 + 16^2}$	A1
	$PQ = 4\sqrt{17}$	A1
		(3)
		(8 marks)

Question	Scheme		Marks
4(a)	{Coordinates of *A* are} $(4.5, 0)$	See notes below	B1
			(1)
(b)(i)			
		Horizontal translation	M1
		-3 and their ft 1.5 on postitive *x*-axis	A1 ft
		Maximum at 27 marked on the *y*-axis	B1
			(3)
(ii)			
		Correct shape, minimum at $(0, 0)$ and a maximum within the first quadrant.	M1
		1.5 on *x*-axis	A1 ft
		Maximum at $(1, 27)$	B1
			(3)
(c)	$\{k =\}\ -17$		B1
			(1)
			(8 marks)

Question	Scheme		Marks
5(a)		$y = \frac{2}{x}$ is translated up or down.	M1
		$y = \frac{2}{x} - 5$ is in the correct position.	A1
		Intersection with *x*-axis at $\left(\frac{2}{5}, \{0\}\right)$ **only** Independent mark.	B1
		$y = 4x + 2$: attempt at straight line, with positive gradient with positive *y* intercept.	B1
	Check graph in question for possible answers and space below graph for answers to part (b)	Intersection with *x*-axis at $\left(-\frac{1}{2}, \{0\}\right)$ **and** *y*-axis at $\left(\{0\}, 2\right)$.	B1
			(5)
(b)	Asymptotes : $x = 0$ (or *y*-axis) and $y = -5$. (Lose second B mark for extra asymptotes)	An asymptote stated correctly. Independent of (a)	B1
		These two lines only. Not ft their graph.	B1
			(2)
(c)	Method 1: $\frac{2}{x} - 5 = 4x + 2$	Method 2: $\frac{y-2}{4} = \frac{2}{y+5}$	M1
	$4x^2 + 7x - 2 = 0 \Rightarrow x =$	$y^2 + 3y - 18 = 0 \rightarrow y =$	dM1
	$x = -2, \frac{1}{4}$	$y = -6, 3$	A1
	When $x = -2$, $y = -6$,When $x = \frac{1}{4}$, $y = 3$	When $y = -6$, $x = -2$ When $y = 3$, $x = \frac{1}{4}$.	M1A1
			(5)
			(12 marks)

Question	Scheme	Marks
6(a)	$x(5-x)=\frac{1}{2}(5x+4)$ (o.e.)	M1
	$2x^2-5x+4(=0)$ (o.e.) e.g. $x^2-2.5x+2(=0)$	A1
	$b^2-4ac=(-5)^2-4\times2\times4$	M1
	$=25-32$ <0, so no roots <u>or</u> no intersections <u>or</u> no solutions	A1
		(4)
(b)	 Curve: ∩ shape and passing through (0, 0) ∩ shape and passing through (5, 0) Line : +ve gradient and no intersections with *C*. If no *C* drawn score B0 Line passing through (0, 2) and $(-0.8, 0)$ marked on axes	
		(4)
		(8 marks)

Question	Scheme		Marks
7(a)	(4, 7)	Accept (4, 7) or $x = 4$, $y = 7$ or a sketch of $y = \mathrm{f}(x-2)$ with a maximum point marked at (4, 7). (Condone missing brackets) There should be no other coordinates.	B1
			(1)
(b)	(x =) 2.5	Allow (2.5, 0) (condone missing brackets) but no other values or points. Allow a sketch of f(2x) with the only x-intercept marked at x = 2.5 (Allow (0, 2.5) marked in the correct place.	B1
			(1)
(c)	$y = 1$ (oe e.g. $y - 1 = 0$)	Must be an equation and not just '1' and no other asymptotes stated.	B1
			(1)
(d)	$k \leq 1$ **or** $k = 7$	Either of $k \leq 1$ or $k = 7$ Accept either of $y \leq 1$ or $y = 7$ Note that k = 7 may sometimes be seen embedded in e.g. k = 0, 1, 7 and can score B1 here.	B1
	$k \leq 1 \quad k = 7$	Both correct and in terms of k with no other solutions.	B1
			(2)
			(5 marks)

Question	Scheme	Marks
8(a)	$(4,-3)$	B1
		(1)
(b)	$x=6$	B1
		(1)
(c)	x „ **4**	B1
		(1)
(d)	$k>1.5$	B1
		(1)
		(4 marks)

Chapter 9: Trigonometric Ratios

Calculators may be used to answer these questions

1.

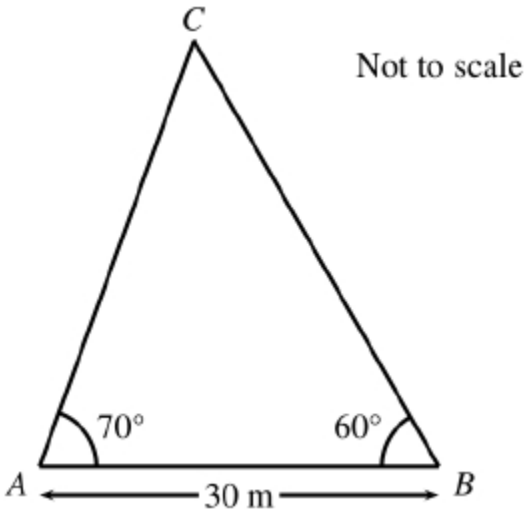


Figure 1

A triangular lawn is modelled by the triangle ABC, shown in Figure 1. The length AB is to be 30 m long.

Given that angle $BAC = 70°$ and angle $ABC = 60°$,

(a) calculate the area of the lawn to 3 significant figures.

(4)

(b) Why is your answer unlikely to be accurate to the nearest square metre?

(1)

(5 marks)

2.

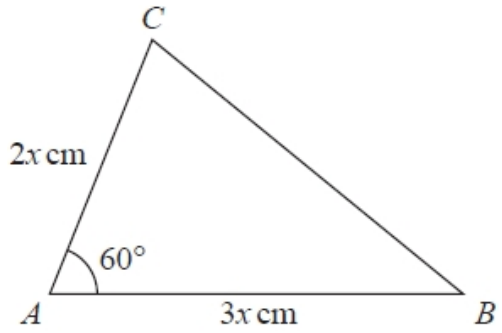


Figure 2

Figure 2 shows a sketch of a triangle ABC with $AB = 3x$ cm, $AC = 2x$ cm and angle $CAB = 60°$

Given that the area of triangle ABC is $18\sqrt{3}$ cm^2

(a) show that $x = 2\sqrt{3}$

(3)

(b) Hence find the exact length of BC, giving your answer as a simplified surd.

(3)

(6 marks)

3. *ABCD* is a quadrilateral.

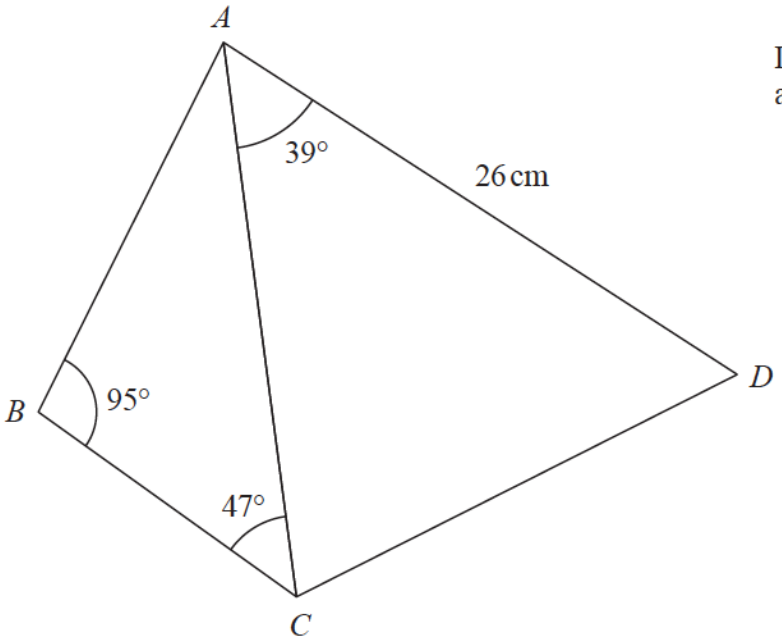


Diagram **NOT** accurately drawn

The area of triangle *ACD* is 250 cm^2

Calculate the area of the quadrilateral *ABCD*.

Show your working clearly.

Give your answer correct to 3 significant figures.

(6 marks)

4. Here is triangle ABC.

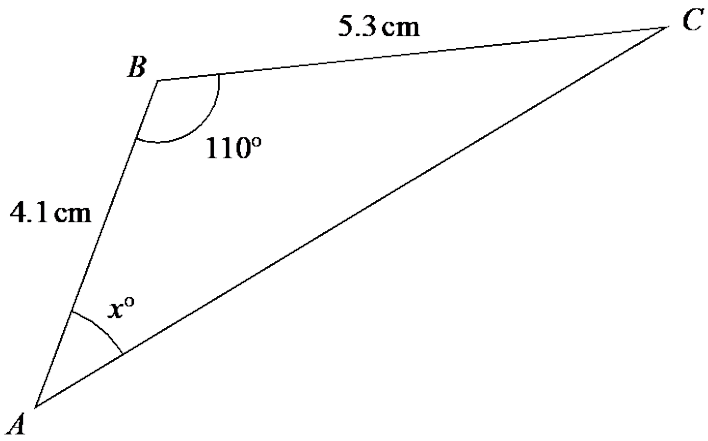


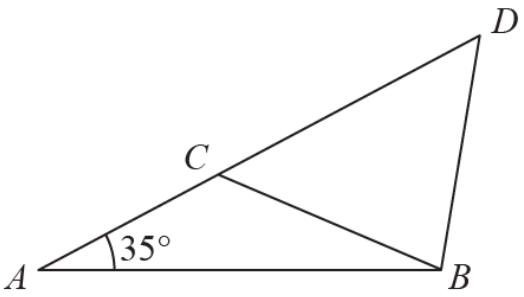
Diagram **NOT** accurately drawn

Calculate the value of x.

Give your answer correct to 3 significant figures.

(5 marks)

5.



Not to scale

Figure 3

Figure 3 shows the design for a structure used to support a roof.

The structure consists of four wooden beams, AB, BD, BC and AD.

Given $AB = 6.5$ m, $BC = BD = 4.7$ m and angle $BAC = 35°$

(a) find, to one decimal place, the size of angle ACB,

(3)

(b) find, to the nearest metre, the total length of wood required to make this structure.

(3)

(6 marks)

6. A parallelogram $ABCD$ has area 40 cm^2

Given that AB has length 10 cm, BC has length 6 cm and angle DAB is obtuse, find

(a) the size of angle DAB, in degrees, to 2 decimal places,

(3)

(b) the length of diagonal BD, in cm, to one decimal place.

(2)

(5 marks)

7.

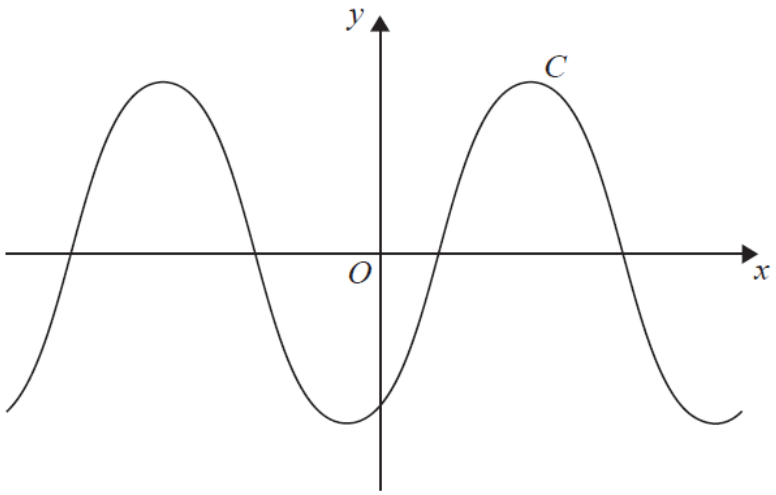


Figure 4

Figure 4 shows a sketch of the curve C with equation $y = \sin(x - 60°)$, $-360° \leq x \leq 360°$.

(a) Write down the exact coordinates of the points at which C meets the two coordinate axes.

(3)

(b) Solve, for $-360° \leq x \leq 360°$,

$$4\sin(x - 60°) = \sqrt{6} - \sqrt{2}$$

showing each stage of your working.

(5)

(8 marks)

Chapter 9: Trigonometric Ratios – Mark Scheme

Question	Scheme		Marks
1(a)	Finds third angle of triangle and uses or states $\frac{x}{\sin 60°} = \frac{30}{\sin "50°"}$	Finds third angle of triangle and uses or states Finds third angle of triangle and uses or states $\frac{y}{\sin 70°} = \frac{30}{\sin "50°"}$	M1
	So $x = \frac{30\sin 60°}{\sin 50°}$ $(= 33.9)$	So $y = \frac{30\sin 70°}{\sin 50°} (= 36.8)$	A1
	Area = $\frac{1}{2} \times 30 \times x \times \sin 70°$ or $\frac{1}{2} \times 30 \times y \times \sin 60$		M1
	= 478 m^2		A1 ft
			(4)
(b)	Plausible reason, e.g. Because the angles and the side length are not given to four significant figures Or e.g. The lawn may not be flat		B1
			(1)
			(5 marks)

Notes

(a) M1: Uses sine rule with third angle to find one of the unknown side lengths

A1: finds expression for, or value of either side length

M1: Completes method to find area of triangle

A1 ft: Obtains a correct answer for their value of x or their value of y.

(b) B1: As information given in the equation may not be accurate to 4sf or the lawn may not be flat so modelling by a plane figure may not be accurate.

Question	Scheme	Marks
2(a)	Uses $18\sqrt{3} = \frac{1}{2} \times 2x \times 3x \times \sin 60°$	M1
	Sight of $\sin 60° = \frac{\sqrt{3}}{2}$ and proceeds to $x^2 = k$ oe	M1
	$x = \sqrt{12} = 2\sqrt{3}$ *	A1*
		(3)
(b)	Uses $BC^2 = \left(6\sqrt{3}\right)^2 + \left(4\sqrt{3}\right)^2 - 2 \times 6\sqrt{3} \times 4\sqrt{3} \times \cos 60°$	M1
	$BC^2 = 84$	A1
	$BC = 2\sqrt{21}$ (cm)	A1
		(3)
		(6 marks)

Notes

(a)

M1: Attempts to use the formula $A = \frac{1}{2}ab\sin C$.

If the candidate writes $18\sqrt{3} = \frac{1}{2} \times 5x \times \sin 60°$ **without** sight of a previous correct line then this would be M0

M1: Sight of $\sin 60° = \frac{\sqrt{3}}{2}$ or awrt 0.866 and proceeds to $x^2 = k$ oe such as $px^2 = q$

This may be awarded from the correct formula or $A = ab\sin C$

A1*: Look for $x^2 = 12 \Rightarrow x = 2\sqrt{3}$, $x^2 = 4 \times 3 \Rightarrow x = 2\sqrt{3}$ or $x = \sqrt{12} = 2\sqrt{3}$

This is a given answer and all aspects must be correct including one of the above intermediate lines. It cannot be scored by using decimal equivalents to $\sqrt{3}$

Alternative using the given answer of $x = 2\sqrt{3}$

M1: Attempts to use the formula $A = \frac{1}{2} \times 4\sqrt{3} \times 6\sqrt{3} \sin 60°$ oe

M1: Sight of $\sin 60° = \frac{\sqrt{3}}{2}$ and proceeds to $A = 18\sqrt{3}$

A1*: Concludes that $x = 2\sqrt{3}$

(b)

M1: Attempts the cosine rule with the sides in the correct position.

This can be scored from $BC^2 = (3x)^2 + (2x)^2 - 2\times 3x \times 2x \times \cos 60°$ as long as there is some attempt to substitute *x* in later. Condone slips on the squaring

A1: $BC^2 = 84$ Accept $BC^2 = 7\times 12$, $BC = \sqrt{84}$ or $BC = 2\sqrt{21}$

If they replace the surds with decimals they can score the A1 for $BC^2 = \text{awrt } 84.0$

A1: $BC = 2\sqrt{21}$

Condone other variables, say $x = 2\sqrt{21}$, but it cannot be scored via decimals.

Question	Scheme	Marks
3	250 = 0.5 × 26 × *AC* × sin(39) oe	M1
	(*AC*=) 30.5(5579...) or 30.6	A1
	$\frac{(AB)}{\sin 47} = \frac{'30.56'}{\sin 95}$ oe **or** $\frac{(BC)}{\sin(180-95-47)} = \frac{'30.56'}{\sin 95}$ oe	M1
	$(AB =)\frac{'30.56'}{\sin 95} \times \sin 47$ (= 22.4(3407...)) **or** $(BC =)\frac{'30.56'}{\sin 95} \times \sin(180-95-47)$ (= 18.8(8524...))	M1
	250 + 0.5 × '30.56' × '22.43' × sin(180 – 95 – 47) (= 461.03....) **or** 250 + 0.5 × '30.56' × '18.88' × sin(47) (= 461.03....)	M1
	461	A1
		(6 marks)

Notes

M1 for using the area formula correctly. If this mark is awarded then ft on the remaining M marks

M1 dep on M1 for correct substitution into sine rule

M1 (dep on previous M marks) for a correct method to find a missing length or sight of values in the ranges

22.39 – 22.47 for AB

18.8 – 18.92 for BC

M1 for a complete method to find total area

A1 accept 461 - 462

Question	Scheme	Marks
4	(AC^2 =) $4.1^2 + 5.3^2 - 2\times 4.1\times 5.3\times\cos(110)$	M1
	(AC =) $\sqrt{16.81 + 28.09 + 14.8(641...)}$ or $\sqrt{59.7(641...)}$ or 7.7(3073) **or** AC^2 = 59.7...	M1
	Eg $\frac{\sin x}{5.3} = \frac{\sin 110}{"7.7"}$ **or** $\frac{5.3}{\sin x} = \frac{"7.7"}{\sin 110}$ **or** $5.3^2 = 4.1^2 + "7.7"^2 - 2\times 4.1\times "7.7"\times\cos x$ oe	M1
	Eg $\sin x = \frac{\sin 110}{"7.7"}\times 5.3$ (= 0.644(2...)) **or** $\cos x = \frac{4.1^2 + "7.7"^2 - 5.3^2}{2\times 4.1\times "7.7"}$ (= 0.764(83...) (= 22.4(3407...)) **or** $(BC =)\frac{'30.56'}{\sin 95}\times\sin(180-95-47)$ (= 18.8(8524...))	M1
	40.1	A1
		(6 marks)

Notes

M1 for the correct use of Cosine rule to find AC

M1 NB: there must be evidence of correct order of operations for this mark to be awarded

M1dep on first M1

for correct use of sine rule or cosine rule ft for their value of AC or AC2

M1for isolating sinx or cosx

A1for 40.1 – 40.11

Question	Scheme	Marks
5(a)	Attempts $\frac{\sin\angle ACB}{6.5}=\frac{\sin 35}{4.7}$	M1
	$\angle ACB=\text{awrt}(52 \text{ or } 53)^\circ \quad \text{or} \quad \text{awrt}(127 \text{or} 128)^\circ$	A1
	$\angle ACB=127.5^\circ$	A1
		(3)
(b)	Eg $\frac{(AC)}{\sin"17.5°"}=\frac{6.5}{\sin"127.5°"}$ or $=\frac{4.7}{\sin 35^\circ}$	M1
	$\left[\frac{(CD)}{\sin"75°"}=\frac{4.7}{\sin"127.5°"}\Rightarrow(CD)=...\Rightarrow(AC)+(CD)\right]$=awrt 8.2	A1
	Total length of wood $=8.1+6.5+4.7+4.7=\text{awrt}24.1$	A1
		(3)
		(6 marks)
Alt1(a)	$\cos 35=\frac{AC^2+6.5^2-4.7^2}{2\times 6.5\times AC}\Rightarrow AC^2-13\cos(35)AC+20.16=0\Rightarrow AC=...$ $\cos\angle ACB=\frac{"AC"^2+4.7^2-6.5^2}{2\times"AC"\times 4.7}$ oe	M1

Question	Scheme	Marks
6 (a)	Area *ABCD* is 40 cm^2 $\Rightarrow 40 = 6\times 10\sin\theta$ oe	M1
	$\sin\theta = \frac{2}{3} \Rightarrow \theta = 180° - 41.8°$	M1
	$\angle DAB = \text{awrt } 138.19°$	A1
		(3)
(b)	Attempts $DB^2 = 10^2 + 6^2 - 2\times 10\times 6\cos"138.19°"$	M1
	$DB = \text{awrt } 15.0$ (cm)	A1
		(2)
		(5 marks)

Notes

(a)

M1 Scored for a correct attempt at using the area of *ABCD* is 40 cm^2

Score for $40 = 6\times 10\times \sin\theta$ or $20 = \frac{1}{2}\times 6\times 10\times \sin\theta$ where θ is one of the corner angles.

M1 Score for $\sin\theta = k \Rightarrow \theta = 180° - \arcsin k$

A1 $\angle DAB = \text{awrt } 138.19°$

(b)

M1 Attempts $DB^2 = 10^2 + 6^2 - 2\times 10\times 6\cos"138.19°"$ - allow if the angle used is acute as long as it is clearly their attempt at angle *DAB*. So allow use of $41.8°$ unless they have correctly found angle *DAB* and chosen the wrong one here.

A1 $DB = \text{awrt } 15.0$ (cm) Accept 15 in place of 15.0. Allow from attempts using awrt 138°

.....

Alt for (a)

M1 Area *ABCD* is 40 cm^2 $\Rightarrow h = \frac{40}{10} = ... \Rightarrow \sin\angle ABC = \frac{"4"}{6}$ OR $\cos\angle ABC = \frac{"4"}{6}$ oe

Essentially this mark is for using the area together with an appropriate trig identity to form an equation in the sine or cosine of one of the angles of the parallelogram. Attempts finding "*DX*" where *X* is where the perpendicular to *DC* through *A* meets *DC* are possible.

Question	Scheme	Marks
M1	$\angle DAB = 180° - \arcsin\left(\frac{"4"}{6}\right) = ...$ or may see $\angle DAB = 90° + \arccos\left(\frac{"4"}{6}\right) = ...$ This is for a complete correct method to find the angle *DAB*	
A1	$\theta =$ awrt $138.19°$	

Question	Scheme	Marks
7(a)	$\left(0, -\frac{\sqrt{3}}{2}\right)$	B1
	and (60°, 0) and (240°, 0) and (-120°, 0) and (-300°, 0)	B1 B1
		(3)
(b)	$\sin(x - 60^\circ) = \frac{\sqrt{6} - \sqrt{2}}{4}$ (= .2588)	M1
	x – 60° = 15° (or 165° or – 195° or – 345°) or 0.262 or $\frac{\pi}{12}$ radians	A1
	So x = 75° or 225° or – 135° or –285° (allow awrt)	M1 A1 A1
		(5)
		8 marks

Notes

(a) **B1** : Correct exact *y* intercept (not decimal) – allow on the diagram or in the text. Allow $y = -\frac{\sqrt{3}}{2}$

B1 for 2 correct *x* intercepts then **third B1** for all 4 correct *x* intercepts (may or may not be given as coordinates – may be given on graph) Must be in degrees. (Extra answers in the range lose the **third B1**)

(b) **M1**: Divides by 4 first giving correct statement $\sin(x - 60^\circ) = \frac{\sqrt{6} - \sqrt{2}}{4}$ but

$(x - 60^\circ) = \frac{\sqrt{6} - \sqrt{2}}{4}$ **is M0 and** $\sin x - \sin 60^\circ = \frac{\sqrt{6} - \sqrt{2}}{4}$ **is also M0 and** $\sin(x - 60^\circ) = \frac{\sqrt{4}}{4}$

is M0 if not preceded by correct statement

A1: Obtains 15° (or 165° or – 195° or – 345°)

M1: Adds 60° to their previous answer which should have been in degrees and obtained by using inverse sine

A1: Two correct answers second **A1:** All four correct answers Extra answers outside range are ignored. Lose final A mark for extra wrong answers in the range.

If they approximate too early allow awrt answers given for full marks. (e.g. 75.01 etc)

Answers in mixture, degrees and radians: Allow first M A1 only so M1A1M0A0A0 for 60.262 for example

QR Codes and Tiny URLs

The following QR Codes and Tiny URLs will take you to the videos that explain individual concepts from chapters 1, 2, 3, 4 and 9 of the textbook.

Chapter 1 – Algebraic Expressions

View Chapter Page

- Index Laws: https://youtu.be/6yZjc0b4EpY

- Simplifying Expressions: https://youtu.be/ug2WBa6LJFE

- Simplifying Fractions: https://youtu.be/Vh6NNYHsLmE

- Expanding Double Brackets: https://youtu.be/-h9ekx4zJkg

- Expanding Trinomials: https://youtu.be/AkaxXHLXN-w

- Factorising Quadratics: https://youtu.be/1sAOcQwNxRw

- Simplifying Indices: https://youtu.be/K_e_gUq445c

- Fractional Indices: https://youtu.be/sDDPE2y-VIg

- Indices – Problem Solving: https://youtu.be/Rv7dDQcjHHQ

- Simplifying Surds: https://youtu.be/NVlmUcn_kkg

- Expanding Brackets and Surds: https://youtu.be/87gzPqaHHXQ

- Rationalising the Denominator: https://youtu.be/5TxRft07OEk

Chapter 2 – Quadratic Equations

View Chapter Page

- Factorising Quadratics: https://youtu.be/6FJGGX4lo6I

- Using the Quadratic Formula: https://youtu.be/0jldmApcakU

- Completing the Square (Basic): https://youtu.be/mZmZOYxvpRE

- Completing the Square (Advanced): https://youtu.be/37F3joTkPcQ

- Solving Quadratics (Mixed): https://youtu.be/_IzS-1bx3kA

- Function Substitution: https://youtu.be/XWqSxaesAF4

- Finding Roots from Graphs: https://youtu.be/YbQ2Ca1jpVk

- Sketching Quadratic Graphs: https://youtu.be/ryNodjOq2Y4

- Using the Discriminant: https://youtu.be/UcBulm9YdEI

- Applications of Quadratics: https://youtu.be/-8jDjtMB-3Y

- Modelling with Quadratics: https://youtu.be/26zaRd8s2zQ

- Interpreting Graphs: https://youtu.be/duMwNAoDe4Y

- Using Functions in Context: https://youtu.be/wvi31ZPIcjg

- Problem Solving with Roots: https://youtu.be/62mBZmr47MI

- Advanced Quadratic Forms: https://youtu.be/_ldnyp0ksy0

Chapter 3 – Equations and Inequalities

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- Example 1 – Equations and Inequalities: https://youtu.be/00mgRP3LGB8

- Example 2 – Equations and Inequalities: https://youtu.be/KX5GRuDyPQs

- Example 3 – Equations and Inequalities: https://youtu.be/t-NS82wVhbA

- Example 4 – Equations and Inequalities: https://youtu.be/UbW-SLrMwy0

- Example 5 – Equations and Inequalities: https://youtu.be/r4pSTxEvB5M

- Example 6 – Equations and Inequalities: https://youtu.be/KHC1vEcfsmE

- Example 7 – Equations and Inequalities: https://youtu.be/NUbUh4hXbXc

- Example 8 – Equations and Inequalities: https://youtu.be/HJDWOrGwL3s

- Example 9 – Equations and Inequalities: https://youtu.be/_y83Iv9Qk4I

- Example 10 – Equations and Inequalities: https://youtu.be/xWWzdCRb9VQ

- Example 11 – Equations and Inequalities: https://youtu.be/Fzn9ul7N9BM

- Example 12 – Equations and Inequalities: https://youtu.be/NDSm276qvJg

- Example 13 – Equations and Inequalities: https://youtu.be/2rWhTCmiY4w

- Example 14 – Equations and Inequalities: https://youtu.be/XImvhDtZQlk

- Example 15 – Equations and Inequalities: https://youtu.be/BWVKaFXKVAQ

Chapter 4 – Graphs and Transformations

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- Example 1 – Graph Transformations: https://youtu.be/iQjErIGlDzI

- Example 2 – Graph Transformations: https://youtu.be/KLRoTTmLkrw

- Example 3 – Graph Transformations: https://youtu.be/NohDQMHcQ-s

- Example 4 – Graph Transformations: https://youtu.be/ooFCh5nfFI0

- Example 5 – Graph Transformations: https://youtu.be/et602wehDBk

- Example 6 – Graph Transformations: https://youtu.be/zfZNn4ZuwfU

- Example 7 – Graph Transformations: https://youtu.be/4rD29r3-f90

- Example 8 – Graph Transformations: https://youtu.be/DnrRqa9KEJE

- Example 9 – Graph Transformations: https://youtu.be/r9i3rOuhRcs

- Example 10 – Graph Transformations: https://youtu.be/Ydmy_2rKt1w

- Example 11 – Graph Transformations: https://youtu.be/NSkWe7FYTgg

- Example 12 – Graph Transformations: https://youtu.be/5RYAglug_QU

- Example 13 – Graph Transformations: https://youtu.be/V7hr-foR4mQ

- Example 14 – Graph Transformations: https://youtu.be/ihgNWIFFeXk

- Example 15 – Graph Transformations: https://youtu.be/mdjUo6_ubRg

Chapter 5 – Straight Line Graphs

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- Example 1 – Straight Line Graphs: https://youtu.be/xcIqC56pfds

- Example 2 – Straight Line Graphs: https://youtu.be/Ze9cGzbc4Dl

- Example 3 – Straight Line Graphs: https://youtu.be/wcB9eV5pqeM

- Example 4 – Straight Line Graphs: https://youtu.be/xyZRRoNr_bc

- Example 5 – Straight Line Graphs: https://youtu.be/8XzFDZx910U

- Example 6 – Straight Line Graphs: https://youtu.be/ONmlY4aJKz4

- Example 7 – Straight Line Graphs: https://youtu.be/7KUvMU50qcw

- Example 8 – Straight Line Graphs: https://youtu.be/fGvDR3zUxAI

- Example 9 – Straight Line Graphs: https://youtu.be/uRowrcu_Zio

- Example 10 – Straight Line Graphs: https://youtu.be/9H5dCwxeo7Y

- Example 11 – Straight Line Graphs: https://youtu.be/RTYqG7ZsW7I

- Example 12 – Straight Line Graphs: https://youtu.be/9yM3JGR0930

- Example 13 – Straight Line Graphs: https://youtu.be/_PAFV5CVcm0

- Example 14 – Straight Line Graphs: https://youtu.be/DbUeLkFGmjk

- Example 15 – Straight Line Graphs: https://youtu.be/VlfUCUXhMO0

- Example 16 – Straight Line Graphs: https://youtu.be/nD1zyNZPa2o

- Example 17 – Straight Line Graphs: https://youtu.be/11j8TspZKfk

Chapter 9 – Trigonometric Expressions

View Chapter Page

- Example 1 – Trigonometric Expressions: https://youtu.be/HWrRpxTTO4E

- Example 2 – Trigonometric Expressions: https://youtu.be/ly-zgiwHiFc

- Example 3 – Trigonometric Expressions: https://youtu.be/Rh3SjwzfSoc

- Example 4 – Trigonometric Expressions: https://youtu.be/9Y6yLdmzxM8

- Example 5 – Trigonometric Expressions: https://youtu.be/W_cAVr344rc

- Example 6 – Trigonometric Expressions: https://youtu.be/YA9CYdZVZqQ

- Example 7 – Trigonometric Expressions: https://youtu.be/xGY5pJTLWJA

- Example 8 – Trigonometric Expressions: https://youtu.be/AvoC_jySMWU

- Example 9 – Trigonometric Expressions: https://youtu.be/-bXNDJz6_WY

- Example 10 – Trigonometric Expressions: https://youtu.be/uLS-RIh6HVI

- Example 11 – Trigonometric Expressions: https://youtu.be/wxlnZBaUmi4

- Example 12 – Trigonometric Expressions: https://youtu.be/QtOJTyHCmHY

- Example 13 – Trigonometric Expressions: https://youtu.be/kTZeT9ZafNE

- Example 14 – Trigonometric Expressions: https://youtu.be/rUhOlnoO82A

- Example 15 – Trigonometric Expressions: https://youtu.be/wDxr-Z1HMGg

Edexcel Level 3 Algebra Paper – January 2020

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Award

Centre Number	Candidate Number

Thursday 9 January 2020

Morning (Time: 2 hours)	Paper Reference **AAL30/01**

Algebra

Level 3
Calculator NOT allowed

You must have: Ruler graduated in centimetres and millimetres, pair of compasses, pen, HB pencil, eraser.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- **Calculators are not allowed.**

Information

- The total mark for this paper is 90
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P63045RA

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1/1/1/1/1/1/

P 6 3 0 4 5 R A 0 1 2 4

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

You must NOT use a calculator.

1 (a) Expand and simplify $(x - y)(x + 2y)$

.....

(2)

(b) Factorise $12u^2t^2 + 18ut^3$

.....

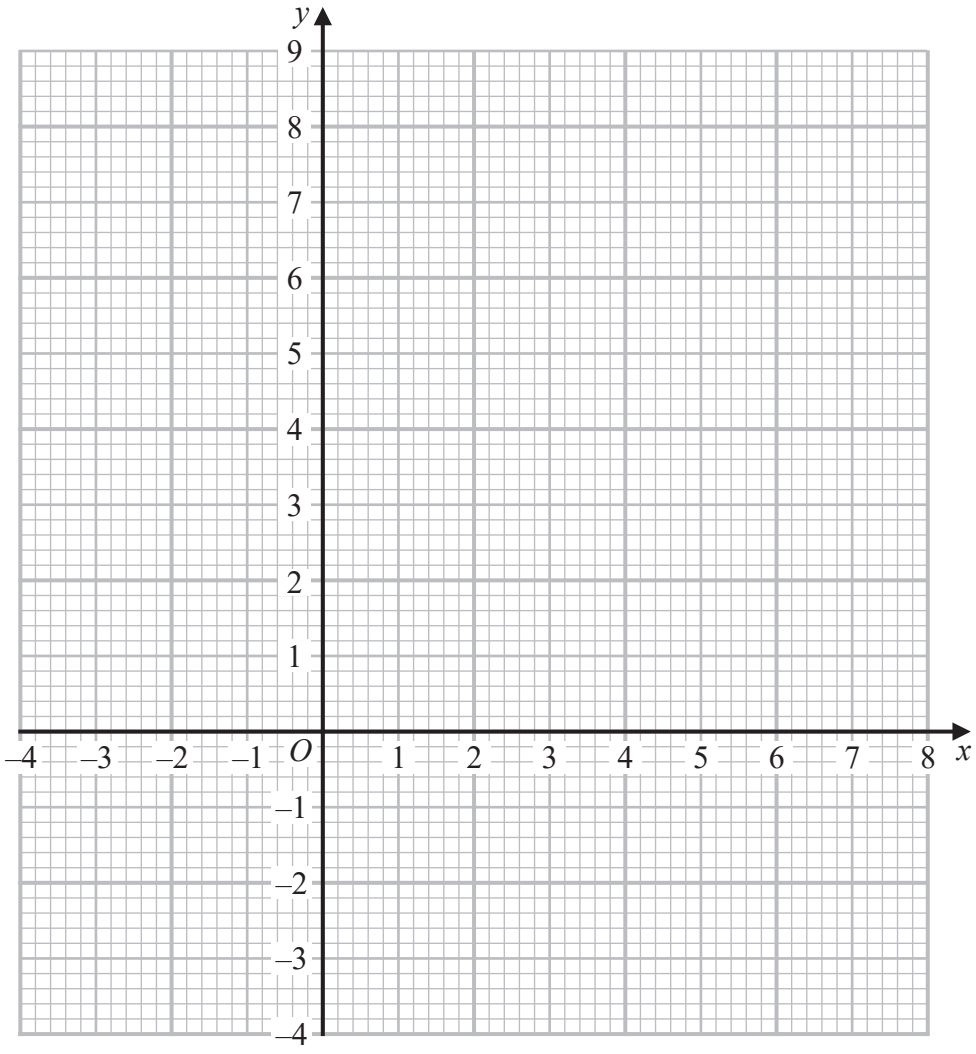
(2)

(Total for Question 1 is 4 marks)

2 (a) On the grid, shade the region that satisfies all these inequalities.

$$x < 3 \qquad y - x < 5 \qquad 7x + 5y > 35$$

Label the region **R**



(5)

(b) Write down the coordinates of each of the points, with integer coordinates, that satisfy

$$x < 3 \qquad y - x < 5 \qquad 7x + 5y > 35$$

.....

(1)

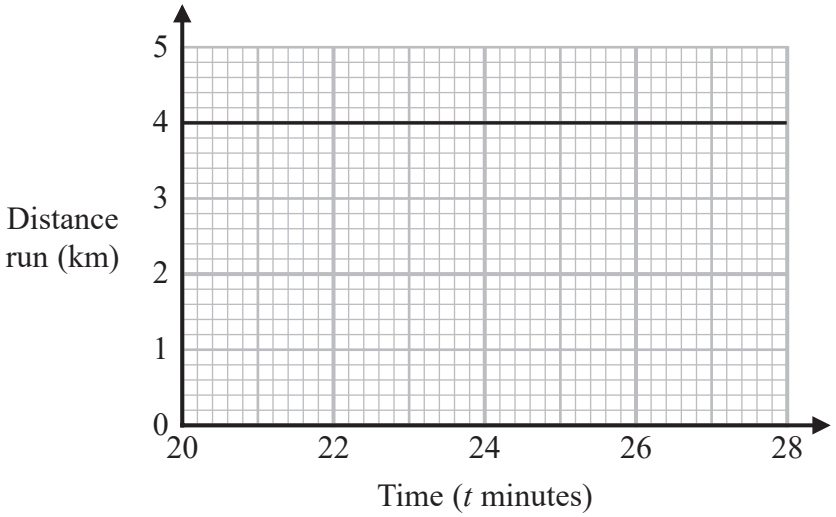
(Total for Question 2 is 6 marks)

3 Solve $3k^2 - 27 \geqslant 0$

.....

(Total for Question 3 is 2 marks)

4 John went for a run.
Here is part of his distance-time graph.



What does this graph show about John's speed for values of t between $t = 20$ and $t = 28$?

.....

(Total for Question 4 is 1 mark)

5 Here is a quadratic equation.

$$3x^2 - 7x + 5 = 0$$

(a) (i) Calculate the discriminant of this equation.

.....

(2)

(ii) State what your answer tells you about the roots of the equation $3x^2 - 7x + 5 = 0$

(1)

(b) Find the sum and the product of the roots of the equation $10x^2 = 3 - 5x$

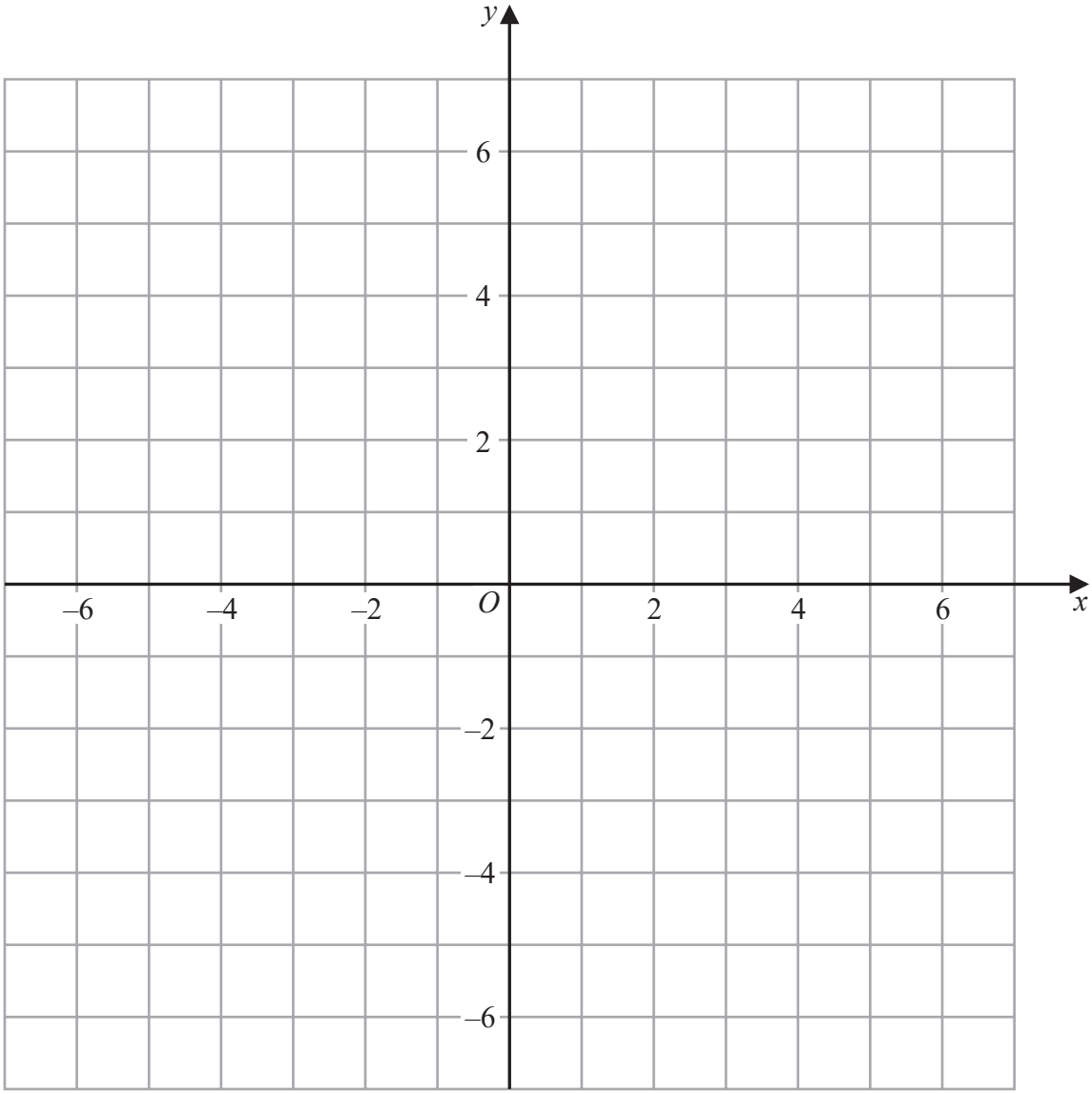
sum = ...

product = ...

(3)

(Total for Question 5 is 6 marks)

6 On the grid of centimetre squares, construct the locus of points that are 4 cm from the point (–2, 1)



(Total for Question 6 is 2 marks)

7 (a) Simplify $(p^{-2})^{-4}$

.....

(1)

(b) Simplify $(16t^2)^{\frac{3}{2}}$

.....

(2)

(c) Simplify fully $\dfrac{x^2 - 9}{(x-3)^2(x+3)^2}$

.....

(2)

(Total for Question 7 is 5 marks)

8 The straight line $\mathbf{L}_1$ has equation $y = \frac{1}{2}x - 1$

(a) Write the equation of $\mathbf{L}_1$ in the form $ax + by = c$ where a, b and c are integers.

.....

(1)

The straight line $\mathbf{L}_2$ is parallel to $\mathbf{L}_1$ and passes through the point with coordinates (–2, –6)

(b) Find an equation for $\mathbf{L}_2$ in the form $y = mx + c$

.....

(3)

(Total for Question 8 is 4 marks)

9 $t = \dfrac{n}{5 - 2n}$

(a) Find the value of t when $n = \dfrac{1}{2}$

.....

(1)

(b) Find the value of t when $n = \sqrt{5}$
Give your answer in the form $c + \sqrt{d}$ where c and d are integers.

.....

(4)

(c) Make n the subject of the formula $t = \dfrac{n}{5 - 2n}$

.....

(3)

(Total for Question 9 is 8 marks)

10 (a) (i) Write the equation $\frac{x^2}{2} = \frac{x}{3} + \frac{1}{4}$ in the form $ax^2 + bx + c = 0$ where a, b, and c are integers.

.....

(1)

(ii) Hence use the quadratic formula to solve the equation $\frac{x^2}{2} = \frac{x}{3} + \frac{1}{4}$

Give your answer in the form $\frac{p \pm \sqrt{q}}{6}$ where p and q are integers.

.....

(3)

(b) Solve the equation $(x + 3)^2 = (x + 3)$

.....

(3)

(c) Write the quadratic expression $x^2 - 8x + 3$ in the form $(x + m)^2 + n$ where m and n are integers.

.....

(2)

(Total for Question 10 is 9 marks)

11 Here are the first five terms of an arithmetic series.

25 35 45 55 65

(a) Find the sum of the first 120 terms of this series.

.....

(2)

The pth term of this series is the first term to be greater than 1000

(b) Find the value of p.

.....

(3)

(Total for Question 11 is 5 marks)

12 The equation of the straight line **L** is $4x + 3y + 2 = 0$

(a) Find the gradient of **L**

.....

(2)

The straight line **L** is the normal to a curve at the point $A(1, -2)$

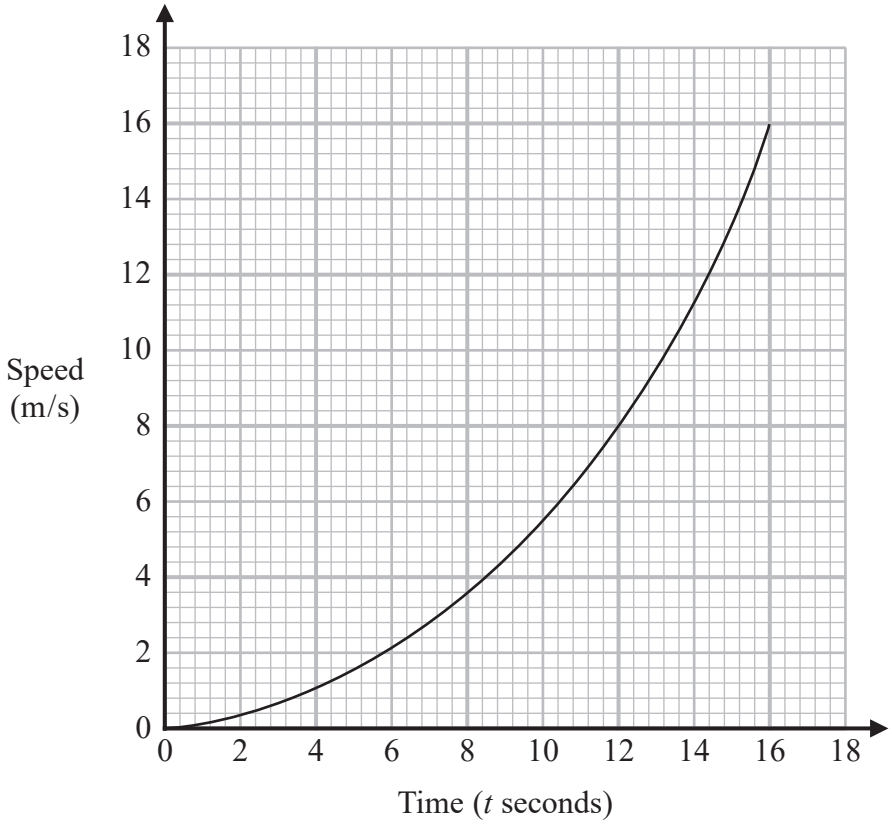
(b) Find an equation of the tangent to this curve at A.
Give your answer in the form $px + qy + r = 0$ where p, q and r are integers.

.....

(3)

(Total for Question 12 is 5 marks)

13 Here is a speed-time graph for a particle moving in a straight line.



(a) (i) Use the trapezium rule to find an estimate for the area of the region under the curve between $t = 0$, $t = 16$ and the time axis.
Use 4 strips of equal width.

.....

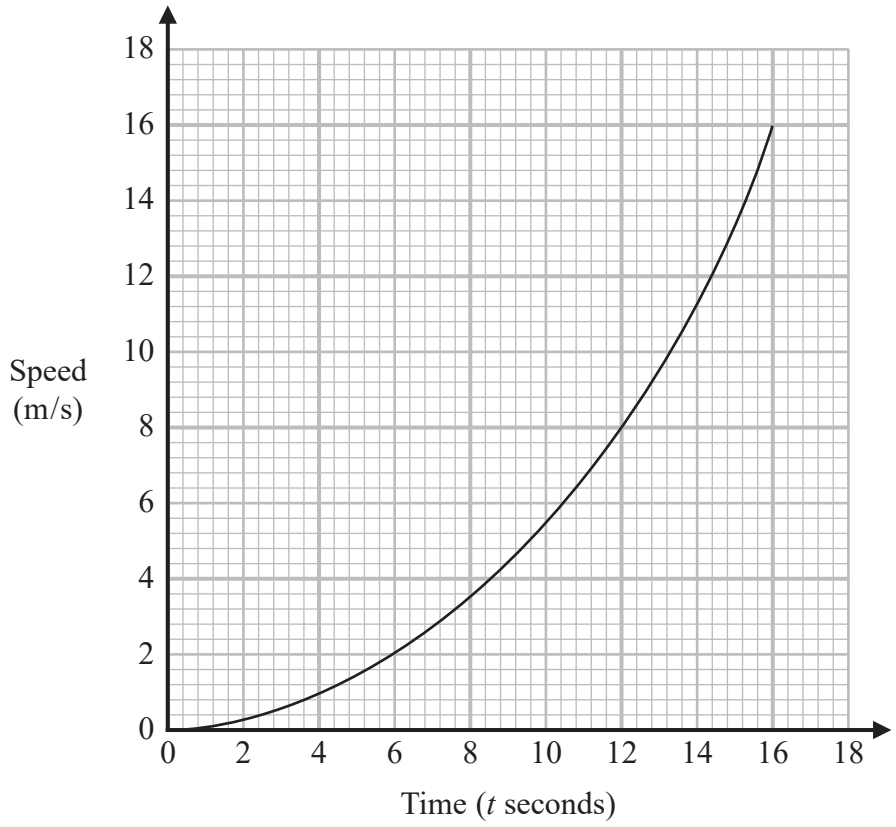
(3)

(ii) What does this area represent?

.....

.....

(1)



(b) (i) On the grid above, draw the tangent to the curve at $t = 12$

(1)

(ii) Calculate the gradient of this tangent.

.....

(2)

(c) What does the gradient of the curve at the point where $t = 12$ represent?

.....

.....

(1)

(Total for Question 13 is 8 marks)

14 (a) Simplify $\frac{1}{\sqrt{2}} + \frac{1}{\left(\sqrt{2}\right)^3} + \frac{1}{\left(\sqrt{2}\right)^5}$

Give your answer in the form $\frac{a}{b\sqrt{c}}$ where a, b and c are integers.

.....

(3)

(b) Simplify $\frac{\sqrt{20} + \sqrt{5}}{\sqrt{20} - \sqrt{5}}$

.....

(3)

(Total for Question 14 is 6 marks)

15 r is proportional to the cube root of v.

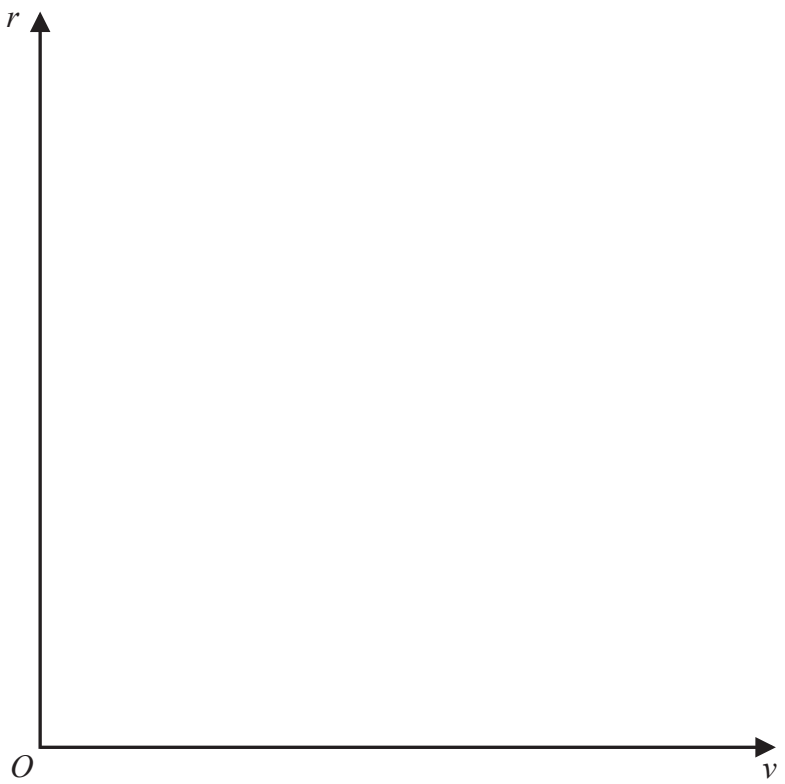
$r = 15$ when $v = 27$

(a) Find a formula for r in terms of v.

.....

(3)

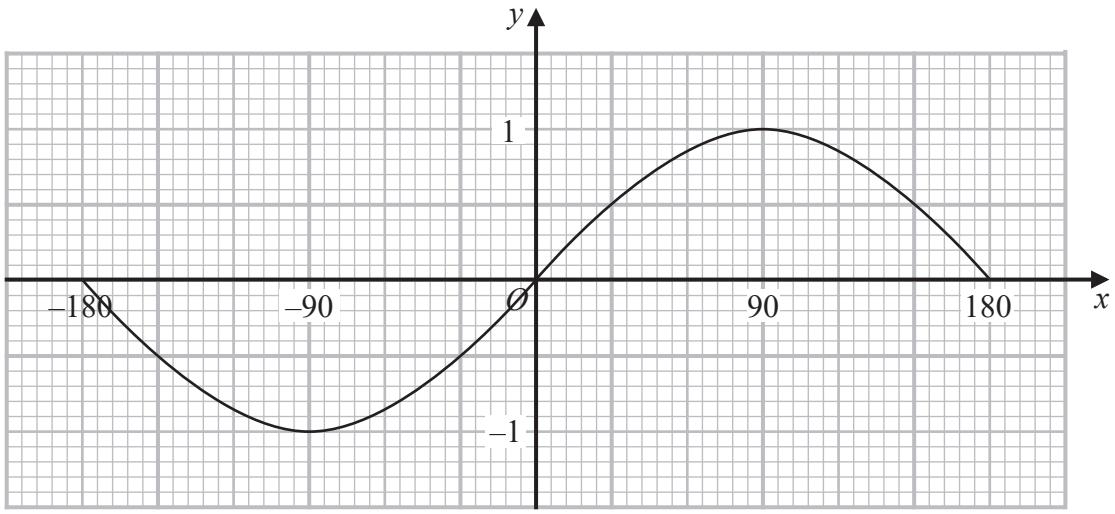
(b) Sketch the graph of r against v for $v \geqslant 0$



(1)

(Total for Question 15 is 4 marks)

16 Here is the graph of $y = \sin x°$ for $-180 \leqslant x \leqslant 180$



(a) Use the graph above to find an estimate for each of the solutions of the equation

$$5 \sin x° = 2 \quad \text{for } -180 \leqslant x \leqslant 180$$

.....

(2)

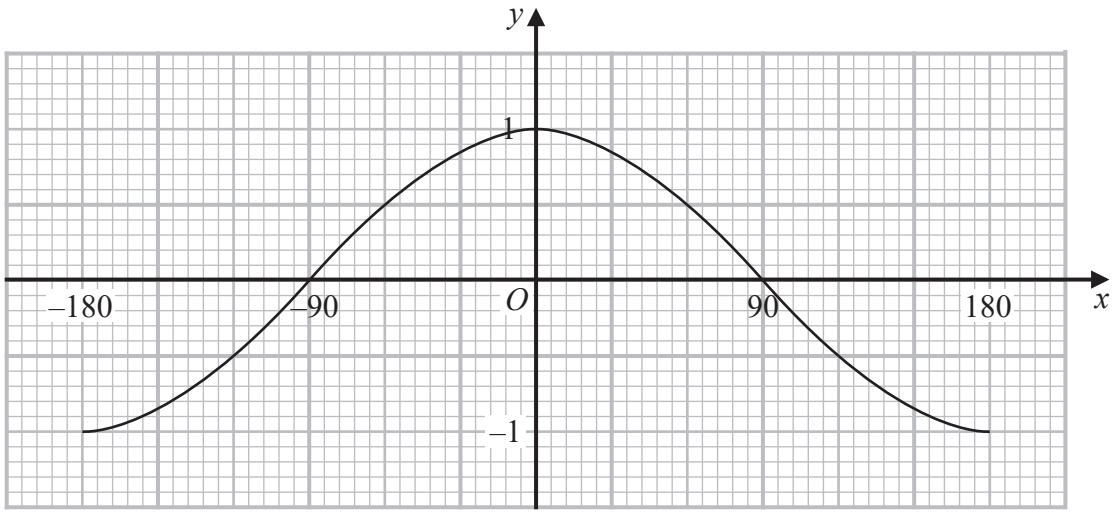
(b) Use the graph above to find an estimate for each of the solutions of the equation

$$\sin (x + 20)° = 0.7 \quad \text{for } -180 \leqslant x \leqslant 180$$

.....

(2)

Here is the graph of $y = \cos x°$ for $-180 \leqslant x \leqslant 180$



(c) On the grid above, sketch the graph of $y = \cos \frac{1}{2}x°$ for $-180 \leqslant x \leqslant 180$

(2)

(Total for Question 16 is 6 marks)

17 Solve, algebraically, the simultaneous equations

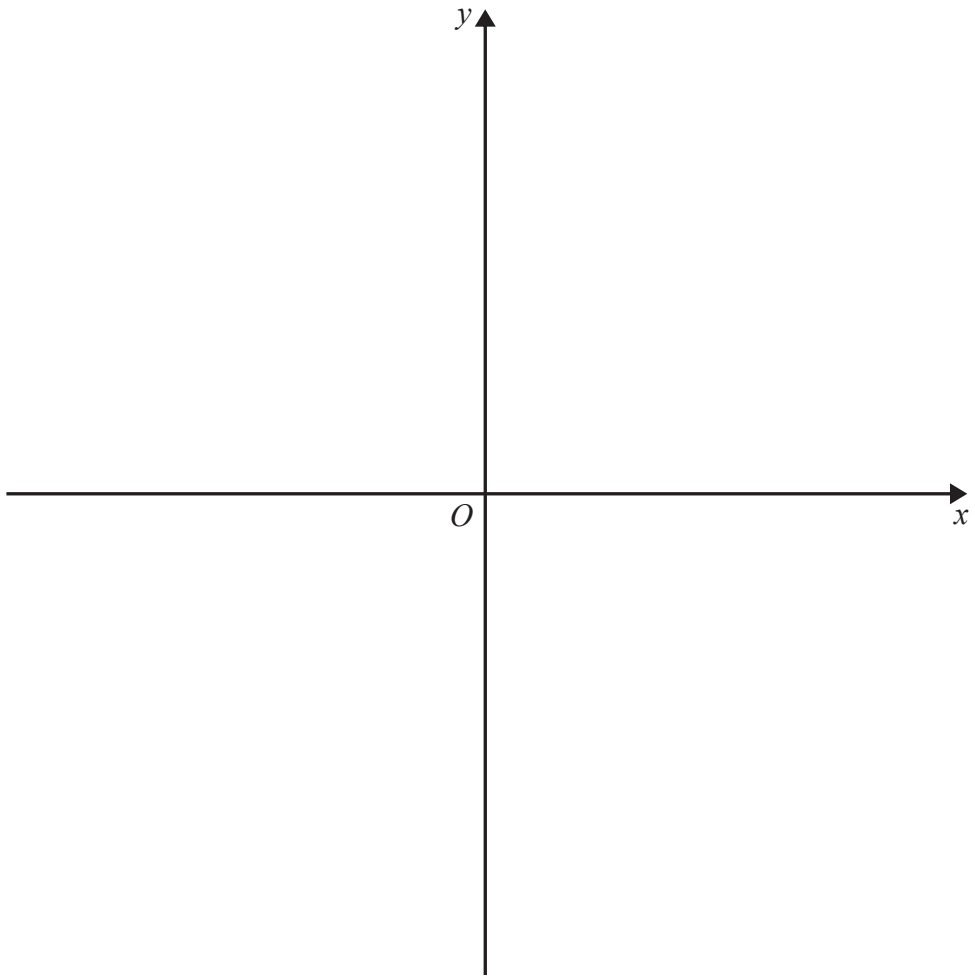
$$4x^2 + 4y^2 = 125$$
$$2y = 2x - 5$$

.....

(Total for Question 17 is 5 marks)

18 Sketch the graph of $y = \dfrac{1}{2 - x}$

Show clearly any asymptotes and the coordinates of any points of intersection of the graph with the axes.



(Total for Question 18 is 4 marks)

TOTAL FOR PAPER IS 90 MARKS

Edexcel Level 3 Algebra Paper – January 2020 – Mark Scheme

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
1 (a)		$x^2 + xy - 2y^2$	2	M1 for expanding bracket to obtain 4 terms with all 4 correct without considering signs or for 3 terms out of 4 correct with correct signs A1 for $x^2 + xy - 2y^2$
(b)		$6ut^2(2u + 3t)$	2	B2 for correct factorisation (B1 for a partial correct factorisation which shows a product of 3 or 4 factors)
2 (a)		Correct region indicated	5	M1 for drawing $x = 3$ correctly M1 for drawing $y - x = 5$ correctly M1 for drawing $7x + 5y = 35$ correctly A2 for correctly shading required region (A1 for correct shading for 2 inequalities)
(b)		(2, 5) (2, 6)	1	B1 for both correct and no extras
3		$k \leq -3$, $k \geq 3$	2	M1 for critical values ±3 or for $k \leq -3$ or for $k \geq 3$ A1 for $k \leq -3$, $k \geq 3$
4		Correct statement	1	B1 for statement, eg speed is zero, has stopped running oe

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
5 (a)(i)	$a = 3$, $b = -7$, $c = 5$	-11	2	M1 for use of $b^2 - 4ac$ A1 cao
(ii)		no real roots	1	B1 (dep M1) consistent with (a)(i)
(b)		$-\frac{1}{2}$, $-\frac{3}{10}$	3	M1 for sum $= -\frac{b}{a}$ **or** product $= \frac{c}{a}$ **or** $10x^2 + 5x - 3 = 0$ **or** $a = 10$, $b = 5$, $c = -3$ A1 for sum $= -\frac{1}{2}$ oe A1 for product $= -\frac{3}{10}$ oe
6		Circle centre $(-2, 1)$, radius 4 cm drawn	2	M1 for using $(-2, 1)$ as the centre of a circle **or** a circle of radius 4 cm drawn A1
7 (a)		p^8	1	B1 cao
(b)		$64t^3$	2	B2 cao (B1 for $64t^n$, $n \neq 3$ or ct^3, $c \neq 64$)
(c)		$\frac{1}{x^2 - 9}$	2	M1 for $x^2 - 9 = (x + 3)(x - 3)$ or for $(x - 3)^2(x + 3)^2 = (x^2 - 9)^2$ A1 for $\frac{1}{x^2 - 9}$ or $\frac{1}{(x+3)(x-3)}$

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
8 (a)		$x - 2y = 2$	1	B1 for eg $x - 2y = 2$ or $-x + 2y = -2$
(b)		$y = \frac{1}{2}x - 5$	3	M1 for use of gradient of $\mathbf{L_2} = \frac{1}{2}$, eg $y = \frac{1}{2}x + c$ M1 for a correct method to find c, eg $-6 = \frac{1}{2} \times -2 + c$ A1for $y = \frac{1}{2}x - 5$
9 (a)		$\frac{1}{8}$	1	B1 for $\frac{1}{8}$ or 0.125
(b)		$2 + \sqrt{5}$	4	M1 for substitution, eg $\frac{\sqrt{5}}{5-2\sqrt{5}}$ M1 for multiplying by $\frac{5+2\sqrt{5}}{5+2\sqrt{5}}$ or a multiple of $\frac{5+2\sqrt{5}}{5+2\sqrt{5}}$ A1 for a single fraction with surds resolved eg $\frac{5\sqrt{5}+10}{25-20}$ or $\frac{5(\sqrt{5}+2)}{5}$ A1 for $2 + \sqrt{5}$
(c)		$n = \frac{5t}{2t+1}$	3	M1 for correct first step, eg $t(5 - 2n) = n$ M1 for isolating terms in n on one side of the equation eg $2nt + n = 5t$ A1 for $n = \frac{5t}{2t+1}$ oe

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
10 (a)(i)		$6x^2 - 4x - 3 = 0$	1	B1 for correct equation with integer coefficients
(ii)	$\frac{--4 \pm \sqrt{(-4)^2 - 4 \times 6 \times -3}}{2 \times 6}$	$\frac{2 \pm \sqrt{22}}{6}$	3	M1 for stating the quadratic formula or correct substitution into formula ft from (a)(i) A1 ft for $\frac{4 \pm \sqrt{88}}{12}$ A1 for $\frac{2 \pm \sqrt{22}}{6}$
(b)		$-3, -2$	3	M1 for $(x + 3)[(x + 3) - 1] = 0$ M1 for $(x + 3)(x + 2) = 0$ A1 for $-3, -2$ OR M1 for $x^2 + 6x + 9 - x - 3 = 0$ M1 for $(x + 3)(x + 2) = 0$ **or** use of the quadratic formula as far as $\frac{-5 \pm \sqrt{1}}{2}$ A1 for $-3, -2$
(c)		$(x - 4)^2 - 13$	2	M1 $(x - 4)^2$ oe A1 $(x - 4)^2 - 13$

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
11 (a)		74 400	2	M1 for substitution into $\frac{1}{2}n(2a + (n-1)d)$ or $\frac{1}{2}n(a + l)$ eg $\frac{1}{2} \times 120(2 \times 25 + (120 - 1) \times 10)$ or $\frac{1}{2} \times 120(25 + 1215)$ A1 cao
(b)		99	3	M1 for setting up an equation or inequality, eg $25 + (n - 1) \times 10 = 1000$ or $10n + 15 = 1000$ M1(dep M1) for $n = 98.5$ A1 cao
12 (a)		$-\frac{4}{3}$	2	M1 for method to find gradient, eg rearrangement to $y = -\frac{4}{3}x - \frac{2}{3}$ A1 for $-\frac{4}{3}$ oe
(b)	$y = \frac{3}{4}x + c$ $-2 = \frac{3}{4} \times 1 + c$ $c = -\frac{11}{4}$ $y = \frac{3}{4}x - \frac{11}{4}$ $3x - 4y - 11 = 0$	$3x - 4y - 11 = 0$	3	M1 for using relationship between gradient of normal and tangent, eg gradient of tangent $= \frac{3}{4}$ **or** ft from (a) M1(dep M1) for method to find c, eg $-2 = \frac{3}{4} \times 1 + c$ or $c = -\frac{11}{4}$ or $y + 2 = \frac{3}{4}(x - 1)$ A1ft for $3x - 4y - 11 = 0$ oe provided in correct form

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
13 (a)(i)		82.4	3	M1 for using values, eg (y_0 =) 0, (y_1 =)1 to 1.2, (y_2 =) 3.6, (y_3 =) 8, (y_4 =)16 (condone 1 error) M1(dep M1) for substituting "values" and $h = 4$ into trapezium rule, eg $\frac{1}{2}\times 4\{(0 + 16) + 2(1 + 3.6 + 8)\}$ A1 for 82.4 to 83.2 oe from correct values
(ii)		distance	1	B1 for distance travelled (between 0 seconds and 16 seconds)
(b)(i)		Tangent drawn	1	B1 professional judgement
(ii)		1.4 – 1.5	2	M1(dep on B1 in (b)(i)) for method to find the gradient eg sight of right angled triangle with their height divided by their base A1 for 1.4 – 1.5 oe or ft
(c)		Acceleration (of the particle at $t = 12$)	1	B1 oe

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
14 (a)		$\frac{7}{4\sqrt{2}}$	3	M1 for $\frac{1}{(\sqrt{2})^3} = \frac{1}{2\sqrt{2}}$ or $\frac{1}{(\sqrt{2})^5} = \frac{1}{4\sqrt{2}}$ M1 for $\frac{4+2+1}{4\sqrt{2}}$ A1 for $\frac{7}{4\sqrt{2}}$ OR M1 for $\frac{(\sqrt{2})^4+(\sqrt{2})^2+1}{(\sqrt{2})^5}$ or $\frac{\sqrt{16}+\sqrt{4}+\sqrt{1}}{\sqrt{32}}$ M1 for $(\sqrt{2})^4 = 4$ or $(\sqrt{2})^2 = 2$ or $(\sqrt{2})^5 = 4\sqrt{2}$ A1 for $\frac{7}{4\sqrt{2}}$
(b)		3	3	M1 for multiplying by $\frac{\sqrt{20}+\sqrt{5}}{\sqrt{20}+\sqrt{5}}$ or a multiple of $\frac{\sqrt{20}+\sqrt{5}}{\sqrt{20}+\sqrt{5}}$ A1 for $\frac{20+10+10+5}{20-5}$ A1 cao OR M1 for $\frac{2\sqrt{5}+\sqrt{5}}{2\sqrt{5}-\sqrt{5}}$ M1 for $\frac{3\sqrt{5}}{\sqrt{5}}$ A1 cao
15 (a)	$15 = k\sqrt[3]{27}$	$r = 5\sqrt[3]{v}$	3	M1 $r \propto \sqrt[3]{v}$ or $r = k\sqrt[3]{v}$ oe, may be implied by substitution M1 for substitution to find k A1
(b)		sketch	1	B1 for correct general shape

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
16 (a)		24, 156	2	M1 for $\sin x° = \frac{2}{5}$ **or** $y = \frac{2}{5}$ shown on graph **or** 1 correct solution A1 for 21 to 24 and 156 to 159
(b)		22 – 28 and 112 – 118	2	M1 for $x + 20 = 42$ to 48 **or** $x + 20 = 132$ to 138 **or** 1 correct solution **or** sketches graph of $y = \sin(x + 20)°$ A1 for 22 – 28 and 112 – 118
(c)		Sketch graph	2	M1 for stretch parallel to x-axis A1 for stretch, factor 2 parallel to x-axis
17		$x = 5$, $y = \frac{5}{2}$ $x = -\frac{5}{2}$, $y = -5$	5	M1 for substitution of $2y = 2x - 5$ or $y = x - \frac{5}{2}$ into $4x^2 + 4y^2 = 125$oe to obtain equation in one variable M1 for writing equation in the form $ax^2 + bx + c$ (= 0) eg $8x^2 - 20x - 100$ (= 0) oe M1 for method to solve the equation, eg $(2x + 5)(x - 5)$ (= 0) A1 $x = -\frac{5}{2}$, $x = 5$ OR $y = \frac{5}{2}$, $y = -5$ OR $x = -\frac{5}{2}$, $y = -5$ OR $x = 5$, $y = \frac{5}{2}$ A1 for $x = 5$, $y = \frac{5}{2}$ and $x = -\frac{5}{2}$, $y = -5$
18		Graph sketched	4	B1 for asymptote of $x = 2$ B1 for intercept at $(0, \frac{1}{2})$ M1 for correct shape A1 for fully correct sketch.