Equations and Inequalities - Edexcel Past Exam Questions MARK SCHEME

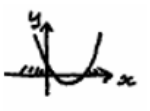
Question 1: Jan 05 Q4

Question number	Scheme	Marks
	$x^2+2(2-x)=12$ or $(2-y)^2+2y=12$ (Eqn. in x or y only)	M1
	$x^2-2x-8=0$ or $y^2-2y-8=0$ (Correct 3 term version)	A1
	$(x-4)(x+2)=0$ $x=\ldots$ or $(y-4)(y+2)=0$ $y=\ldots$	M1
	$x=4,\ x=-2$ or $y=4,\ y=-2$	A1
	$y=-2,\ y=4$ or $x=-2,\ x=4$ (M: attempt one, A: both)	M1 A1ft (6) **6**
	A1ft requires 3 s.f. accuracy if not exact. "Non-algebraic" solutions: No working, and only one correct solution pair found (e.g. $x=4, y=-2$): M0 A0 M0 A0 M1 A1 No working, and both correct solution pairs found, but not demonstrated: M0 A0 M1 A1 M1 A1 Both correct solution pairs found, and demonstrated, perhaps in a table of values: Full marks	

Question 2: Jan 05 Q10

	$x=1+2y$ and sub $\rightarrow (1+2y)^2+y^2=29$ $\Rightarrow 5y^2+4y-28(=0)$ i.e. $(5y+14)(y-2)=0$ $(y=)2$ or $-\frac{14}{5}$ (o.e.) (both) $y=2\Rightarrow x=1+4=5$; $y=-\frac{14}{5}\ \Rightarrow x=-\frac{23}{5}$ (o.e)	M1 A1 M1 A1 M1A1 f.t. **(6)**
	1st M1 Attempt to sub leading to equation in 1 variable 1st A1 Correct 3TQ (condone = 0 missing) 2nd M1 Attempt to solve 3TQ leading to 2 values for y. 2nd A1 Condone mislabelling x = for y = … but then M0A0 in part (c). 3rd M1 Attempt to find at least one x value 3rd A1 f.t. f.t. only in $x=1+2y$ (3sf if not exact) Both values N.B. False squaring (e.g. $y=x^2+4y^2=1$) can only score the last 2 marks.	

Question 3: June 05 Q6

Question Number	Scheme	Marks
(a)	$6x+3>5-2x \quad \Rightarrow 8x>2$ $x>\frac{1}{4}$ or 0.25 or $\frac{2}{8}$	M1 A1 (2)
(b)	$(2x-1)(x-3)$ (>0) Critical values $x=\frac{1}{2}$, 3 (both)  Choosing "outside" region $x>3$ or $x<\frac{1}{2}$	M1 A1 M1 A1 f.t. (4)
(c)	$x>3$ or $\frac{1}{4}<x<\frac{1}{2}$	B1f.t. B1f.t. (2) **(8)**

(a) M1 Multiply out and collect terms (allow one slip and allow use of = here)

(b) 1st M1 Attempting to factorise 3TQ $\rightarrow x = ...$

2nd M1 Choosing the outside region

2nd A1 f.t. f.t. their critical values N.B.($x>3, x>\frac{1}{2}$ is M0A0)

For $p<x<q$ where $p>q$ penalise the final A1 in (b).

(c) **f.t. their answers to (a) and (b)**

1st B1 a correct f.t. leading to an infinite region

2nd B1 a correct f.t. leading to a finite region

Penalise $\leq$ or $\geq$ once only at first offence.

e.g.	(a)	(b)	(c)	Mark
	$x>\frac{1}{4}$	$\frac{1}{2}<x<3$	$\frac{1}{2}<x<3$	B0 B1
	$x>\frac{1}{4}$	$x>3,\ x>\frac{1}{2}$	$x>3$	B1 B0

Question 4: June 06 Q2

Question number	Scheme	Marks
	Critical Values $(x \pm a)(x \pm b)$ with ab=18 or $x = \frac{7 \pm \sqrt{49 - -72}}{2}$ or $\left(x - \frac{7}{2}\right)^2 \pm \left(\frac{7}{2}\right)^2 - 18$ $(x-9)(x+2)$ or $x = \frac{7 \pm 11}{2}$ or $x = \frac{7}{2} \pm \frac{11}{2}$ Solving Inequality $x > 9$ or $x < -2$ Choosing "outside"	M1 A1 M1 A1 **4**
	1st M1 For attempting to find critical values. Factors alone are OK for M1, $x =$ appearing somewhere for the formula and as written for completing the square 1st A1. Factors alone are OK . Formula or completing the square need $x =$ as written. 2nd M1 For choosing outside region. Can f.t. their critical values. They must have two different critical values. $-2 > x > 9$ is M1A0 but ignore if it follows a correct version $-2 < x < 9$ is M0A0 whatever the diagram looks like. 2nd A1 Use of $\geq$ in final answer gets A0	

Question 5: Jan 07 Q4

Question number	Scheme	Marks
	$(x-2)^2 = x^2 - 4x + 4$ or $(y+2)^2 = y^2 + 4y + 4$ M: 3 or 4 terms	M1
	$(x-2)^2 + x^2 = 10$ or $y^2 + (y+2)^2 = 10$ M: Substitute	M1
	$2x^2 - 4x - 6 = 0$ or $2y^2 + 4y - 6 = 0$ Correct 3 terms	A1
	$(x-3)(x+1) = 0, \quad x = \ldots$ or $(y+3)(y-1) = 0, \quad y = \ldots$ (The above factorisations may also appear as $(2x-6)(x+1)$ or equivalent).	M1
	$x = 3 \quad x = -1$ or $y = -3 \quad y = 1$	A1
	$y = 1 \quad y = -3$ or $x = -1 \quad x = 3$ (Allow equivalent fractions such as: $x = \frac{6}{2}$ for $x = 3$).	M1 A1 (7)
		7
	1st M: 'Squaring a bracket', needs 3 or 4 terms, one of which must be an x^2 or y^2 term. 2nd M: Substituting to get an equation in one variable (awarded generously). 1st A: Accept equivalent forms, e.g. $2x^2 - 4x = 6$. 3rd M: Attempting to solve a 3-term quadratic, to get 2 solutions. 4th M: Attempting at least one y value (or x value). If y solutions are given as x values, or vice-versa, penalise at the end, so that it is possible to score M1 M1A1 M1 A1 M0 A0. Strict "pairing of values" at the end is not required. "Non-algebraic" solutions: No working, and only one correct solution pair found (e.g. $x = 3, y = 1$): M0 M0 A0 M0 A0 M1 A0 No working, and both correct solution pairs found, but not demonstrated: M0 M0 A0 M1 A1 M1 A1 Both correct solution pairs found, and demonstrated, perhaps in a table of values: Full marks Squaring individual terms: e.g. $y^2 = x^2 + 4$ M0 $x^2 + 4 + x^2 = 10$ M1 A0 (Eqn. in one variable) $x = \sqrt{3}$ M0 A0 (Not solving 3-term quad.) $y^2 = x^2 + 4 = 7 \quad y = \sqrt{7}$ M1 A0 (Attempting one y value)	

Question 6: June 07 Q6

Question number	Scheme	Marks
	(a) $2x^2 - x(x-4) = 8$	M1
	$x^2 + 4x - 8 = 0$ (*)	A1cso (2)
	(b) $x = \dfrac{-4 \pm \sqrt{4^2 - (4\times1\times-8)}}{2}$ or $(x+2)^2 \pm 4 - 8 = 0$	M1
	$x = -2 \pm$ (any correct expression)	A1
	$\sqrt{48} = \sqrt{16}\sqrt{3} = 4\sqrt{3}$ or $\sqrt{12} = \sqrt{4}\sqrt{3} = 2\sqrt{3}$	B1
	$y = \left(-2 \pm 2\sqrt{3}\right) - 4$ M: Attempt at least one y value	M1
	$\underline{x = -2 + 2\sqrt{3},\ \ y = -6 + 2\sqrt{3}}$ $\underline{x = -2 - 2\sqrt{3},\ \ y = -6 - 2\sqrt{3}}$	A1 (5)
		7

(a) M1 for correct attempt to form an equation in x only. Condone sign errors/slips but attempt at this line must be seen. E.g. $2x^2 - x^2 \pm 4x = 8$ is OK for M1.

A1cso for correctly simplifying to printed form. No incorrect working seen. The = 0 is required.

These two marks can be scored in part (b). For multiple attempts pick best.

(b) 1st M1 for use of correct formula. If formula is not quoted then a fully correct substitution is required. Condone missing $x =$ or just + or − instead of $\pm$ for M1.

For completing the square must have as printed or better.

If they have $x^2 - 4x - 8 = 0$ then M1 can be given for $(x-2)^2 \pm 4 - 8 = 0$.

1st A1 for -2 $\pm$ any correct expression. (The $\pm$ is required but $x =$ is not)

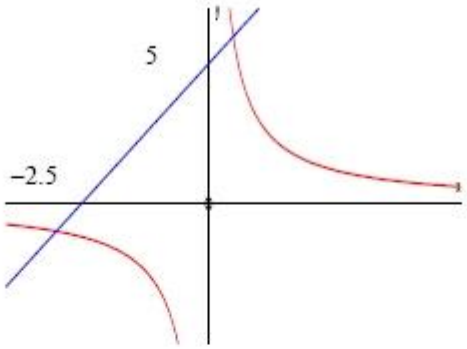
B1 for simplifying the surd e.g. $\sqrt{48} = 4\sqrt{3}$. Must reduce to $b\sqrt{3}$ so $\sqrt{16}\sqrt{3}$ or $\sqrt{4}\sqrt{3}$ are OK.

2nd M1 for attempting to find at least one y value. Substitution into one of the given equations and an attempt to solve for y.

2nd A1 for correct y answers. Pairings need not be explicit but they must say which is x and which y.

Mis-labelling x and y loses final A1 only.

Question 7: June 08 Q6

Question Number	Scheme	Marks
(a)		B1 M1 A1 (3)
(b)	$2x+5=\frac{3}{x}$	M1
	$2x^2+5x-3\,[=0]$ or $2x^2+5x=3$	A1
	$(2x-1)(x+3)\,[=0]$	M1
	$x=-3$ or $\frac{1}{2}$	A1
	$y=\frac{3}{-3}$ or $2\times(-3)+5$ or $y=\frac{3}{\frac{1}{2}}$ or $2\times\left(\frac{1}{2}\right)+5$	M1
	Points are $(-3,-1)$ and $(\frac{1}{2},6)$ (correct pairings)	A1 ft (6)
		(9 marks)

Question 8: June 09 Q4

Question Number	Scheme	Marks
Q (a)	$5x > 10$, $x > 2$ [Condone $x > \frac{10}{5} = 2$ for M1A1]	M1, A1 (2)
(b)	$(2x+3)(x-4) = 0$, 'Critical values' are $-\frac{3}{2}$ and 4	M1, A1
	$-\frac{3}{2} < x < 4$	M1 A1ft (4)
(c)	$2 < x < 4$	B1ft (1) [7]
(a)	M1 for attempt to collect like terms on each side leading to $ax > b$, or $ax < b$, or $ax = b$ Must have a or b correct so eg $3x > 4$ scores M0	
(b)	1st M1 for an attempt to factorize or solve to find critical values. Method must potentially give 2 critical values 1st A1 for $-\frac{3}{2}$ and 4 seen. They may write $x < -\frac{3}{2}$, $x < 4$ and still get this A1 2nd M1 for choosing the "inside region" for their critical values 2nd A1ft follow through their 2 distinct critical values Allow $x > -\frac{3}{2}$ with "or" "," "$\cup$" "" $x < 4$ to score M1A0 but "and" or "$\cap$" score M1A1 $x \in (-\frac{3}{2}, 4)$ is M1A1 but $x \in [-\frac{3}{2}, 4]$ is M1A0. Score M0A0 for a number line or graph only	
(c)	B1ft Allow if **a correct answer is seen** or follow through their answer to (a) and their answer to (b) but their answers to (a) and (b) must be regions. Do not follow through single values. If their follow through answer is the empty set accept $\varnothing$ or {} or equivalent in words If (a) or (b) are not given then score this mark for cao NB You may see $x<4$ (with anything or nothing in-between) $x < -1.5$ in (b) and empty set in (c) for B1ft **Do not award marks for part (b) if only seen in part (c)** Use of $\leq$ instead of $<$ (or $\geq$ instead of $>$) loses one accuracy mark only, at first occurrence.	

Question 9: Jan 10 Q5

Question number	Scheme	Marks
	$y = 3x - 2 \quad (3x-2)^2 - x - 6x^2 (= 0)$	M1
	$9x^2 - 12x + 4 - x - 6x^2 = 0$ $3x^2 - 13x + 4 = 0$ (or equiv., e.g. $3x^2 = 13x - 4$)	M1 A1cso
	$(3x-1)(x-4) = 0 \quad x = \ldots \quad x = \frac{1}{3}$ (or exact equivalent) $x = 4$	M1 A1
	$y = -1 \quad y = 10$ (Solutions need not be "paired")	M1 A1
		[7]
	1st M: Obtaining an equation in x only (or y only). Condone missing "= 0" Condone sign slips, e.g. $(3x+2)^2 - x - 6x^2 = 0$, but not other algebraic mistakes (such as squaring individual terms... see bottom of page). 2nd M: Multiplying out their $(3x-2)^2$, which must lead to a 3 term quadratic, i.e. $ax^2 + bx + c$, where $a \neq 0, b \neq 0, c \neq 0$, and collecting terms. 3rd M: Solving a 3-term quadratic (see general principles at end of scheme). 2nd A: Both values. 4th M: Using an x value, found algebraically, to attempt at least one y value (or using a y value, found algebraically, to attempt at least one x value)... allow b.o.d. for this mark in cases where the value is wrong but working is not shown. 3rd A: Both values. If y solutions are given as x values, or vice-versa, penalise at the end, so that it is possible to score M1 M1A1 M1 A1 M0 A0. "Non-algebraic" solutions: No working, and only one correct solution pair found (e.g. $x = 4, y = 10$): M0 M0 A0 M0 A0 M1 A0 No working, and both correct solution pairs found, but not demonstrated: M0 M0 A0 M1 A1 M1 A1 Both correct solution pairs found, and demonstrated: Full marks Alternative: $x = \frac{y+2}{3} \quad y^2 - \frac{y+2}{3} - 6\left(\frac{y+2}{3}\right)^2 = 0$ M1 $y^2 - \frac{y+2}{3} - 6\left(\frac{y^2+4y+4}{9}\right) = 0 \quad y^2 - 9y - 10 = 0$ M1 A1 $(y+1)(y-10) = 0 \quad y = \ldots \quad y = -1 \quad y = 10$ M1 A1 $x = \frac{1}{3} \quad x = 4$ M1 A1 Squaring each term in the first equation, e.g. $y^2 - 9x^2 + 4 = 0$, and using this to obtain an equation in x only could score at most 2 marks: M0 M0 A0 M1 A0 M1 A0.	

Question 10: June 10 Q3

Question Number	Scheme	Marks
(a)	$3x-6<8-2x \rightarrow 5x<14$ (Accept $5x-14<0$ (o.e.))	M1
	$x<2.8$ or $\frac{14}{5}$ or $2\frac{4}{5}$ (condone $\leq$)	A1 (2)
(b)	Critical values are $x=\frac{7}{2}$ and -1	B1
	Choosing "inside" $-1<x<\frac{7}{2}$	M1 A1 (3)
(c)	$-1<x<2.8$	B1ft (1)
	Accept any exact equivalents to -1, 2.8, 3.5	6

Notes

(a)

M1 for attempt to rearrange to $kx<m$ (o.e.) Either $k=5$ or $m=14$ should be correct
Allow $5x=14$ or even $5x>14$

(b)

B1 for both correct critical values. (May be implied by a correct inequality)
M1 ft their values and choose the "inside" region
A1 for fully correct inequality (Must be in part (b): do not give marks if only seen in (c))
Condone seeing $x<-1$ in working provided $-1<x$ is in the final answer.

e.g. $x>-1$, $x<\frac{7}{2}$ or $x>-1$ "or" $x<\frac{7}{2}$ or $x>-1$ "blank space" $x<\frac{7}{2}$ score M1A0

BUT allow $x>-1$ and $x<\frac{7}{2}$ to score M1A1 (the "and" must be seen)

Also $\left(-1,\frac{7}{2}\right)$ will score M1A1

NB $x<-1, x<\frac{7}{2}$ is of course M0A0 and a number line even with "open" ends is M0A0

Allow 3.5 instead of $\frac{7}{2}$

(c)

B1ft for $-1<x<2.8$ (ignoring their previous answers) or ft their answers to part (a) and part (b) provided both answers were regions and not single values.
Allow use of "and" between inequalities as in part (b)
If their set is empty allow a suitable description in words or the symbol $\varnothing$.

Common error: If (a) is correct and in (b) they simply leave their answer as $x<-1$, $x<3.5$ then in (c) $x<-1$ would get B1ft as this is a correct follow through of these 3 inequalities.

Penalise use of $\leq$ only on the A1 in part (b). [i.e. condone in part (a)]

Question 11: June 11 Q4

Question Number	Scheme	Marks
	Either $y^2 = 4 - 4x + x^2$ $4(4 - 4x + x^2) - x^2 = 11$ or $4(2-x)^2 - x^2 = 11$ $3x^2 - 16x + 5 = 0$ $(3x-1)(x-5) = 0, \quad x =$ $x = \frac{1}{3} \quad x = 5$ $y = \frac{5}{3} \quad y = -3$ Or $x^2 = 4 - 4y + y^2$ $4y^2 - (4 - 4y + y^2) = 11$ or $4y^2 - (2-y)^2 = 11$ $3y^2 + 4y - 15 = 0$ Correct 3 terms $(3y-5)(y+3) = 0, \quad y = \ldots$ $y = \frac{5}{3} \quad y = -3$ $x = \frac{1}{3} \quad x = 5$	M1 M1 A1 M1 A1 M1 A1 (7) 7
	Notes 1st M: Squaring to give 3 or 4 terms (need a middle term) 2nd M: Substitute to give quadratic in one variable (may have just two terms) 3rd M: Attempt to solve a **3 term** quadratic. 4th M: Attempt to find at least one y value (or x value). (The second variable) This will be by substitution or by starting again. If y solutions are given as x values, or vice-versa, penalise accuracy, so that it is possible to score M1 M1A1 M1 A0 M1 A0. "Non-algebraic" solutions: No working, and only one correct solution pair found (e.g. $x = 5, y = -3$): M0 M0 A0 M1 A0 M1 A0 No working, and both correct solution pairs found, but not demonstrated: M0 M0 A0 M1 A1 M1 A1 Both correct solution pairs found, and demonstrated: Full marks are possible (send to review)	