ADDITIONAL MATHEMATICS

0606 P2

2017 - 2022
QUESTIONS+ANSWERS

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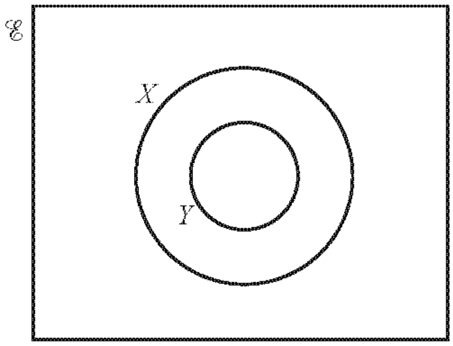
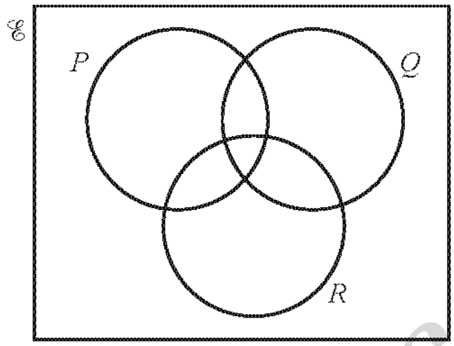
1 - (0606-S 2017-Paper 2/1-Q7) - *SETS*

(a) On each of the Venn diagrams below shade the region which represents the given set.

$X \cap Y'$



$P' \cap Q \cap R$



[2]

(b) In a group of students, each student studies at most two of art, music and design. No student studies both music and design.

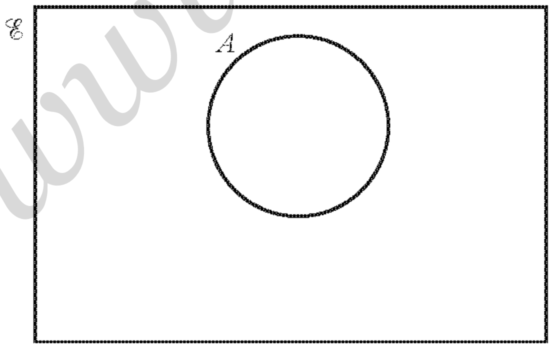
A denotes the set of students who study art,
M denotes the set of students who study music,
D denotes the set of students who study design.

(i) Write the following using set notation.

No student studies both music and design. [1]

There are 100 students in the group. 39 students study art, 45 study music and 36 study design. 12 students study both art and music. 25 students study both art and design.

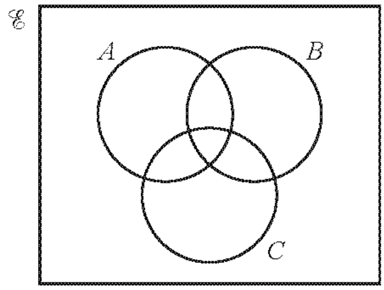
(ii) Complete the Venn diagram below to represent this information and hence find the number of students in the group who do not study any of these subjects.



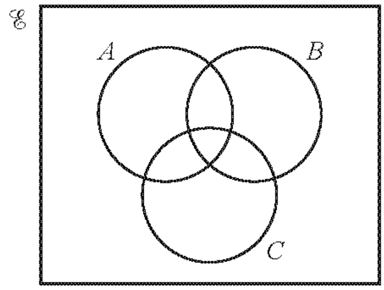
[3]

2 - (0606-W 2017-Paper 2/3-Q1) - *SETS*

(a) On each of the diagrams below, shade the region which represents the given set.

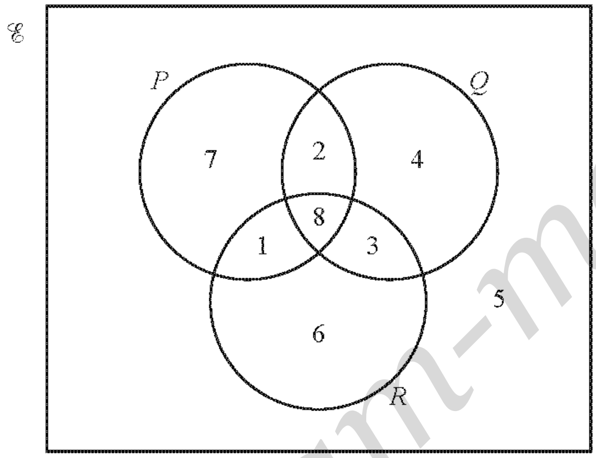


$(A \cup B) \cap C'$



$(A \cap B') \cup C$ [2]

(b)



The Venn diagram shows the number of elements in each of its subsets.

Complete the following.

$n(P')$ = ...

$n((Q \cup R) \cap P)$ = ...

$n(Q' \cup P)$ = ... [3]

3 - (0606-S 2018-Paper 2/1-Q1) - *SETS*

A, B and C are subsets of the same universal set.

(i) Write each of the following statements in words.

(a) $A \not\subset B$ [1]

(b) $A \cap C = \varnothing$ [1]

(ii) Write each of the following statements in set notation.

(a) There are 3 elements in set A or B or both. [1]

(b) x is an element of A but it is not an element of C. [1]

4 - (0606-S 2018-Paper 2/3-Q1) - *SETS*

A, B and C are subsets of the same universal set.

(i) Write each of the following statements in words.

(a) $A \not\subset B$ [1]

(b) $A \cap C = \varnothing$ [1]

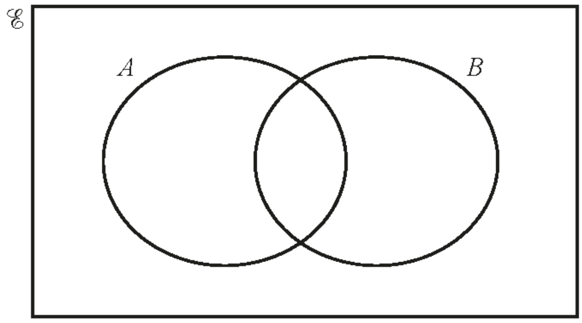
(ii) Write each of the following statements in set notation.

(a) There are 3 elements in set A or B or both. [1]

(b) x is an element of A but it is not an element of C. [1]

5 - (0606-S 2018-Paper 2/2-Q2) - *SETS*

(a) On the Venn diagram below, shade the region that represents $A \cap B'$.



[1]

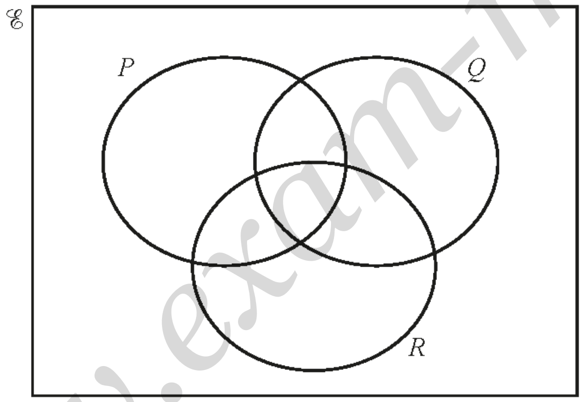
(b) The universal set ℰ and sets P, Q and R are such that

$(P \cup Q \cup R)' = \varnothing$, $P' \cap (Q \cap R) = \varnothing$,

$n(Q \cap R) = 8$, $n(P \cap R) = 8$, $n(P \cap Q) = 10$,

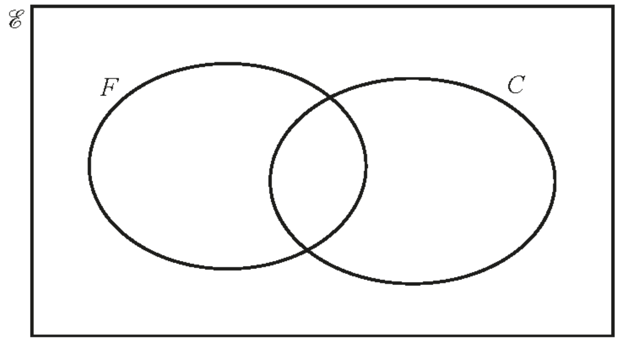
$n(P) = 21$, $n(Q) = 15$, $n(\mathscr{E}) = 30$.

Complete the Venn diagram to show this information and state the value of n(R).



n(R) = ... [4]

6 - (0606-W 2018-Paper 2/2-Q2) - *SETS*



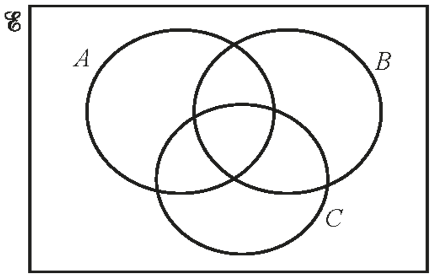
There are 105 boys in a year group at a school. Some boys play football (F) and some play cricket (C).

- x boys play both football and cricket.
- The number of boys that play neither game is the same as the number of boys that play both.
- 40 boys play cricket.
- The number of boys that only play football is twice the number of boys that only play cricket.

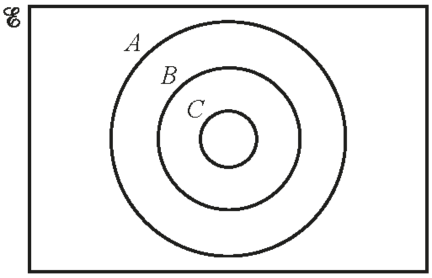
Complete the Venn diagram and find the value of x. [5]

7 - (0606-W 2018-Paper 2/3-Q2) **-** *SETS*

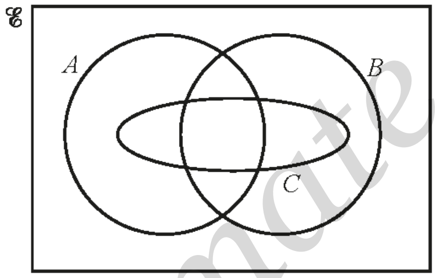
On each of the Venn diagrams below, shade the region indicated.



$(A \cup B \cup C)'$



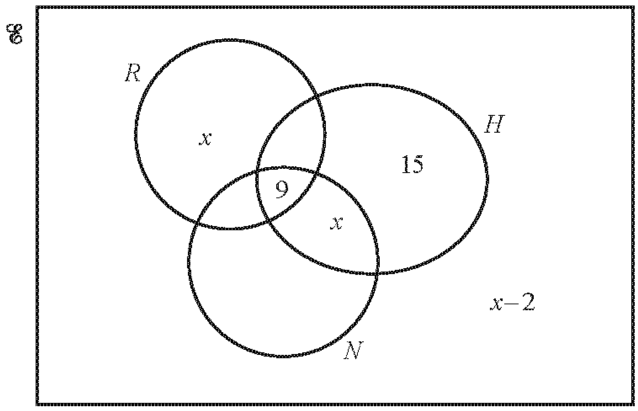
$A \cap B \cap C'$



$(A \cap B) \cup C'$

[3]

8 - (0606-W 2018-Paper 2/1-Q11) **-** *SETS*



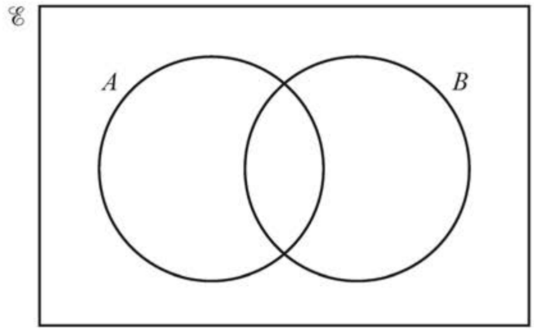
There are 70 girls in a year group at a school. The Venn diagram gives **some** information about the numbers of these girls who play rounders (R), hockey (H) and netball (N).

$n(R) = 28$ $n(H) = 38$ $n(N) = 35.$

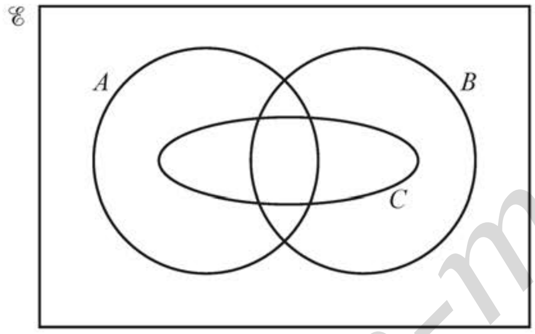
Find the value of x and hence the number of girls who play netball only. [6]

9 - (0606-W 2019-Paper 2/2-Q1) **-** *SETS*

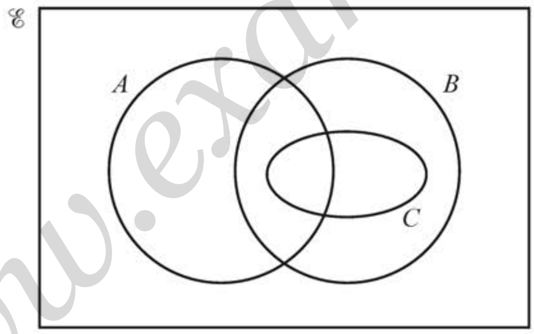
On each of the Venn diagrams below, shade the region indicated.



$(A' \cap B) \cup (A \cap B')$



$(A \cap B) \cup C$



$A \cap B \cap C'$

[3]

1 - (0606-S 2017-Paper 2/1-Q9) **-** *INTERSECTION POINTS, COORDINATE GEOMETRY*

The curve $3x^2 + xy - y^2 + 4y - 3 = 0$ and the line $y = 2(1 - x)$ intersect at the points A and B.

(i) Find the coordinates of A and of B. [5]

(ii) Find the equation of the perpendicular bisector of the line AB, giving your answer in the form $ax + by = c$, where a, b and c are integers. [4]

2 - (0606-W 2017-Paper 2/1-Q4) **-** *INTERSECTION POINTS*

Solve the following simultaneous equations for x and y, giving each answer in its simplest surd form.

$$\sqrt{3}x + y = 4$$

$$x - 2y = 5\sqrt{3}$$

[5]

3 - (0606-S 2018-Paper 2/2-Q4) - *INTERSECTION POINTS*

Find the coordinates of the points where the line $2y - 3x = 6$ intersects the curve $\frac{x^2}{4} + \frac{y^2}{9} = 5$. [5]

4 - (0606-W 2018-Paper 2/1-Q10) - *INTERSECTION POINTS*

The line $y = 12 - 2x$ is a tangent to two curves. Each curve has an equation of the form $y = k + 6 + kx - x^2$, where k is a constant.

(i) Find the two values of k. [5]

The line $y = 12 - 2x$ is a tangent to one curve at the point A and the other curve at the point B.

(ii) Find the coordinates of A and of B. [3]

(iii) Find the equation of the perpendicular bisector of AB. [3]

5 - (0606-W 2018-Paper 2/2-Q10) - *INTERSECTION POINTS*

Two lines are tangents to the curve $y = 12 - 4x - x^2$. The equation of each tangent is of the form $y = 2k + 1 - kx$, where k is a constant.

(i) Find the two possible values of k. [5]

(ii) Find the coordinates of the point of intersection of the two tangents. [4]

6 - (0606-W 2018-Paper 2/3-Q11) - *INTERSECTION POINTS*

A line with equation $y = -5x + k + 5$ is a tangent to a curve with equation $y = 7 - kx - x^2$.

(i) Find the two possible values of k. [5]

(ii) Find, for **each** of your values of k,

- the equation of the tangent
- the equation of the curve
- the coordinates of the point of contact of the tangent and the curve. [5]

(iii) Find the distance between the two points of contact. [2]

7 - (0606-W 2019-Paper 2/1-Q4) - *INTERSECTION POINTS*

Do not use a calculator in this question.

Solve the following simultaneous equations, giving your answers for both x and y in the form $a+b\sqrt{2}$, where a and b are integers.

$$2x+y=5$$

$$3x-\sqrt{2}y=7$$

[5]

8 - (0606-W 2019-Paper 2/2-Q4) **-** *INTERSECTION POINTS*

Find the values of k for which the line $y = kx + 3$ does not meet the curve $y = x^2 + 5x + 12$. [5]

9 - (0606-S 2020-Paper 2/3-Q2) **-** *INTERSECTION POINTS*

Find the set of values of k for which $4x^2 - 4kx + 2k + 3 = 0$ has no real roots. [5]

10 - (0606-S 2020-Paper 2/2-Q3) **-** *INTERSECTION POINTS*

Find the values of k for which the line $y = x - 3$ intersects the curve $y = k^2x^2 + 5kx + 1$ at two distinct points. [6]

11 - (0606-S 2020-Paper 2/1-Q6) **-** *INTERSECTION POINTS*

Find the values of k for which the line $y = kx - 7$ and the curve $y = 3x^2 + 8x + 5$ do not intersect.
[6]

12 - (0606-W 2020-Paper 2/1-Q2) - *INTERSECTION POINTS*

Find the coordinates of the points of intersection of the curve $x^2 + xy = 9$ and the line $y = \frac{2}{3}x - 2$.

[5]

13 - (0606-W 2020-Paper 2/3-Q2) **-** *INTERSECTION POINTS*

Solve the simultaneous equations.

$$x^2 + 3xy = 4$$
$$2x + 5y = 4$$

[5]

14 - (0606-W 2020-Paper 2/3-Q3) - *INTERSECTION POINTS*

Find the values of k for which the equation $x^2 + (k+9)x + 9 = 0$ has two distinct real roots. [4]

15 - (0606-S 2021-Paper 2/2-Q3) - *INTERSECTION POINTS*

Find the values of the constant k for which $(2k-1)x^2+6x+k+1=0$ has real roots. [5]

16 - (0606-S 2021-Paper 2/1-Q7) **-** *INTERSECTION POINTS*

Find the exact values of the constant k for which the line $y = 2x + 1$ is a tangent to the curve $y = 4x^2 + kx + k - 2$. [6]

17 - (0606-S 2021-Paper 2/2-Q9) **-** *INTERSECTION POINTS*

Solve the following simultaneous equations.

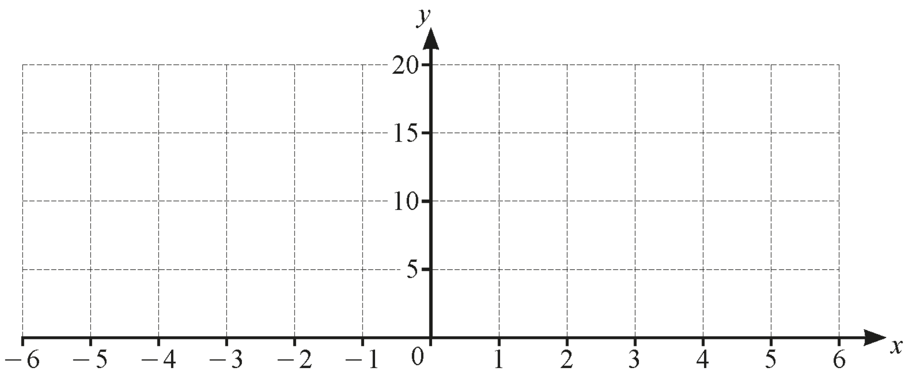
$$4x^2 + 3xy + y^2 = 8$$
$$xy + 4 = 0$$

[6]

18 - (0606-W 2021-Paper 2/1-Q1) **-** *INTERSECTION POINTS*

Solve the inequality $(x+5)(x-2) > 3x+6$. [3]

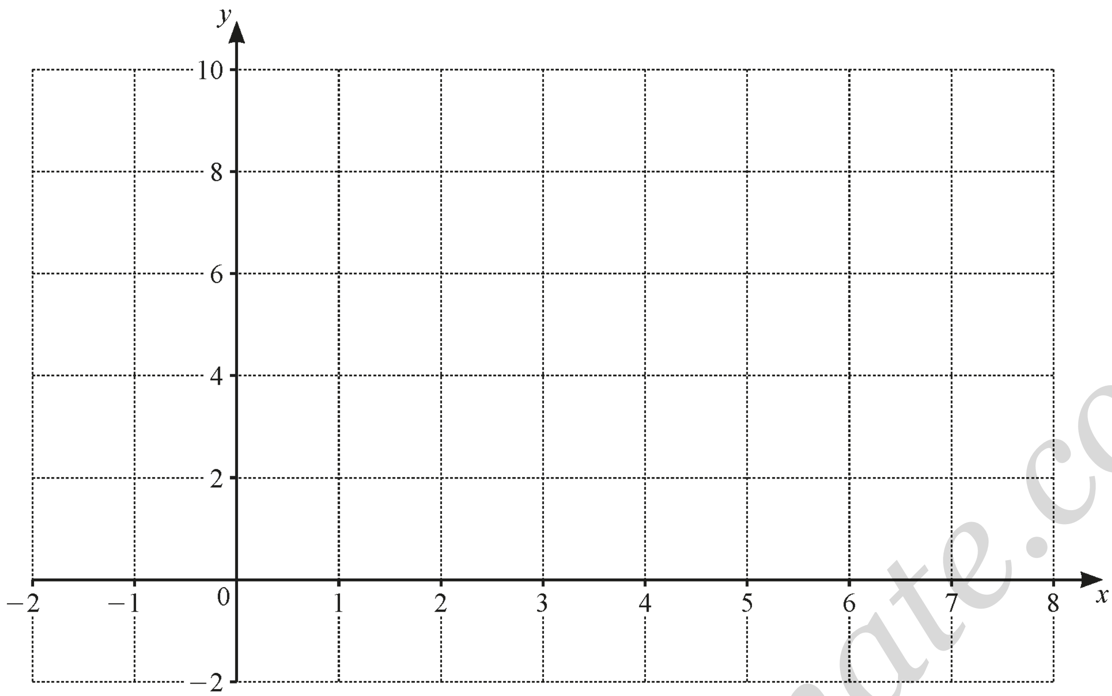
19 - (0606-W 2021-Paper 2/2-Q1) - *INTERSECTION POINTS*



(a) On the axes, draw the graphs of $y = 5 + |3x - 2|$ and $y = 11 - x$. [4]

(b) Using the graphs, or otherwise, solve the inequality $11 - x < 5 + |3x - 2|$. [2]

20 - (0606-W 2021-Paper 2/3-Q1) - *INTERSECTION POINTS*



(a) On the axes draw the graphs of $y = |x-5|$ and $y = 6-|2x-7|$. [4]

(b) Use your graphs to solve the inequality $|x-5| > 6-|2x-7|$. [2]

21 - (0606-W 2021-Paper 2/1-Q6) **-** *INTERSECTION POINTS*

Find the values of m for which the line $y = mx - 2$ does not touch or cut the curve $y = (m+1)x^2 + 8x + 1$. [6]

22 - (0606-S 2022-Paper 2/2-Q3) - *INTERSECTION POINTS*

Find the possible values of k for which the equation $kx^2 + (k+5)x - 4 = 0$ has real roots. [5]

23 - (0606-S 2022-Paper 2/3-Q4) - *INTERSECTION POINTS*

(a) Find the range of values of x satisfying the inequality $(5x-1)(6-x) < 0$. [2]

(b) Show that the equation $(2k+1)x^2 - 4kx + 2k - 1 = 0$, where $k \neq -\frac{1}{2}$, has distinct, real roots. [3]

24 - (0606-W 2022-Paper 2/1-Q1) **-** *INTERSECTION POINTS*

Solve the following simultaneous equations, giving your answers in the form $a+b\sqrt{7}$ where a and b are integers.

$$x+3y=11$$

$$x-\sqrt{7}y=7$$

[5]

25 - (0606-W 2022-Paper 2/2-Q1) **-** *INTERSECTION POINTS*

Solve the following simultaneous equations.

$$x + 5y = -4$$
$$3y - xy = 6$$

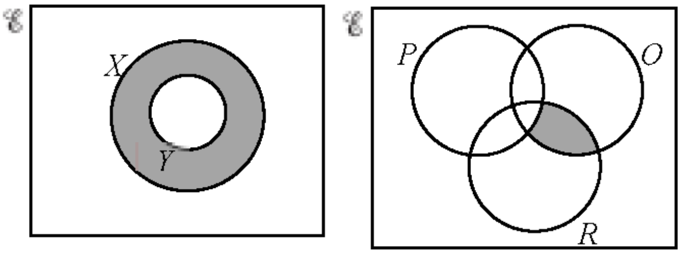
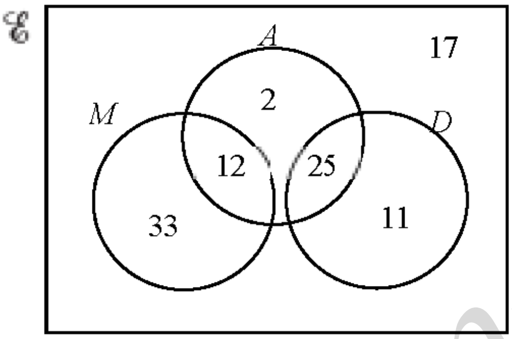
[5]

26 - (0606-W 2022-Paper 2/3-Q2) - *INTERSECTION POINTS*

The tangent to the curve $y = ax^2 - 5x + 2$ at the point where $x = 2$ has equation $y = 7x + b$. Find the values of the constants a and b. [5]

ANSWERS

1 - (0606-S 2017-Paper 2/1-Q7) **-** *SETS*

(a)	
(b)(i)	$\text{n}(M \cap D) = 0$ or $M \cap D = \varnothing$
(b)(ii)	

2 - (0606-W 2017-Paper 2/3-Q1) **-** *SETS*

(a)			B2
(b)	$\text{n}(P')$	$= 18$	B1
	$\text{n}((Q \cup R) \cap P)$	$= 11$	B1
	$\text{n}(Q' \cup P)$	$= 29$	B1

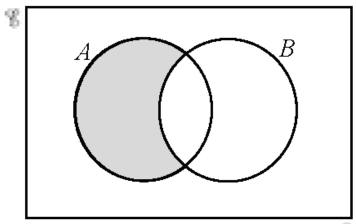
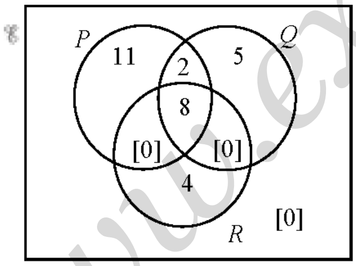
3 - (0606-S 2018-Paper 2/1-Q1) - *SETS*

(i)(a)	A is not a [proper] subset of B oe	**B1**	
(i)(b)	A and C are mutually exclusive oe or A intersection C is the empty set oe	**B1**	
(ii)(a)	$n(A \cup B) = 3$	**B1**	
(ii)(b)	$x \in (A \cap C')$ oe	**B1**	

4 - (0606-S 2018-Paper 2/3-Q1) - *SETS*

(i)(a)	A is not a [proper] subset of B oe	**B1**	
(i)(b)	A and C are mutually exclusive oe or A intersection C is the empty set oe	**B1**	
(ii)(a)	$n(A \cup B) = 3$	**B1**	
(ii)(b)	$x \in (A \cap C')$ oe	**B1**	

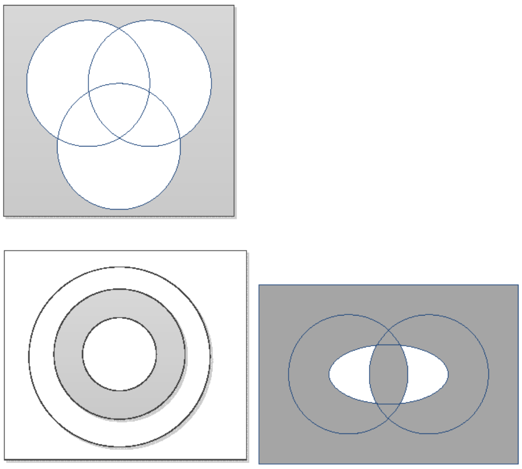
5 - (0606-S 2018-Paper 2/2-Q2) - *SETS*

(a)		**B1**	
(b)		**B3**	B1 for 8 correctly placed and all the empty regions correct B1 for 11, 2, 5 correctly placed B1 for 4 correctly placed **maximum of 2 marks if fully correct but other values such as 30, 21 and/or 15 present within the diagram**
	their 12	**B1**	**STRICT FT** *their* Venn diagram

6 - (0606-W 2018-Paper 2/2-Q2) - *SETS*

	$n(F \cap C) = n(F \cup C)' = x$	**B1**	
	$n(C \cap F') = 40 - x$	**B1**	
	$n(F \cap C') = 80 - 2x$ or $2(40 - x)$	**B1**	
	$x + x + 40 - x + 80 - 2x = 105$	**M1**	
	$x = 15$	**A1**	cao

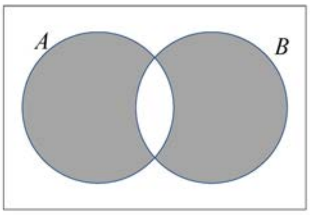
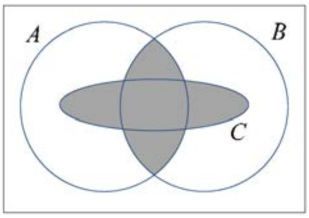
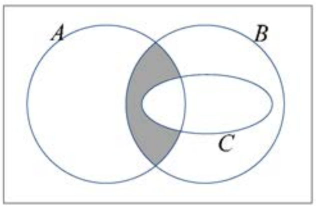
7 - (0606-W 2018-Paper 2/3-Q2) **-** *SETS*

		**3**	**B1** for each correct diagram

8 - (0606-W 2018-Paper 2/1-Q11) **-** *SETS*

	$\mathrm{n}\left((R\cap H)\cap N'\right)=14-x$	**B1**	
	$\mathrm{n}\left((R\cap N)\cap H'\right)=5$	**B1**	
	$\mathrm{n}(N\cap(\mathrm{R}\cup H)')=21-x$	**B1**	
	$x+9+x+15+14-x+5+21-x+x-2$ $=70$	**M1**	correctly form equation in x and attempt to solve
	$x=8$	**A1**	
	$\mathrm{n}(N\cap(\mathrm{R}\cup H)')=13$	**A1**	

9 - (0606-W 2019-Paper 2/2-Q1) **-** *SETS*

		**B1**	
		**B1**	
		**B 1**	

1 - (0606-S 2017-Paper 2/1-Q9) - *INTERSECTION POINTS, COORDINATE GEOMETRY*

(i)	Substitution of $y = 2(1-x)$
	$-3x^2 + 2x + 1 = 0$ oe $\left(3x^2 - 2x - 1 = 0\right)$
	Solving *their* quadratic found from eliminating one variable $(3x+1)(1-x)$ or $(3x+1)(x-1)$
	$\left(-\frac{1}{3}, \frac{8}{3}\right)$ oe and $(1, 0)$ oe isw nfww

(ii)	$[m =]\frac{1}{2}$ cao
	$\left(\frac{1}{3}, \frac{4}{3}\right)$
	$y - their\frac{4}{3} = their\frac{1}{2}\left(x - their\frac{1}{3}\right)$
	$6y - 3x = 7$

2 - (0606-W 2017-Paper 2/1-Q4) **-** *INTERSECTION POINTS*

$x-2\left(4-\sqrt{3}x\right)=5\sqrt{3}$	**M1**
$x=\dfrac{5\sqrt{3}+8}{2\sqrt{3}+1}$	**A1**
$x=\dfrac{\left(5\sqrt{3}+8\right)\left(2\sqrt{3}-1\right)}{\left(2\sqrt{3}+1\right)\left(2\sqrt{3}-1\right)}$	**M1**
$x=2+\sqrt{3}$	**A1**
$y=1-2\sqrt{3}$	**A1**
<u>Alternative method</u> $\sqrt{3}\left(5\sqrt{3}+2y\right)+y=4$	**M1**
$y=\dfrac{-11}{\left(2\sqrt{3}+1\right)}$	**A1**
$y=\dfrac{-11\left(2\sqrt{3}-1\right)}{\left(2\sqrt{3}+1\right)\left(2\sqrt{3}-1\right)}$	**M1**
$y=1-2\sqrt{3}$	**A1**
$x=2+\sqrt{3}$	**A1**

3 - (0606-S 2018-Paper 2/2-Q4) **-** *INTERSECTION POINTS*

	Eliminates one of the unknowns	**M1**	
	Simplifies to a correct 3-term quadratic: $2x^2 + 4x - 16$ [= 0] oe or $2y^2 - 6y - 36$ [= 0] oe	**A1**	
	Factorises or solves $(x+4)(x-2)=0$ oe or $(y+3)(y-6)=0$ oe	**M1**	**FT** *their* 3-term quadratic in x or y;
	(2, 6) and (–4, –3) oe	**A2**	Not from wrong working **A1** for either (2, 6) or (–4, –3) or **A1** for $x = 2$ and $x = -4$ or $y = 6$ and $y = -3$

4 - (0606-W 2018-Paper 2/1-Q10) **-** *INTERSECTION POINTS*

(i)	$12-2x=k+6+kx-x^2$ $\rightarrow x^2-(2+k)x+6-k=0$	**M1**	* Equate and collect terms
	$b^2-4ac=0$ $\rightarrow (2+k)^2=4(6-k)$	**M1**	**Dep***
	$k^2+8k-20=0$	**A1**	
	$(k+10)(k-2)=0$	**M1**	
	$k=-10$ or 2	**A1**	
(ii)	$(-4,\ 20)$ and $(2,\ 8)$	**3**	**M1** Insert values of k in equations and solve for x **A1** $x^2+8x+16=0 \rightarrow x=-4 \rightarrow y=20$ **A1** $x^2-4x+4=0 \rightarrow x=2 \rightarrow y=8$

(iii)	Grad of perpendicular $=\dfrac{1}{2}$	**B1**	
	Midpoint $(-1\ ,14)$	**B1**	**FT**
	Eqn $\dfrac{y-14}{x+1}=\dfrac{1}{2}\rightarrow y=\dfrac{1}{2}x+14.5$	**B1**	**FT**

5 - (0606-W 2018-Paper 2/2-Q10) **-** *INTERSECTION POINTS*

(i)	$2k+1-kx=12-4x-x^2$ $x^2+4x-kx+2k-12+1$	**M1**	*
	b^2-4ac $\rightarrow(4-k)^2-4(2k-11)$	**M1**	**Dep***
	$k^2-16k+60$	**A1**	
	$(k-6)(k-10)$	**M1**	
	$k=6$ or10	**A1**	
	OR		
	$k=4+2x$	**M1**	*
	$-4x-2x^2+8+4x+1=12-4x-x^2$ or $2k+1-k\left(\frac{k-4}{2}\right)=12-2(k-4)-\left(\frac{k-4}{2}\right)^2$	**M1**	**Dep***
	x^2-4x+3 or $k^2-16k+60$	**A1**	
	$(x-1)(x-3)$ or $(k-6)(k-10)$	**M1**	
	$x=1$ or $x=3\rightarrow k=$ 6 or 10	**A1**	
(ii)	$k=6\rightarrow[y]=13-6x$	**B1**	**FT**
	$k=10\rightarrow[y]=21-10x$	**B1**	**FT**
		M1	solve
	$x=2$, $y=1$.	**2**	cao

6 - (0606-W 2018-Paper 2/3-Q11) **-** *INTERSECTION POINTS*

(i)	$-5x+k+5=7-kx-x^2$	**M1**	*
	$b^2-4ac\ (=0)\ \rightarrow\ (k-5)^2-4(k-2)\ (=0)$	**M1**	**Dep***
	$k^2-14k+33\quad(=0)$	**A1**	
	$(k-11)(k-3)\ (=0)$	**M1**	**Dep dep** * solve quadratic in k
	$k=11$ and $k=3$	**A1**	
(ii)	$y=-5x+16$ and $y=7-11x-x^2$ $y=-5x+8$ and $y=7-3x-x^2$	**B2**	FT *their k* **B1** for any two correct
	solve one tangent/curve pair for one variable from quadratic equation with repeated root	**M1**	
	$(-3, 31)$ and $(1, 3)$	**A2**	**A1** for one correct point or two correct x values
(iii)	find distance between any two points found in **(ii)**	**M1**	
	$\sqrt{800}$ oe	**A1**	

7 - (0606-W 2019-Paper 2/1-Q4) **-** *INTERSECTION POINTS*

	Eliminate x or y	**M1**	
	$x=\frac{7+5\sqrt{2}}{3+2\sqrt{2}}$ or $y=\frac{1}{3+2\sqrt{2}}$	**A1**	
	Multiply numerator and denominator by $3-2\sqrt{2}$	**M1**	
	$x=1+\sqrt{2}$	**A1**	
	$y=3-2\sqrt{2}$	**A1**	

8 - (0606-W 2019-Paper 2/2-Q4) **-** *INTERSECTION POINTS*

	$kx + 3 = x^2 + 5x + 12$ $\rightarrow x^2 + (5 - k)x + 9 (= 0)$	**M1**	Equate and attempt to simplify to all terms on one side.
	Use discriminant of *their* quadratic.	**M1**	**dep**
	$(5 - k)^2 - 36$ oe	**A1**	Unsimplified
	$k = -1$ and 11	**A1**	Both boundary values
	$-1 < k < 11$	**A1**	Must be in terms of k.
	OR $2x + 5 \sim k$	**M1**	Connect gradients of line and curve
	$y = (2x+5)x + 3 \rightarrow$ $2x^2 + 5x + 3 = x^2 + 5x + 12$	**M1**	Eliminate k and y.
	$x^2 = 9 \rightarrow x = \pm 3$	**A1**	
	$k = 11$ or $k = -1$	**A1**	
	$-1 < k < 11$	**A1**	

9 - (0606-S 2020-Paper 2/3-Q2) **-** *INTERSECTION POINTS*

	Uses $b^2 - 4ac$ $(-4k)^2 - 4(4)(2k+3)$ soi	**M1**	
	Correctly simplifies $16k^2 - 32k - 48$	**A1**	**FT** provided of equivalent difficulty
	$16(k+1)(k-3)$ oe	**M1**	
	CV $-1, 3$	**A1**	
	$-1 < k < 3$	**A1**	**FT** *their* lower CV $< k <$ *their* upper CV

10 - (0606-S 2020-Paper 2/2-Q3) - *INTERSECTION POINTS*

	$x-3=k^2x^2+5kx+1$	**M1**	
	$k^2x^2+(5k-1)x+4=0$ soi	**A1**	
	$(5k-1)^2-4(k^2)(4)$	**M1**	
	$9k^2-10k+1*0$	**M1**	
	Critical values: $\frac{1}{9}$ and 1 soi	**A1**	
	$k<\frac{1}{9}$ or $k>1$	**A1**	

11 - (0606-S 2020-Paper 2/1-Q6) - *INTERSECTION POINTS*

	$3x^2+8x+5=kx-7$	**M1**	
	$3x^2+(8-k)x+12$ [= 0] soi	**A1**	
	$(8-k)^2-4(3)(12)$	**M1**	
	$k^2-16k-80*0$	**M1**	
	Critical values: –4 and 20 soi	**A1**	
	$-4<k<20$	**A1**	Alternative method: **M1** for $k=6x+8$ oe **M1** for $y=(6x+8)x-7$ **M1** for $3x^2+8x+5=(6x+8)x-7$ **A1** for $x=\pm 2$ **A1** for $k=-4$, $k=20$ **A1** for $-4<k<20$

12 - (0606-W 2020-Paper 2/1-Q2) - *INTERSECTION POINTS*

	$x^2+x\left(\frac{2}{3}x-2\right)=9$	**M1**	Eliminate y
	$5x^2-6x-27=0$	**A1**	
	$(x-3)(5x+9)=0$	**M1**	Factorise or formula
	(3, 0)	**A1**	Or both x values
	$\left(-\frac{9}{5},-\frac{16}{5}\right)$	**A1**	

13 - (0606-W 2020-Paper 2/3-Q2) **-** *INTERSECTION POINTS*

	$x^2+3x\left(\frac{4-2x}{5}\right)=4$	**M1**	eliminate x or y
	$x^2-12x+20 \quad (=0)$	**A1**	3 terms on one side if eliminating y $5y^2+16y \quad (=0)$ if eliminating x
	$(x-2)(x-10) \quad (=0)$	**M1**	or $y(5y+16) \quad (=0)$
	$x=2$ or $x=10$ nfww	**A1**	or correct pair
	$y=0$ or $y=-\frac{16}{5}$ nfww	**A1**	

14 - (0606-W 2020-Paper 2/3-Q3) **-** *INTERSECTION POINTS*

	$(k+9)^2-4\times 9 \ (>0)$	**M1**	use b^2-4ac
	$k^2+18k+45 \quad (>0)$	**A1**	
	$k=-15 \quad k=-3$	**A1**	
	$k<-15$ or $k>-3$ no isw mark final answer	**A1**	not 'and' A0 if combined as one statement

15 - (0606-S 2021-Paper 2/2-Q3) **-** *INTERSECTION POINTS*

Uses b^2-4ac : $6^2-4(2k-1)(k+1)$	**M1**	
$-8k^2-4k+40 * 0$ oe	**M1**	**dep** on first **M1** where * is = or any inequality sign condone one sign or arithmetic slip in simplification
Factorises or solves *their* 3-term quadratic expression or equation for CVs e.g. $(5+2k)(8-4k)$ oe	**M1**	
Finds correct CVs: -2.5 oe, 2	**A1**	
$-2.5 \leqslant k \leqslant 2$	**A1**	mark final answer

16 - (0606-S 2021-Paper 2/1-Q7) - *INTERSECTION POINTS*

$4x^2 + kx + k - 2 = 2x + 1$	**M1**	
$4x^2 + (k-2)x + k - 3$ [*0] soi	**A1**	* can be <, >, =, ≤, ≥
$(k-2)^2 - 4(4)(k-3)$	**M1**	
$k^2 - 20k + 52 * 0$	**A1**	
$k = \dfrac{-(-20) \pm \sqrt{(-20)^2 - 4(1)(52)}}{2}$	**M1**	
$k = 10 \pm \sqrt{48}$ oe isw	**A1**	
Alternative (using calculus) $2 = 8x + k$ oe	**(M1)**	
$y = 4x^2 + (2-8x)x + 2 - 8x - 2$ or $y = -4x^2 - 6x$	**(M1)**	
$0 = 4x^2 + 8x + 1$	**(A1)**	
$x = \dfrac{-8 \pm \sqrt{8^2 - 4(4)(1)}}{8}$	**(M1)**	
$x = -1 \pm \dfrac{\sqrt{48}}{8}$ oe	**(A1)**	
for $k = 10 \pm \sqrt{48}$ oe	**(A1)**	

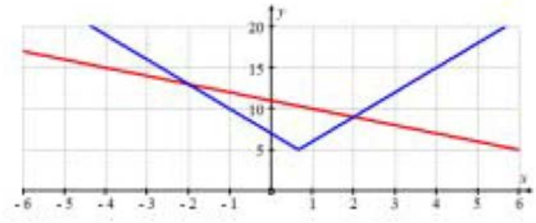
17 - (0606-S 2021-Paper 2/2-Q9) **-** *INTERSECTION POINTS*

Correctly eliminates x or y e.g. $4x^2+3x\left(-\frac{4}{x}\right)+\left(-\frac{4}{x}\right)^2=8$ oe or $4\left(-\frac{4}{y}\right)^2+3\left(-\frac{4}{y}\right)y+y^2=8$ oe	**M1**	
Rearranges to a 3-term quadratic in x^2 or y^2 soi e.g. $4x^4-20x^2+16=0$ or $y^4-20y^2+64=0$	**A1**	
Factorises or solves *their* 3-term quadratic in x^2 or y^2 soi : $(x^2-1)(x^2-4)$ or $(y^2-16)(y^2-4)$	**M1**	
$x^2=1$, $x^2=4$ oe, nfww or $y^2=16$, $y^2=4$ oe, nfww	**A1**	
$x=\pm1$ $x=\pm2$ $y=\mp4$ $y=\mp2$ oe, nfww	**A2**	**A1** for all 4 x values or all 4 y values

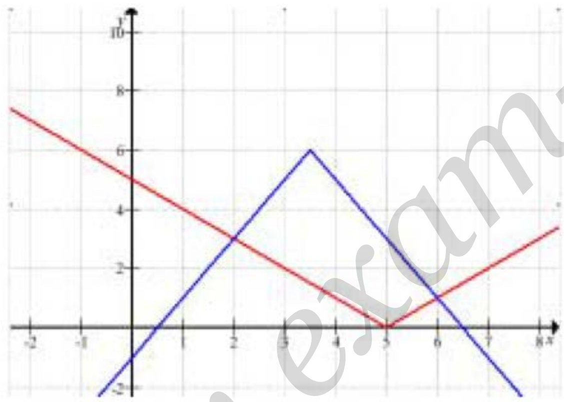
18 - (0606-W 2021-Paper 2/1-Q1) **-** *INTERSECTION POINTS*

$x^2+3x-10-3x-6 * 0$ oe	**M1**	Condone one sign or arithmetic error * can be = or any inequality sign
Critical Values: 4 and –4	**A1**	
$x>4$ or $x<-4$	**A1**	Mark final answer

19 - (0606-W 2021-Paper 2/2-Q1) **-** *INTERSECTION POINTS*

(a)		4	**M1** for ∨ shape of $y = 5 + \lvert 3x - 2 \rvert$ with vertex at $\left(\frac{2}{3}, 5\right)$ **A1** for correct graph with y-intercept $(0, 7)$ **M1** for correct straight line for $y = 11 - x$ **A1** for correct straight line with y-intercept $(0, 11)$
(b)	$x > 2$ or $x < -2$	**B2**	Mark final answer for **B2** **B1 FT** for exactly two correct critical values or correct FT critical values soi, FT dependent on at least M1 in **(a)**

20 - (0606-W 2021-Paper 2/3-Q1) **-** *INTERSECTION POINTS*

(a)		4	**M1** for $y = \lvert x - 5 \rvert$: ∨ shape with vertex at (5, 0) **A1** Correct graph with y-intercept at (0, 5) **M1** for $y = 6 - \lvert 2x - 7 \rvert$: ∧ shape with vertex at (3.5, 6) **A1** Correct graph with y-intercept at (0, −1)
(b)	$x < 2$ or $x > 6$ final answer	**B2**	**B1** for exactly two correct critical values or **B1 FT** for exactly two correct FT critical values soi, FT dependent on at least M1 in **(a)** If the CVs are decimal allow BOD for reasonable values

21 - (0606-W 2021-Paper 2/1-Q6) - *INTERSECTION POINTS*

$(m+1)x^2+(8-m)x+3=0$ oe, soi	**B1**	
$(8-m)^2-4(m+1)(3)$	**M1**	
$m^2-28m+52$ [*0] oe	**M1**	dep on previous **M1**; condone one sign error where * is = or any inequality sign
Factorises or solves *their* 3-term quadratic expression or equation for CVs	**M1**	dep on use of b^2-4ac
Finds correct CVs: 2, 26	**A1**	
$2<m<26$	**A1**	Mark final answer

22 - (0606-S 2022-Paper 2/2-Q3) - *INTERSECTION POINTS*

	Uses b^2-4ac oe: $(k+5)^2-4k(-4)$ [* 0, where * could be = or any inequality sign]	**M1**	
	Forms a correct 3-term expression: $k^2+26k+25$	**A1**	
	Factorises $k^2+26k+25$ or solves $k^2+26k+25=0$ oe	**M1**	**dep** on first **M1**, **FT** *their* 3-term quadratic in k
	Correct critical values -1, -25 soi	**A1**	
	$k\leqslant -25$, $k\geqslant -1$	**A1**	mark final answer

23 - (0606-S 2022-Paper 2/3-Q4) - *INTERSECTION POINTS*

(a)	CVs $\frac{1}{5}$, 6	**M1**	
	$x<\frac{1}{5}$, $x>6$	**A1**	mark final answer
(b)	$(-4k)^2-4(2k+1)(2k-1)$	**M1**	
	$16k^2-4(4k^2-1)$ or $16k^2-16k^2-8k+8k+4$ or better	**A1**	
	$4>0$	**A1**	

24 - (0606-W 2022-Paper 2/1-Q1) - *INTERSECTION POINTS*

	Finds by elimination $3y+\sqrt{7}y=4$ oe or substitutes $x=11-3y$ into $x-\sqrt{7}y=7$ oe OR Finds by elimination $3y+\sqrt{7}y=21+11\sqrt{7}$ oe or substitutes $y=\frac{11-x}{3}$ into $x-\sqrt{7}y=7$ oe	**M1**	
	$y=\frac{4}{3+\sqrt{7}}$ or $x=\frac{21+11\sqrt{7}}{3+\sqrt{7}}$	**A1**	
	$y=\frac{4}{3+\sqrt{7}}\times\frac{3-\sqrt{7}}{3-\sqrt{7}}$ oe or $x=\frac{21+11\sqrt{7}}{3+\sqrt{7}}\times\frac{3-\sqrt{7}}{3-\sqrt{7}}$ oe	**M1**	**FT** *their* value of x or y providing of equivalent difficulty
	$y=6-2\sqrt{7}$ and $x=6\sqrt{7}-7$	**A2**	**A1** for either and no extra values

25 - (0606-W 2022-Paper 2/2-Q1) - *INTERSECTION POINTS*

	$3y-(-5y-4)y=6$ oe or $3\left(\frac{-4-x}{5}\right)-x\left(\frac{-4-x}{5}\right)=6$ or $x+5\left(\frac{6}{3-x}\right)=-4$ oe	**M1**	
	$5y^2+7y-6=0$ or $x^2+x-42=0$	**A1**	
	Factorises *their* 3-term quadratic expression or solves *their* 3-term quadratic equation, e.g. $(5y-3)(y+2)$ [= 0] or $(x-6)(x+7)$ [= 0]	**M1**	
	$x=6$, $y=-2$ $x=-7$, $y=0.6$	**A2**	**A1** for either $x=6$, $x=-7$ or $y=-2$, $y=0.6$ or for an x, y pair from a correct factorisation or correct solving of a correct equation. The method of solution **must** be seen in this case.

26 - (0606-W 2022-Paper 2/3-Q2) - *INTERSECTION POINTS*

	$\frac{dy}{dx} = 2ax - 5$	**B1**	
	$2a \times 2 - 5 = 7$ oe	**M1**	**FT** *their* $\left(\frac{dy}{dx}\Big\|_{x=2}\right) = 7$
	$a = 3$	**A1**	
	$7 \times 2 + b = their\ 4$ or $b = 2 - 4 \times their\ a$	**M1**	**dep** on previous **M1** where *their* 4 is an attempt to evaluate $y = ax^2 - 5x + 2$ using $x = 2$ and *their a*
	$b = -10$	**A1**	
	Alternative		
	$(-12)^2 - 4a(2-b) = 0$ oe	**(B1)**	for use of discriminant on $ax^2 - 12x + 2 - b = 0$
	$144 - 8a + 4a(4a - 22) = 0$ oe or $144 - (b+22)(2-b) = 0$ oe	**(M1)**	Condone one sign or arithmetic error
	$a^2 - 6a + 9\ [=0]$ oe or $b^2 + 20b + 100\ [=0]$ oe	**(A1)**	for correct 3-term quadratic in solvable form
	$a = 3$ and $b = -10$	**(A2)**	**A1** for $a = 3$ or $b = -10$