9/1 Review the following topics from June. Complete problems 1-3.

Quadratics

① solutions → factoring → quadratics

② vertex $f(x) = ax^2+bx+c$

$f(x) = a(x-h)^2+k$; $h = \frac{-b}{2a}$

③ discriminant $= b^2-4ac$

$b^2-4ac > 0$ 2 distinct

$b^2-4ac = 0$ 1 distinct (tangent)

$b^2-4ac < 0$ 0 real

④ inequalities

⑤ substitution

Coordinate Geometry

① midpoint $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

② gradient $m = \frac{y_2-y_1}{x_2-x_1}$

③ distance $d = \sqrt{(y_2-y_1)^2+(x_2-x_1)^2}$

④ parallel/perpendicular $m_1 = m_2$ $m_1 \cdot m_2 = -1$

⑤ line $y = mx+b$

⑥ circle $(x-h)^2+(y-k)^2 = r^2$ $x^2+y^2+2gx+2fy+c = 0$

Sequence/Series

① Binomial expansion

a) Pascal's triangle

b) $nCr = \binom{n}{r} = \frac{n!}{r!(n-r)!}$

c) $(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \ldots + b^n$

② arithmetic sequence/series *common difference $a_n - a_{n-1}$

a) $a_n = a_1+(n-1)d$

b) $S_n = \frac{n}{2}(a_1+a_n) = \frac{n}{2}(a_1+(n-1)d)$

③ geometric sequence/series *common ratio $\frac{r_n}{r_{n-1}}$ *

a) $a_n = a_1 r^{n-1}$

b) $S_n = \frac{a_1(1-r^n)}{1-r}$

c) $S_\infty = \frac{a_1}{1-r}$

1

The function f is such that $f(x) = a^2x^2 - ax + 3b$ for $x \leqslant \frac{1}{2a}$, where a and b are constants.

(i) For the case where $f(-2) = 4a^2 - b + 8$ and $f(-3) = 7a^2 - b + 14$, find the possible values of a and b. [5]

2

Solve the inequality $x^2 - x - 2 > 0$. [3]

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3

(i) Express $x^2 + 6x + 2$ in the form $(x+a)^2 + b$, where a and b are constants. [2]

(ii) Hence, or otherwise, find the set of values of x for which $x^2 + 6x + 2 > 9$. [2]

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(i) Express $2x^2 - 10x + 8$ in the form $a(x+b)^2 + c$, where a, b and c are constants, and use your answer to state the minimum value of $2x^2 - 10x + 8$. [4]

(ii) Find the set of values of k for which the equation $2x^2 - 10x + 8 = kx$ has no real roots. [4]

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9/2 Complete problems 1-6

1

The point A has coordinates (–2, 6). The equation of the perpendicular bisector of the line AB is $2y = 3x + 5$.

(i) Find the equation of AB. [3]

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

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2

Two points have coordinates A(5, 7) and B(9, –1).

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

The line through C(1, 2) parallel to AB meets the perpendicular bisector of AB at the point X.

(ii) Find, by calculation, the distance BX. [5]

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3

The point A has coordinates $(p, 1)$ and the point B has coordinates $(9, 3p + 1)$, where p is a constant.

(i) For the case where the distance AB is 13 units, find the possible values of p. [3]

(ii) For the case in which the line with equation $2x + 3y = 9$ is perpendicular to AB, find the value of p. [4]

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4

A line has equation $y = 2x - 7$ and a curve has equation $y = x^2 - 4x + c$, where c is a constant.
Find the set of possible values of c for which the line does not intersect the curve. [3]

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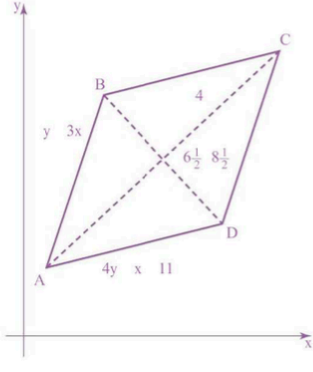
5

The diagram shows a parallelogram ABCD, in which the equation of AB is $y = 3x$ and the equation of AD is $4y = x + 11$. The diagonals AC and BD meet at the point $E\left(6\frac{1}{2}, 8\frac{1}{2}\right)$.
Find, by calculation, the coordinates of A, B, C and D. [9]



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6

Find the set of values of m for which the line $y = mx + 4$ intersects the curve $y = 3x^2 - 4x + 7$ at two distinct points. [5]

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9/3 Complete problems 1-3. Check your answers.

1

(i) Find the coefficient of x in the expansion of $\left(2x - \frac{1}{x}\right)^5$. [2]

(ii) Hence find the coefficient of x in the expansion of $\left(1 + 3x^2\right)\left(2x - \frac{1}{x}\right)^5$. [4]

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2

The sum of the 1st and 2nd terms of a geometric progression is 50 and the sum of the 2nd and 3rd terms is 30. Find the sum to infinity. [6]

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3

A water tank holds 2000 litres when full. A small hole in the base is gradually getting bigger so that each day a greater amount of water is lost.

(i) On the first day after filling, 10 litres of water are lost and this increases by 2 litres each day.

(a) How many litres will be lost on the 30th day after filling? [2]

(b) The tank becomes empty during the nth day after filling. Find the value of n. [3]

(ii) Assume instead that 10 litres of water are lost on the first day and that the amount of water lost increases by 10% on each succeeding day. Find what percentage of the original 2000 litres is left in the tank at the end of the 30th day after filling. [4]

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4) The function f is such that $f(x) = a^2x^2 - ax + 3b$ for $x \leqslant \frac{1}{2a}$, where a and b are constants.

(i) For the case where $f(-2) = 4a^2 - b + 8$ and $f(-3) = 7a^2 - b + 14$, find the possible values of a and b. [5]

$\begin{cases} 4a^2 - b + 8 = 4a^2 + 2a + 3b \\ 7a^2 - b + 14 = 9a^2 + 3a + 3b \end{cases} \Rightarrow \begin{cases} 2a - 8 = -4b \\ 2a^2 + 3a + 4b - 14 = 0 \end{cases}$

1 Solve the inequality $x^2 - x - 2 > 0$. [3] $x < -1$ or $x > 2$

$2a^2 + a - 6 = 0$

$(a+2)(2a-3) = 0$

$a = -2, 3/2$

$b = 3, 5/4$

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2 (i) Express $x^2 + 6x + 2$ in the form $(x + a)^2 + b$, where a and b are constants. [2] $(x+3)^2 - 7$

(ii) Hence, or otherwise, find the set of values of x for which $x^2 + 6x + 2 > 9$. [2]

$x > 1$ or $x < -7$

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3 (i) Express $2x^2 - 10x + 8$ in the form $a(x + b)^2 + c$, where a, b and c are constants, and use your answer to state the minimum value of $2x^2 - 10x + 8$. [4] $2(x - 5/2)^2 - 9/2$

(ii) Find the set of values of k for which the equation $2x^2 - 10x + 8 = kx$ has no real roots. [4]

$-18 < k < -2$

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1 The point A has coordinates (−2, 6). The equation of the perpendicular bisector of the line AB is $2y = 3x + 5$.
(i) Find the equation of AB. [3] $y = -2/3x + 14/3$
(ii) Find the coordinates of B. [3] B(4,2) → find midpoint

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2 Two points have coordinates A(5, 7) and B(9, −1).
(i) Find the equation of the perpendicular bisector of AB. [3] $y = \frac{1}{2}x - 1/2$
The line through C(1, 2) parallel to AB meets the perpendicular bisector of AB at the point X.
(ii) Find, by calculation, the distance BX. [5] BX = 7.33

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3 The point A has coordinates $(p, 1)$ and the point B has coordinates $(9, 3p + 1)$, where p is a constant.
(i) For the case where the distance AB is 13 units, find the possible values of p. [3] $p = -5, 4$
(ii) For the case in which the line with equation $2x + 3y = 9$ is perpendicular to AB, find the value of p. [4] $p = 3$

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4 A line has equation $y = 2x - 7$ and a curve has equation $y = x^2 - 4x + c$, where c is a constant.
Find the set of possible values of c for which the line does not intersect the curve. [3] $c > 2$

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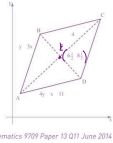
5 The diagram shows a parallelogram ABCD, in which the equation of AB is $y = 3x$ and the equation of AD is $4y = x + 11$. The diagonals AC and BD meet at the point $E(6\frac{1}{2}, 8\frac{1}{2})$.
Find, by calculation, the coordinates of A, B, C and D. [9]



A: (1,3)
C: (12,14) → symmetry
B: (4,12)
D: (9,5)

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6 Find the set of values of m for which the line $y = mx + 4$ intersects the curve $y = 3x^2 - 4x + 7$ at two distinct points. [5] $m < -10, m > 2$

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1 (i) Find the coefficient of x in the expansion of $\left(2x - \frac{1}{x}\right)^5$. [2] 80x

(ii) Hence find the coefficient of x in the expansion of $\left(1 + 3x^2\right)\left(2x - \frac{1}{x}\right)^5$. [4] −40x

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2 The sum of the 1st and 2nd terms of a geometric progression is 50 and the sum of the 2nd and 3rd terms is 30. Find the sum to infinity. [6] 78.1

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3 A water tank holds 2000 litres when full. A small hole in the base is gradually getting bigger so that each day a greater amount of water is lost.
(i) On the first day after filling, 10 litres of water are lost and this increases by 2 litres each day.
(a) How many litres will be lost on the 30th day after filling? [2] 68
(b) The tank becomes empty during the nth day after filling. Find the value of n. [3] 41
(ii) Assume instead that 10 litres of water are lost on the first day and that the amount of water lost increases by 10% on each succeeding day. Find what percentage of the original 2000 litres is left in the tank at the end of the 30th day after filling. [4] 17.8%.

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