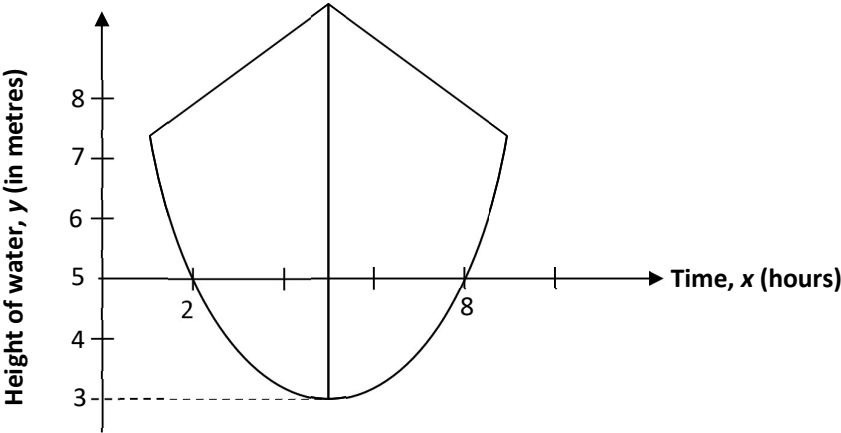




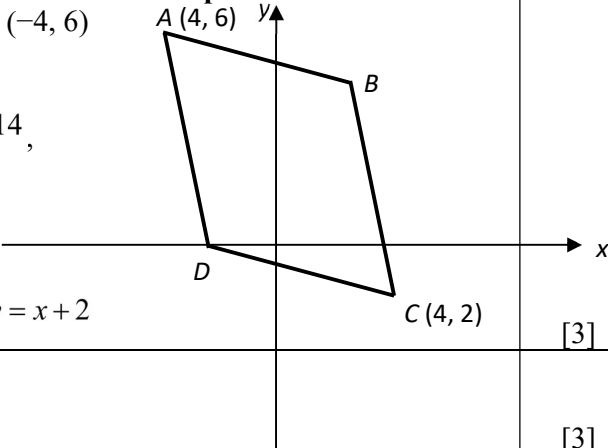
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Topical Revision Worksheet 6

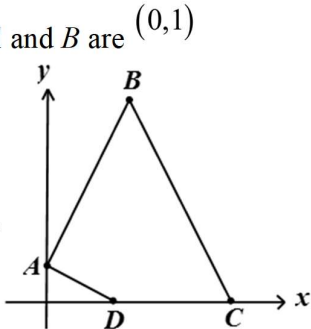
Topic: Coordinate Geometry & Standard Graphs

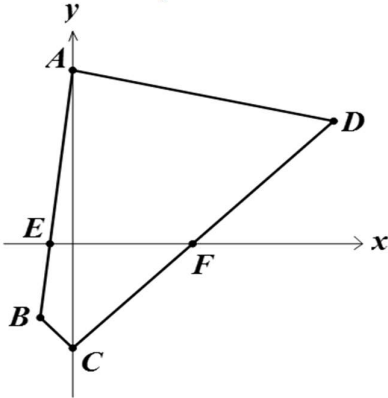
| Question 1 [2008 EOY, Q9]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | marks |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p>The graph below shows part of a quadratic curve which represents the water level, <math>y</math> metres, of a river over a period of time in hours during the operation of a water dam nearby. At 2 pm and 8 pm, the water level was at the recommended level of 5 metres. Let <math>x</math> represents the time in hours since 12pm.</p>  <p>(i) At what time did the water level reaches its minimum?</p> <p><b>Answer:</b> at 5pm</p> | [1]   |
| <p>(ii) Find the equation of the curve, expressing it in the form <math>y = a(x - h)^2 + k</math> where <math>a</math>, <math>h</math> and <math>k</math> are real numbers.</p> <p><b>Answer:</b> <math>y = \frac{2}{9}(x - 5)^2 + 3</math></p>                                                                                                                                                                                                                                                                                 | [4]   |
| <p>(iii) Hence, or otherwise, determine the height of the water level at 12 pm.</p> <p><b>Answer:</b> <math>8\frac{5}{9}</math> metres</p>                                                                                                                                                                                                                                                                                                                                                                                      | [2]   |
| Question 2 [2008 EOY, Q10]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | marks |
| <p>Find the range of values of <math>k</math> if the line <math>2y = x + k</math> intersects the curve <math>y = 2x + \frac{6}{x}</math> more than once.</p> <p><b>Answer:</b> <math>k &lt; -12</math> or <math>k &gt; 12</math></p>                                                                                                                                                                                                                                                                                            | [5]   |



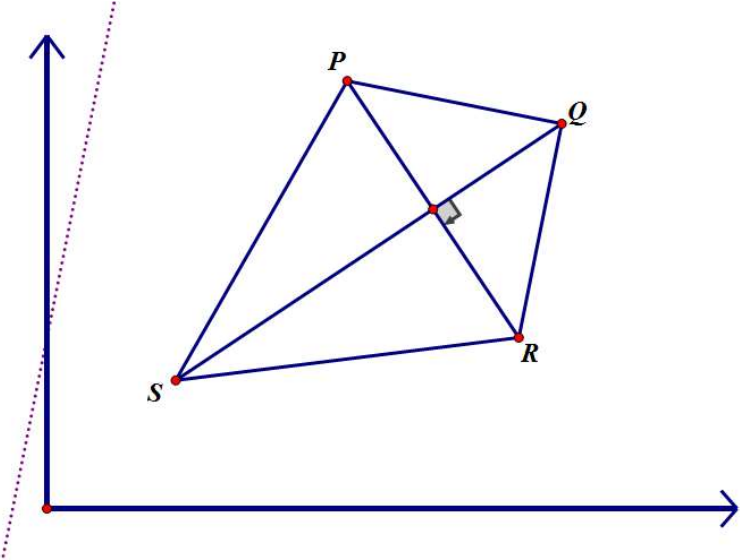
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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Question 5 [2009 EOY, Q1]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | marks                                                                                                                           |
| Find the coordinates of the points at which the straight line $y = -x - 5$ intersects the curve $x^2 + (y + 2)^2 = 5$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | [4]                                                                                                                             |
| <b>Answer:</b> $(-1, -4)$ and $(-2, -3)$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                 |
| Question 6 [2009 EOY, Q9]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | marks                                                                                                                           |
| The equation of a circle $A$ is $x^2 + y^2 + 6x - 4y + 4 = 0$ . Find the coordinates of the centre of circle $A$ and state its radius.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | [3]                                                                                                                             |
| <b>Answer:</b> centre $(-3, 2)$ , radius = 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                 |
| Question 7 [2009 EOY, Q11]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | marks                                                                                                                           |
| <p><b>Solutions to this question by accurate drawing will not be accepted.</b></p> <p>In the figure, <math>ABCD</math> is a rhombus with vertices <math>A(-4, 6)</math> and <math>C(4, -2)</math>.</p> <p>Given that the vertex <math>B</math> lies on the line <math>3x + 2y = 14</math>, calculate the</p> <p>(i) equations of <math>AC</math> and <math>BD</math>,</p> <p><b>Answer:</b><br/>Equation of <math>AC</math>: <math>y = -x + 2</math>    Equation of <math>BD</math>: <math>y = x + 2</math></p> <p>(ii) coordinates of <math>B</math> and <math>D</math>,</p> <p><b>Answer:</b> <math>B = (2, 4)</math>    <math>D = (-2, 0)</math></p> <p>(iii) equation of <math>AB</math>,</p> <p><b>Answer:</b> <math>y = -\frac{1}{3}x + \frac{14}{3}</math></p> <p>(iv) area of the rhombus <math>ABCD</math> and hence find the perpendicular distance from <math>B</math> to the line <math>CD</math>.</p> <p><b>Answer:</b> <math>32 \text{ units}^2</math>; <math>1.6\sqrt{10}</math> or <math>5.06</math> units</p> |  <p>[3]</p> <p>[3]</p> <p>[2]</p> <p>[4]</p> |
| Question 8 [2010 EOY, Q4]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | marks                                                                                                                           |
| Find the range of values of $k$ such that the curve $y + 2x^2 = k(x - 1)$ meets the line $2y = 6kx + 2k^2 - 3$ at two distinct points.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | [5]                                                                                                                             |
| <b>Answer:</b> $-3 < k < 1$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                 |
| Question 9 [2010 EOY, Q5]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | marks                                                                                                                           |
| A quadratic curve is such that it is symmetrical about the line $x = 2k$ , where $k > 1$ . Given that it cuts the $x$ -axis when $x = 2$ , and the maximum value of the curve is $k - 1$ ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | [1]                                                                                                                             |
| (i) explain why the other $x$ -intercept is $4k - 2$ , and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                 |
| (ii) find, in terms of $x$ , $y$ and $k$ , the equation of the curve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | [3]                                                                                                                             |
| <b>Answer:</b> $y = \frac{(x - 2k)^2}{4(1 - k)} + (k - 1)$ or $y = \frac{(x - 2)(x - 4k + 2)}{4(1 - k)}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                 |

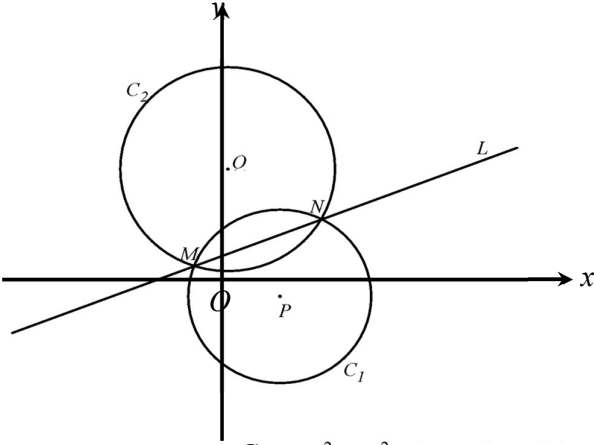
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| <p>(cont'd)</p> <p>Given further that the distance between the two <math>x</math>-intercepts is 6 units, find the coordinates of the <math>y</math>-intercept.</p> <p style="text-align: center;"><math>-\frac{8}{3}</math></p> <p><b>Answer:</b></p>                                                                                                                                                                                                                    | [3]          |
| <p>Question 10 [2010 EOY, Q6]</p> <p>On separate axes, sketch the graphs of</p> <p>(i) <math>y = a(x-h)^2 + k</math> for <math>a &lt; 0</math>, <math>h &lt; 0</math> and <math>k &gt; 0</math></p> <p><b>Answer:</b> [G1] – Open downwards [G1] – Vertex in 2<sup>nd</sup> quadrant</p>                                                                                                                                                                                 | marks<br>[2] |
| <p>(ii) <math>y = k(x-\alpha)(x-\beta)</math> for <math>\alpha\beta &lt; 0</math>, <math> \alpha  =  \beta </math> and <math>k &gt; 0</math></p> <p><b>Answer:</b> [G1] – Open upwards [G1] – Vertex lies on <math>y</math>-axis</p>                                                                                                                                                                                                                                     | [2]          |
| <p>Question 11 [2010 EOY, Q7]</p> <p>The diagram below shows three small identical circles inscribed in a big circle centred at the origin. Each small circle has radius <math>r</math> units (where <math>r &gt; 2</math>) and one of the small circles has its centre at the point <math>(\sqrt{3}, a)</math>. The small circles are arranged with a rotational symmetry about the origin of order 3.</p> <div> </div> | marks<br>[2] |
| <p>(i) By considering the rotational symmetry of the diagram, explain fully why <math>a = 1</math>.</p> <p>(ii) Write down the equation of the bigger circle, in terms of <math>x</math>, <math>y</math> and <math>r</math>.</p> <p><b>Answer:</b> <math>x^2 + y^2 = (r+2)^2</math> or <math>x^2 + y^2 = r^2 + 4r + 4</math></p>                                                                                                                                         | [2]          |
| <p>Given further that <math>r = 3</math>,</p> <p>(iii) find the coordinates of <math>A</math>, the point of contact between the smaller circle and the bigger circle as shown in the diagram, and</p> <p style="text-align: center;"><math>\left(\frac{5\sqrt{3}}{2}, \frac{5}{2}\right)</math></p> <p><b>Answer:</b></p>                                                                                                                                                | [3]          |
| <p>(iv) show that the area of the triangle <math>ABC</math> is <math>\frac{75\sqrt{3}}{4}</math> units<sup>2</sup>.</p>                                                                                                                                                                                                                                                                                                                                                  | [3]          |

| Question 12 [2011 EOY, Q7]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | marks |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p>The variables <math>x</math> and <math>y</math> are related by the equation <math>\sqrt{2^y} = ay + \frac{b}{\sqrt{x}}</math>. A straight line passes through <math>(5, 7)</math> is obtained when <math>\sqrt{2^y x}</math> is plotted against <math>y\sqrt{x}</math>.</p> <p>(i) Given that the gradient of this line is 2, calculate the value of <math>a</math> and of <math>b</math>.</p> <p><b>Answer:</b> <math>a = \text{gradient} = 2</math> and <math>b = -3</math></p>                                                                                                                             | [3]   |
| <p>(ii) Given that this line also passes through <math>(k, 13)</math>, find the value of <math>k</math>.</p> <p><b>Answer:</b> <math>k = 8</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                            | [2]   |
| Question 13 [2011 EOY, Q10a]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | marks |
| <p>A quadratic curve has a minimum point at <math>(1, 5)</math> and passes through <math>(0, 7)</math>.</p> <p>If the curve does not meet the line <math>2(y - mx) = 13</math>, find the range of values of <math>m</math>.</p> <p><b>Answer:</b> <math>-6 &lt; m &lt; -2</math></p>                                                                                                                                                                                                                                                                                                                             | [5]   |
| Question 14 [2011 EOY, Q14]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | marks |
| <p><b>Solutions to this question by accurate drawing will not be accepted.</b></p> <p>The diagram shows the quadrilateral <math>ABCD</math>. The coordinates of <math>A</math> and <math>B</math> are <math>(0, 1)</math> and <math>(3, 7)</math> respectively. Points <math>C</math> and <math>D</math> lie on the <math>x</math>-axis and <math>\angle BAD = 90^\circ</math>.</p> <p>(i) Find the equation of the perpendicular bisector of line <math>AB</math>.</p> <p><b>Answer:</b> <math>y = -0.5x + 4.75</math></p>  |       |
| <p>(ii) Find the equation of <math>AD</math> and hence find the coordinates of <math>D</math>.</p> <p><b>Answer:</b> <math>D(2, 0)</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | [2]   |
| <p>(iii) If the area of <math>\triangle BCD</math> is 14 square units, find the coordinates of <math>C</math>.</p> <p><b>Answer:</b> <math>C(6, 0)</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | [1]   |
| <p>(iv) Find all the possible coordinates of <math>E</math> for which <math>A, B, C</math> and <math>E</math> are vertices of a parallelogram.</p> <p><b>Answer:</b> <math>E(3, -6)</math> or <math>E(9, 6)</math> or <math>E(-3, 8)</math></p>                                                                                                                                                                                                                                                                                                                                                                  | [3]   |

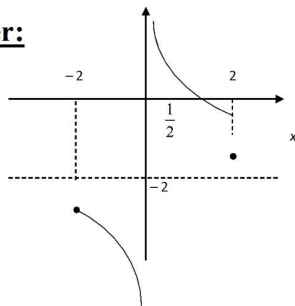
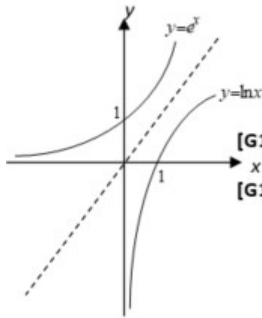
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| Question 15 [2012 EOY, Q5]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | marks                                                  |
| <p>A set of points with coordinates <math>(x, y)</math> lies on the graph whose equation is</p> $\frac{x^2 + 2x}{4} + \left(\frac{y}{2} - 1\right)^2 = 2$ <p>The points are <math>d</math> units from a fixed point <math>P</math>. Find the coordinates of <math>P</math> and the value of <math>d</math>.</p> <p><b>Answer:</b> <math>\therefore P(-1, 2)</math> and <math>d = 3</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | [4]                                                    |
| Question 16 [2012 EOY, Q10 c]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | marks                                                  |
| <p>Find the coordinates of the points of intersection of the line <math>10x + 5y + 4 = 0</math> and the curve <math>4x^2 + y^2 = 16</math>.</p> <p><math>\therefore</math> the points of intersection are <math>\left(\frac{6}{5}, -\frac{16}{5}\right)</math> and <math>\left(-\frac{8}{5}, \frac{12}{5}\right)</math></p> <p><b>Answer:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | [5]                                                    |
| Question 17 [2012 EOY Q11]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | marks                                                  |
| <p><b>Solutions to this question by accurate drawing will not be accepted.</b></p> <p>The diagram shows a quadrilateral <math>ABCD</math> with <math>A(0, 6)</math>, <math>B(-1, -3)</math>, <math>C(0, -4)</math>, and <math>D(9, 5)</math>. <math>AB</math> and <math>CD</math> intersect the <math>x</math>-axis at points <math>E\left(-\frac{2}{3}, 0\right)</math> and <math>F(4, 0)</math> respectively.</p>  <p>(i) Show that angle <math>BAD = 90^\circ</math>.</p> <p>(ii) Find the equation of the perpendicular bisector of <math>AD</math>.</p> <p><b>Answer:</b> <math>y = 9x - 35</math></p> <p>(iii) Given that <math>ABCD</math> is a cyclic quadrilateral, find the exact length of the diameter of the circle passing through <math>A, B, C</math> and <math>D</math>.</p> <p><b>Answer:</b> <math>2\sqrt{41}</math></p> <p>(iv) A point <math>P</math> is such that <math>BCDP</math> is a rectangle, find the coordinates of <math>P</math>.</p> <p><b>Answer:</b> <math>(8, 6)</math></p> <p>(v) Find the area of the quadrilateral <math>AEFD</math>.</p> <p><b>Answer:</b> 39</p> | <p>[2]</p> <p>[3]</p> <p>[2]</p> <p>[2]</p> <p>[2]</p> |

| Question 18 [2013 EOY, Q13]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | marks |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p>(i) The equation of a circle is given by <math>x^2 + y^2 - 10x + 2y + 1 = 0</math>.<br/>Find the centre and the radius of the circle.</p> <p><b>Answer:</b> Centre is (5, -1) and the radius is 5 units</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | [2]   |
| <p>(ii) The tangent to the circle at a point <math>A</math> is parallel to the straight line <math>x - y + 2 = 0</math>.<br/>Find the equation of the diameter of the circle through <math>A</math>.</p> <p><b>Answer:</b> <math>x + y = 4</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | [2]   |
| <p>(iii) The circle is then reflected on the line <math>y = x</math>. State the equation of the new circle formed.</p> <p><b>Answer:</b> <math>(x+1)^2 + (y-5)^2 = 5^2 \Rightarrow x^2 + y^2 + 2x - 10y + 1 = 0</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | [1]   |
| Question 19 [2013 EOY, Q14]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | marks |
| <p>Circles <math>A</math>, <math>B</math> and <math>C</math> are externally tangent to each other and internally tangent to circle <math>D</math>. Circles <math>B</math> and <math>C</math> are congruent. <math>E</math>, <math>F</math> and <math>G</math> are the centres of circles <math>A</math>, <math>B</math> and <math>C</math> respectively. Circle <math>A</math> has radius 1 and passes through <math>O</math>, the centre of circle <math>D</math>. Both circles <math>B</math> and <math>C</math> have radii <math>y</math>. By considering <u>two right-angled triangles</u>, find the radius <math>y</math> of the circle <math>B</math>.</p> <div> </div> <p><b>Answer:</b> <math>\frac{8}{9}</math></p> | [6]   |

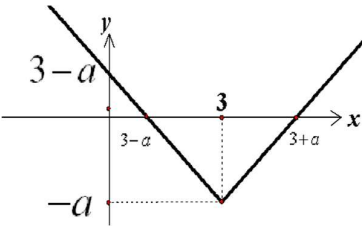
| Question 20 [2013 EOY, Q16]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | marks |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p><b>Solutions to this question by accurate drawing will not be accepted</b></p> <p>The diagram shows a quadrilateral <math>PQRS</math> in which <math>QS</math> is the perpendicular bisector of <math>PR</math>. The mid-point of <math>PR</math> is <math>M</math>.</p> <p>The coordinates of <math>R</math> and <math>M</math> are <math>(11, 4)</math> and <math>(9, 7)</math> respectively. <math>RQ</math> is parallel to the line <math>y = 5x + 4</math> and the equation of <math>SR</math> is <math>x - 8y + 21 = 0</math>.</p>  <p>Find</p> <p>(i) the coordinates of <math>P</math>,</p> <p><b>Answer:</b> <math>P(7, 10)</math></p> | [2]   |
| <p>(ii) the equations of <math>QR</math> and <math>QS</math>,</p> <p><b>Answer:</b></p> <p>Equation of <math>QR</math> is <math>y - 4 = 5(x - 11)</math> or <math>y = 5x - 51</math></p> <p>Equation of <math>QS</math> is <math>2x - 3y + 3 = 0</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | [4]   |
| <p>(iii) the coordinates of <math>Q</math> and of <math>S</math>,</p> <p><b>Answer:</b> <math>Q(12, 9)</math> <math>S(3, 3)</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | [3]   |
| <p>(iv) the area of <math>PQRS</math>.</p> <p><b>Answer:</b> 39 square unit</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | [2]   |

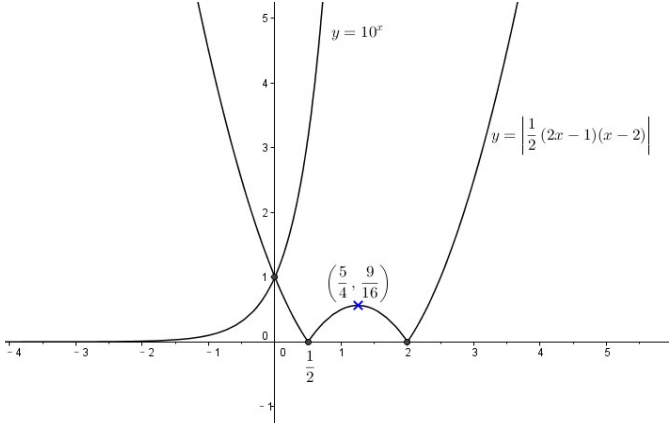
| Question 21 [2014 EOY, Q16]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | marks |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p>The diagram shows two intersecting circles <math>C_1</math> and <math>C_2</math> with centres <math>P</math> and <math>Q</math> respectively. A straight line <math>L</math> passes through <math>M</math> and <math>N</math>, which are the points of intersections of the two circles.</p>  <p>(i) Given that the equation of the circle <math>C_1</math> is <math>x^2 + y^2 - 6x + 4y - 21 = 0</math>, find the coordinates of <math>P</math> and the radius of <math>C_1</math>.</p> <p><b>Answer:</b> <math>P(3, -2)</math>, radius of <math>C_1</math> is <math>\sqrt{34}</math> units.</p> | [3]   |
| <p>(ii) It is also given that the equation of the line <math>L</math> is <math>4y - x = 6</math>, find the coordinates of <math>M</math> and of <math>N</math>.</p> <p><b>Answer:</b> <math>34.3^\circ</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | [4]   |
| <p>(iii) Find the equation of the perpendicular bisector of <math>MN</math>.</p> <p><b>Answer:</b> <math>y = -4x + 10</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | [3]   |
| <p>(iv) Given that the radius of circle <math>C_2</math> is <math>\frac{1}{2}\sqrt{221}</math> units, find the coordinates of <math>Q</math>.</p> <p><b>Answer:</b> <math>\left(\frac{1}{2}, 8\right)</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | [4]   |
| <p>(v) Calculate the area of the quadrilateral <math>PMQN</math>.</p> <p><b>Answer:</b> <math>42\frac{1}{2}</math> units<sup>2</sup></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | [2]   |

| Question 22 [2015 EOY, Q10]                                                                                                                                                                                                                                                                                                 | marks |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p>Two lines <math>l_1</math> and <math>l_2</math> are such that they are parallel, and <math>l_2</math> is the perpendicular bisector of two points <math>A(-2,4)</math> and <math>B(3,-6)</math>.</p> <p>(i) Find the equation of <math>l_2</math>.</p> <p><b>Answer:</b> <math>y = \frac{1}{2}x - \frac{5}{4}</math></p> | [3]   |
| <p>(ii) Hence find the equation of <math>l_1</math> if it passes through the point <math>C(5,8)</math>.</p> <p><b>Answer:</b> <math>y = \frac{1}{2}x + \frac{11}{2}</math></p>                                                                                                                                              | [2]   |
| <p>(iii) Find the distance between the two lines.</p> <p><b>Answer:</b> <math>2.7\sqrt{5}</math> or 6.04 (3 sf.) units</p>                                                                                                                                                                                                  | [4]   |

| Question 1 [2008 EOY, Q13 (i)]                                                                                                                                                                                                                           | marks                                                                                                                                                                                                         |
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| <p>A function <math>f</math> is defined by <math>f(x) = \frac{1}{x} - 2</math>, where <math>-2 \leq x \leq 2, x \neq 0</math>.</p> <p>Sketch the graph of <math>y = f(x)</math>, showing clearly any asymptote(s) and intersection(s) with the axes.</p> | <p>[3]</p> <p><b>Answer:</b></p>  <p>[G1] – correct shape<br/>[G1] – correct asymptotes<br/>[G1] – correct intercepts</p> |
| Question 2 [2008 EOY, Q14]                                                                                                                                                                                                                               | marks                                                                                                                                                                                                         |
| <p>Sketch the graphs of <math>y = \ln x</math> and <math>y = e^x</math> on the same axes.</p>                                                                                                                                                            | <p>[2]</p>  <p>[G1] – correct <math>y = \ln x</math><br/>[G1] – correct <math>y = e^x</math></p> <p><b>Answer:</b></p>    |

| <p>Describe using geometrical transformations how you would obtain the graphs of</p> <p>(a) <math>y = \ln x^2</math>, and</p>                                                                                                                                      | <p>[2]</p> <p><b>Answer:</b></p> <p><math>y = \ln x^2 \Rightarrow y = 2 \ln x</math>. Scale the graph of <math>y = \ln x</math> by a factor of 2 parallel to the y-axis and reflect a copy of the graph about y-axis</p> |
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| <p>(b) <math>y = 2 + e^{-x}</math></p> <p>from the graphs you have drawn above. You are <b>not</b> required to draw them.</p>                                                                                                                                      | <p>[2]</p> <p><b>Answer:</b></p> <p>Reflect the graph of <math>y = e^x</math> about y-axis and translate the graph upwards along the y-axis by 2 units</p>                                                               |
| Question 3 [2009 EOY, Q4]                                                                                                                                                                                                                                          | marks                                                                                                                                                                                                                    |
| <p>Sketch the graphs of <math>y =  x - 2 </math> and <math>y =  x^2 - 3x - 4 </math> for the domain <math>-2 \leq x \leq 5</math> on the same axes and hence state the number of Answers of the equation <math> x - 2  =  x^2 - 3x - 4 </math>.</p>                | <p>[5] <b>Answer:</b></p>                                                                                                                                                                                                |
| Question 4 [2009 EOY, Q8 (ii)]                                                                                                                                                                                                                                     | marks                                                                                                                                                                                                                    |
| <p>Function f is defined by <math>f(x) = 3x + 1</math>.</p> <p>Describe using geometrical transformation(s) how you would obtain the graph of <math>y = -f(x)</math> from the graph of <math>y = f(x)</math>.</p> <p><b>You are not required to draw them.</b></p> | <p>[1]</p> <p><b>Answer:</b></p> <p><math>y = -f(x)</math> is the reflection of <math>y = f(x)</math> in the x-axis.</p>                                                                                                 |

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| Question 5 [2011 EOY, Q8]                                                                                                                                                                                                                                              | marks                                                                                                                                                                                                                                                    |
| <p>(i) Solve the inequality <math> 2x-3  &lt; 5</math>.<br/>Hence state the Answer of <math>-4 &lt;  2x-3  &lt; 5</math>.</p>                                                                                                                                          | <p>[3]<br/><b>Answer:</b><br/><math>-5 &lt; 2x-3 &lt; 5</math>, <math>-1 &lt; x &lt; 4</math></p>                                                                                                                                                        |
| <p>(ii) By sketching appropriate graphs or otherwise determine the number of root(s) for the equation <math>\frac{2}{x} = 2^x</math>.</p>                                                                                                                              | <p>[3]<br/><b>Answer:</b> Graph of <math>y = \frac{2}{x}</math>      Graph of <math>y = 2^x</math><br/>One intersection means one root</p>                                                                                                               |
| Question 6 [2012 EOY, Q4]                                                                                                                                                                                                                                              | marks                                                                                                                                                                                                                                                    |
| <p>(a) Sketch the graph <math>y =  x-3  - a</math> where <math>0 &lt; a &lt; 3</math>, showing clearly the intercepts with the axes.</p>                                                                                                                               | <p>[3]<br/><b>Answer:</b><br/>G1 – correct V-shaped<br/>G1 – V-shape shifted to be right by 3 units.<br/>G1 – V-shape shifted downwards by <math>a</math> units.</p>  |
| <p>(b) Find the range of values of <math>k</math>, in terms of <math>a</math>, for which the equation <math> x-3  - a = k</math></p> <p>(i) has no Answer,<br/>(ii) has two Answers of opposite signs.</p>                                                             | <p>[2]<br/><b>Answer:</b><br/>(i) <math>k &lt; -a</math>      (ii) <math>k &gt; 3-a</math></p>                                                                                                                                                           |
| Question 7 [2012 EOY, Q14 (a)]                                                                                                                                                                                                                                         | marks                                                                                                                                                                                                                                                    |
| <p>Function <math>f</math> is defined by <math>f(x) = \frac{2x+13}{x+3}</math>.</p> <p>(a)<br/>(i) State the largest possible domain for <math>f</math>.</p>                                                                                                           | <p>[1]<br/><b>Answer:</b><br/><math>x \in \mathbb{R}, x \neq -3</math></p>                                                                                                                                                                               |
| <p>(ii) <math>A</math> and <math>B</math> are such that <math>\frac{2x+13}{x+3} = A + \frac{B}{x+3}</math> for all values of <math>x</math> except <math>x = -3</math>.<br/>By long division or otherwise, find the value of <math>A</math> and of <math>B</math>.</p> | <p>[2]<br/><b>Answer:</b><br/><math>\frac{2x+13}{x+3} = \frac{2(x+3)+7}{x+3} = 2 + \frac{7}{x+3}</math><br/><math>A = 2, \quad B = 7</math></p>                                                                                                          |

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| <p>(a)(iii)</p> <p>State precisely a sequence of transformations by which the graph of</p> $y = \frac{2x+13}{x+3}$ <p>may be obtained from the graph of <math>y = \frac{1}{x}</math>.</p>                                                                                                                                                              | <p>[3] <b><u>Answer:</u></b></p> $y = \frac{1}{x}$ <p>(I) <math>\rightarrow y = \frac{1}{x+3}</math></p> <p>Translation of 3 unit in the negative <math>x</math>-direction.</p> <p>(II) <math>\rightarrow y = \frac{7}{x+3}</math></p> <p>Stretching/Scaling parallel to the <math>y</math>-axis by a factor of 7</p> <p>(III) <math>\rightarrow y = 2 + \frac{7}{x+3}</math></p> <p>Translation of 2 unit in the positive <math>y</math>-direction</p> |
| <p>Question 8 [2014 EOY, Q13 (a)]</p>                                                                                                                                                                                                                                                                                                                  | <p>marks</p>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Sketch the graphs of <math>y = 10^x</math> and <math>y = \left  \frac{1}{2}(2x-1)(x-2) \right </math> on the same axes, showing clearly the <math>x</math>-intercepts, <math>y</math>-intercepts and turning points, if any.</p> <p>Hence, state the range of values of <math>x</math> such that</p> $10^x < \left  \frac{1}{2}(2x-1)(x-2) \right $ | <p>[5]</p> <p><b><u>Answer:</u></b></p>  <p>Hence, the range of values of <math>x</math> such that</p> $10^x < \left  \frac{1}{2}(2x-1)(x-2) \right  \text{ is } x < 0.$                                                                                                                                                                                             |