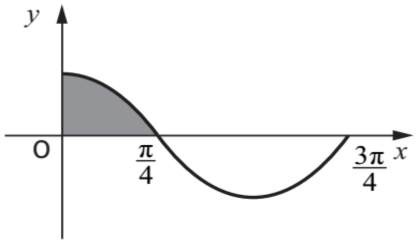
<table>
<tr><th>Y</th><th>Q</th><th>P</th><th>INTEGRATION</th></tr>
<tr><td>15</td><td>12</td><td>1</td><td>
The diagram shows part of the graph of $y = a\cos bx$.

The shaded area is $\frac{1}{2}$ unit^2.



What is the value of $\int_0^{\frac{3\pi}{4}} (a\cos bx)dx$? **2**
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<tr><td>15</td><td>15</td><td>1</td><td>
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The rate of change of the temperature, T °C of a mug of coffee is given by

$$\frac{dT}{dt} = \frac{1}{25}t - k\ ,\ 0 \le t \le 50$$

- t is the elapsed time, in minutes, after the coffee is poured into the mug
- k is a constant
- initially, the temperature of the coffee is 100 °C
- 10 minutes later the temperature has fallen to 82 °C.

Express T in terms of t. **6**
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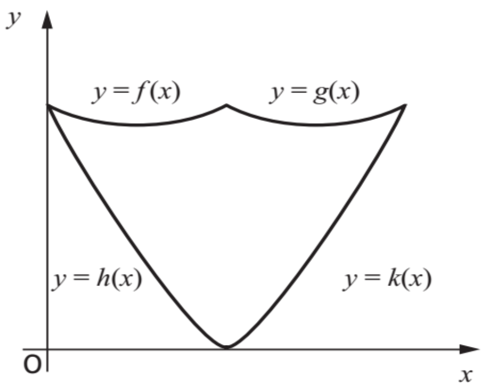
<tr><td>15</td><td>4</td><td>2</td><td>
A wall plaque is to be made to commemorate the 150th anniversary of the publication of “*Alice’s Adventures in Wonderland*”.

The edges of the wall plaque can be modelled by parts of the graphs of four quadratic functions as shown in the sketch.



- $f(x) = \frac{1}{4}x^2 - \frac{1}{2}x + 3$
- $g(x) = \frac{1}{4}x^2 - \frac{3}{2}x + 5$
- $h(x) = \frac{3}{8}x^2 - \frac{9}{4}x + 3$
- $k(x) = \frac{3}{8}x^2 - \frac{3}{4}x$

(a) Find the x-coordinate of the point of intersection of the graphs with equations $y = f(x)$ and $y = g(x)$. **2**

The graphs of the functions $f(x)$ and $h(x)$ intersect on the y-axis.
The plaque has a vertical line of symmetry.

(b) Calculate the area of the wall plaque. **7**
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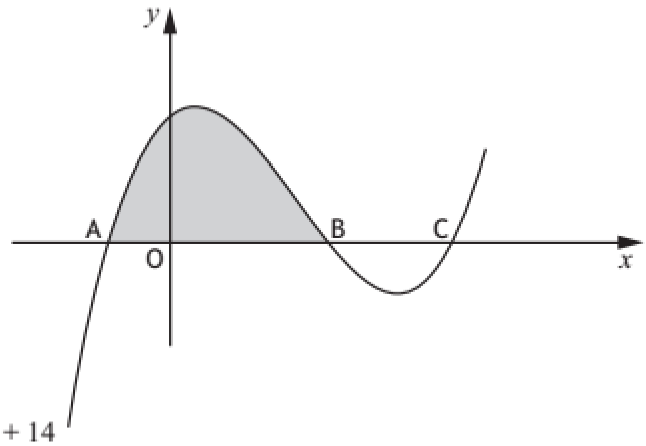
15	7	2	(a) Find $\int(3\cos 2x+1)\,dx$. **2** (b) Show that $3\cos 2x + 1 = 4\cos^2 x - 2\sin^2 x$. **2** (c) Hence, or otherwise, find $\int(\sin^2 x - 2\cos^2 x)\,dx$. **2**
16	5	1	Find $\int 8\cos(4x+1)\,dx$. **2**
16	3	2	(a) (i) Show that $(x+1)$ is a factor of $2x^3 - 9x^2 + 3x + 14$. **2** (ii) Hence solve the equation $2x^3 - 9x^2 + 3x + 14 = 0$. **3** (b) The diagram below shows the graph with equation $y = 2x^3 - 9x^2 + 3x + 14$. The curve cuts the x-axis at A, B and C.  $y = 2x^3 - 9x^2 + 3x + 14$ (i) Write down the coordinates of the points A and B. **1** (ii) Hence calculate the shaded area in the diagram. **4**
16	9	2	For a function f, defined on a suitable domain, it is known that: • $f'(x) = \dfrac{2x+1}{\sqrt{x}}$ • $f(9) = 40$ Express $f(x)$ in terms of x. **4**

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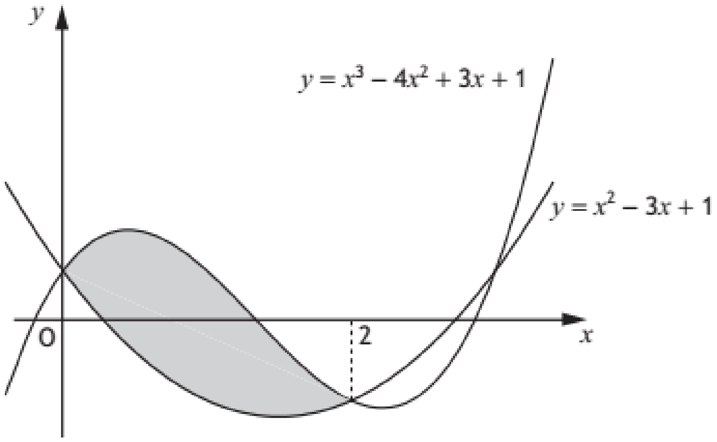
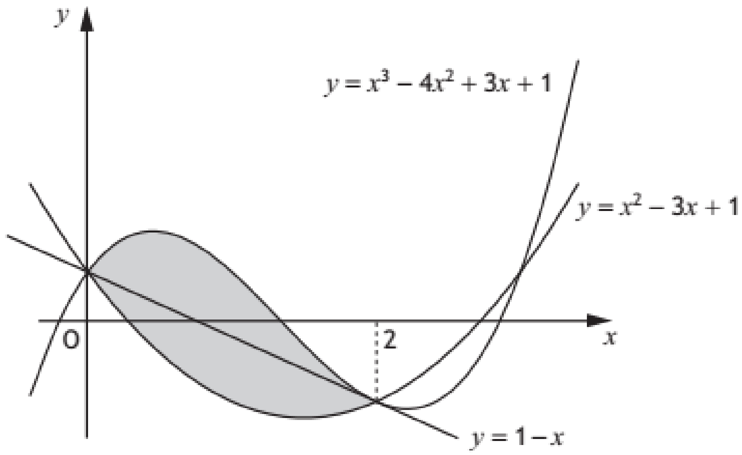
<tr><td>17</td><td>10</td><td>1</td><td>
Two curves with equations $y = x^3 - 4x^2 + 3x + 1$ and $y = x^2 - 3x + 1$ intersect as shown in the diagram.



(a) Calculate the shaded area. **5**

The line passing through the points of intersection of the curves has equation $y = 1 - x$.



(b) Determine the fraction of the shaded area which lies below the line $y = 1 - x$. **4**
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<tr><td>17</td><td>13</td><td>1</td><td>
Find $\int \frac{1}{(5-4x)^{\frac{1}{2}}}\,dx, \; x < \frac{5}{4}$. **4**
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<tr><td>18</td><td>10</td><td>1</td><td>
Given that

- $\frac{dy}{dx} = 6x^2 - 3x + 4$, and
- $y = 14$ when $x = 2$,

express y in terms of x. **4**
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<tr><td>18</td><td>14</td><td>1</td><td>
Evaluate $\int_{-4}^{9} \frac{1}{\sqrt[3]{(2x+9)^2}}\,dx$. **5**
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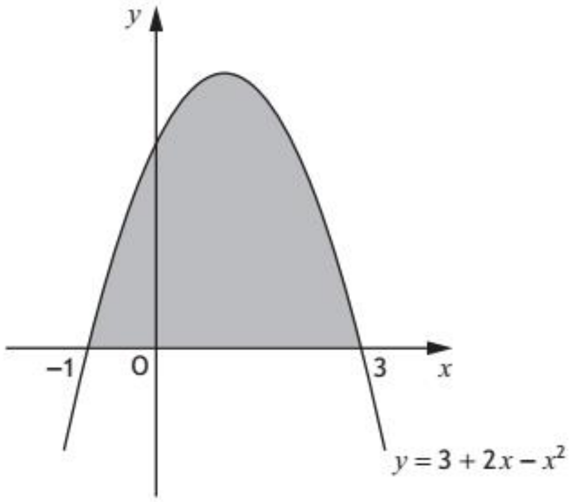
<tr><td>18</td><td>1</td><td>2</td><td>

The diagram shows the curve with equation $y = 3 + 2x - x^2$.



Calculate the shaded area. **4**

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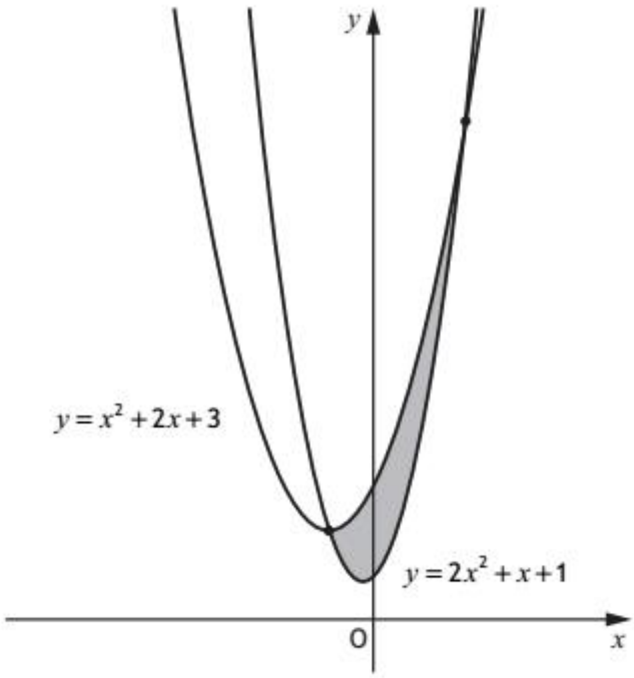
<tr><td>19</td><td>8</td><td>1</td><td>

The graphs of $y = x^2 + 2x + 3$ and $y = 2x^2 + x + 1$ are shown below.



The graphs intersect at the points where $x = -1$ and $x = 2$.

(a) Express the shaded area, enclosed between the curves, as an integral. **1**

(b) Evaluate the shaded area. **3**

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<tr><td>19</td><td>11</td><td>1</td><td>

Evaluate $\int_0^{\frac{\pi}{9}} \cos\left(3x - \frac{\pi}{6}\right) dx$. **4**

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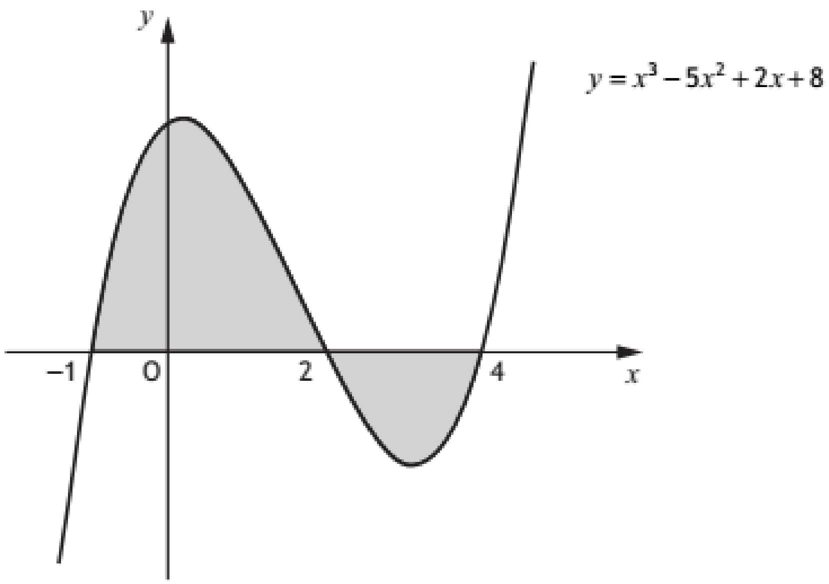
19	17	1	(a) Express $(\sin x-\cos x)^2$ in the form $p+q\sin rx$ where p, q and r are integers. (b) Hence, find $\int(\sin x-\cos x)^2\,dx$.	3 2
19	2	2	Find $\int\left(6\sqrt{x}-4x^{-3}+5\right)dx$.	4
19	13	2	For a function, f, defined on the set of real numbers, $\mathbb{R}$, it is known that • the rate of change of f with respect to x is given by $3x^2-16x+11$ • the graph with equation $y=f(x)$ crosses the x-axis at (7,0). Express $f(x)$ in terms of x.	5
22	6	1	Evaluate $\int_{-5}^{2}(10-3x)^{-\frac{1}{2}}\,dx$.	4
22	4	2	The graph shown has equation $y=x^3-5x^2+2x+8$. The total shaded area is bounded by the curve and the x-axis.  (a) Calculate the shaded area above the x-axis. (b) Hence calculate the total shaded area.	4 3
22	6	2	A curve with equation $y=f(x)$ is such that $\frac{dy}{dx}=1\ \frac{3}{x^2}$, where $x>0$. The curve passes through the point $(3,6)$. Express y in terms of x.	MARKS 5