1. Nov/2022/Paper_9709_11/No.2

The equation of a curve is such that $\frac{dy}{dx} = 12\left(\frac{1}{2}x - 1\right)^{-4}$. It is given that the curve passes through the point $P(6, 4)$.

(a) Find the equation of the tangent to the curve at P. [2]

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(b) Find the equation of the curve. [4]

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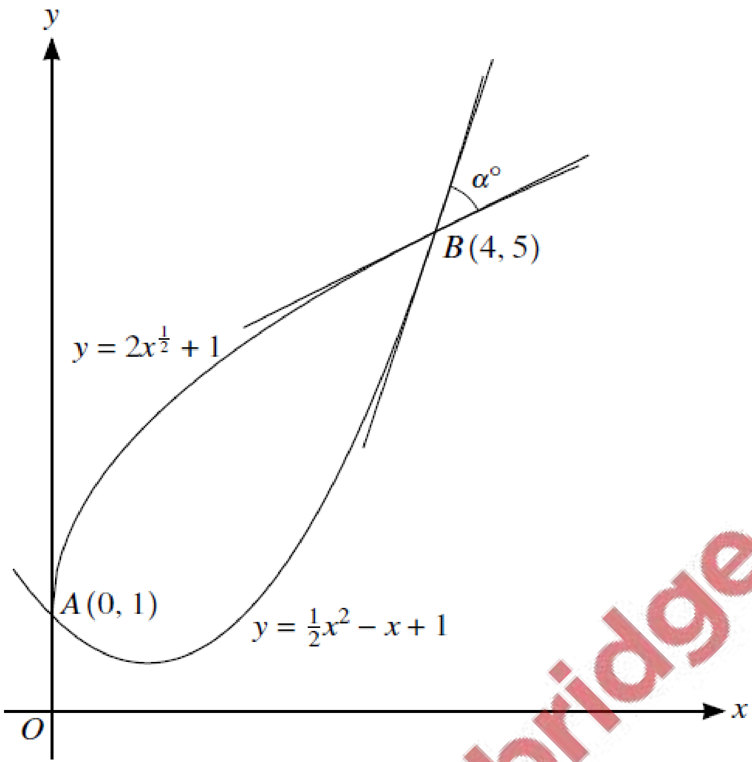
2. Nov/2022/Paper_9709_11/No.3

A curve has equation $y = ax^{\frac{1}{2}} - 2x$, where $x > 0$ and a is a constant. The curve has a stationary point at the point P, which has x-coordinate 9.

Find the y-coordinate of P. [5]

3. Nov/2022/Paper_9709_11/No.10



Curves with equations $y = 2x^{\frac{1}{2}} + 1$ and $y = \frac{1}{2}x^2 - x + 1$ intersect at $A\ (0,\ 1)$ and $B\ (4,\ 5)$, as shown in the diagram.

(a) Find the area of the region between the two curves. [5]

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The acute angle between the two tangents at B is denoted by $\alpha°$, and the scales on the axes are the same.

(b) Find α. [5]

4. Nov/2022/Paper_9709_12/No.8

The equation of a curve is such that $\frac{dy}{dx} = 3x^{\frac{1}{2}} - 3x^{-\frac{1}{2}}$. The curve passes through the point (3, 5).

(a) Find the equation of the curve. [4]

(b) Find the x-coordinate of the stationary point. [2]

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(c) State the set of values of x for which y increases as x increases. [1]

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5. Nov/2022/Paper_9709_12/No.11

(a) Find the coordinates of the minimum point of the curve $y = \frac{9}{4}x^2 - 12x + 18$. [3]

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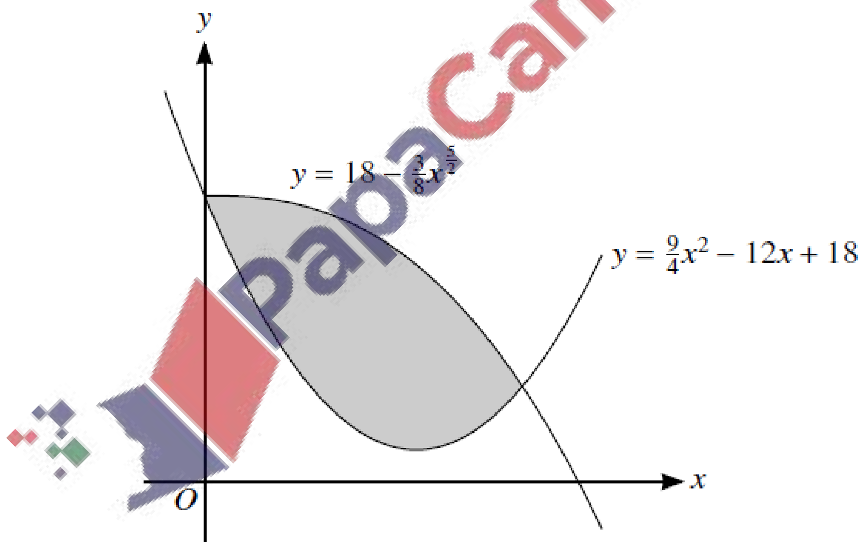

The diagram shows the curves with equations $y = \frac{9}{4}x^2 - 12x + 18$ and $y = 18 - \frac{3}{8}x^{\frac{5}{2}}$. The curves intersect at the points (0, 18) and (4, 6).

(b) Find the area of the shaded region. [5]

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(c) A point P is moving along the curve $y = 18 - \frac{3}{8}x^{\frac{5}{2}}$ in such a way that the x-coordinate of P is increasing at a constant rate of 2 units per second.

Find the rate at which the y-coordinate of P is changing when $x = 4$. [3]

6. Nov/2022/Paper_9709_13/No.4

A large industrial water tank is such that, when the depth of the water in the tank is x metres, the volume $V\,\text{m}^3$ of water in the tank is given by $V = 243 - \frac{1}{3}(9 - x)^3$. Water is being pumped into the tank at a constant rate of $3.6\,\text{m}^3$ per hour.

Find the rate of increase of the depth of the water when the depth is $4\,\text{m}$, giving your answer in cm per minute. [5]

7. Nov/2022/Paper_9709_13/No.7

The curve $y = \mathrm{f}(x)$ is such that $\mathrm{f}'(x) = \dfrac{-3}{(x+2)^4}$.

(a) The tangent at a point on the curve where $x = a$ has gradient $-\frac{16}{27}$.

Find the possible values of a. [4]

(b) Find $f(x)$ given that the curve passes through the point $(-1, 5)$. [3]