


$$\frac{dx}{d\theta} = \left(\frac{1}{5}x + 1\right) \sin^2 2\theta,$$

Solve the differential equation and obtain an expression for x in terms of θ .

[7]

This image shows a full page of primary-ruled paper. It features multiple horizontal rows, each defined by two parallel dotted lines. A large, light-gray watermark with the text "pastpaperbenjamin.com" is oriented diagonally from the bottom-left towards the top-right across the entire page. The background is white, and there are no other markings or text present.

- 7 The variables x and y satisfy the differential equation

$$e^{2x} \frac{dy}{dx} = 4xy^2,$$

and it is given that $y = 1$ when $x = 0$.

Solve the differential equation, obtaining an expression for y in terms of x .

[7]

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7 The variables x and θ satisfy the differential equation

$$\frac{x}{\tan \theta} \frac{dx}{d\theta} = x^2 + 3.$$

It is given that $x = 1$ when $\theta = 0$.

Solve the differential equation, obtaining an expression for x^2 in terms of θ .

[7]

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7 The variables x and y satisfy the differential equation

$$\cos 2x \frac{dy}{dx} = \frac{4 \tan 2x}{\sin^2 3y},$$

where $0 \leq x < \frac{1}{4}\pi$. It is given that $y = 0$ when $x = \frac{1}{6}\pi$.

Solve the differential equation to obtain the value of x when $y = \frac{1}{6}\pi$. Give your answer correct to 3 decimal places. [8]

This image shows a full page of primary-ruled paper. It features multiple sets of horizontal dashed lines for writing. A large, light gray watermark with the text "pastpaperpenguin.com" is oriented diagonally across the page from the bottom-left towards the top-right. The background is white, and there are no margins or other markings present.

- 6 The variables x and y satisfy the differential equation

$$\frac{dy}{dx} = xe^{y-x},$$

and $y = 0$ when $x = 0$.

- (a) Solve the differential equation, obtaining an expression for y in terms of x . [7]

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- (b) Find the value of y when $x = 1$, giving your answer in the form $a - \ln b$, where a and b are integers. [1]

- 6 The variables x and y satisfy the differential equation

$$\frac{dy}{dx} = \frac{1 + 4y^2}{e^x}.$$

It is given that $y = 0$ when $x = 1$.

- (a) Solve the differential equation, obtaining an expression for y in terms of x . [7]

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(b) State what happens to the value of y as x tends to infinity.

[1]

- 8** The variables x and y satisfy the differential equation

$$\frac{dy}{dx} = \frac{y^2 + 4}{x(y + 4)}$$

for $x > 0$. It is given that $x = 4$ when $y = 2\sqrt{3}$.

Solve the differential equation to obtain the value of x when $y = 2$.

[8]

This image shows a full page of primary-ruled paper designed for handwriting practice. It features multiple rows of horizontal lines. Each row consists of three lines: a solid top line, a dashed middle line, and a solid bottom line. This pattern repeats down the entire page. A large, light gray watermark is oriented diagonally from the bottom-left towards the top-right, reading "pastpaperpenquin.co". The background is white, and the lines are black.

9 The variables x and y satisfy the differential equation

$$(x+1)(3x+1)\frac{dy}{dx} = y,$$

and it is given that $y = 1$ when $x = 1$.

Solve the differential equation and find the exact value of y when $x = 3$, giving your answer in a simplified form. [9]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. A large, light gray watermark is oriented diagonally from the bottom left towards the top right, containing the text "pastpaperpenquin.co".

- 7 The variables x and t satisfy the differential equation

$$e^{3t} \frac{dx}{dt} = \cos^2 2x,$$

for $t \geq 0$. It is given that $x = 0$ when $t = 0$.

- (a) Solve the differential equation and obtain an expression for x in terms of t .

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(b) State what happens to the value of x when t tends to infinity.

[1]

- 10** The variables x and t satisfy the differential equation $\frac{dx}{dt} = x^2(1 + 2x)$, and $x = 1$ when $t = 0$.

Using partial fractions, solve the differential equation, obtaining an expression for t in terms of x .

[11]

[illegible]

- 8** At time t days after the start of observations, the number of insects in a population is N . The variation in the number of insects is modelled by a differential equation of the form $\frac{dN}{dt} = kN^{\frac{3}{2}} \cos 0.02t$, where k is a constant and N is a continuous variable. It is given that when $t = 0$, $N = 100$.

- (a) Solve the differential equation, obtaining a relation between N , k and t . [5]

[illegible]

- (b) Given also that $N = 625$ when $t = 50$, find the value of k . [2]

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- (c) Obtain an expression for N in terms of t , and find the greatest value of N predicted by this model. [2]

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It is given that $y = 0$ when $\theta = \frac{1}{4}\pi$.

$$(1+y)(1+\cos 2\theta)\frac{dy}{d\theta} = e^{3y}.$$

Solve the differential equation and find the exact value of $\tan \theta$ when $y = 1$.

[9]

