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Geylang Methodist School (Secondary)
Preliminary Examination 2024

Candidate Name			
Class		**Index Number**	

ADDITIONAL MATHEMATICS
Paper 1

4049 / 01

4 Express/5 Normal(A)

Candidates answer on the Question Paper.

No Additional Materials are required.

2 hours 15 minutes

Setter: **Mr Johney Joseph**

12 August 2024

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces at the top of this page.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an approved scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

The number of marks is given in brackets **[ ]** at the end of each question or part question.
The total score for this paper is **90**.

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90

This document consists of **19** printed pages and **1** blank page.

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Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial expansion

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

where n is a positive integer and $\binom{n}{r} = \frac{n!}{r!(n-r)!} = \frac{n(n-1)\ \ldots\ (n-r+1)}{r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$
$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$
$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$
$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$
$$\sin 2A = 2 \sin A \cos A$$
$$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$$
$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$\Delta = \frac{1}{2} ab \sin C$$

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1 Find the range of values of p for which the curve $y = px^2 + 2(p+2)x + p + 7$ has no x-intercepts. [4]

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2 Given that $y = 3e^{2x} + 2e^{-x}$, and that $\frac{\mathrm{d}^2y}{\mathrm{d}x^2} + \frac{\mathrm{d}y}{\mathrm{d}x} + y = Ae^{2x} + Be^{-x}$, find the values of each of the constants A and B. [5]

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3 The equation of a curve is $y = 4 - 3\cos 2x$.

(a) State the period and amplitude of y. [2]

(b) Sketch the graph of $y = 4 - 3\cos 2x$ for $0 \leq x \leq 2\pi$. [3]

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4 For a particular curve $\frac{d^2y}{dx^2} = 3x - 2$.

The tangent to the curve at the point $A(4, -40)$ is parallel to the line $3x - y = 2$.

Find the equation of the curve. [6]

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5 The triangle ABC is such that its area is $\frac{16+7\sqrt{10}}{2}$ cm^2, the length of AB is $\left(3\sqrt{2}+\sqrt{5}\right)$ cm, and AB is perpendicular to BC.

(a) Find the length, in cm, of BC in the form $\left(a\sqrt{2}+b\sqrt{5}\right)$, where a and b are integers.

[3]

(b) Find an expression, in cm^2, for AC^2 in the form $c+d\sqrt{10}$, where c and d are integers.

[3]

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6 The function f is defined by $f(x) = 3\sin x - 4\cos 2x$, $0 < x < \frac{\pi}{2}$.

(a) Explain with working, whether f is an increasing or a decreasing function. [4]

A point P moves along the curve $y = f(x)$ in such a way that the x-coordinate of P is increasing at the rate of 2 units per second.

(b) Show that the y-coordinate of P increases at the rate of $11\sqrt{3}$ units per second when $x = \frac{\pi}{6}$. [3]

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7 **(a)** By considering the general term in the expansion of $\left(\frac{2}{x^3}-x^2\right)^{10}$, explain why there is no term in x^6. [3]

(b) Find the coefficient of x^6 in the expansion of $\left(\frac{2}{x^3}-x^2\right)^{10}\left(3-\frac{x^6}{8}\right)$. [4]

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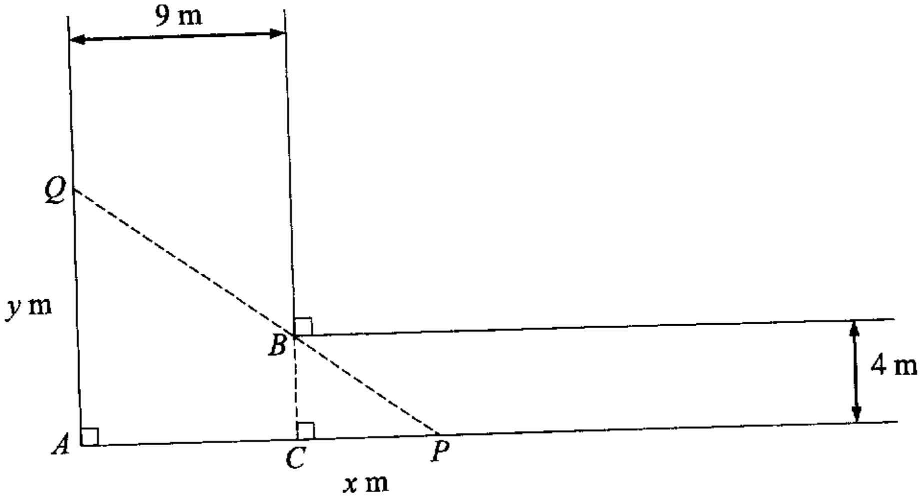
8



The diagram shows the junction of two corridors of width 9 m and 4 m which are at right angles. P and Q are variable points and PBQ is a straight line.

(a) Given that the length of CP is x m and the length of AQ is y m,

show that $y = 4 + \dfrac{36}{x}$. [3]

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(b) Find the least possible area of triangle APQ. [4]

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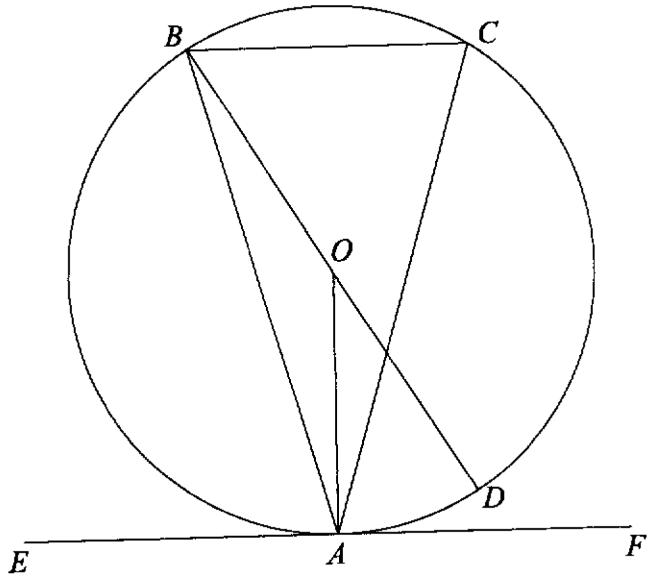
9



In the diagram, A, B, C and D lie on the circumference of a circle with centre O such that $AB = AC$ and EAF is a tangent to the circle at A.

(a) Show that angle BCA = angle CAF. [3]

(b) Show that OA bisects angle BAC. [5]

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10 **(a)** Solve the equation $\log_3(x-8)=2-\log_3 x$. [4]

(b) Given $\log_b a = c$, show that $\log_{\frac{1}{b}} a = -c$. [4]

[Turn Over

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11 The equation of a curve is $y = 16 - ax - x^2$, where a is positive constant.

(a) Given that y can be expressed in the form $25 - (b + x)^2$, where b is a positive constant, find the values of a and b. [4]

(b) State the maximum value of y and the corresponding value of x. [2]

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(c) Find the range of values of x when y is positive. [3]

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12 **(a)** Prove the identity $\sin\left(\frac{\pi}{3}+x\right)-\sin\left(\frac{\pi}{3}-x\right)=\sin x$. [4]

(b) Hence solve the equation $\sin\left(\frac{\pi}{3}+2x\right)-\sin\left(\frac{\pi}{3}-2x\right)-2=4\sin 2x$ for $0\leq x\leq\pi$. [5]

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13 The table shows the experimental values of two variables x and y.

x	0.5	1.0	1.5	2.0	2.5	3
y	6.2	4.7	3.7	2.9	2.2	1.7

It is known that x and y are connected by the equation $y = ab^x$, where a and b are constants.

(a) Express the equation in a form suitable to draw a straight line graph. [1]

(b) On the grid on **page 19**, draw the straight line graph to represent the above data. [3]

(c) Use your graph to estimate the values of a and b. [3]

(d) Use your graph to find the value of y when $x = 0.8$. [2]

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Marking Scheme AM P1 (4049/01)- Prelim 2024

Qn	Answer	Marks	Partial Marks	Guidance
1	$b^2-4ac<0$ $[2(p+2)]^2-4p(p+7)<0$ $4(p^2+4p+4)-4p^2-28p<0$ $4p^2+16p+16-4p^2-28p<0$ $-12p+16<0$ $12p-16>0$ $p>\frac{4}{3}$			
2	$y=3e^{2x}+2e^{-x}$ $\frac{dy}{dx}=6e^{2x}-2e^{-x}$ $\frac{d^2y}{dx^2}=12e^{2x}+2e^{-x}$ $\frac{d^2y}{dx^2}+\frac{dy}{dx}+y=12e^{2x}+2e^{-x}+6e^{2x}-2e^{-x}+3e^{2x}+2e^{-x}$ $=21e^{2x}+2e^{-x}$ $A=21$ $B=2$			
3(a)	Period $=180^\circ$ $(or\ \pi)$ Amplitude $=3$			

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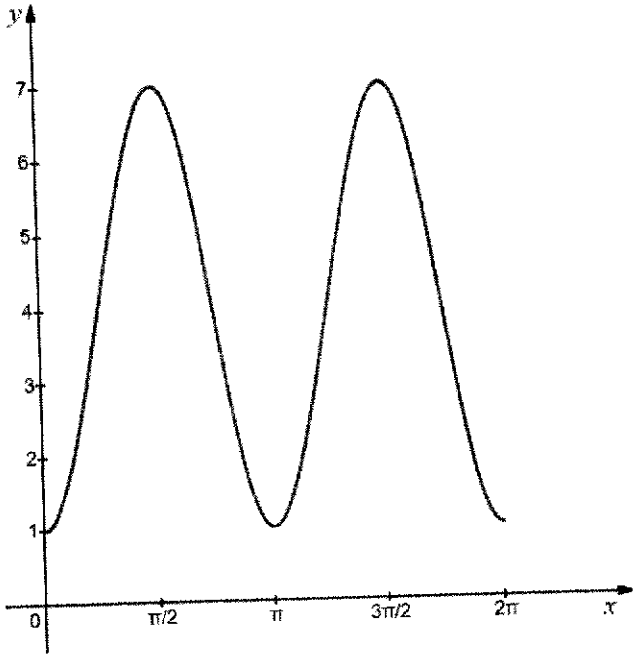
3(b)				
4	$\frac{d^2y}{dx^2}=3x-2$ $\frac{dy}{dx}=\int(3x-2)dx$ $=\frac{3x^2}{2}-2x+c$ $c=-13$ $\frac{dy}{dx}=\frac{3x^2}{2}-2x-13$ $y=\int\frac{3x^2}{2}-2x-13\ dx$ $=\frac{x^3}{2}-x^2-13x+d$ $-40=\frac{(4)^3}{2}-(4)^2-13(4)+d$ $d=-4$ $y=\frac{x^3}{2}-x^2-13x-4$			

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5(a)	$\frac{1}{2}(3\sqrt{2}+\sqrt{5})BC=\frac{16+7\sqrt{10}}{2}$ $BC=\frac{16+7\sqrt{10}}{3\sqrt{2}+\sqrt{5}}$ $=\frac{(16+7\sqrt{10})(3\sqrt{2}-\sqrt{5})}{(3\sqrt{2}+\sqrt{5})(3\sqrt{2}-\sqrt{5})}$ $=\frac{48\sqrt{2}-16\sqrt{5}+21\sqrt{20}-7\sqrt{50}}{13}$ $=\frac{48\sqrt{2}-16\sqrt{5}+42\sqrt{5}-35\sqrt{2}}{13}$ $=\frac{13\sqrt{2}+26\sqrt{5}}{13}$ $=\sqrt{2}+2\sqrt{5}$			
5(b)	$AC^2=(3\sqrt{2}+\sqrt{5})^2+(\sqrt{2}+2\sqrt{5})^2$ $=18+6\sqrt{10}+5+2+4\sqrt{10}+20$ $=45+10\sqrt{10}$			
6(a)	$f'(x)=3\cos x+8\sin 2x$ $\cos x>0$ and $\sin 2x>0$ for $0<x<\frac{\pi}{2}$ $\therefore 3\cos x+8\sin 2x>0$ for $0<x<\frac{\pi}{2}$ $f'(x)>0$ for $0<x<\frac{\pi}{2}$ Hence f is an increasing function			
6(b)	$\frac{dy}{dx}=3\cos\frac{\pi}{6}+8\sin\left(2\times\frac{\pi}{6}\right)$ $=3\times\frac{\sqrt{3}}{2}+8\times\frac{\sqrt{3}}{2}$ $=11\frac{\sqrt{3}}{2}$ $\frac{dy}{dt}=\frac{11\sqrt{3}}{2}\times 2$ $=11\sqrt{3}$			

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7(a)	General term $=\binom{10}{r}\left(\frac{2}{x^3}\right)^{10-r}\left(-x^2\right)^r$ $=\binom{10}{r}2^{10-r}(-1)^r x^{5r-30}$ when $5r-30=6$ $r=\frac{36}{5}$ Hence there is no term in x^6			
7(b)	$5r-30=0$ $r=6$ $\binom{10}{6}2^{10-6}(-1)^6=3360$ $(....+3360+...)\left(3-\frac{x^6}{8}\right)$ Coefficient of $x^6=3360\times\frac{-1}{8}$ $=-420$			

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8(a)	$\frac{4}{y}=\frac{x}{x+9}$ (similar triangles) $xy=4x+36$ $y=4+\frac{36}{x}$			
8(b)	$A=\frac{1}{2}(x+9)y$ $=\frac{1}{2}(x+9)\left(4+\frac{36}{x}\right)$ $=2x+36+\frac{162}{x}$ $\frac{dA}{dx}=2-\frac{162}{x^2}$ when $\frac{dA}{dx}=0$, $2-\frac{162}{x^2}=0$ $2=\frac{162}{x^2}$ $x^2=81$ $x=9$ Minimum Area $=2\times9+36+\frac{162}{9}$ $=72\text{ m}^2$			
9(a)	$\angle BCA=\angle ABC$ (given $AB=AC$) $\angle ABC=\angle CAF$ (Alternate segment theorem) $\therefore \angle BCA=\angle CAF$			
9(b)	$\angle OAE=\angle OAF=90^\circ$ (Radius perpendicular to tangent) $\angle BAE=\angle BCA$ (Alternate segment theorem) $\angle BAE=\angle CAF$ (Using part a) $\angle OAB=\angle OAC$ (Both 90° – Equal angles) Hence OA bisects angle BAC			
10	$\log_3(x-8)+\log_3 x=2$			

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(a)	$\log_3 x(x-8)=2$ $x(x-8)=3^2$ $x^2-8x-9=0$ $(x-9)(x+1)=0$ $x=9$ *or* $x=-1$ (NA) $\therefore x=9$			
10 (b)	$\log_{\frac{1}{b}} a=\dfrac{1}{\log_a\left(\frac{1}{b}\right)}$ $=\dfrac{1}{\log_a 1-\log_a b}$ $=\dfrac{1}{-\log_a b}$ $=\dfrac{-1}{\left(\frac{1}{\log_b a}\right)}$ $=\dfrac{-1}{\left(\frac{1}{c}\right)}$ $=-c$			
11 (a)	$16-ax-x^2=16-\left(x^2+ax\right)$			

	$=16-\left[\left(x+\frac{a}{2}\right)^2-\frac{a^2}{4}\right]$ $=16+\frac{a^2}{4}-\left(\frac{a}{2}+x\right)^2$ $16+\frac{a^2}{4}=25$ $\frac{a^2}{4}=9$ $a^2=36$ $a=6$ $b=\frac{a}{2}$ $=3$ **Alternate solution** $16-ax-x^2=25-\left(b^2+2bx+x^2\right)$ $16-ax-x^2=25-b^2-2bx-x^2$ **B2** $16=25-b^2$ $b^2=9$ $b=3$			
11 (b)	$y=25-(3+x)^2$ Max value of $y=25$ Corresponding value of $x=-3$			
11 (c)	$y>0$ $16-6x-x^2>0$ $x^2+6x-16<0$ $(x+8)(x-2)<0$  $-8<x<2$			
12 (a)	$\sin\left(\frac{\pi}{3}+x\right)-\sin\left(\frac{\pi}{3}-x\right)$			

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	$=\sin\frac{\pi}{3}\cos x+\cos\frac{\pi}{3}\sin x-\left(\sin\frac{\pi}{3}\cos x-\cos\frac{\pi}{3}\sin x\right)$ $=\sin\frac{\pi}{3}\cos x+\cos\frac{\pi}{3}\sin x-\sin\frac{\pi}{3}\cos x+\cos\frac{\pi}{3}\sin x$ $=2\cos\frac{\pi}{3}\sin x$ $=2\times\frac{1}{2}\times\sin x$ $=\sin x$			
12 (b)	$\sin\left(\frac{\pi}{3}+2x\right)-\sin\left(\frac{\pi}{3}-2x\right)=\sin 2x$ $\sin 2x-2=4\sin 2x$ $3\sin 2x=-2$ $\sin 2x=-\frac{2}{3}$ Basic angle $=0.72973$ $2x=\pi+0.72973,\quad 2\pi-0.72973$ $x=1.94,\quad 2.78$			
13 (a)	$\lg y=(\lg b)x+\lg a$			
13 (b)	$\lg y$ | 0.792 | 0.672 | 0.568 | 0.462 | 0.342 | 0.230 Straight line graph			
13 (c)	$\lg a\approx 0.9$ $a\approx 7.94$ $\lg b\approx\frac{0.3-0.5}{2.7-1.8}\approx -0.222$ $b=0.599$			
13 (d)	when $x=0.8$ $\lg y=0.72$ $y=5.23$			

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Geylang Methodist School (Secondary)
Preliminary Examination 2024

Candidate Name			
Class		**Index Number**	

ADDITIONAL MATHEMATICS
Paper 2

4049 / 02

4 Express/5 Normal(A)

Candidates answer on the Question Paper.

No Additional Materials are required.

2 hours 15 minutes

Setters: **Mr Johney Joseph**
Ms Ng Siew Lee

19 August 2024

READ THESE INSTRUCTIONS FIRST

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Mathematical Formulae

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$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial expansion

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

where n is a positive integer and $\binom{n}{r} = \frac{n!}{r!(n-r)!} = \frac{n(n-1)\ldots(n-r+1)}{r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} ab \sin C$$

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1 Solve the equation $2\sin^4 x + 7\cos^2 x = 4$ for $0^\circ \leq x \leq 360^\circ$. [6]

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2 At a certain time, the mass of a radioactive substance was recorded as 150 g. This mass decreased with time due to decay and after t hours, the recorded mass was M g. It is known that M can be modelled by the formula $M = 150e^{-kt}$, where k is a positive constant. After 50 hours, its mass has decreased to 120g.

(a) Estimate the mass of the substance after 120 hours. [4]

(b) Estimate after how many hours one third of the substance is decayed. [3]

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3 A curve has the equation $y = \dfrac{e^{2x}}{x-2}$, where $x > 2$.

(a) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$. [2]

(b) Find the exact value of the coordinates of the stationary point. [3]

(c) Determine the nature of the stationary point. [2]

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4 The line $\frac{x}{a}+\frac{y}{b}=1$, where a and b are positive constants, intersects the x-axis at A and the y-axis at B. The perpendicular bisector of the line joining A and B passes through the point $P(-3,-7)$.

(a) Show that $a^2+6a=b^2+14b$. [6]

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(b) Given that the gradient of the perpendicular bisector of AB is 2, find the values of a and b. [4]

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5 A circle, with centre C, has equation $x^2 + y^2 - 10x - 4y + 25 = 0$.

(a) Find the coordinates of C and the radius of the circle. [4]

(b) Explain why the x-axis is a tangent to the circle. [2]

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(c) The tangent to the circle at the point where $x = 3$ meets the x-axis at the point P. Find the coordinates of P. [3]

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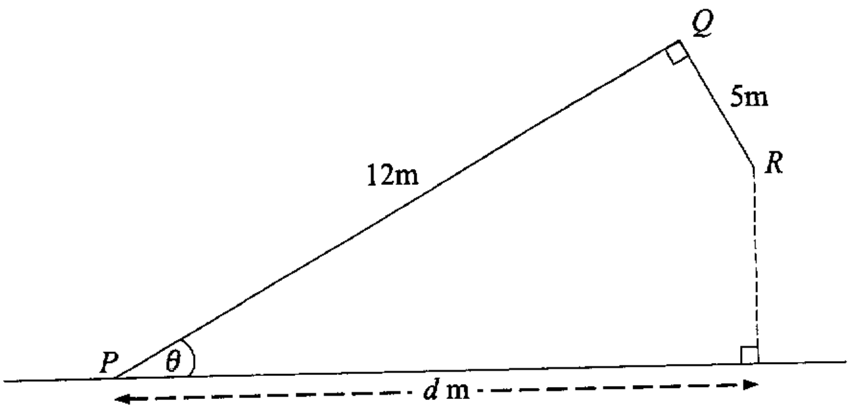

The diagram shows two rods PQ and QR, of lengths 12m and 5m respectively. The rods are fixed at Q such that angle $PQR = 90^\circ$ and hinged at P so as to rotate in a vertical plane. The rod PQ makes an angle θ with horizontal ground.

(a) Obtain an expression, in terms of θ, for d, where d is the horizontal distance of R from P. [3]

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(b) Express d in the form $R\cos(\theta-\alpha)$ where $R>0$ and $0^\circ<\alpha<90^\circ$. [4]

(c) Given $d=10$, find the value of θ. [2]

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7 The expression $x^3 - 4x^2 + ax + b$, where a and b are constants, has a factor of $x + 1$ and leaves a remainder of -60 when divided by $x + 3$.

(a) Find the value of a and of b. [4]

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(b) Using these values of a and b, solve the equation $x^3 - 4x^2 + ax + b = 0$. [4]

(c) Explain how the solution from **part (b)** can be used to solve the equation $9^x + 1 = 4(3^x) - 6(3^{-x})$. [2]

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8 A particle P starts from rest at a fixed point O and moves in a straight line. The velocity, v ms $^{-2}$, of the particle, t s after passing through O is given by
$v = 8t - ct^3$ where c is a positive constant.
The velocity of the particle is 12 ms $^{-1}$ after 2 seconds.

Find

(a) the value of c, [1]

(b) the acceleration after 2 seconds, [2]

(c) the time at which P will change its direction of motion, [2]

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(d) the average speed of the particle in the first 5 seconds. [5]

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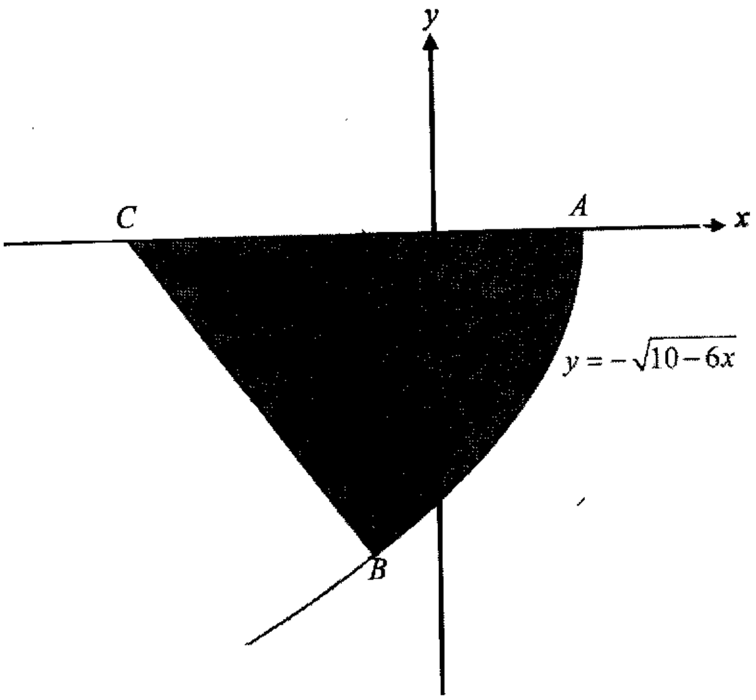
9 The diagram shows part of the curve $y = -\sqrt{10-6x}$ meeting the x-axis at the point A. The normal to the curve at B, where $x = -1$, meets the x-axis at the point C.



(a) Find the equation of the normal at B. [6]

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

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10 **(a)** **(i)** Express $\dfrac{2x^2+3x}{x^2+3x+2}$ in partial fractions. [4]

(ii) Hence evaluate $\displaystyle\int_1^3 \frac{2x^2+3x}{x^2+3x+2}\,\mathrm{d}x$. [3]

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(b) Given that $y = x\ln\left(x^2+3x+2\right)$, find an expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$. [2]

(c) Using the results from **parts (a)(ii)** and **(b)**, evaluate $\int_1^3 \ln\left(x^2+3x+2\right)\mathrm{d}x$. [2]

End of paper

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Marking Scheme AM P2 (4049/02)

Qn	Answer	Marks	Partial Marks	Guidance
1	$2\sin^4 x+7\left(1-\sin^2 x\right)=4$			
	$\sin^2 x=\frac{1}{2}$			
	Basic angle $=45^\circ$			
	$x=45^\circ,135^\circ,225^\circ,315^\circ$			
2(a)	$120=150e^{-50k}$			
	$e^{50k}=\frac{150}{120}$ $k=\frac{\ln\left(\frac{150}{120}\right)}{50}$ $=0.00446287$			
	$M=150e^{-120\times0.00446287}$ $=87.8g$ (3 s.f.)			
2(b)	When M $=\frac{2}{3}\times150=100\,g$ $100=150e^{-0.00446287t}$ $e^{0.00446287t}=\frac{150}{100}$ $t=\frac{\ln\left(\frac{150}{100}\right)}{0.00446287}$ $=90.9$ hours (3 s.f.)			
3(a)	$\frac{dy}{dx}=\frac{2e^{2x}(x-2)-e^{2x}}{(x-2)^2}$			
3(b)	$\frac{2e^{2x}(x-2)-e^{2x}}{(x-2)^2}=0$ $e^{2x}(2x-4-1)=0$ $x=\frac{5}{2}=2.5$ $y=2e^5$ $\left(2.5,\ 2e^5\right)$			
3(c)	(2.5, $2e^5$) is a minimum point.			

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4(a)	A$(a,0)$ and B$(0,b)$ gradient of AB $=-\dfrac{b}{a}$ gradient of perpendicular bisector $=\dfrac{a}{b}$ midpoint of AB is $=\left(\dfrac{a}{2},\dfrac{b}{2}\right)$ gradient of perpendicular bisector $=\dfrac{\frac{b}{2}+7}{\frac{a}{2}+3}$ $\dfrac{a}{b}=\dfrac{b+14}{a+6}$ $a^2+6a=b^2+14b$ (shown)			
4(b)	$a=2b$ $(2b)^2+6(2b)=b^2+14b$ $3b^2-2b=0$ $b(3b-2)=0$ $b=\dfrac{2}{3}$ $a=\dfrac{4}{3}$			
5(a)	$2g=-10,\quad 2f=-4$ centre$(5,2)$ $r=\sqrt{(-5)^2+(-2)^2-25}$ $=2$ units			
5(b)	The centre of the circle is 2 units above the x-axis and the radius of the circle is 2 units. Hence the x-axis is a tangent to the circle.			
5(c)	When $x=3$ $y=2$ $(3,2)$ and $(5,2)$ gradient $=0$ Equation of tangent is $x=3$ $\therefore$ P$(3,0)$			

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Qn	Answer	Marks	Partial Marks	Guidance
6(a)	$PT = 12\cos\theta$ $SR = 5\sin\theta$ $d = 12\cos\theta + 5\sin\theta$			
6(b)	$R = \sqrt{12^2 + 5^2}$ $= 13$ $\alpha = \tan^{-1}\left(\frac{5}{12}\right)$ $= 22.6^\circ$ $d = 13\cos\left(\theta - 22.6^\circ\right)$			
6(c)	$13\cos\left(\theta - 22.6^\circ\right) = 10$ $\theta = 62.3^\circ$			
7(a)	$f(-1) = 0 \rightarrow -a + b = 5$ $f(-3) = -60 \rightarrow -3a + b = 3$ $a = 1,\ b = 6$			
7(b)	$x^3 - 4x^2 + x + 6 = 0$ $(x+1)\left(x^2 - 5x + 6\right) = 0$ $x = -1,\ 2,\ 3$			
7(c)	$\left(3^x\right)^2 + 1 = 4\left(3^x\right) - \frac{6}{3^x}$ $\left(3^x\right)^3 - 4\left(3^x\right)^2 + 3^x + 6 = 0$ The equation can be solved by taking each solution in part b 3^x.			

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Qn	Answer	Marks	Partial Marks	Guidance
8 (a)	$12=8(2)-c(2)^3$ $c=\frac{1}{2}$			
8(b)	$\frac{dv}{dt}=a=8-\frac{3}{2}t^2$ $=8-\frac{3}{2}(2)^2$ $=2\ m/s^2$			
8(c)	$8t-\frac{1}{2}t^3=0$ $t\left(8-\frac{1}{2}t^2\right)=0$ $t^2=16$ $t=4$			
	$s=\int\left(8t-\frac{1}{2}t^3\right)dt$ $=\frac{8t^2}{2}-\frac{t^4}{8}+c$ $s=0, t=0 \Rightarrow c=0$ $s=4t^2-\frac{1}{8}t^4$ $t=4,$ $s=4(4)^2-\frac{1}{8}(4)^4$ $=32$ m $t=5,$ $s=4(5)^2-\frac{1}{8}(5)^4$ $=21.875$m Distance travelled = $=32+32-21.875=42.125$ Average speed = $42.125 \div 5 = 8.425$ m/s			

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Qn	Answer	Marks	Partial Marks	Guidance
9(a)	$\frac{dy}{dx}=-\frac{1}{2}(10-6x)^{-\frac{1}{2}}(-6)$ $=3(10-6x)^{-\frac{1}{2}}$ $x=-1,\ \frac{dy}{dx}=\frac{3}{4},$ $y=-4$ Gradient of normal = $-\frac{4}{3}$ Equation of normal : $y+4=-\frac{4}{3}(x+1)$ $3y=-4x-16$			
9(b)	At $C, y=0, x=-4$ At $A, y=0, x=\frac{5}{3}$ Area of triangle = $\frac{1}{2}\times3\times4=6$ unit^2 Area under curve = $-\int_{-1}^{\frac{5}{3}}-\sqrt{10-6x}\,dx$ $=\left[\frac{(10-6x)^{\frac{3}{2}}}{\frac{3}{2}\times(-6)}\right]_{-1}^{\frac{5}{3}}=\left[0-\frac{4^3}{9}\right]$ Area of shaded region = $6+\frac{4^3}{9}$ $=13\frac{1}{9}$ or 13.1 unit^2			

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Qn	Answer	Marks	Partial Marks	Guidance
10 (a) (i)	$\frac{2x^2+3x}{x^2+3x+2}=2-\frac{3x+4}{x^2+3x+2}$ $\frac{3x+4}{x^2+3x+2}=\frac{A}{x+2}+\frac{B}{x+1}$ $3x+4=A(1+x)+B(x+2)$ $Let\ x=-1, B=1$ $Let\ x=-2, A=2$ $\frac{2x^2+3x}{x^2+3x+2}=2-\frac{2}{x+2}-\frac{1}{x+1}$			
10 (a) (ii)	$\int_1^3 \left(2-\frac{2}{x+2}-\frac{1}{x+1}\right)dx$ $=\left[2x-2\ln(x+2)-\ln(x+1)\right]_1^3$ $=[6-2\ln 5-\ln 4]-[2-2\ln 3-\ln 2]$ $=2.29$			
10 (b)	$\frac{dy}{dx}=\ln(x^2+3x+2)+\frac{x}{x^2+3x+2}\times(2x+3)$ $=\ln(x^2+3x+2)+\frac{2x^2+3x}{2+x-x^2}$			
10 (c)	$\int_1^3\left[\ln(x^2+3x+2)+\frac{2x^2+3x}{x^2+3x+2}\right]dx$ $=\left[x\ln(x^2+3x+2)\right]_1^3$ $\int_1^3 \ln(x^2+3x+2)dx$ $=\left[x\ln(x^2+3x+2)\right]_1^3-\int_1^3\left[\frac{2x^2+3x}{x^2+3x+2}\right]dx$ $=3\ln 20-\ln 6-2.2852$ $=4.91$			