Name:___________________________________ Class_______ Index No____

BUKIT PANJANG GOVERNMENT HIGH SCHOOL
PRELIMINARY EXAMINATION 2020
SECONDARY FOUR EXPRESS
SECONDARY FIVE NORMAL ACADEMIC

ADDITIONAL MATHEMATICS	**4047/1**
Paper 1	Date: 21 August 2020
Candidates answer on the question paper.	Time: 0800 – 1000
No additional materials are required.	Duration: 2h

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all 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.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This paper has a total of 22 printed pages.

Setter: Ms Penny Goh **[Turn over]**

1. ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

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

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

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

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

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

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

1 It is given that $\cos A = -m$, where $m > 0$, and that A is obtuse.
Find the value of each of the following in terms of m.

(a) $\tan A$ [2]

(b) $\cot(180 - A)$ [1]

(c) $\cos\left(\frac{A}{2}\right)$ [3]

2 **(i)** Find the range of values of p for which the line $y = 2x + 5$ will meet the curve $y^2 = px$. [4]

(ii) Hence, on the same axes, sketch the graphs of $y = 2x + 5$ and $y^2 = 5x$. [2]

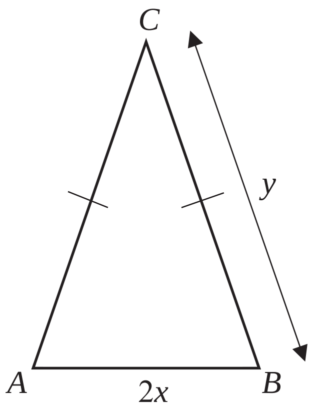
3 The gradient of a curve is $\frac{dy}{dx} = p + \frac{q}{x^3}$, where p and q are constants. The gradient of the normal at $A(1, 4)$ on the curve is -1 and the tangent to the curve at $B(2, 10)$ is $y = 8x - 6$.

(i) Calculate the value of p and of q. [4]

(ii) Using the value of p and of q found in (i), find the equation of the curve. [2]

(iii) Show that gradient increases as x increases. [2]

4 In the diagram below, ΔABC is an isosceles triangle with $BC = y$ cm and $AB = 2x$ cm. It is also given that the perimeter of ΔABC is 50 cm.



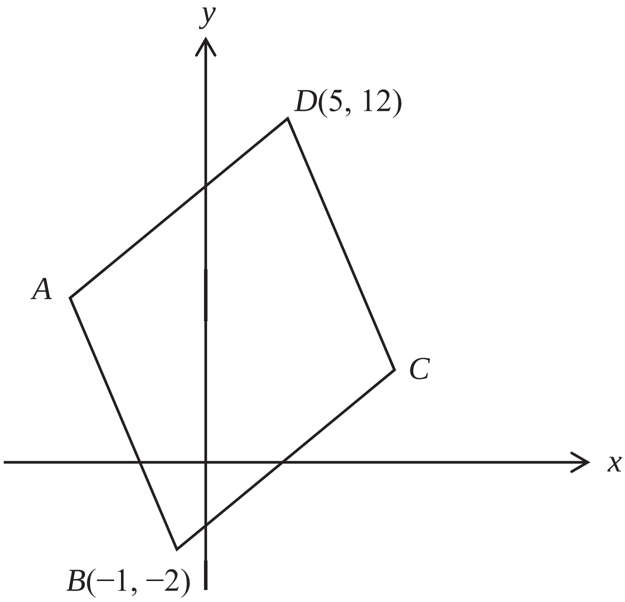
(i) Show that the area of ΔABC is given by $A = x\sqrt{625 - 50x}$. [3]

(ii) Given that x is increasing at a rate of 0.2 cm/s, find the rate at which the area is increasing at the instant when $x = 3$. [3]

5 **(a)** The sum of the coefficients of the first two terms in the expansion, in descending powers of x, of $(1+2x)\left(2x-\frac{1}{x^2}\right)^n$ is 768, where n is a positive integer greater than 2. Show that n is 8. [4]

(b) Find the term containing x^{-7} in the expansion of $\left(2x - \dfrac{1}{x^2}\right)^8$. [4]

6 Solutions to this question by accurate drawing will not be accepted.



In the diagram, *ABCD* is a rhombus. The points *B* and *D* have coordinates (−1, −2) and (5, 12) respectively.

(i) Show that the equation of *AC* is $7y = -3x + 41$. [4]

(ii) Given that a line $5y = 3x + 55$ passes through point *A*, find the coordinates of *A*. [2]

(iii) Find the coordinates of *C*. [2]

(iv) Find the area of the rhombus *ABCD*. [2]

(v) If point *E* lies on *BD* produced such that *BD* : *DE* = 2 : 3, find the coordinates of *E*. [2]

7 **(a)** Given that $3^{n+2} - 3^{n} = \dfrac{5^{n+1}}{25^{n}}$, find the value of 15^{n}. [3]

(b) Without using a calculator, find the root of the equation $x\sqrt{80} = \sqrt{20} - x\sqrt{48}$ in the form $\dfrac{a + b\sqrt{c}}{4}$. [3]

8 A particle moves in a straight line from a point O such that t seconds after leaving O, its velocity, v m/s, is given by $v = 5(4t-1)^2 - 125$. Find

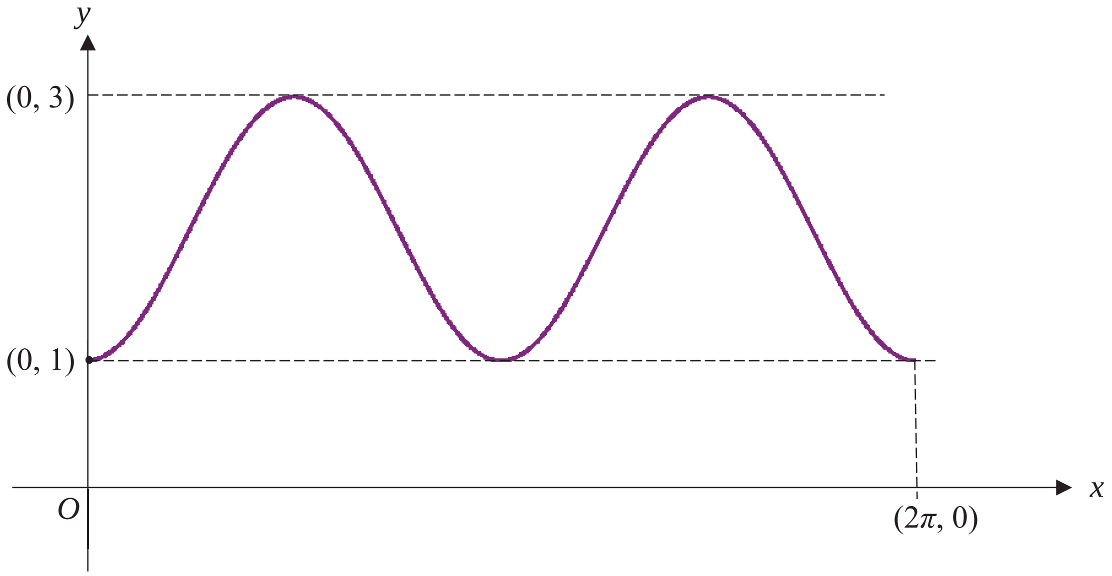
(i) the initial acceleration of the particle, [2]

(ii) the value of t at which the particle is instantaneously at rest, [2]

(iii) the minimum velocity of the particle. [1]

(iv) the distance travelled by the particle in the second second, [5]

9



The diagram shows the curve $y = a + b\cos(cx)$ for $0 \le x \le 2\pi$.

(i) Write down the value of a, of b and of c. [3]

(ii) Sketch, on the same diagram, the graph of $y = \sin\left(\frac{x}{2}\right) + 2$ for $0 \leq x \leq 2\pi$. [3]

(iii) Deduce the largest integer value of k such that $a + b\cos(cx) > \sin\left(\frac{x}{2}\right) + k$ for $0 \leq x \leq 2\pi$. [1]

10 A curve has the equation $y = x^3e^{2x}$.

Find the x-coordinates of the stationary points and determine the nature of each point [7]

11 In an experimental environment, the population of a type of insect was observed. Over a period of 10 days from the start of the experiment, the number of insects decreased from 1100 to 600. The insect population is given by the formula $P = A + 900e^{kt}$, where A and k are constants and t is the number of days from the start of the experiment.

(a) Find the value of A and of k. [3]

(b) Explain why the population of the insects approaches the value of A after a long period of time. [1]

End of Paper

Name:__________________________________ **Class**_______ **Index No**____

BUKIT PANJANG GOVERNMENT HIGH SCHOOL

PRELIMINARY EXAMINATION 2020

SECONDARY FOUR EXPRESS

SECONDARY FIVE NORMAL ACADEMIC

ADDITIONAL MATHEMATICS	**4047/2**
Paper 2	Date: 26 August 2020
Candidates answer on the question paper.	Time: 08 00 – 10 30
Additional materials: Graph paper	Duration: 2h 30 min

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen on both sides of the paper.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all 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.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 100.

This paper has a total of 21 pages.

Setter: Mrs Chiu H W

[Turn over]

1. ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

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

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

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

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

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

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

1 The expression $f(x) = x^3 + ax^2 + bx + c$ leaves the same remainder, R, when it is divided by $x + 2$ and when it is divided by $x - 2$.

(i) Evaluate b. [2]

$f(x)$ also leaves the same remainder, R, when divided by $x - 1$.

(ii) Evaluate a. [2]

$f(x)$ leaves a remainder of 4 when divided by $x - 3$.

(iii) Evaluate c. [1]

2 The equation of a polynomial is given by $p(x) = 2x^3 - x^2 + 16x - 8$.

(i) Show that $2x - 1$ is a factor of $p(x)$. [1]

(ii) Show that $p(x) = 0$ has only one real root. [3]

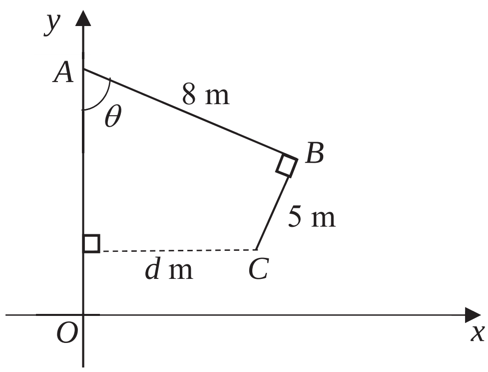
(iii) Express $\dfrac{x^2+2x+40}{2x^3-x^2+16x-8}$ in partial fractions. [5]

(iv) Hence find $\displaystyle\int \frac{x^2+2x+40}{2x^3-x^2+16x-8}\,dx$ [3]

3 (a) Solve the equation $\log_2(x+2)-\log_{\sqrt{2}}(x-1)=3$. [5]

(b) The curve $y = ax^b + 7$, where a and b are constants, passes through the points $(2, 47)$, $(-3, -128)$ and $(5, k)$. Find the values of a, b and k. [5]

4 The diagram shows a rod AB which is hinged at A, and a rod BC which is fixed at B such that angle $ABC = 90°$. The rods can move in the xy-plane with origin O where the x and y axes are horizontal and vertical respectively. The rod AB can turn about A and is inclined at an angle θ to the y-axis, where $0° \leq \theta \leq 180°$. The lengths of AB and BC are 8 m and 5 m respectively.



Given that C is d m from the y-axis,

(i) find the values of a and b for which $d = a \sin \theta - b \cos \theta$ [2]

Using the values of a and b found in part (i),

(ii) express d in the form $R \sin (\theta - \alpha)$, where $R > 0$ and $0° < \alpha < 90°$. [3]

Hence

(iii) explain if it is possible for d to be 10 m, [2]

(iv) find the value(s) of θ when $d = 6$ m. [2]

5 (a) It is given that $\mathrm{f}(x) = \ln \sqrt[3]{\dfrac{5+x}{5-x}}$.

(i) Find $\mathrm{f}'(x)$ and $\mathrm{f}''(x)$. [4]

(ii) Hence determine the range of values of x for which both $f'(x)$ and $f''(x)$ are positive. [4]

(b) Show that $\frac{d}{dx}\left[4\sin^2\left(\frac{x}{2}+\pi\right)\right]=k\sin x$ where k is a constant. [3]

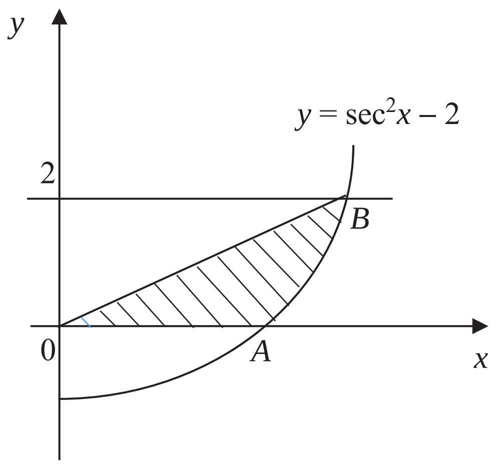
6 (i) Prove that $\dfrac{\operatorname{cosec}^2\theta - 2}{\operatorname{cosec}^2\theta} = \cos 2\theta$. [3]

(ii) Hence solve the equation $\dfrac{\operatorname{cosec}^2\theta - 2}{\operatorname{cosec}^2\theta} + \dfrac{3}{\operatorname{cosec} 2\theta} = 0$ for $0 < \theta < 5$. [4]

7 A quadratic equation with integer coefficients has roots α and β.

Given that $\alpha - \beta = 2$ and $\alpha^2 - \beta^2 = 3$, find the quadratic equation **without** calculating the values of α and β. [5]

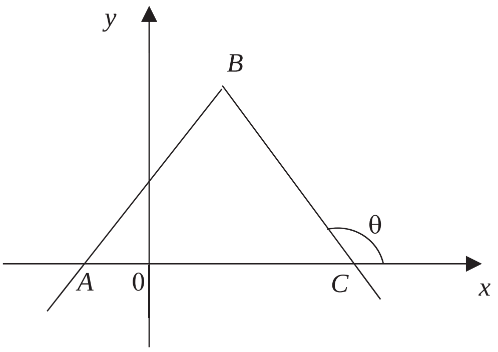
8 The diagram shows the line $y = 2$ and part of the curve $y = \sec^2 x - 2$. The curve intersects the x-axis at the point A and line $y = 2$ at the point B. A straight line through the origin intersects the curve at point B.



(i) Find the x-coordinate of A and B. Express your answers in terms of π. [3]

(ii) Determine the area of the shaded region bounded by the curve, the x-axis and the line OB. Give your answer as exact value. [5]

9



The diagram shows part of the graph of $y = 3 - |1 - 2x|$.

(i) Find the coordinates of the points *A*, *B* and *C*. [3]

(ii) The line *BC* makes an angle θ with the *x*-axis. Find the value of tan θ. [1]

(iii) Solve the equation $3-|1-2x|=2x-x^2$. [4]

(iv) Without solving for x, explain why there is no real solution for the equation stated below.

$$3-|1-2x|=4+x^2$$ [3]

10 A circle, C_1, and another circle, C_2, pass through the same point $(0, -3)$.

(i) Given that the radius of both circles is $\sqrt{5}$ units and their centres lie on the line $y = x$, find the equations of C_1 and C_2. [5]

(ii) Circle, C_1 and circle, C_2, intersect at a point on the x-axis. Find the x-coordinate of the point of intersection of C_1 and C_2 on the x-axis . [3]

(iii) Given that a point P lies on circle, C_1 and another point Q lies on circle, C_2, find the greatest distance between P and Q. [3]

11 The table below shows experimental values of two variables, x and y.

x	1	2	3	4	5
y	0.50	2.12	3.18	4.00	4.70

It is known that x and y are related by the equation $y = \frac{a}{\sqrt{x}} + b\sqrt{x}$ where a and b are constants.

(i) Plot $\frac{y}{\sqrt{x}}$ against $\frac{1}{x}$ and draw a straight line. [3]

(ii) Use your graph to estimate the value of each of the constants a and b. [3]

(iii) By drawing another straight line on the graph in part (i), solve the following simultaneous equations. [5]

$$y = \frac{a}{\sqrt{x}} + b\sqrt{x}$$

$$y\sqrt{x} = 3$$

– END –

1 (i) $b = -4$

(ii) $a = -1$

(iii) $c = -2$

2 (i) Show $p\left(\frac{1}{2}\right) = 0$

(ii) $x = \frac{1}{2}$

$\left(x^2 + 8\right) = 0$ no real solution

(iii) $\frac{5}{2x-1} - \frac{2x}{x^2+8}$

(iv) $\frac{5}{2}\ln(2x-1) - \ln\left(x^2+8\right) + c$

3 (a) $x = 1.68$, 0.447 (rejected)

(b) $a = 5$, $b = 3$, $k = 632$

4 (i) $d = 8\sin\theta - 5\cos\theta$

(ii) $d = \sqrt{89}\ \sin(\theta - 32.0°)$

(iii) Max value of $d = \sqrt{89} = 9.43$

when $\sin(\theta - 32.0°) = 1$. So not possible for d to be 10 m.

(iv) 71.5° , 172.5°

5 (a) (i) $f'(x) = \frac{10}{3\left(25-x^2\right)}$

$f''(x) = \frac{20x}{3\left(25-x^2\right)^2}$

(ii) $0 < x < 5$

(b) $\frac{d}{dx}\left[4\sin^2\left(\frac{x}{2}+\pi\right)\right] = 2\sin x$

6 (ii) 1.41 , 2.98 , 4.55

7 $16x^2 - 24x - 7 = 0$

8 (i) x-coordinate of $A = \frac{\pi}{4}$

x-coordinate of $B = \frac{\pi}{3}$

(ii) $\left(1 - \sqrt{3} + \frac{\pi}{2}\right)$ units^2

9 (i) $A(-1, 0)$, $B\left(\frac{1}{2}, 3\right)$

$C(2, 0)$

(ii) $\tan\theta = -2$

(iii) $x = 2$

(iv) Max value of $3 - |1-2x|$ is 3 when $x = \frac{1}{2}$.

Min value of $4 + x^2$ is 4 when $x = 0$.

The curve and line do not intersect so there is no real solution.

10 (i) $C_1 : (x+1)^2 + (y+1)^2 = 5$

$C_2 : (x+2)^2 + (y+2)^2 = 5$

(ii) $x = -3$

(iii) $\sqrt{2} + 2\sqrt{5}$ or 5.89 units

11 (ii) $a = -2$, $b = 2.5$

(iii) Draw the line $\frac{y}{\sqrt{x}} = \frac{3}{x}$.

Point of intersection is

(0.5 , 1.5)

$x = 2$, $y = 2.12$

Name: Solution Class______ Index No____

BUKIT PANJANG GOVERNMENT HIGH SCHOOL
PRELIMINARY EXAMINATION 2020
SECONDARY FOUR EXPRESS
SECONDARY FIVE NORMAL ACADEMIC

ADDITIONAL MATHEMATICS	**4047/1**
Paper 1	Date: 21 August 2020
Candidates answer on the question paper.	Time: 0800 – 1000
No additional materials are required.	Duration: 2h

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all 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.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This paper has a total of 22 printed pages.

Setter: Ms Penny Goh **[Turn over]**

1. ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

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

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

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

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

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

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

1 It is given that $\cos A = -m$, where $m > 0$, and that A is obtuse.
Find the value of each of the following in terms of m.

(a) $\tan A$ [2]

$$\text{opp.} = \sqrt{1-m^2} \quad \text{[M1]}$$

$$\tan A = -\frac{\sqrt{1-m^2}}{m} \quad \text{[A1]}$$

(b) $\cot(180 - A)$ [1]

$$= \frac{1}{\tan(180-A)}$$

$$= \frac{m}{\sqrt{1-m^2}} \quad \text{[B1]}$$

(c) $\cos\left(\frac{A}{2}\right)$ [3]

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

$$-m = 2\cos^2\frac{A}{2} - 1 \quad \text{[M1]}$$

$$\cos^2\frac{A}{2} = \frac{1-m}{2} \quad \text{[M1]}$$

$$\cos\frac{A}{2} = \sqrt{\frac{1-m}{2}} \quad \text{or} \quad -\sqrt{\frac{1-m}{2}} \text{ (rejected)}$$

[A1]

2 **(a)** Find the range of values of p for which the line $y = 2x + 5$ will meet the curve $y^2 = px$. [4]

$y = 2x + 5 \quad — ①$

$y^2 = px \quad — ②$

Sub ① into ②,

$(2x+5)^2 = px$

$4x^2 + 20x + 25 = px$

$4x^2 + 20x - px + 25 = 0$ [M1]

$a = 4, \quad b = 20 - p, \quad c = 25$

$b^2 - 4ac \geq 0$

$(20-p)^2 - 4(4)(25) \geq 0$ [M1]

$400 - 40p + p^2 - 400 \geq 0$

$p^2 - 40p \geq 0$

$p(p-40) \geq 0$ [M1]

$p \leq 0$ or $p \geq 40$ [A1]

(ii) Hence, on the same axes, sketch the graphs of $y = 2x + 5$ and $y^2 = 5x$. [2]

$y = 2x+5$

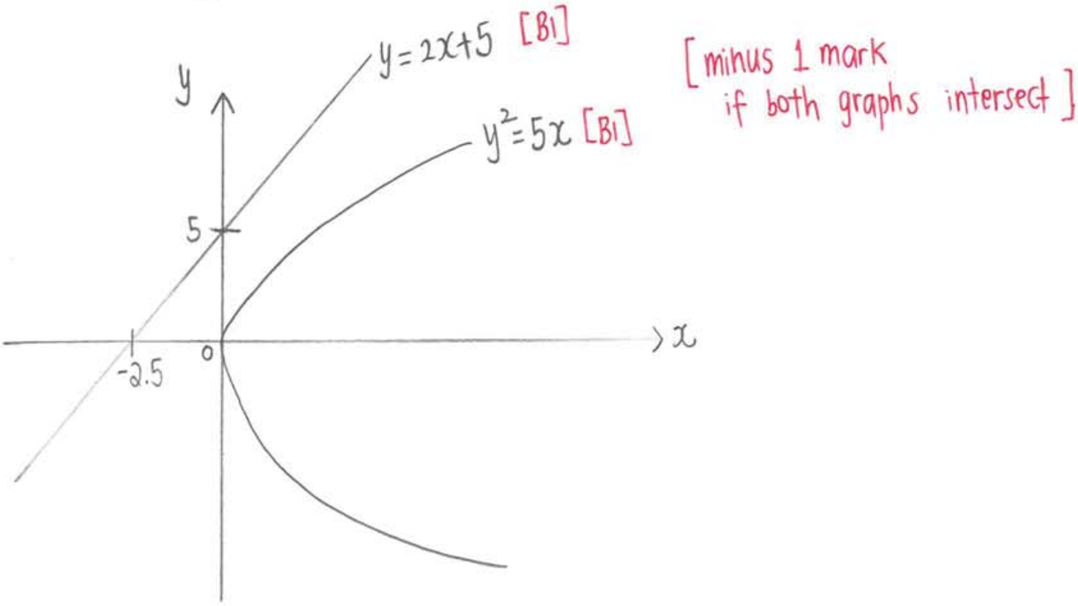
when $x=0$,

$y = 5$

when $y=0$,

$2x+5 = 0$

$x = -2.5$



3 The gradient of a curve is $\frac{dy}{dx} = p + \frac{q}{x^3}$, where p and q are constants. The gradient of the normal at $A(1, 4)$ on the curve is -1 and the tangent to the curve at $B(2, 10)$ is $y = 8x - 6$.

(i) Calculate the value of p and of q. [4]

Gradient of tangent at A = 1

When $x = 1$, $\frac{dy}{dx} = 1$,

$p + q = 1$ [M1]

$q = 1 - p$ — ①

when $x = 2$, $\frac{dy}{dx} = 8$,

$p + \frac{q}{8} = 8$ [M1]

$8p + q = 64$

$q = 64 - 8p$ — ②

① = ② : $1 - p = 64 - 8p$

$7p = 63$

$p = 9$ // [A1]

Sub $p = 9$ into ①,

$q = 1 - 9$

$= -8$ // [A1]

Using the value of p and of q found in (i),

(b) Find the equation of the curve. [2]

$$\frac{dy}{dx} = 9 - 8x^{-3}$$

$$y = \int 9 - 8x^{-3}\, dt$$

$$= 9x - \frac{8x^{-2}}{-2} + c \quad [M1]$$

Sub $x=1$, $y=4$,

$$4 = 9 - \frac{8}{-2} + c$$

$$c = -9$$

$$y = 9x + \frac{4}{x^2} - 9 \quad [A1]$$

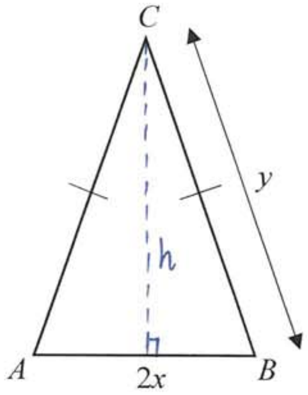
(c) Show that gradient increases as x increases. [2]

$$\frac{d^2y}{dx^2} = 24x^{-4}$$

$$= \frac{24}{x^4} > 0 \quad [M1]$$

Since $\frac{d^2y}{dx^2} > 0$, gradient increases as x increases. [A1]

4 In the diagram below, ΔABC is an isosceles triangle with $BC = y$ cm and $AB = 2x$ cm. It is also given that the perimeter of ΔABC is 50 cm.



(a) Show that the area of ΔABC is given by $A = x\sqrt{625-50x}$. [3]

$$2x + 2y = 50$$
$$x + y = 25$$
$$y = 25 - x \quad \text{[M1]}$$

$$h = \sqrt{y^2 - x^2}$$
$$= \sqrt{(25-x)^2 - x^2}$$
$$= \sqrt{625 - 50x} \quad \text{[M1]}$$

$$\text{Area of } \Delta ABC = \frac{1}{2} \times \sqrt{625-50x} \times 2x$$
$$= x\sqrt{625-50x} \text{ (shown)} \quad \text{[A1]}$$

(b) Given that x is increasing at a rate of 0.2 cm/s, find the rate at which the area is increasing at the instant when $x = 3$. [3]

$$\frac{dx}{dt} = 0.2$$

$$A = x\sqrt{625 - 50x}$$

$$\frac{dA}{dx} = (625 - 50x)^{\frac{1}{2}} + x\left(\tfrac{1}{2}\right)(625 - 50x)^{-\frac{1}{2}}(-50) \quad [M1]$$

$$= \sqrt{625 - 50x} - \frac{25x}{\sqrt{625 - 50x}}$$

$$\frac{dA}{dt} = \frac{dA}{dx} \times \frac{dx}{dt}$$

$$= \left[\sqrt{625 - 50(3)} - \frac{25(3)}{\sqrt{625 - 50(3)}}\right] \times 0.2 \quad [M1]$$

$$= 3.67 \text{ cm}^2/\text{s} \quad (\text{to } 3 \text{ s.f.}) \quad [A1]$$

5 **(a)** The sum of the coefficients of the first two terms in the expansion, in descending powers of x, of $(1+2x)\left(2x-\frac{1}{x^2}\right)^n$ is 768, where n is a positive integer greater than 2. Show that n is 8. ~~[3]~~ [4]

$$\left(2x-\frac{1}{x^2}\right)^n = \binom{n}{0}(2x)^n + \binom{n}{1}(2x)^{n-1}\left(-\frac{1}{x^2}\right) + \dots \quad [M1]$$

$$= 2^n x^n - n(2^{n-1})(x^{n-1})(x^{-2}) + \dots$$

$$= 2^n x^n - n(2^{n-1})(x^{n-3}) + \dots$$

$$(1+2x)\left(2x-\frac{1}{x^2}\right)^n = (1+2x)(2^n x^n - n2^{n-1}x^{n-3} + \dots)$$

$$= \underbrace{2^n x^n}_{T_2} - n2^{n-1}x^{n-3} + \underbrace{2^{n+1}x^{n+1}}_{T_1} - n2^n x^{n-2} + \dots \quad [M1]$$

$$2^{n+1} + 2^n = 768 \quad [M1]$$

$$2^n(2+1) = 768$$

$$2^n = 256 \quad [A1]$$

$$n = 8 \text{ (shown)}$$

term containing

(b) Hence, find the ~~term~~ term containing x^{-7} in the expansion of $\left(2x-\frac{1}{x^2}\right)^8$. [4]

$$\left(2x-\frac{1}{x^2}\right)^8$$

$$T_{r+1} = \binom{8}{r}(2x)^{8-r}\left(-\frac{1}{x^2}\right)^r \quad [M1]$$

$$= \binom{8}{r}(2)^{8-r}(x)^{8-r}(-1)^r(x)^{-2r}$$

$$= \binom{8}{r}(2)^{8-r}(-1)^r(x)^{8-3r} \quad [M1]$$

$$8-3r=-7$$

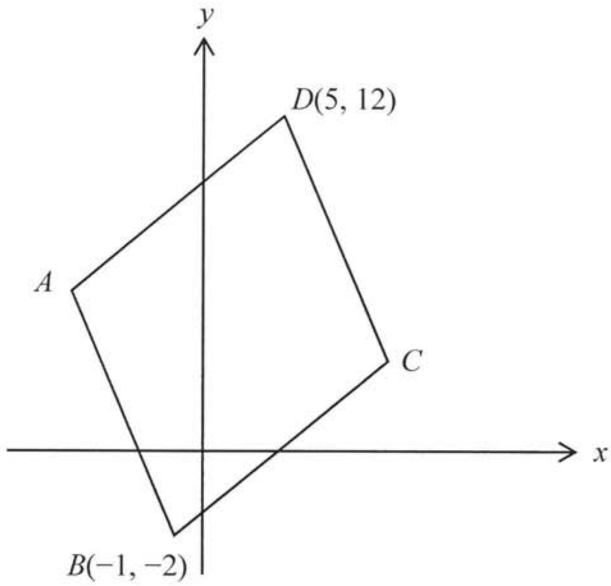
$$3r=15$$

$$r=5 \quad [M1]$$

$$T_6 = \binom{8}{5}(2)^{8-5}(-1)^5(x^{-7})$$

$$= -448x^{-7} \quad [A1]$$

6 Solutions to this question by accurate drawing will not be accepted.



In the diagram, $ABCD$ is a rhombus. The points B and D have coordinates $(-1, -2)$ and $(5, 12)$ respectively.

(a) Show that the equation of AC is $7y = -3x + 41$. [4]

midpoint of BD $= \left(\frac{5-1}{2}, \frac{12-2}{2}\right)$ [M1]

$= (2, 5)$

gradient of BD $= \frac{12+2}{5+1}$ [M1]

$= \frac{7}{3}$

gradient of AC $= -\frac{3}{7}$

Equation of AC : $y = -\frac{3}{7}x + c$ [M1]

$5 = -\frac{3}{7}(2) + c$

$c = \frac{41}{7}$

$y = -\frac{3}{7}x + \frac{41}{7}$

$7y = -3x + 41$ (shown) [A1]

(b) Given that a line $5y = 3x + 55$ passes through point A, find the coordinates of A. [2]

$7y = -3x + 41$ — ①

$5y = 3x + 55$ — ②

① + ② : $12y = 96$ [M1]

$y = 8$

Sub $y = 8$ into ②,

$5(8) = 3x + 55$

$3x = -15$

$x = -5$

$A(-5, 8)$ [A1]

(c) Find the coordinates of C. [2]

let C be (x, y).

$\left(\frac{-5+x}{2}, \frac{8+y}{2}\right) = (2, 5)$ [M1]

$\frac{-5+x}{2} = 2$ $\frac{8+y}{2} = 5$

$-5 + x = 4$ $8 + y = 10$

$x = 9$ $y = 2$

$\therefore C(9, 2)$ [A1]

(d) Find the area of the rhombus *ABCD*. [2]

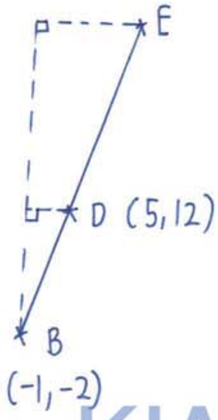
$$\text{Area} = \frac{1}{2}\begin{vmatrix} -5 & -1 & 9 & 5 & -5 \\ 8 & -2 & 2 & 12 & 8 \end{vmatrix} \quad \text{[M1]}$$

$$= \frac{1}{2}\left| 10-2+108+40+8+18-10+60 \right|$$

$$= \frac{1}{2}(232)$$

$$= 116 \text{ units}^2 \quad \text{[A1]}$$

(e) If point *E* lies on *BD* produced such that *BD* : *DE* = 2 : 3, find the coordinates of *E*. [2]



diff. in x between B and D = 6

diff. in y between B and D = 14

diff. in x between D and E = 9

diff. in y between D and E = 21

$E\,(5+9,\ 12+21)$

$= (14,\ 33)$ [B2]

7 **(a)** Given that $3^{n+2} - 3^n = \frac{5^{n+1}}{25^n}$, find the value of 15^n. [3]

$$3^n 3^2 - 3^n = \frac{5^{n+1}}{5^{2n}}$$

[M1]

$$3^n(3^2-1) = 5^{n+1-2n}$$

$$3^n(8) = 5^{1-n}$$

$$= 5^1 5^{-n} \quad \text{[M1]}$$

$$3^n(5^n) = \frac{5}{8}$$

$$15^n = \frac{5}{8} \quad \text{[A1]}$$

//

(b) Without using a calculator, find the root of the equation $x\sqrt{80} = \sqrt{20} - x\sqrt{48}$ in the form $\dfrac{a + b\sqrt{c}}{4}$. [4] [3]

$$x\sqrt{80} = \sqrt{20} - x\sqrt{48}$$

$$4x\sqrt{5} = 2\sqrt{5} - 4x\sqrt{3}$$ [M1] - simplify surds

$$4x\sqrt{5} + 4x\sqrt{3} = 2\sqrt{5}$$

$$x(4\sqrt{5} + 4\sqrt{3}) = 2\sqrt{5}$$

$$x = \frac{2\sqrt{5}}{4\sqrt{5} + 4\sqrt{3}}$$ [M1]

$$= \frac{\sqrt{5}}{2\sqrt{5} + 2\sqrt{3}} \times \frac{2\sqrt{5} - 2\sqrt{3}}{2\sqrt{5} - 2\sqrt{3}}$$

$$= \frac{10 - 2\sqrt{15}}{(2\sqrt{5})^2 - (2\sqrt{3})^2}$$

$$= \frac{10 - 2\sqrt{15}}{20 - 12}$$

$$= \frac{10 - 2\sqrt{15}}{8}$$

$$= \frac{5 - \sqrt{15}}{4}$$ [A1]

8 A particle moves in a straight line from a point O such that t seconds after leaving O, its velocity, v m/s, is given by $v = 5(4t-1)^2 - 125$. Find

(a) the initial acceleration of the particle, [2]

$$a = \frac{dv}{dt}$$

$$= 10(4t-1)(4) \quad [M1]$$

sub $t=0$,

$$a = 10(-1)(4)$$

$$= -40 \text{ m/s}^2 \quad [A1]$$

(b) the value of t at which the particle is instantaneously at rest, [2]

when $v=0$,

$$5(4t-1)^2 - 125 = 0 \quad [M1]$$

$$(4t-1)^2 = 25$$

$$4t-1 = 5 \text{ or } -5 \text{ (rej.)}$$

$$t = 1.5\text{s} \quad [A1]$$

(c) the minimum velocity of the particle. [1]

minimum velocity $= -125$ m/s [B1]

(d) the distance travelled by the particle in the second second, [5]

$$s = \int 5(4t-1)^2 - 125 \; dt$$

$$= \frac{5(4t-1)^3}{3(4)} - 125t + c \quad [M1]$$

Sub $t=0$, $s=0$,

$$0 = \frac{5(-1)^3}{12} + c$$

$$c = \frac{5}{12}$$

$$s = \frac{5(4t-1)^3}{12} - 125t + \frac{5}{12}. \quad [M1]$$

Sub $t=1$,

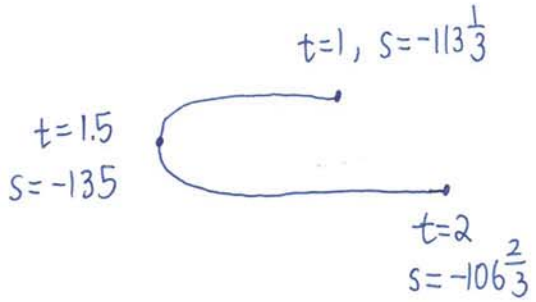
$$s = \frac{5(3)^3}{12} - 125 + \frac{5}{12}$$

$$= -113\frac{1}{3}$$

Sub $t=1.5$,

$$s = \frac{5(4(1.5)-1)^3}{12} - 125(1.5) + \frac{5}{12}$$

$$= -135 \quad [M1]$$



Sub $t=2$,

$$s = \frac{5(7)^3}{12} - 125(2) + \frac{5}{12}$$

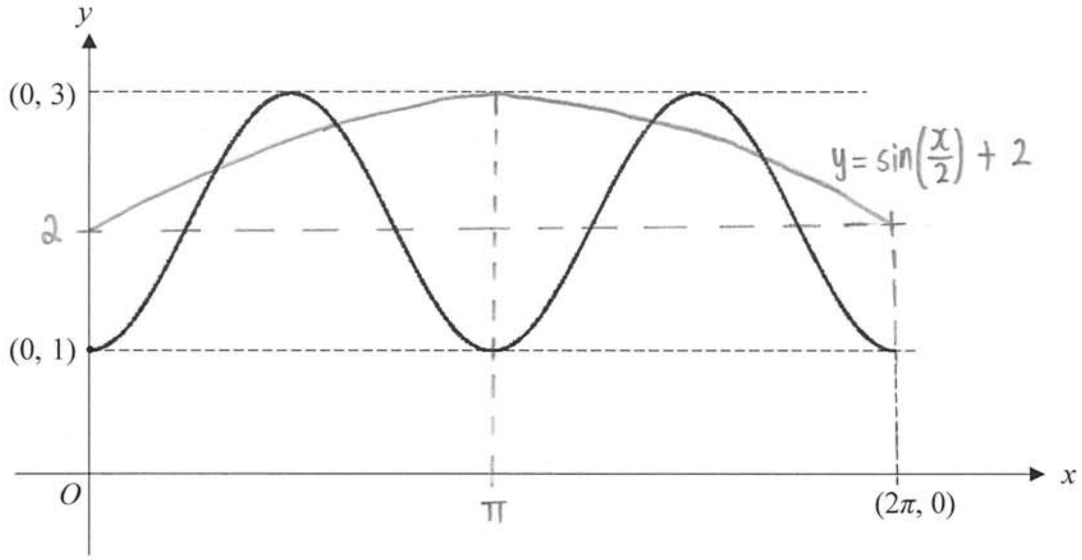
$$= -106\frac{2}{3}$$

Distance travelled $= (135 - 113\frac{1}{3}) + (135 - 106\frac{2}{3})$ [M1]

$= 50$m [A1]

//

9



The diagram shows the curve $y = a + b\cos(cx)$ for $0 \le x \le 2\pi$.

(a) Write down the value of a, of b and of c. [3]

period $= \pi$

$\frac{2\pi}{c} = \pi$

$c = 2$ [B1]

$a = 2$ [B1]

$b = -1$ [B1]

(b) Sketch, on the same axes above, the graph of $y = \sin\left(\frac{x}{2}\right) + 2$ for $0 \le x \le 2\pi$. [3]

[1] shape

[1] period

[1] maximum.

period $= 2\pi \div \frac{1}{2}$

$= 4\pi$

$-1 \le \sin\left(\frac{x}{2}\right) \le 1$

$1 \le \sin\left(\frac{x}{2}\right) + 2 \le 3$

(c) Deduce the largest integer value of k such that $a + b\cos(cx) > \sin\left(\frac{x}{2}\right) + k$ for $0 \le x \le 2\pi$. [1]

$k = -1$ [B1]

10 A curve has the equation $y = x^3 e^{2x}$.

Find the x-coordinates of the stationary points and determine the nature of each point [7]

$$\frac{dy}{dx} = 3x^2 e^{2x} + 2x^3 e^{2x} \quad \text{[M1]}$$

$$= x^2 e^{2x}(3 + 2x)$$

$$\frac{dy}{dx} = 0$$

$$x^2 e^{2x}(3 + 2x) = 0 \quad \text{[M1]}$$

$x = 0$ [A1] or $x = -\frac{3}{2}$ [A1]

By First Derivative Test,

x	-0.1	0	0.1		-1.6	-1.5	-1.4
$\frac{dy}{dx}$	+ve	0	+ve		−ve	0	+ve
	/	—	/		\	—	/

[M1]

point of inflexion [A1] at $x = 0$.

minimum point [A1] at $x = -\frac{3}{2}$.

11 In an experimental environment, the population of a type of insect was observed. Over a period of 10 days from the start of the experiment, the number of insects decreased from 1100 to 600. The insect population is given by the formula $P = A + 900e^{kt}$, where A and k are constants and t is the number of days from the start of the experiment.

(a) Find the value of A and of k. ~~[4]~~ [3]

$P = A + 900e^{kt}$

when $t=0$, $P = 1100$,

$1100 = A + 900$

$A = 200$ [B1]

when $t=10$, $P = 600$,

$600 = 200 + 900e^{10k}$

$e^{10k} = \frac{4}{9}$ [M1]

$10k = \ln\frac{4}{9}$

$k = -0.0811$ (to 3s.f.) [A1]

(b) Explain why the population of the insects approaches the value of A after a long period of time. [1]

As t increases, e^{kt} will approach 0, so P will approach 200. [B1]

End of Paper

BPGHS Preliminary Exam 2020

Sec 4E/5N Additional Mathematics Paper 2 (Solutions)

1(i)	$f(-2) = -8 + 4a - 2b + c$ $f(2) = 8 + 4a + 2b + c$ $-8 + 4a - 2b + c = 8 + 4a + 2b + c$ $-8 - 2b = 8 + 2b$ $4b = -16$ $b = -4$	M1 A1
(ii)	$f(1) = 1 + a - 4 + c = a + c - 3$ $f(1) = f(2)$ $a + c - 3 = 8 + 4a - 8 + c$ $a - 3 = 4a$ $a = -1$	M1 A1
(iii)	$f(x) = x^3 - x^2 - 4x + c$ $f(3) = 27 - 9 - 12 + c$ $6 + c = 4$ $c = -2$	A1
2(i)	$p\left(\frac{1}{2}\right) = 2\left(\frac{1}{2}\right)^3 - \left(\frac{1}{2}\right)^2 + 16\left(\frac{1}{2}\right) - 8$ $= 2\left(\frac{1}{8}\right) - \frac{1}{4} + 8 - 8$ $= 0$ Since remainder is 0, $2x - 1$ is a factor of $p(x)$.	A1
2(ii)	$2x^3 - x^2 + 16x - 8 = 0$ $x^2(2x - 1) + 8(2x - 1) = 0$ $(2x - 1)(x^2 + 8) = 0$ $2x - 1 = 0$ $x^2 + 8 = 0$ $x = \frac{1}{2}$ no real solution since $x^2 + 8 > 0$ There is only one real root. $x^2 + 8$ $2x - 1 \overline{)\, 2x^3 - x^2 + 16x - 8}$ $-(2x^3 - x^2)$ $0 + 16x - 8$ $-\ (16x - 8)$ 0	M1 A1 , A1

2(iii)	$\frac{x^2+2x+40}{2x^3-x^2+16x-8}=\frac{A}{2x-1}+\frac{Bx+C}{x^2+8}$ $=\frac{A\left(x^2+8\right)+(2x-1)(Bx+C)}{(2x-1)\left(x^2+8\right)}$ $x^2+2x+40=A\left(x^2+8\right)+(2x-1)(Bx+C)$ Sub $x=\frac{1}{2}$ $\left(\frac{1}{2}\right)^2+2\left(\frac{1}{2}\right)+40=A\left(\frac{1}{4}+8\right)$ $A=5$ Sub $x=0$, $A=5$ $40=40-C$ $C=0$ Sub $x=1$ $1+2+40=5\ (9)+B$ $B=-2$ Ans : $\frac{5}{2x-1}-\frac{2x}{x^2+8}$	M1 M1 A1 A1 A1 Deduct 1 m if final ans not shown.
2(iv)	$\int\frac{x^2+2x+40}{2x^3-x^2+16x-8}\ dx$ $=\int\frac{5}{2x-1}-\frac{2x}{x^2+8}\ dx$ $=\frac{5}{2}\ln(2x-1)-\ln\left(x^2+8\right)+c$	A1 (1st term) A2 (2nd term) Deduct 1 m if c is missing
3(a)	$\log_2(x+2)-\frac{\log_2(x-1)}{\log_2\sqrt{2}}=3$ $\log_2(x+2)-2\log_2(x-1)=3$ $\log_2\frac{(x+2)}{(x-1)^2}=3$ $\frac{x+2}{(x-1)^2}=8$ $x+2=8(x-1)^2$ $8x^2-17x+6=0$ $x=\frac{17\pm\sqrt{(-17)^2-4(8)(6)}}{2(8)}$ $x=\frac{17\pm\sqrt{97}}{16}$ $x=1.68$, 0.447 (rejected)	M1 M1 M1 M1 A1 [deduct 1 m if did not reject 0.447]

3(b)	Sub $x = 2$, $y = 47$ $a \times 2^b + 7 = 47$ $a \times 2^b = 40$ ------------ (1) Sub $x = -3$, $y = -128$ $a \times (-3)^b + 7 = -128$ $a \times (-3)^b = -135$ ---------- (2) $\frac{(1)}{(2)}$ $\frac{2^b}{(-3)^b} = \frac{40}{-135}$ $\left(\frac{2}{-3}\right)^b = -\frac{8}{27} = \left(\frac{2}{-3}\right)^3$ $b = 3$ Sub $b = 3$ into (1) $a \times 2^3 = 40$ $a = 5$ $y = 5x^3 + 7$ Sub $x = 5$, $y = k$ $k = 5\,(5)^3 + 7 = 632$	M1 for eqn (1) & (2) M1 A1 A1 A1
4(i)	$d = 8 \sin \theta - 5 \cos \theta$	A2 [1 m for each term]
4(ii)	$d = \text{R} \sin (\theta - \alpha)$ $\text{R} = \sqrt{8^2 + 5^2} = \sqrt{89}$ $\tan \alpha = \frac{5}{8}$ $\alpha = 32.0°$ $d = \sqrt{89} \sin (\theta - 32.0°)$	A1 A1 A1
4(iii)	Max value of $d = \sqrt{89} = 9.43$ m when $\sin (\theta - 32.0°) = 1$ or $\theta = 122°$ Not possible for d to be 10 m	A1 A1
4(iv)	$\sqrt{89} \sin (\theta - 32.0°) = 6$ $\sin (\theta - 32.0°) = \frac{6}{\sqrt{89}}$ $\theta - 32.0° = 39.49°$, $140.51°$ $\theta = 71.5°$, $172.5°$	A1 , A1

5(a)(i)	$f(x)=\ln\left(\frac{5+x}{5-x}\right)^{\frac{1}{3}}$ $=\frac{1}{3}\ln\left(\frac{5+x}{5-x}\right)$ $=\frac{1}{3}\left[\ln(5+x)-\ln(5-x)\right]$ $f'(x)=\frac{1}{3}\left(\frac{1}{5+x}+\frac{1}{5-x}\right)$ $=\frac{1}{3}\left[\frac{5-x+5+x}{(5+x)(5-x)}\right]$ $=\frac{10}{3(5+x)(5-x)}$ $=\frac{10}{3\left(25-x^2\right)}$ $f''(x)=\frac{10}{3}(-1)\left(25-x^2\right)^{-2}(-2x)$ $=\frac{20x}{3\left(25-x^2\right)^2}$	M1 M1 A1 A1
5(a)(ii)	For $f'(x)>0$ $25-x^2>0$ $(5+x)(5-x)>0$ $-5<x<5$ For $f''(x)>0$ $20x>0$ $x>0$ For both $f'(x)$ and $f''(x)$ to be positive, $0<x<5$	M1 A1 A1 A1
5(b)	$\frac{d}{dx}\left[4\sin^2\left(\frac{x}{2}+\pi\right)\right]$ $=4\times2\sin\left(\frac{x}{2}+\pi\right)\cos\left(\frac{x}{2}+\pi\right)\times\frac{1}{2}$ $=4\sin\left(\frac{x}{2}+\pi\right)\cos\left(\frac{x}{2}+\pi\right)$ $=2\sin2\left(\frac{x}{2}+\pi\right)$ $=2\sin(x+2\pi)$ or $2(\sin x\cos2\pi+\cos x\sin2\pi)$ $=2\sin x$	M1 M1 A1

6(i)	LHS = $\dfrac{\operatorname{cosec}^2\theta-2}{\operatorname{cosec}^2\theta}$ $=1-\dfrac{2}{\operatorname{cosec}^2\theta}$ $=1-2\sin^2\theta$ $=\cos 2\theta$	 B1 B1 A1
6(ii)	$\cos 2\theta + 3\sin 2\theta = 0$ $3\sin 2\theta = -\cos 2\theta$ $\tan 2\theta = -\dfrac{1}{3}$ basic $\angle = 0.3218$ $2\theta = \pi - 0.3218$, $2\pi - 0.3218$, $3\pi - 0.3218$ $\theta = 1.41$, 2.98 , 4.55	M1 M1 A2 Deduct 1 m for each wrong ans
7	$\alpha - \beta = 2$ $\alpha^2 - \beta^2 = 3$ $(\alpha + \beta)(\alpha - \beta) = 3$ $\alpha+\beta=\dfrac{3}{2}$ $(\alpha+\beta)^2=\dfrac{9}{4}$ $\alpha^2+\beta^2+2\alpha\beta=\dfrac{9}{4}$ $(\alpha-\beta)^2+4\alpha\beta=\dfrac{9}{4}$ $4+4\alpha\beta=\dfrac{9}{4}$ $\alpha\beta=-\dfrac{7}{16}$ Equation is $x^2-\dfrac{3}{2}x-\dfrac{7}{16}=0$ $16x^2-24x-7=0$	 A1 M1 M1 A1 A1
8(i)	At A, $\sec^2 x - 2 = 0$ $\cos^2 x=\dfrac{1}{2}$ $\cos x=\sqrt{\dfrac{1}{2}}$ $x=\dfrac{\pi}{4}$	 A1

	At B, $\sec^2 x - 2 = 2$ $\sec^2 x = 4$ $\cos^2 x = \frac{1}{4}$ $\cos x = \sqrt{\frac{1}{4}}$ $x = \frac{\pi}{3}$	M1 A1
8(ii)	Area of $\Delta OBC = \frac{1}{2} \times \frac{\pi}{3} \times 2 = \frac{\pi}{3}$ units^2 , C is $\left(\frac{\pi}{3}, 0\right)$ Area bounded by curve, x-axis and line $x = \frac{\pi}{3}$ $= \int_{\frac{\pi}{4}}^{\frac{\pi}{3}} \left(\sec^2 x - 2\right) dx$ $= \left[\tan x - 2x\right]_{\frac{\pi}{4}}^{\frac{\pi}{3}}$ $= \tan\frac{\pi}{3} - \frac{2\pi}{3} - \left(\tan\frac{\pi}{4} - \frac{\pi}{2}\right)$ $= \sqrt{3} - 1 - \frac{\pi}{6}$ Required area = $\frac{\pi}{3} - \left(\sqrt{3} - 1 - \frac{\pi}{6}\right)$ $= \left(1 - \sqrt{3} + \frac{\pi}{2}\right)$ units^2	A1 M1 A1 M1 A1
9(i)	When $y = 0$, $\lvert 1 - 2x \rvert = 3$ $1 - 2x = 3$ or $1 - 2x = -3$ $x = -1$ or $x = 2$ A(–1 , 0) C(2 , 0) B$\left(\frac{1}{2}, 3\right)$	 A1 , A1 A1
9(ii)	$\tan\theta = -2$ ($\tan\theta$ = gradient of BC)	A1
9(iii)	$3 - \lvert 1 - 2x \rvert = 2x - x^2$ $x^2 - 2x + 3 = \lvert 1 - 2x \rvert$ $x^2 - 2x + 3 = 1 - 2x$ $x^2 + 2 = 0$ No real solution as $x^2 + 2 > 0$ for all real values of x.	 B1 A1

	$x^2-2x+3=2x-1$ $x^2-4x+4=0$ $(x-2)^2=0$ $x=2$	B1 A1
9(iv)	Max value of $3-\lvert 1-2x\rvert$ is 3 when $x=\frac{1}{2}$. Min value of $4+x^2$ is 4 when $x=0$. The curve and line <u>do not intersect</u> so there is no real solution.	B1 B1 A1
10(i)	Let the centres of C_1 and C_2 be (a , a) $a^2+(a+3)^2=5$ $a^2+a^2+6a+9-5=0$ $2a^2+6a+4=0$ $(2a+2)(a+2)=0$ $a=-1$ or a = -2 C_1 : $(x+1)^2+(y+1)^2=5$ C_2 : $(x+2)^2+(y+2)^2=5$	M1 M1 A1 A1 A1
10(ii)	C_1 : Sub $y=0$ $(x+1)^2+1=5$ ---------- (1) C_2 : Sub $y=0$ $(x+2)^2+4=5$ ---------- (2) $(x+1)^2+1=(x+2)^2+4$ $x^2+2x+1+1=x^2+4x+4+4$ $2x+6=0$ $x=-3$	A1 (both (1) & (2) correct) M1 A1
10(iii)	Dist between 2 centres = $\sqrt{(-1+2)^2+(-1+2)^2}=\sqrt{2}$ Greatest dist = $\sqrt{5}+\sqrt{2}+\sqrt{5}$ = $\sqrt{2}+2\sqrt{5}$ or 5.89 units	A1 M1 A1
11(i)	$y=\frac{a}{\sqrt{x}}+b\sqrt{x}$ $\frac{y}{\sqrt{x}}=\frac{a}{x}+b$	
	(table below)	A1 (table) B2 (4 to 5 correct points for line of best fit)

$\frac{1}{x}$	1	0.5	0.33	0.25	0.20
$\frac{y}{\sqrt{x}}$	0.5	1.50	1.84	2.0	2.10

<table>
<tr><td>11(ii)</td><td>$a=-2$
$b=2.5$</td><td>M1 , A1
A1</td></tr>
<tr><td>11(iii)</td><td>$y\sqrt{x}=3$
$\frac{y}{\sqrt{x}}=\frac{3}{x}$

Draw $\frac{y}{\sqrt{x}}$ against $\frac{1}{x}$.
<table><tr><td>$\frac{1}{x}$</td><td>1</td><td>0.5</td><td>0.25</td></tr><tr><td>$\frac{y}{\sqrt{x}}$</td><td>3</td><td>1.5</td><td>0.75</td></tr></table>
Point of intersection is (0.5 , 1.5)
$\frac{1}{x}=0.5$
$x=2$
$\frac{y}{\sqrt{x}}=1.5$
$y=1.5\times\sqrt{2}=2.12$</td><td>A1

B1 (str line graph)

A1

A1 (correct x value)

A1 (correct y value)</td></tr>
</table>