SYDNEY BOYS HIGH SCHOOL
MOORE PARK, SURRY HILLS

2007
Year 10 Yearly Examination

Advanced Mathematics

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- Board approved calculators may be used.

Time allowed: 2 hours.

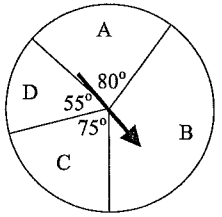
Examiner: *D.McQuillan*

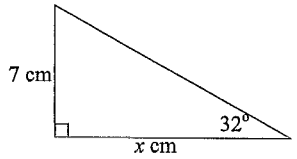
Name:_____

Your Mathematics Class (Tick the box)		
10MaA	Mr Boros	
10MaB	Ms Evans	
10MaC	Ms Nesbitt	
10MaD	Mr Kourtesis	
10MaE	Mr Gainford	
10MaF	Ms Ward	

Marker Use Only

Question	Mark
1	/20

Question One (20 marks)		Answer	Marks
A	Factorise $x^2+12x+35$.		1
B	Find the value of a if $a\sqrt{7}=\sqrt{112}$.		1
C	If this spinner is spun, what is the probability that it will point to sector B. 		1
D	Find the interest paid on a \$30 000 loan with a flat rate of 9% p.a. for 10 months.		1
E	Solve $\frac{p}{3}-\frac{p}{5}=1$.		1
F	A conical cocktail glass in 8 cm across and 8 cm deep. How many millilitres will it hold? (Correct to nearest millilitre.)		1
G	Two squares have side lengths in a ratio of 5:7 what is the ratio of their areas?		1
H	Write $\left(\frac{2a}{b^3}\right)^{-2}$ without parentheses or negative indices.		1
I	Solve $(x+4)(3x-6)=0$		1
J	Find the volume of a cylinder with radius 5cm and height 8cm to the nearest cubic centimetre.		1

K	If the point (2, -1) lies on the hyperbola $y=\frac{k}{x}$, what is the value of k?		1
L	The results of a 10En3 class essay were: 5 6 6 7 9 11 11 13 13 13 13 16 17 20 Draw a neat box-and-whisker plot for this data.		2
M	Find the value of x correct to 2 decimal places.  		2
N	Rationalise the denominator of $\frac{2}{1-\sqrt{3}}$.		2
O	Solve and graph $\frac{8-x}{3}>2$.		2
P	Factorise x^2+7x-y^2-7y.		1

End of Question One

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Marker Use Only

Question	Mark
2	/20

Question Two (20 marks)		Answer	Marks
A	Solve $5x^2 - 14x - 3 = 0$.		1
B	Taryn wants to borrow money to buy a house. The bank sent her an email with the following table attached.		

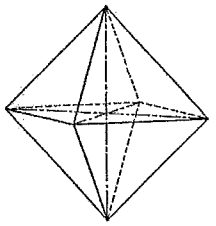
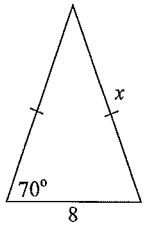
Monthly repayments

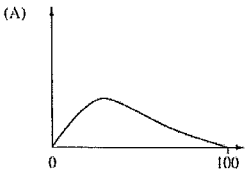
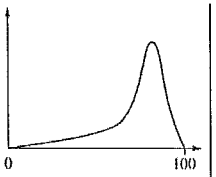
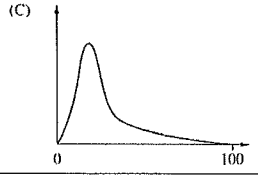
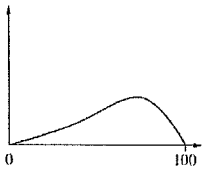
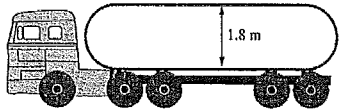
Amount borrowed	*Term of loan*				
	10 years	15 years	20 years	25 years	30 years
	120 months	180 months	240 months	300 months	360 months
$80 000	$970.62	$764.52	$669.15	$617.45	$587.01
$90 000	$1091.95	$860.09	$752.80	$694.63	$660.39
$100 000	$1213.28	$955.65	$836.44	$771.82	$733.76
$110 000	$1334.60	$1051.22	$920.08	$849.00	$807.14
$120 000	$1455.93	$1146.78	$1003.73	$926.18	$880.52
$130 000	$1577.26	$1242.35	$1087.37	$1003.36	$953.89
$140 000	$1698.59	$1337.91	$1171.02	$1080.54	$1027.27
$150 000	$1819.91	$1433.48	$1254.66	$1157.72	$1100.65
$160 000	$1941.24	$1529.04	$1338.30	$1234.91	$1174.02

(i) Taryn decides that she can afford $1000 per month on repayments. What is the maximum amount she can borrow, and how many years will she have to repay the loan? — 1

(ii) Douglas intends to borrow $160 000 over 15 years from the same bank.

If he chooses to borrow $160 000 over 20 years instead, how much more interest will he pay? — 2

C	Substitute $X = \frac{1}{a}$ into $\frac{2}{X} + 3X$ then simplify.		1
D	It is possible to precisely fit an octahedron inside a sphere such that the six vertices all touch the surface of the sphere. If an octahedron was precisely fitted within a sphere of radius 5 cm what would be the volume of the octahedron?  Octahedron		2
E	Use the sine rule or otherwise, find the value of x correct to 2 decimal places. 		2
F	Find the equation of the line that passes through (0, -2) and (2, 6). Write your answer in general form.		2

G	Which of these graphs represents positively skewed data with the smaller standard deviation? (A)  (B)  (C)  (D) 		1
H	Find the point of intersection of the two lines with the following equations. $4x+3y=6$ $3x+2y=5$		2
I	At Eric's birth his parents decided to invest \$3000 that they would hold in trust until his 21st birthday. They had a choice of investments; either 7% p.a. compounded monthly or 7.5% p.a. compounded yearly. Which is the best investment and by how much? (correct to the nearest cent)		2
J	Where does the parabola $y=x^2-9x-22$ cross the x-axis?		2
K	A container on the road trailer carrying liquefied gas is in the shape of a cylinder 6 m long together with 2 hemispherical ends. The total length is 7.8 m. What is volume in cubic metres? 		2

End of Question Two

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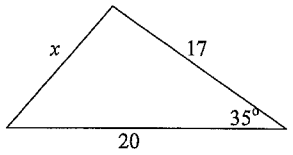
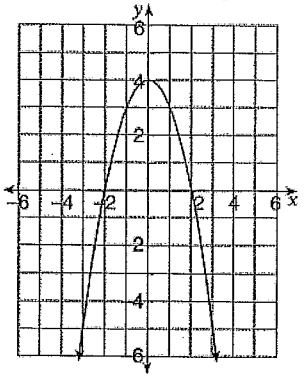
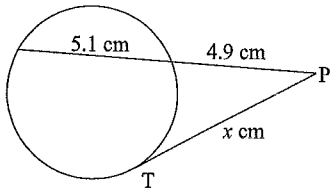
Marker Use Only

Question	Mark
3	/20

Question Three (20 marks)		Answer	Marks
A	Given the two points $(-5,3)$ and $\left(5\frac{1}{2},3\frac{1}{4}\right)$ and the circle $x^2+y^2=36$ which of the following is true. (I) Both points are inside the circle. (II) Both points are outside the circle. (III) One point is inside and the other is outside the circle. (IV) One point is on the circle and the other is inside.		1
B	In the formula $M=\sqrt{t-3}$, which values can t possibly take?		1
C	Find the value of x correct to 2 decimal places.  		2
D	Four cards with the numbers 1,4, 5 and 7 written on them are picked at random and used to form a four digit number. Find the probability that the number is (i) odd? (ii) greater than 5200?		2
E	Solve $2x^2-12x+17=0$. Write your answer in simplified surd form.		2
F	What is the equation of this parabola?  		2
G	TP is a tangent. Find the value of x.  		2
H	Given the points A(-1, 1), B(2, 5) and C(7, -3) find the coordinates of point D such that ABCD is a parallelogram.		2

I	Finola selected 30 students at random from Year 10 at her high school, and asked each of them how many text messages they had sent from a mobile phone within the last day. The results are summarised in the following table. *Number of text messages sent* / *Frequency* 0 / 3 1 / 3 2 / 4 3 / 4 4 / 9 5 / 7 (i) Determine the median number of text messages sent. (ii) Find the inter-quartile range of text messages sent. (iii) Calculate the mean number of text messages sent. (Give your answer correct to two decimal places.) (iv) Calculate the standard deviation. (Give your answer correct to two decimal places.)	4
J	For the parabola $y = x^2 + 2x + 5$. (i) Find the equation of the axis of symmetry. (ii) And hence the minimum y-value of the parabola.	2

End of Question Three

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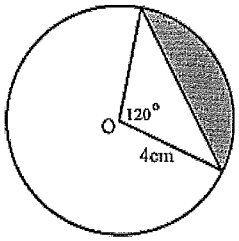
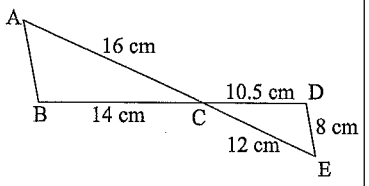
Question	Mark
4	/20

Question Four (20 marks)		Answer	Marks
A	Two unbiased dice are thrown. Each die has six faces. The faces are numbered 1, 2, 3, 4, 5 and 6. (i) What is the probability that neither shows a 6? (ii) Mark plays a game with these dice. There is no entry fee. When the dice are thrown: • Mark wins \$20 if both dice show a 6. • He wins \$2 if there is only one 6. • He loses \$2 if neither shows a 6. How much will he expect to win/lose after playing 10 games?		3
B	For θ between 0° and 180° find all values of θ to the nearest degree such that $\sin\theta = 0.342$.		1
C	Solve $3(3^x)^2 - 28(3^x) + 9 = 0$ for x.		2
D	O is the centre of a circle with radius 4cm. Find the area of the shaded region to the nearest square centimetre.  		2
E	The results of the Year 10 Half Yearly Exams are given in the table. |	Mean	Standard Deviation
---	---	---
English	62	7
Mathematics	75	11
History	68	10 | (i) Andrew's results were 70 for English, 86 for Mathematics and 87 for History. List his subjects in order of his relative performance, best to worst. In normally distributed data 50% of data points will be above the mean and 68% of data points will fall within one standard deviation of the mean. (ii) If 175 students did mathematics and the results had a normal distribution how many people beat Andrew?		2
F	What length of wire is needed to build the frame of a square pyramid with base length 1 metre and height 1.5 metres? Answer in metres rounded to the nearest centimetre.		2
G	Ronald is thinking of purchasing a new BMW M5 for \$81 200. If cars' values depreciate 20% in the first year and 6% every year after, how many years will it take for the car to lose more than half its value? (Using a calculator, no working required.)		2

H	To buy the BMW M5 ($81 200) Ronald makes a 10% deposit and borrows the remainder at an interest rate of 8% p.a.. The interest is calculated monthly and repayments of $866.66 are made at the end of the month so that the loan is paid off after 10 years. (i) Calculate the amount still owing at the end of 3 months. (ii) Determine the total amount of interest paid on the entire loan. (iii) What is the equivalent flat rate of interest?		3
I	Given the following figure.  (i) Prove that $\Delta ABC \parallel\parallel \Delta CDE$. (ii) Hence find the length of AB.		3

End of Question Four

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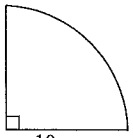
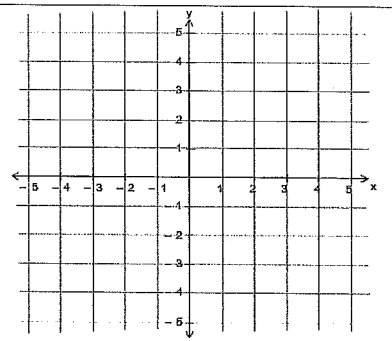
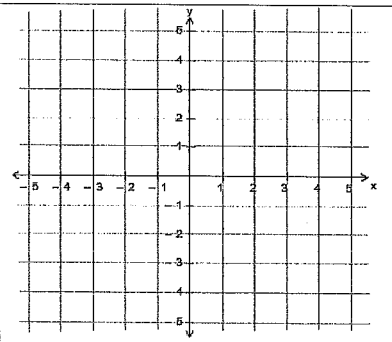
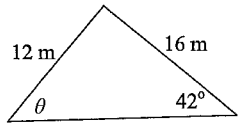
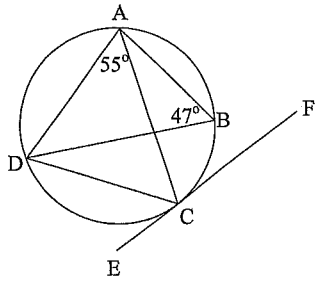
Marker Use Only

Question	Mark
5	/20

Question Five (20 marks)		Answer	Marks
A	Use the "completing the square method" to solve $x^2 - 6x + 7 = 0$. Leave your answer in surd form.		2
B	Find the points of intersection of $y = x^2 + 6x - 21$ $y = 15 - 3x$		2
C	If the following sector was to be bent into a cone what would be the base radius? Answer in exact form.  10 cm		2
D	Two similar solids have volumes 105.6 cm^3 and 1650 cm^3. If the smaller solid has a surface area of 83.8 cm^2, what is the surface area of the larger solid?		2
E	The three legs of a triangular sailing course are 700 m, 1000 m and 1400 m. Find the largest angle (correct to the nearest degree) through which the boats must turn when completing two laps of the course.		2

F	Sketch the graphs of $y = x^3$ and $y = \frac{1}{2}x^3$ on the same axes.		2
G	Sketch the graphs of the equations $y = 3^x$ and $y = 3^{-x}$ on the same axis.		2
H	Find all possible values of θ correct to the nearest minute.  12 m, 16 m, θ, 42°		2
I	Find the radii of two spheres if the difference of their radii is 25 mm and the difference of their surface areas is $10\,000\pi$ mm^2.		2

J	EF is a tangent. Find the size of $\angle ACF$ giving reasons.  		2

End of Question Five

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Marker Use Only

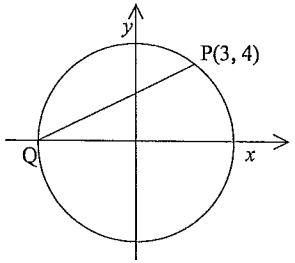
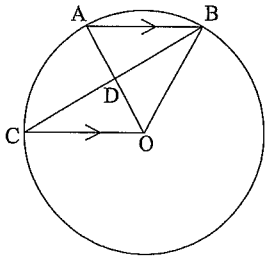
Question	Mark
6	/20

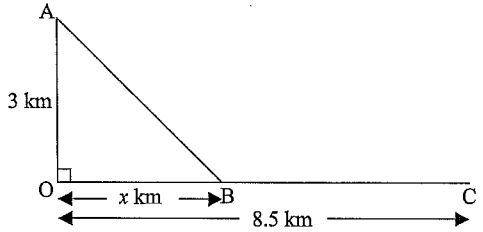
Question Six (20 marks)		Answer	Marks
A	Paul has two children. If one is a boy what is the probability that the other is a boy?		1
B	The total resistance in a circuit, R_T, is given by the formula, $\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}$ where R_1 and R_2 are resistors in parallel. Find R_2 in terms of R_1 and the total resistance.		2
C	The NFS Tyre Company ran endurance tests on 200 of its newest brand of tyres. The results of the tests are given in the following table.		1

Durability of Tyre (1000's km)	Frequency	Relative Frequency
<120	38	
120-140	62	
140-160	90	
>160	10	
Totals		

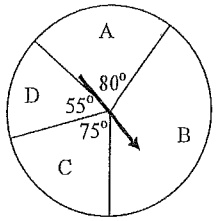
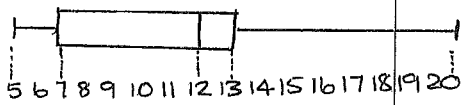
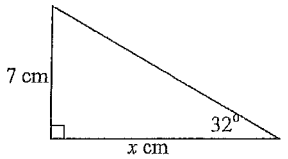
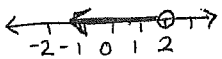
(i) Complete the table.

	(ii) If you were to buy a set of these tyres what is the probability that all 4 tyres would last for over 140 000 km?		2

D	P(3, 4) is a point on the circle $x^2+y^2=25$. Find the length of the minor arc PQ correct to three significant figures. 		3
E	The Golden Ratio is defined such that the ratio of the small part to the big part is equal to the ratio of the big part to the whole. Find the Golden Ratio in exact form.		3
F	AB is a chord of the circle centre O. AB is parallel to CO. Prove that angle ADC is three times the size of angle ABC. 		3

G	Chris is in a boat at point A, which is 3 km from the nearest point O of a straight beach. He rows in a straight line from A to a point B on the beach at 4 km/h. He then walks along the beach, at 6 km/h to point C which is 8.5 km along the beach from the point O.  		
	(i) Write an expression for the time in terms of x (the distance B is from O) it takes Chris to row to point B.		2
	(ii) If it takes Chris 2 hours to reach point C from point A, find all possible values of x (that is distances that B could be from O).		3

End of Exam

Question One (20 marks)		Answer	Marks
A	Factorise $x^2+12x+35$.	$(x+7)(x+5)$	1
B	Find the value of a if $a\sqrt{7}=\sqrt{112}$.	$\sqrt{112}=\sqrt{16\times7}=4\sqrt{7}$. $a=4$.	1
C	If this spinner is spun, what is the probability that it will point to sector B. 	$360-80-55-75=150$ $\frac{150}{360}=\frac{5}{12}$. $p=5/12,\ 0.416$	1
D	Find the interest paid on a \$30 000 loan with a flat rate of 9% p.a. for 10 months.	$I=30000\times\frac{9}{12}\times10$ $I=2250$	1
E	Solve $\frac{p}{3}-\frac{p}{5}=1$.	$\frac{5p-3p}{15}=1$. $2p=15$ $p=\frac{15}{2}=7.5$	1
F	A conical cocktail glass in 8 cm across and 8 cm deep. How many millilitres will it hold? (Correct to nearest millilitre.)	$V=\frac{1}{3}\pi r^2h$ $=\frac{1}{3}\pi\times4^2\times8$ $=134.$ (mL)	1
G	Two squares have side lengths in a ratio of 5:7 what is the ratio of their areas?	25 : 49.	1
H	Write $\left(\frac{2a}{b^3}\right)^{-2}$ without parentheses or negative indices.	$\frac{b^6}{4a^2}$.	1
I	Solve $(x+4)(3x-6)=0$	$x=4$ $x=-2$.	1
J	Find the volume of a cylinder with radius 5cm and height 8cm to the nearest cubic centimetre.	$V=\pi r^2h$. $=\pi\times5^2\times8$. $=628\ cm^3$.	1
K	If the point (2, -1) lies on the hyperbola $y=\frac{k}{x}$, what is the value of k?	$-1=\frac{k}{2}$. $\therefore k=-2$	1
L	The results of a 10En3 class essay were: <table><tr><td>5</td><td>6</td><td>6</td><td>7</td><td>9</td><td>11</td><td>11</td></tr><tr><td>13</td><td>13</td><td>13</td><td>13</td><td>16</td><td>17</td><td>20</td></tr></table> Draw a neat box-and-whisker plot for this data.		2
M	Find the value of x correct to 2 decimal places. 	$\tan32=\frac{7}{x}$. $x=\frac{7}{\tan32}$. $=11.20$ cm.	2
N	Rationalise the denominator of $\frac{2}{1-\sqrt{3}}$.	$\frac{2}{1-\sqrt{3}}\times\frac{1+\sqrt{3}}{1+\sqrt{3}}=\frac{2(1+\sqrt{3})}{1-3}$ $=\frac{2}{-2}(1+\sqrt{3})$ $=-1-\sqrt{3}$	2
O	Solve and graph $\frac{8-x}{3}>2$.	$8-x>6$ $-x>-2$. $x<2$ 	2
P	Factorise x^2+7x-y^2-7y.	$x^2-y^2+7x-7y$ $=(x+y)(x-y)+7(x-y)$ $=(x-y)(x+y+7)$	1

End of Question One

Question Two (20 marks)

A Solve $5x^2 - 14x - 3 = 0$. (1 mark)

$(5x+1)(x-3)=0$

$x = -\frac{1}{5}, 3$

$5x \times 1$, $x \times -3$

Answer: $x = -\frac{1}{5}, 3$

B Taryn wants to borrow money to buy a house. The bank sent her an email with the following table attached.

Monthly repayments

Amount borrowed	*Term of loan*				
	10 years	15 years	20 years	25 years	30 years
	120 months	180 months	240 months	300 months	360 months
$80 000	$970.62	$764.52	$669.15	$617.45	$587.01
$90 000	$1091.95	$860.09	$752.80	$694.63	$660.39
$100 000	$1213.28	$955.65	$836.44	$771.82	$733.76
$110 000	$1334.60	$1051.22	$920.08	$849.00	$807.14
$120 000	$1455.93	$1146.78	$1003.73	$926.18	$880.52
$130 000	$1577.26	$1242.35	$1087.37	$1003.36	$953.89
$140 000	$1698.59	$1337.91	$1171.02	$1080.54	$1027.27
$150 000	$1819.91	$1433.48	$1254.66	$1157.72	$1100.65
$160 000	$1941.24	$1529.04	$1338.30	$1234.91	$1174.02

(i) Taryn decides that she can afford $1000 per month on repayments. What is the maximum amount she can borrow, and how many years will she have to repay the loan? (1 mark)

$130,000, 30 years

(ii) Douglas intends to borrow $160 000 over 15 years from the same bank.

If he chooses to borrow $160 000 over 20 years instead, how much more interest will he pay? (2 marks)

$275227.20 (15 yrs) $321192 (20 yrs)

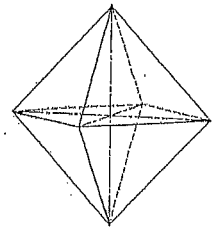
Extra interest: $45964

C Substitute $X = \frac{1}{a}$ into $\frac{2}{X} + 3X$ then simplify. (1 mark)

$\frac{2}{1/a} + 3\left(\frac{1}{a}\right) = 2a + \frac{3}{a}$

Answer: $2a + \frac{3}{a}$

D It is possible to precisely fit an octahedron inside a sphere such that the six vertices all touch the surface of the sphere. If an octahedron was precisely fitted within a sphere of radius 5 cm what would be the volume of the octahedron? (2 marks)



Octahedron

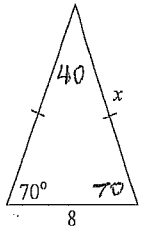
Eight pyramids

$\therefore V_d = 8 \times \frac{1}{2} \times \frac{1}{3} \times 5 \times 5^2$

$= \frac{500}{3}$

$= 166.6 \text{ cm}^3$

E Use the sine rule or otherwise, find the value of x correct to 2 decimal places. (2 marks)



$\frac{x}{\sin 70} = \frac{8}{\sin 40}$

$x = \frac{8 \sin 70}{\sin 40}$

$\doteq 11.70$

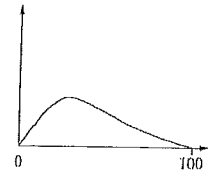
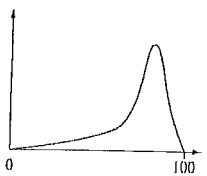
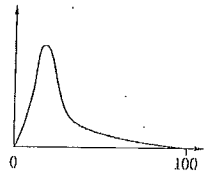
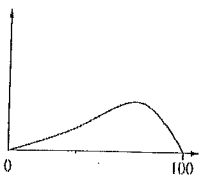
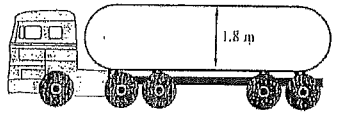
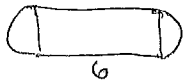
F Find the equation of the line that passes through (0, -2) and (2, 6). Write your answer in general form. (2 marks)

$\frac{y+2}{6+2} = \frac{x-0}{2-0}$

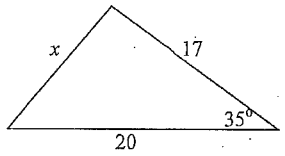
$2y + 4 = 8x$

$8x - 2y - 4 = 0$

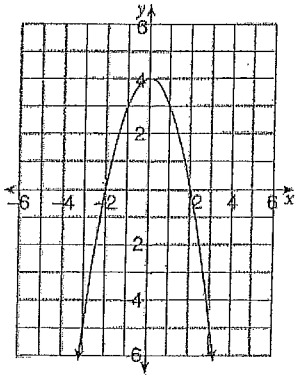
$4x - y - 2 = 0$

G	Which of these graphs represents positively skewed data with the smaller standard deviation? (A)  (B)  (C)  (D) 		1
H	Find the point of intersection of the two lines with the following equations. $4x+3y=6$ —① $3x+2y=5$ —② 2×①: $8x+6y=12$ 3×②: $9x+6y=15$	$\therefore x=3$ So $12+3y=6$ $y=-2$ $(3,-2)$	2
I	At Eric's birth his parents decided to invest \$3000 that they would hold in trust until his 21st birthday. They had a choice of investments; either 7% p.a. compounded monthly or 7.5% p.a. compounded yearly. Which is the best investment and by how much? (correct to the nearest cent)	$I_1 = \$3000\left(1+\frac{7}{1200}\right)^{21\times12}$ $= \$12992.10$ $I_2 = \$3000\left(1+\frac{7.5}{100}\right)^{21}$ $= \$13699.32$ The second is better, by \$707.22	2
J	Where does the parabola $y=x^2-9x-22$ cross the x-axis? $(x+2)(x-11)=0$ $x=-2$ or 11	$x=-2$ or 11	2
K	A container on the road trailer carrying liquefied gas is in the shape of a cylinder 6 m long together with 2 hemispherical ends. The total length is 7.8 m. What is volume in cubic metres? 	 $V = \pi r^2 h + \frac{4}{3}\pi r^3$ $= \pi(0.9)^2\times6 + \frac{4}{3}\pi(0.9)^3$ $\doteq 18.32\ m^3$	2

End of Question Two

Question Three (20 marks)		Answer	Marks
A	Given the two points $(-5,3)$ and $\left(5\frac{1}{2},3\frac{1}{4}\right)$ and the circle $x^2+y^2=36$ which of the following is true. (I) Both points are inside the circle. (II) Both points are outside the circle. (III) One point is inside and the other is outside the circle. (IV) One point is on the circle and the other is inside.	Distance from $(-5,3)$ to O is $\sqrt{34}$ < radius (=6) $\therefore (-5,3)$ INSIDE Distance from $(5\frac{1}{2},3\frac{1}{4})$ to O is $\sqrt{\frac{290}{4}}$ > radius (=6) $\therefore$ (III) ①	1
B	In the formula $M=\sqrt{t-3}$, which values can t possibly take?	$t-3\geq0$ $\therefore t\geq3$ ①	1
C	Find the value of x correct to 2 decimal places. 	By Cosine Rule ① $x^2=17^2+20^2-2.17.20\cos35°$ $x\doteq11.49$ ①	2
D	Four cards with the numbers 1,4, 5 and 7 written on them are picked at random and used to form a four digit number. Find the probability that the number is (i) odd? (ii) greater than 5200?	(i) $18/24 = 3/4$ ① (ii) $10/24 = 5/12$ ①	2
E	Solve $2x^2-12x+17=0$. Write your answer in simplified surd form.	$x=\frac{-(-12)\pm\sqrt{(-12)^2-4(2)(17)}}{4}$ $x=\frac{12\pm\sqrt{8}}{4}=\frac{12\pm2\sqrt{2}}{4}$ $=\frac{6\pm\sqrt{2}}{2}$ (2)	2

F What is the equation of this parabola? 2



$y = k(x+2)(x-2)$

When $x=0$, $y=4$

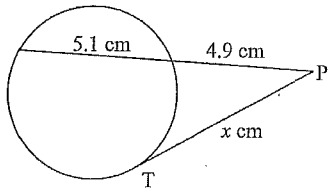
$4 = k(0+2)(0-2)$

$k = -1$ (2)

$\therefore y = -(x+2)(x-2)$

$y = 4 - x^2$

G TP is a tangent. Find the value of x. 2

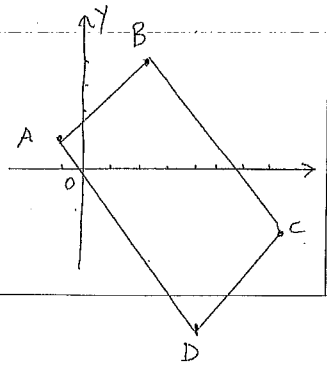


$x^2 = (5.1 + 4.9)\,4.9$ (1)

$x^2 = 49$

$x = 7$ (1)

H Given the points A(-1, 1), B(2, 5) and C(7, -3) find the coordinates of point D such that ABCD is a parallelogram. 2



(MANY METHODS)

Midpt of AC is same as midpt of BD

ie $(3,-1) = \left(\frac{x+2}{2}, \frac{y+5}{2}\right)$

$\Rightarrow x = 4,\ y = -7$

$D(4,-7)$ (2)

I Finola selected 30 students at random from Year 10 at her high school, and asked each of them how many text messages they had sent from a mobile phone within the last day. The results are summarised in the following table. 4

Number of text messages sent	*Frequency*
0	3
1	3
2	4
3	4
4	9
5	7

(i) Determine the median number of text messages sent.

4 (1)

(ii) Find the inter-quartile range of text messages sent.

$Q_1 = 2$ $Q_3 = 4.5$ $IQR = Q_3 - Q_2 = 2.5$ (1)

OR $IQR = 4 - 2 = 2$ (accept)

(iii) Calculate the mean number of text messages sent. (Give your answer correct to two decimal places.)

$\bar{x} = \frac{94}{30} = 3\frac{2}{15} \doteq 3.13$ (1)

(iv) Calculate the standard deviation. (Give your answer correct to two decimal places.)

$\sigma_n = 1.63$ (1)

J For the parabola $y = x^2 + 2x + 5$. 2

(i) Find the equation of the axis of symmetry.

(i) $x = -\frac{b}{2a} = -\frac{2}{2} = -1$

$x = -1$ (1)

(ii) And hence the minimum y-value of the parabola.

(ii) $y = (-1)^2 + 2(-1) + 5$

$y = 4$

MIN value is 4 (1)

End of Question Three

QUESTION 4

A(i) $P(\bar{6},\bar{6}) = \frac{5}{6} \times \frac{5}{6} = \frac{25}{36}$

(ii) $P(6,6) = \frac{1}{36} \times \$20 = \$\frac{5}{9}$

$P(6,\bar{6}) + P(\bar{6},6) = \frac{1}{6} \times \frac{5}{6} + \frac{5}{6} \times \frac{1}{6}$

$= \frac{10}{36} \times \$2 = \$\frac{5}{9}$

$P(\bar{6},\bar{6}) = \frac{25}{36} \times -\$2 = -\$1\frac{7}{18}$

Total $= -\$\frac{5}{18}$

After 10 games loss of $2.78

B $20^\circ \quad 160^\circ$

C $3a^2 - 28a + 9 = 0 \quad (a = 3^x)$

$(3a - 1)(a - 9) = 0$

$a = \frac{1}{3} \quad a = 9$

$3^x = \frac{1}{3} \quad 3^x = 9$

$x = -1, \quad 2$

D $A = \frac{\pi \times 4^2 \times 120}{360} - \frac{1}{2} \times 4^2 \times \sin 120^\circ$

$= 9.82 = 10\ cm^2$

E History Mark = Mean + 50 × 1.9

English Mk = Mean + 50 × 1.14

Maths Mk = Mean + 50 × 1

HISTORY ENGLISH MATHS

(ii) $175 \times 16\% = 28$ stud.

F $4 \times \sqrt{2.75} + 4$

$= 10.63$ cm

G after 1 yr 64960

9 years

H End Month 1

Amount after deposit $73080

$73080 \times \frac{151}{150} - 866.66$

$\$72700$

End Month 2

$72700 \times \frac{151}{150} - 866.66$

$= \$72318.55$

End Month 3

$72318.55 \times \frac{151}{150} - 866.66$

$= \$71934$

(ii) Interest $= 866.66 \times 120 - \$73080$

$= \$30919.20$

(iii) $\frac{30919.20 \times 100}{73080 \times 10} = 4.23\%$

I(i) $\angle ACB = \angle DCE$ (vert opp $\angle$s)

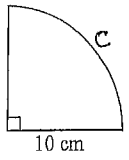
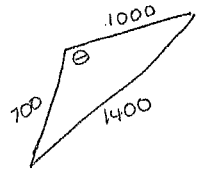
$\frac{AC}{CE} = \frac{BC}{CD}$ (given)

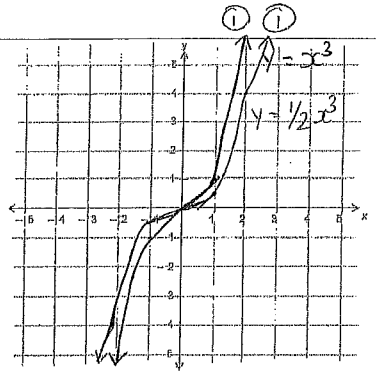
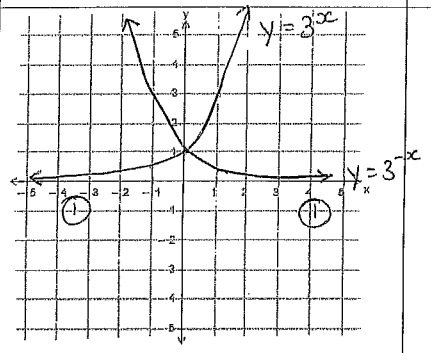
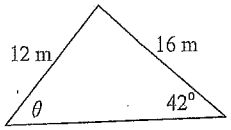
$\therefore \triangle ABC \parallel\parallel DCE$

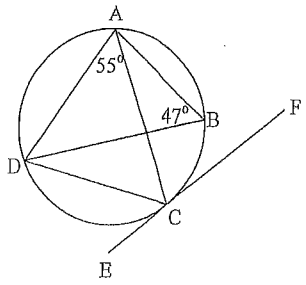
(2 sides in prop. + included angles equal)

(ii) $\frac{AB}{8} = \frac{16}{1}$

$AB = 10\frac{2}{3}$ cm

Question Five (20 marks)		Answer	Marks
A	Use the "completing the square method" to solve $x^2 - 6x + 7 = 0$. Leave your answer in surd form.	$x^2 - 6x = -7$ $x^2 - 6x + 9 = -7 + 9$ $(x-3)^2 = 2$ $x - 3 = \pm\sqrt{2}$ $x = 3 \pm \sqrt{2}$ -1 for no $\pm$	2
B	Find the points of intersection of $y = x^2 + 6x - 21$ $y = 15 - 3x$	$x^2 + 6x - 21 = 15 - 3x$ $x^2 + 9x - 36 = 0$ $(x-3)(x+12) = 0$ $\therefore x = 3, -12$ $\therefore y = 6, 51$	2
C	If the following sector was to be bent into a cone what would be the base radius? Answer in exact form.  	$C = \frac{2\pi r}{4}$ $= \frac{20\pi}{4}$ $= 5\pi$ ① $5\pi = 2\pi r$ $r = 5\pi/2\pi \quad r = 5/2$ ①	2
D	Two similar solids have volumes 105.6 cm^3 and 1650 cm^3. If the smaller solid has a surface area of 83.8 cm^2, what is the surface area of the larger solid? $a^3 : b^3$ $a^2 : b^2$	V : V 105.6 : 1650 SA : SA 83.8 : ? $83.8 = (\sqrt[3]{105.6})^2 \times x$ $x = 3.750893655$ (½) SA big $= (\sqrt[3]{1650})^2 \times x$ $= 523.75\ cm^2$ ①	2
E	The three legs of a triangular sailing course are 700 m, 1000 m and 1400 m. Find the largest angle (correct to the nearest degree) through which the boats must turn when completing two laps of the course.  	$\cos\theta = \frac{700^2 + 1000^2 - 1400^2}{2 \times 700 \times 1000}$ ① $= \frac{-470000}{1400000}$ $\theta = 109.6159791$ $= 110^\circ$ (nearest degree) ①	2

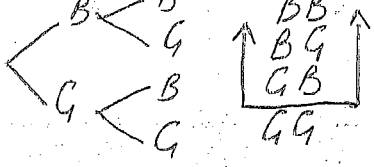
F	Sketch the graphs of $y = x^3$ and $y = \frac{1}{2}x^3$ on the same axes.		2
G	Sketch the graphs of the equations $y = 3^x$ and $y = 3^{-x}$ on the same axis.		2
H	Find all possible values of θ correct to the nearest minute. 	$\frac{\sin 42}{12} = \frac{\sin \theta}{16}$ (1) $\sin\theta = \frac{16 \sin 42}{12}$ $\theta = 63^\circ 09', 116^\circ 51'$ (½) (½)	2
I	Find the radii of two spheres if the difference of their radii is 25 mm and the difference of their surface areas is $10\,000\pi$ mm^2. $SA = 4\pi r^2$ $r : R$ $r + 25 = R$ $4\pi r^2 + 10000\pi = 4\pi(r+25)^2$ (1) $4\pi(r^2 + 2500) = 4\pi(r+25)^2$	$r^2 + 2500 = r^2 + 50r + 625$ $2500 = 50r + 625$ $50r = 1875$ $r = 37.5$ mm (½) $\therefore R = 62.5$ mm (½)	2

J	EF is a tangent. Find the size of ∠ACF giving reasons. 	∠ACD = 47° (∠s in same segment) (½) ∠DCE = 55° (∠s in alt segment) (½) ∴ ∠ACF = 180 − 47 − 55 = 78° (∠ sum st line) (1)	2

End of Question Five

Year 10 2007 Yearly exam Question 6

(A)



we are only interested if the 1st or the 2nd child is a boy given 1 boy already.

$\frac{1}{3}$ (1)

(B) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$.

$\frac{1}{R_T} = \frac{R_2 + R_1}{R_1 R_2}$.

$R_1 R_2 = R_T R_2 + R_T R_1$

$R_1 R_2 - R_T R_2 = R_T R_1$

$R_2 (R_1 - R_T) = R_T R_1$ (2)

$R_2 = \frac{R_T R_1}{(R_1 - R_T)}$

(C) (i) Frequency totals 200 *

R.F $\frac{19}{100} = 0.19$

$\frac{62}{200} = \frac{31}{100} = 0.31$

$\frac{90}{200} = \frac{9}{20} = 0.45$ (1)

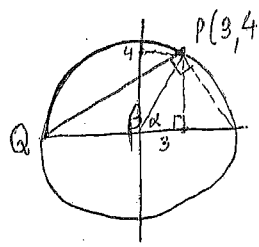
$\frac{10}{200} = \frac{1}{20} = 0.05$ *

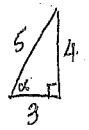
$\Sigma rf = 1.00$

(C) (ii) $\frac{100}{200} = \frac{1}{2}$ each tyre (2)

$\left(\frac{1}{2}\right)^4 = \frac{1}{16}$.

(D)





$\tan\alpha = \frac{4}{3}$

$\alpha = 53^\circ 8'$

So $\beta = 180 - 53^\circ 8'$

$= 126^\circ 52'$

Circumference $C = 2\pi r = 10\pi$

semi circle circumference $= 5\pi$

$\frac{5\pi}{180} = \frac{x}{126^\circ 52'}$

$x = \frac{5\pi \times 126^\circ 52'}{180}$

$\doteq 11.0712\ldots$

$= 11.1$ units (3SF). (3)

(E) let a = small part

b = big part

$\frac{a}{b} = \frac{b}{a+b}$

let $a=1$, $\frac{1}{b} = \frac{b}{1+b}$

$1 + b = b^2$

$b^2 - b - 1 = 0$

quad formula

$b = \frac{1 \pm \sqrt{1 - 4 \times 1 \times -1}}{2 \times 1}$

$= \frac{1 \pm \sqrt{5}}{2}$.

take positive, ratio is

$1 : \frac{1+\sqrt{5}}{2}$ (3)

OR

$\frac{a}{b} = \frac{b}{a+b}$.

$a^2 + ab = b^2$

$a^2 + ab - b^2 = 0$

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

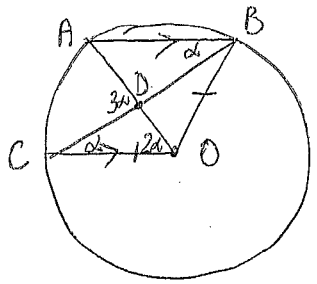
So $\frac{a}{b} = \frac{-b \pm b\sqrt{5}}{2b}$ (3)

$= \frac{-1 \pm \sqrt{5}}{2}$.

So $\frac{\sqrt{5}-1}{2}$ or $\frac{\sqrt{5}+1}{2}$

because $\left(\frac{\sqrt{5}-1}{2}\right) \times \left(\frac{\sqrt{5}+1}{2}\right) = \frac{5-1}{4} = 1$ reciprocals.

(F)



$AB \parallel CO$

Prove $A\hat{D}C = 3A\hat{B}C$

$OB = OC$ radii

Let $A\hat{B}C = \alpha$ (at circumference), stands on arc AC.

$\therefore A\hat{O}C = 2\alpha$ (at centre), stands on arc AC.

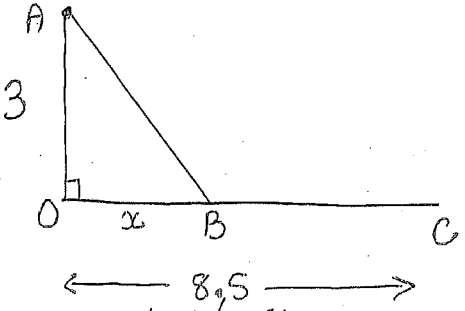
$B\hat{C}O = \alpha$ alternate angles $AB \parallel CO$

Now $A\hat{D}C = \alpha + 2\alpha$ (exterior angle = sum of 2 remote interior angles)

$= 3\alpha$.

$\therefore A\hat{D}C = 3 \times A\hat{B}C$. (3)

(G)



Rows from A to B at 4km/h.

Walks from B to C at 6km/h.

(i) $AB = \sqrt{x^2+9}$

$\text{speed} = \frac{\text{distance}}{\text{time}}$.

$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{\sqrt{x^2+9}}{4}$ hours. (2)

(G) (ii) 2 hours to reach C from A.

$$\frac{\sqrt{x^2+9}}{4} + \frac{(8.5-x)}{6} = \frac{2}{1}$$

$\times 12$

$$3\sqrt{x^2+9} + 2(8.5-x) = 24$$

$$3\sqrt{x^2+9} + 17 - 2x - 24 = 0$$

$$3\sqrt{x^2+9} - 2x - 7 = 0$$

$$3\sqrt{x^2+9} = (2x+7)$$

$$9(x^2+9) = (2x+7)^2$$

$$9x^2 + 81 = 4x^2 + 28x + 49$$

$$5x^2 - 28x + 32 = 0$$

$$x = \frac{28 \pm \sqrt{784 - 4 \times 5 \times 32}}{10}$$

$$= \frac{28 \pm 12}{10}$$

$$= \frac{28+12}{10} \text{ or } \frac{28-12}{10}$$

$x = 4$ or 1.6 km. (3)