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Name ______________________________( ) Class:______

CHIJ KATONG CONVENT
END-OF-YEAR EXAMINATION 2016
SECONDARY 2 EXPRESS

MATHEMATICS
PAPER 2

Duration: 1 hour 15 minutes

Classes: 203, 204, 205, 206

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.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid/tape.

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 50.

The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142.

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

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\Sigma f x}{\Sigma f}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma f x^2}{\Sigma f} - \left(\frac{\Sigma f x}{\Sigma f}\right)^2}$$

Answer all questions.

1 **(a)** Simplify $1-2y^2-(2y+7)(y-5)$. [2]

(b) Make E the subject of the formula $k=\sqrt{\dfrac{8m(U-E)}{h^2+2E}}$. [3]

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2 **(a)** Factorise completely $9x^2-6xy+y^2$. [1]

(b) Hence, factorise completely $9x^2-6xy+y^2+y-3x$. [2]

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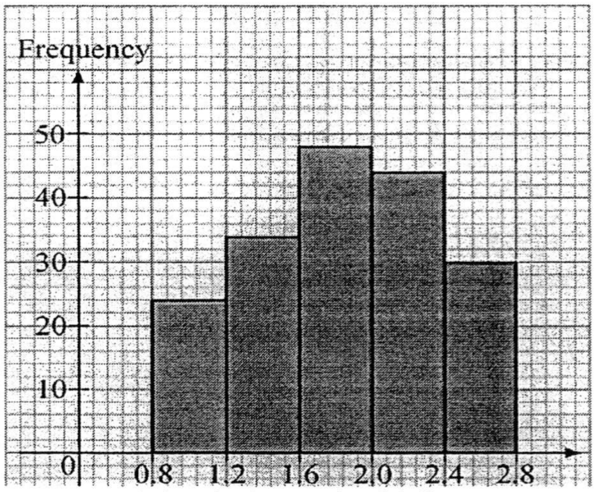
3 The histogram below shows the salaries in thousand dollars of all employees in a company.



Salary in thousands of dollars

[Key: 0.8 thousands = 0.8×1000 = \$800]

Estimate the mean salary, correct to the nearest dollar. [3]

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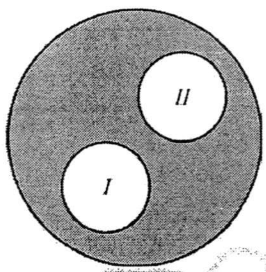
4 Two identical small circles, *I* and *II*, are drawn inside a big circle. The radius of each small circle is 5 cm and the radius of the big circle is 15 cm.



(a) Calculate, in terms of π, the area of the shaded region. [2]

(b) A point is randomly selected inside the big circle. Find the probability of selecting a point in

(i) the shaded region, [1]

(ii) circle *II*. [1]

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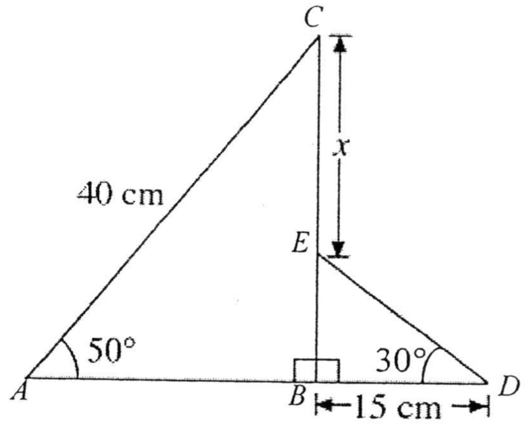
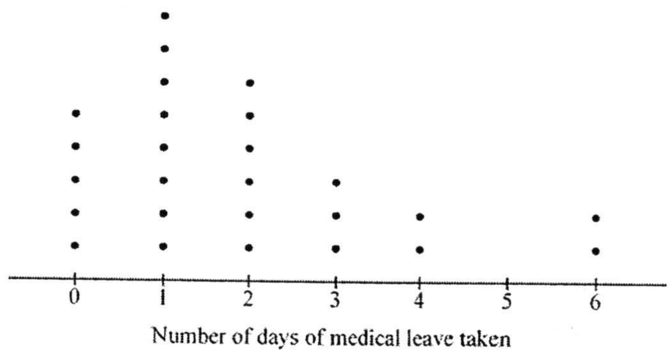
5 The figure below is made of two right-angled triangles ABC and triangle DBE.
Angle $CAB = 50°$ and angle $BDE = 30°$.
$AC = 40$ cm and $BD = 15$ cm.



Find the length x giving your answer to the nearest whole number. [3]

6 The dot diagram below shows the number of days of medical leave workers at Jin Construction Company had taken in the first half of the year.



(a) What is the percentage of workers who took at least 2 days of medical leave? [2]

(b) What is the median number of days of medical leave taken? [1]

(c) At Heng Construction Company, there are five times as many workers as Jin Construction Company.

(i) Explain if a dot diagram would be appropriate for representing the same information of days of medical leave taken at Heng Construction Company. [1]

(ii) Suggest one alternative way of presenting the information at Heng Construction Company. [1]

7 A production worker assembles electronic components at a normal rate of $\$x$ per hour and overtime rate of $\$y$ per hour and works a 5-day week.

In one particular week, she worked for 24 hours at the normal rate and 6 hours at the overtime rate and was paid \$246.

In another week, she worked for 30 hours at the normal rate and 4 hours at the overtime rate and was paid \$269.

(a) Write down two equations satisfied by x and y. [2]

(b) By solving these two simultaneous equations, find her normal and overtime rates of pay. [3]

(c) To meet a higher weekly production rate, Dilys works for 48 hours at the normal rate and 16 hours at the overtime rate. Under the guidelines of the Ministry of Manpower, a worker should not work more than 12 hours a day.

Determine if Dilys has exceeded the limit of 12 hours a day. [1]

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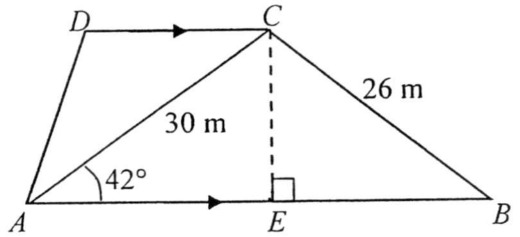
8 A garden is in the shape of a trapezium $ABCD$ where AB is parallel to DC.
CE is perpendicular to AB.
AC divides the garden into two plots so that they may be used for different purposes.
It is given that $AC = 30$ m, $BC = 26$ m and angle $CAB = 42°$.



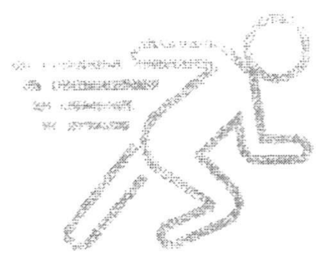
(a) Show that the area of triangle $ABC = 389.62$ m^2 correct to 2 decimal places. [3]

(b) It is further given that $AB : DC = 2 : 1$.

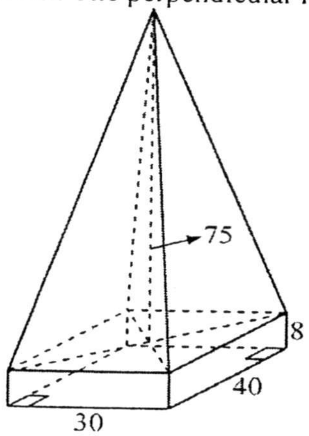
Using **(a)**, find the area of the trapezium, giving your answer to 1 decimal place. [2]

(c) 28 g of seeds is scattered over each square metre of triangle ABC.

Find the amount of seeds, in kilograms, needed, giving your answer to the nearest whole number. [2]



9 The figure below shows the design of a hamper, which consists of a rectangular pyramid above a cuboid of the same rectangular base. The rectangular cuboid measures 30 cm by 40 cm by 8 cm. The perpendicular height of the pyramid is 75 cm.



(a) Calculate the volume of the hamper. [2]

(b) Find the total surface area of the hamper, to the nearest cm^2. [3]

(c) Sam intends to use cellophane paper to wrap the hamper.

Each piece of cellophane paper is a square of side 80 cm and costs \$1.30.

Using your answer from (b), calculate the minimum cost of the cellophane paper required to wrap the above hamper. [2]

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10 Answer the whole of this question on a sheet of graph paper.

(a) A stone was thrown from the top of a vertical tower.

Its position during the flight is represented by the equation, $y = 50 + 18x - x^2$, where y metres is the height of the stone above the ground and x metres is its horizontal distance from the foot of the tower.

Some corresponding values of x and y are given in the following table.

x	0	2	4	6	8	11	13	15	17	20
y	50	82	a	122	130	127	115	95	67	b

Find the value of a and of b. [2]

(b) Using a scale of 4 cm to represent 5 m, draw a horizontal x-axis for $0 \leq x \leq 22$.

Using a scale of 2 cm to represent 20 m, draw a vertical y-axis for $0 \leq y \leq 150$.

On your axes, plot the points in the table and join them with a smooth curve. [3]

(c) Use your graph to estimate

(i) the greatest height reached by the stone. [1]

(ii) the distance the stone is from the foot of the tower when it reaches the ground. [1]

End of Paper

2E Math SA2 2016 Paper 2

Qn	Suggested Solution
1.	(a) $1-2y^2-(2y+7)(y-5)$ $=1-2y^2-(2y^2-10y+7y-35)$ $=1-2y^2-(2y^2-3y-35)$ $=1-2y^2-2y^2+3y+35$ $=-4y^2+3y+36$ (b) $k=\sqrt{\dfrac{8m(U-E)}{h^2+2E}}$ $k^2=\dfrac{8mU-8mE}{h^2+2E}$ $k^2(h^2+2E)=8mU-8mE$ $k^2h^2+2k^2E=8mU-8mE$ $8mE+2k^2E=8mU-k^2h^2$ $E(8m+2k^2)=8mU-k^2h^2$ $E=\dfrac{8mU-k^2h^2}{8m+2k^2}$ or $E=\dfrac{8mU-k^2h^2}{2(4m+k^2)}$
2.	(a) $9x^2-6xy+y^2$ $=(3x-y)^2$ (b) $9x^2-6xy+y^2+y-3x$ $=(3x-y)^2+y-3x$ $=(3x-y)^2-3x+y$ $=(3x-y)^2-(3x-y)$ $=(3x-y)[(3x-y)-1]$ $=(3x-y)(3x-y-1)$
3.	Estimated mean salary $=\dfrac{1000\times 24+1400\times 34+1800\times 48+2200\times 44+2600\times 30}{180}$ $=\dfrac{332800}{180}$ = \$1849 (correct to the nearest dollar)
4.	(a) Area of shaded region $=\pi(15)^2-2\pi(5)^2$ $=175\pi\text{ cm}^2$ (b) (i) P(shaded region) $=\dfrac{175\pi}{225\pi}=\dfrac{7}{9}$ (ii) P(circle II) $=\dfrac{25\pi}{225\pi}=\dfrac{1}{9}$

Qn	Suggested Solution
5.	$\frac{BE}{15} = \tan 30°$ $BE = 15 \tan 30°$ $= 8.6602...$ $\frac{BC}{40} = \sin 50°$ $BC = 40 \sin 50°$ $= 30.6417...$ $x = 30.6417... - 8.6602...$ $= 21.9815...$ $= 22$ cm (nearest whole no.)
6.	(a) % who took at least 2 days MC $= \frac{13}{26} \times 100$ $= 50\%$ (b) Median $= \frac{13th + 14th}{2} = \frac{1+2}{2} = 1.5$ days (c) With 5 times the number of workers, there would be 130 dots that need to be represented in the dot diagram. This makes the diagram **<u>cluttered and difficult to read / interpret</u>**. A clearer diagram such as a bar graph / line graph may be used instead.
7.	(a) $24x + 6y = 246$ --------(1) $30x + 4y = 269$ --------(2) (b) (1) ÷ 6; $4x + y = 41$ $y = 41 - 4x$ ----------(3) Subst (3) in (2); $30x + 4(41 - 4x) = 269$ $30x + 164 - 16x = 269$ $14x = 105$ $x = 7.5$ subst in (3) $y = 41 - 4(7.5)$ $= 41 - 30$ $= 11$ ∴ normal rate = \$7.50, overtime rate = \$11 (c) Total hours Dilys worked that week $= 48 + 16 = 64$ hours If Dilys worked a 5-day week, her average hours would be $64 \div 5 = 12.8$ hours. ∴ she has exceeded the 12 hour requirement by the MOM.
8.	(a) *CE* is the perpendicular from *C* to the base of the

Qn	Suggested Solution
	trapezium AB. $\frac{CE}{30} = \sin 42°$ $CE = 30 \sin 42° = 20.0739...$ $\frac{AE}{30} = \cos 42°$ $AE = 30 \cos 42°$ $= 22.2943...$ $EB = \sqrt{26^2 - 20.0739...^2}$ $= 16.5238...$ $AB = 22.2943... + 16.5238... = 38.8182...$ Area of triangle ABC = ½(38.8182...)(20.0739...) = 389.6166... = 389.62 m^2 (2 dp) [shown] (b) Since $AB : DC = 2 : 1$, DC = ½ AB = ½ (38.8182...) = 19.4091... Since $AB : DC = 2 : 1$, DC = ½ AB = ½ (38.8182...) = 19.4091... Area of triangle ADC = ½ (19.4091...)(20.0739...) = 194.8083... ∴ area of trap = 389.6166...+ 194.8083... = 584.4249... = 584.4 m^2 (1 dp) OR the following was also accepted. Area of trapezium ABC = ½ (38.8182... + 19.4091...)(20.0739...) = 584.4 m^2 (1 dp) (c) 1 sq metre ----------- 28 g ∴ 389.6166... sq metre ---------- 389.6166...× 28 = 10909.2648...g ∴ amount of seeds needed = 11 kg (nearest kg)
9.	(a) Volume of hamper $= 30 \times 40 \times 8 + \frac{1}{3} \times 30 \times 40 \times 75$ $= 39\ 600\ cm^3$ (b) Let slant heights of lateral faces be x cm and y cm respectively. $x^2 = 15^2 + 75^2$ (Pythagoras' Theorem) $= 5850$ $x = \sqrt{5850} = 76.4852...$ cm $y^2 = 20^2 + 75^2$ (Pythagoras' Theorem) $= 6025$ $y = \sqrt{6025} = 77.6208...$

Qn	Suggested Solution
	Area of cellophane paper required = total SA of hamper Area of the base of cuboid = $30\times 40+2\times 8\times 40+2\times 8\times 30$ $= 2320$ cm^2 Area of the 4 triangles $=2\times\frac{1}{2}\times 40\times\sqrt{5850}+2\times\frac{1}{2}\times 30\times\sqrt{6025}$ $= 5388.0379\ldots$ $\therefore$ Combined area of cellophane required = 7708 cm^2 (correct to the nearest cm^2) (c) Area of cellophane paper = $80 \times 80 = 6400$ cm^2. No. of pieces of paper required = $\frac{7708}{6400} = 1.20\ldots$ ≈ 2 pieces Minimum cost = $2 \times \$1.30$ = $2.60
10.	(a) $a = 106$, $b = 10$ (b) Graph paper (c)(i) Fr graph, greatest ht reached = 131m [131 – 132] (ii) Fr graph, distance from foot of the tower to where the stone lands = 20.4 m [20.25-20.5]