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中正中学 (义顺)

CHUNG CHENG HIGH SCHOOL (YISHUN)

Mid-Year Examination (2016)
Secondary 2 Express

Candidate Name _____ Register No _____ Class _____

MATHEMATICS

Date:
Duration: 2 hours

For examiner's use
/ 100

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question, it must be shown with the answer.
Omission of essential workings and units will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
Give your answer in the simplest form. Leave your answer in fraction where applicable or 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.
For π, use your calculator value, unless the question requires the answer in terms of π.

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.

Setter: Ms Marlinda Aziz

This paper consists of 12 printed pages, INCLUDING the cover page. [TURN OVER

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1. (a) Calculate $\dfrac{33.17+55.2^3}{0.3141+\sqrt[3]{647.9}}$ showing all the figures on your calculator display.

(b) Give your answer in (a) correct to

(i) 3 significant figures,

(ii) 2 decimal places.

Answer: (a) ..... [1]

(b) (i) ..... [1]

(ii) ..... [1]

2. Without the use of a calculator, evaluate 998^2, using special product of algebraic expression.

Ans ..... [2]

3. (a) Given that $b=\dfrac{3c-1}{2c+1}$, express c in terms of b, giving your answer in its simplest form.

(b) Hence, write down the value of c when $b = 6$.

Answer: (a) ..... [3]

(b) ..... [1]

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4. (a) Simplify $p^2-(p+q)(p-q)$.

(b) Hence, write down the value of $123456789^2-123456797\times123456781$.

(a) ..... [2]

(b) ..... [1]

5. Given $H=4\pi\sqrt{m^2+n^2}$, make m the subject of the formula.

Answer: ..... [3]

6. Given $(x+y)^2=25$ and $xy=-6$, calculate the value of $\frac{1}{x^2}+\frac{1}{y^2}$.

Answer: ..... [3]

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7. The equation of a line is given as $\frac{y}{3} - \frac{x}{2} = 5$. Find

(a) the gradient,

(b) the coordinates of the y-intercept.

Answer: (a) ..... [2]

(b) ..... [2]

8. The distance, x metres, of an object from a fixed point O at time t seconds is given by $x = 5t^2 - 30t + 45$.

(a) Calculate the initial distance of the object from O.

(b) Write down the distance, in metres, of the object from O when $t = 10$.

(c) Factorise $5t^2 - 30t + 45$ completely.

(d) From 3 to 5 seconds, state whether the object will move nearer or further away from O. Give a reason for your answer.

Answer (d): [2]

Answer: (a) ..... m [1]

(b) ..... m [1]

(c) *[2]*

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9 Charles, Dickson and Elmer took a group photo beside a standing grandfather's clock which is 2.2 m tall. Dickson is 1.66 m tall and he is shorter than Charles by 0.1 m but taller than Elmer by 0.06 m. In the photo, the clock is 1.5 cm taller than Elmer.

(a) Find the scale of the photo in the form 1: n.

Find the height of the clock in the photo.

Answer: (a) ..... [2]

(b) ..... cm [1]

10 Given $\sqrt{p}$ is directly proportional to $\frac{1}{2}q$ and $p = 25$ when $q = 8$.

(a) Express p in terms of q.

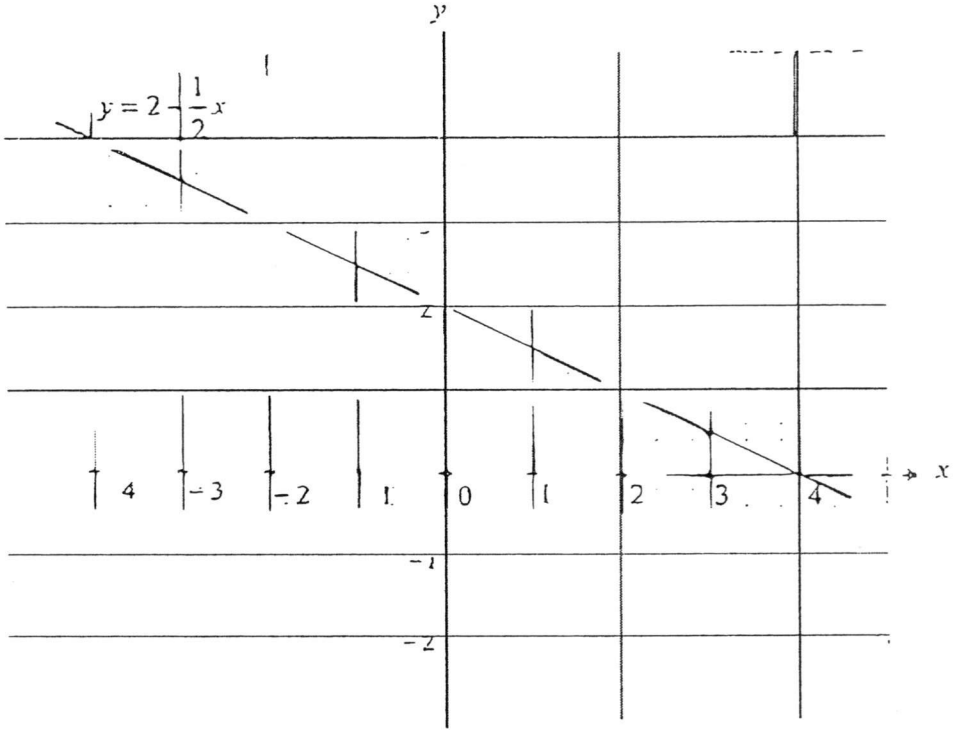
(b) Find the percentage decrease in p if q is decreased by 10%.

Answer: (a) ..... [2]

(b) ..... [3]

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11. The diagram shows the graph of $y = 2 - \frac{1}{2}x$.



(a) Using the graph shown on the diagram, find p if $(p, 3)$ is a solution to $y = 2 - \frac{1}{2}x$.

(b) State the gradient of the graph $y = 2 - \frac{1}{2}x$.

(c) (i) On the diagram, draw the graph of $x = -2$. [1]

(ii) Find the area of the triangle formed by $y = 2 - \frac{1}{2}x$, $x = -2$ and the x-axis.

Answer: (a) $p =$. [1]

(b) .. ... [1]

(c) (ii) .. .. units^2 [2]

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12. Simplify each of the following.

(a) $x^2 + 2x - 3x^2 + 7 - x$

(b) $\dfrac{(-2h)^3}{27gh} \times \dfrac{g^2h}{4}$

(c) $\dfrac{(2x+y)(y-x)}{10-15x} \quad \dfrac{14x^2+9xy+y^2}{3x-2}$

Answer: (a) ..... [1]

(b) ..... [2]

(c) ..... [4]

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13. Factorise completely the following expressions.

(a) $-2y^2 - 7y + 4$

(b) $16n^3 + 16mn^2 - 9n - 9m$

Answer: (a) [2]

(b) [3]

14. (a) Express $\frac{5}{w^2 - w - 6} + \frac{2}{2w - 6}$ as a single fraction in its lowest term.

(b) Solve $4x^2 = 9(4x - 9)$.

Answer: (a) ..... [3]

(b) ... [3]

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15. The roots of the equation $x^2 + bx + c = 0$, where b and c are constants, are -2 and 7.
Find the value of b and of c.

Answer: $b =$ $c =$. [4]

16. (a) Given m is inversely proportional to $(n-3)$ and $m = 2$ when $n = 5$, express m in terms of n

(b) Melvin claims that the distance d travelled by a ball as it is dropped from a tower is directly proportional to the square of the time taken t, for the ball to drop to the ground. To prove his claim, he conducted an experiment and recorded his findings as follows.

t/second	1.5	1.9	2.2	2.8	s
d/metres	13.50	21.66	29.04	47.04	73.50

(i) Prove that Melvin's claim is valid.
(ii) Hence, find the value of s.

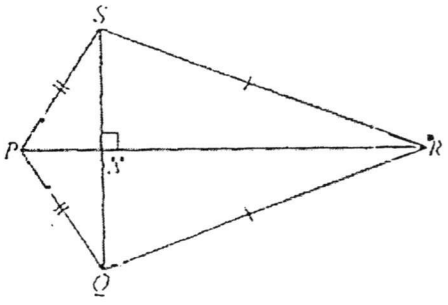
Answer: (b)(i) [2]

Answer: (a) ..... [2]

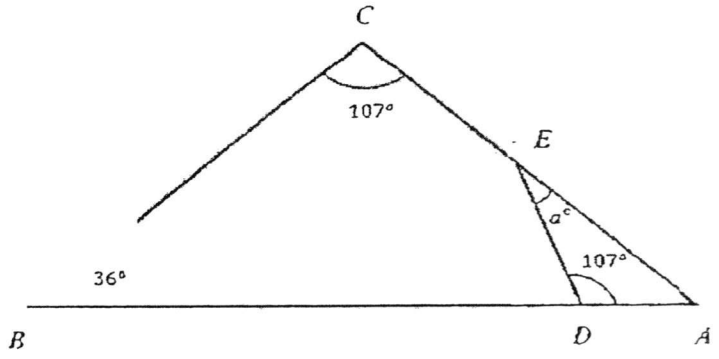
(b) (ii) ..... [2]

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17. (a) A kite $PQRS$ is shown in the diagram. The lines PR and SQ intersect at X.
Write down the three pairs of congruent triangles.



(b) In the diagram below, triangles ABC and AED are similar.



Given BD is 7.7 cm, $AD = 2.1$ cm, $AE = 2.8$ cm and $DE = 2.4$ cm, find
(i) the value of a,
(ii) the length of CE.

Answer: (a) Δ..... and Δ.....

Δ..... and Δ.....

Δ..... and Δ..... [2]

(b) (i) .....° [1]

(ii) ..... cm [2]

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18. Mr Lim drives from Town A to Town B, which are 12 cm apart on a map. He leaves Town A at 08 00 and reaches Town B at 09 30, driving at an average speed of 58 km/h. Find

(a) the actual distance between the two towns,

(b) the scale of the map in the form $\frac{1}{r}$,

(c) the time taken, in hours, by Mr Lim to reach Town C if the distance from Town B to Town C is represented by a length of 4 cm on the map.

(Assume he travels at the same average speed and does not take any break during the journey.)

Answer (a) km [1]

(b) . . [2]

(c) h [2]

19. A nature reserve has an area of 225 km^2.

(a) A map has a scale of 1 cm to 5 km. Find the area of the nature reserve as represented on the map.

(b) On another map, the same nature reserve is represented by an area of 36 cm^2. Express the scale of this map in the form $1 : r$.

Answer (a) . . . . cm^2 [2]

(b) 1 . . . . [2]

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20 A businessman bought x air purifiers for $1050 an intended to sell them at a profit of $6 per purifier.

(a) Write down an expression in terms of x, the selling price of each air purifier.

(b) He made $1050 from selling the air purifiers with 20 left u old Form an equation in terms of x and show that it reduces to $x^2 - 20x - 3500 = 0$.

(c) (i) Solve the equation $x^2 - 20x - 3500 = 0$ to find the number of air purifiers he bought.

(ii) Henc , find the selling price of each purifier

Answer (b) [3]

Answer: (a) . [1]

(c)(i) .... [3]

(ii)..... [1]

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

21. The table below gives some values of x and the corresponding values of y where $y = -x^2 + 2x + 5$ for $-3 \le x \le 5$.

x	-3	-2	-1	0	1	2	3	4	5
y	-10	-3	2	5	p	5	2	-3	-10

(a) Calculate the value of p.

(b) Using a scale of 2 cm to represent 1 unit on the x-axis and 1 cm to represent 1 unit on the y-axis, draw the graph of $y = -x^2 + 2x + 5$. [4]

(c) Use your graph to find

(i) the value of y when $x = 4.5$,

(ii) the x intercept(s),

(iii) the maximum point.

Answer: (a) ..... [1]

(c)(i) ..... [1]

(ii)..... [2]

(iii)..... [1]

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Marking Scheme

No	Solution	Marks
1a	343.4992415	B1
bi	343	B1
bii	343.50	B1
2	$998^2 = (1000-2)^2$ $= 1000^2 - 2(1000)(2)+(2)^2$ $= 996\ 004$	M1 A1
3a	$b(2c+1) = 3c-1$ $2bc + b = 3c - 1$ $2bc - 3c = -1 - b$ $c(2b-3) = -1-b$ $c = \frac{-1-b}{2b-3}$ or $c = \frac{1+b}{3-2b}$	M1: Expand M1: Re-arrange A1
b	$c = \frac{1+6}{3-12}$ $= -\frac{7}{9}$	B1
4a	$p^2 - (p+q)(p-q) = p^2 - (p^2 - q^2)$ $= q^2$	M1 A1
b	$123456789^2 - (123456789 + 8)(123456789 - 8) = 64$	
5	$H^2 = 16\pi^2(m^2 + n^2)$ $16\pi^2 m^2 = H^2 - 16\pi^2 n^2$ $m = \pm\sqrt{\frac{H^2 - 16\pi^2 n^2}{16\pi^2}}$	M1: Remove the square root M1: Simplify A1

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6	$\frac{1}{x^2}+\frac{1}{y^2}=\frac{y^2+x^2}{x^2y^2}$ $(x+y)^2=x^2+y^2+2xy$ $25=x^2+y^2-12$ $x^2+y^2=37$ $\frac{y^2+x^2}{x^2y^2}=\frac{37}{36}$ $=1\frac{1}{36}$	M1: Simplify M1 A1
7a	$2y-3x=30$ $2y=3x+30$ $y=\frac{3}{2}x+15$ Gradient is 1.5 or $1\frac{1}{2}$	M1: Simplify A1
b	When $x=0$, $y=15$ Coordinates of y-intercept is (0 , 15)	M1: Substitution A1
8a	When $t=0$, $x=45$	B1
b	When $t=10$, $5(10)^2-30(10)+45=245$	B1
c	$5t^2-30t+45=5(t^2-6t+9)$ $5(t^2-6t+9)=5(t-3)^2$	M1: Factor out '5' A1
d	When $t=3$, $x=0$ m When $t=4$, $x=5$ m When $t=5$, $x=45$ m Object will move further away from O as t increases.	R1 B1
9a	Charles's height: 1.76 m, Dickson's height: 1.66 m, Elmer's height: 1.6m 1.5 cm : 0.6 m 1.5 cm : 60 cm 1 cm : 40 cm Scale of photo is 1 : 40	M1 A1

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b	Height of clock (photo) $= \frac{220}{40}$ $= 5.5$ cm	B1
10a	$\sqrt{p} = \frac{kq}{2}$ $\sqrt{25} = \frac{8k}{2}$ $k = 1.25$ or $k = 1\frac{1}{4}$ Equation is $p = \frac{25}{64}q^2$	M1 A1
b	$p = \frac{k^2q^2}{4}$ When q is decreased by 10%, $p = \frac{k^2(0.9q)^2}{4}$ $p = \frac{81}{100}(\frac{k^2q^2}{4})$ Decrease $= \frac{k^2q^2}{4} - \frac{81}{100}(\frac{k^2q^2}{4})$ $= \frac{19}{100}(\frac{k^2q^2}{4})$ Percentage decrease $= \frac{19}{100} \times 100\%$ $= 19\%$	M1 M1 A1
11a	$p = -2$	B1
b	Gradient is -0.5 or Gradient is $-\frac{1}{2}$	B1
ci	On the diagram.	B1
cii	Area of triangle $= \frac{1}{2} \times 3 \times 6$ $= 9$ units^2	M1 A1
12a	$x^2 + 2x - 3x^2 + 7 - x = -2x^2 + x + 7$	B1
b	$\frac{(-2h)^3}{27gh} \times \frac{g^2h}{4} = \frac{-8g^2h^4}{108gh}$ $= -\frac{2gh^3}{27}$	M1 A1

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c	$\frac{(2x+y)(y-x)}{10-15x} \div \frac{14x^2+9xy+y^2}{3x-2} = \frac{(2x+y)(y-x)}{5(2-3x)} \times \frac{3x-2}{(7x+y)(2x+y)}$ $= -\frac{(2x+y)(y-x)}{5(-2+3x)} \times \frac{3x-2}{(7x+y)(2x+y)}$ $= -\frac{(y-x)}{5(7x+y)}$ or $\frac{x-y}{5(7x+y)}$	M2: Factorise M1: Change sign A1
13a	$-2y^2-7y+4 = (-2y+1)(y+4)$ or $-2y^2-7y+4 = -(2y^2+7y-4)$ $= -(2y-1)(y+4)$	M1: Cross method A1
b	$16n^3+16mn^2-9n-9m = 16n^2(n+m)-9(n+m)$ $= (16n^2-9)(n+m)$ $= (4n-3)(4n+3)(n+m)$	M1: Factorise by grouping M1 A1
14a	$\frac{5}{w^2-w-6}+\frac{2}{2w-6} = \frac{5}{(w-3)(w+2)}+\frac{2}{2(w-3)}$ $= \frac{5+w+2}{(w-3)(w+2)}$ $= \frac{w+7}{(w-3)(w+2)}$	M1: Factorise M1: Common denominator A1
b	$4x^2-36x+81=0$ $(2x-9)^2=0$ $2x-9=0$ $x=4\frac{1}{2}$ or $x=4.5$	M1 M1 A1: Both values
15	When $x=-2$, $-2b+c=-4$ - (1) When $x=7$, $7b+c=-49$ - (2) (1) – (2) $-2b+c-7b-c=45$ $-9b=45$ $b=-5$ Substitute $b=-5$ into (1) $-2(-5)+c=-4$ $c=-14$ *Alternative: By substitution method*	M1: Derive 2 equations M1: Elimination method A1 A1

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16a	$m = \frac{k}{n-3}$ $2 = \frac{k}{5-3}$ $k = 4$ $m = \frac{4}{n-3}$	M1: Value of 'k' A1
bi	$d = kt^2$ $13.50 = k(1.5)^2$ $k = 6$ $d = 6(1.9)^2$ $d = 6(2.2)^2$ $d = 6(2.8)^2$ $= 21.66$ m $= 29.04$ m $= 47.04$ m Since $d = kt^2$, Melvin's claim is valid.	M1 A1
bii	$73.50 = 6s^2$ $s = \sqrt{\frac{73.50}{6}}$ $= 3.5$ or -3.5 (reject)	B2 B1: If -3.5 is not rejected.
17a	3 pairs of congruent triangles: $\Delta PSR \equiv \Delta PQR$ $\Delta PSX \equiv \Delta PQX$ $\Delta SXR \equiv \Delta QXR$	B2- All 3 pairs are correct B1- 2 pairs are correct. B0- 1 or 0 pair is correct.
bi	$\angle DEA = \angle CBA = 36^\circ$ $a = 36$	B1
bii	$\frac{AC}{AD} = \frac{AB}{AE}$ $\frac{x+2.8}{2.1} = \frac{9.8}{2.8}$ $x = 7.35 - 2.8$ $= 4.55$	M1 A1
18a	Actual distance = 1.5 x 58 = 87 km.	B1

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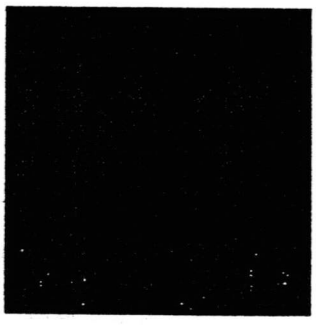
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b	12 cm : 87 km 1 cm : 7.25 km 1 cm : 725 000 cm Map scale is $\frac{1}{725000}$	M1 A1
c	1 cm : 7.25 km 4 cm : 29 km Time taken = $\frac{29}{58}$ = 0.5 h	M1 A1
19a	1 cm : 5 km 1 cm² : 25 km² Area (map) = $\frac{225}{25}$ = 9 cm²	M1: Area scale A1
b	36 cm² : 225 km² 6 cm : 15 km 1 cm : 2.5 km 1 cm : 250000 cm Map scale is 1:250000	M1: Map scale A1
20a	Selling price = $\$\left(6+\frac{1050}{x}\right)$ or $\$\left(\frac{6x+1050}{x}\right)$	B1
b	$\left(6+\frac{1050}{x}\right)\times(x-20)=1050$ $6x-120+1050-\frac{21000}{x}=1050$ $6x^2-120x-21000=0$ $x^2-20x-3500=0$ (Shown)	M1 Forming equation M1: Simplified A1 A0: If "shown" is not included.
ci	$(x-70)(x+50)=0$ $x-70=0$ or $x+50=0$ $x=70$ or $x=-50$ (reject)	M1 A2: Include 'Reject' for the negative value. A1: If 'Reject' is not stated.

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cii	Selling price = $\$\left(6+\frac{1050}{70}\right)$ = \$21	B1
21a	$p = 6$	B1
b	Labelled axes Points are plotted correctly. *Deduct 1 mark for incorrect points.* Smooth curve	1 2 1
ci	-6.3 ($\pm$0.1)	B1
cii	3.45 ± 0.05 and -1.45 ±.0.05	B2 Deduct one for an incorrect answer.
ciii	(1,6)	B1



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