HILLGROVE SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2014

Secondary 2 Express

MATHEMATICS

Paper 1

1October 2014

Time: 7.50 a.m. — 8.50 a.m. Duration: 1 hour

INSTRUCTIONS TO STUDENTS:

Write your name, index number and class on the question paper.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions in the spaces provided in the question paper.
If working is needed for any question, it must be shown in the space below the question.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
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, unless the question requires the answer in terms of π.

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.

Name of Student: _____ ( )

Class/Band: _____/_____

Parent's Signature: _____

Marks
50

Setter: Mrs Quek -AngXue Si

This question paper consists of 9 printed pages including thecover page.

[Turn over

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Answer all the questions.

1 Convert 38 m/s to km/h.

Answer _____ km/h [1]

---

2 Expand and simplify the following expressions.

(a) $g(h-2e)-h(-g+3e)$,

Answer (a) _____ [1]

(b) $(5-3x)(-2x+1)$.

Answer (b) _____ [2]

---

3 Factorise the following completely.

(a) $9a^2+27ab-6b-2a$,

Answer (a) _____ [2]

(b) $8x^2-50y^2$.

Answer (b) _____ [2]

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4 Expressed as a product of its prime factors, $1188 = 2^2 \times 3^3 \times 11$.

(a) Express 4200 as a product of its prime factors, leaving your answers in index notation.

Answer (a) $4200 =$ _____ [2]

(b) Find the smallest integer m such that $1188m$ is a multiple of 4200.

Answer (b) $m =$ _____ [2]

(c) Find the smallest positiveinteger p such that $1188p$ is a square number.

Answer (c) $p =$ _____ [1]

---

5 **(a)** Factorise $6c^2 - 19c - 7$.

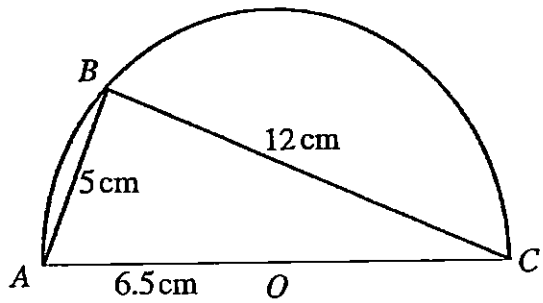
Answer (a) _____ [2]

(b) Hence, simplify $\dfrac{4c-14}{6c^2-19c-7}$.

Answer (b) _____ [1]

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6 The diagram below shows a semi-circle centred at O, the radius of the semi-circle is 6.5 cm, $AB = 5$ cm and $BC = 12$ cm.



(a) Prove that ΔABC is a right-angled triangle.

Answer (a) [2]

(b) Find the perimeter of the semi-circle $ABCO$.

Answer (b) _____ cm [1]

---

7 There are 7 red balls and y black balls in a bag. Given that the probability of drawing a black ball is $\frac{3}{4}$, find the total number of balls in the bag.

Answer _____ balls [2]

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8 Simplify $\frac{2}{m^2-mn} \times \frac{m-n}{4m-2n}$.

Answer _____ [2]

---

9 Five of the interior angles of a n sided polygon are $126°$, $143°$, $147°$, $161°$ and $167°$. The remaining interior angles are $168°$ each.

(a) Find the size of the largest exterior angle of this polygon.

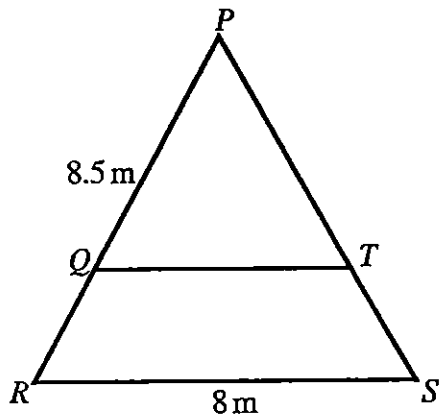
Answer (a) _____ ° [1]

(b) Find the value of n.

Answer (b) $n =$ _____ [2]

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10 ΔPQT is similar to ΔPRS, $PQ = 8.5$ m and $RS = 8$ m.



Given that the ratio of the length of $QT : RS$ is $13 : 20$, find

(a) the length of QT,

Answer (a) _____ m [1]

(b) the length of QR,

Answer (b) _____ m [2]

---

11 Given that $2a - b = \sqrt{3v}$,

(a) express v in terms of a and b,

Answer (a) $v =$ _____ [2]

(b) find the value of v when $a = 8$ and $b = 2$.

Answer (b) $v =$ _____ [2]

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12 Raymond just purchased a 4-room flat and he wants to renovate it. He went to an interior designer who drew the scale drawing of his house using a scale of $1:n$. Raymond measured the actual width of the living room of his flat and found that it was $3.2\,\text{m}$. On the scale drawing, the width of the living room is only $8\,\text{cm}$.

(a) Find the value of n.

Answer (a) $n=$ _____ [1]

(b) Raymond wants to put a fish tank in his flat. According to his measurements, the fish tank takes up an area of $0.72\,\text{m}^2$. Find in square centimetres, the area representing the fish tank on the scale drawing that the interior designer drew.

Answer (b) _____ cm^2 [2]

---

13 The data below shows the weekly pocket money ($) of 20 teenagers.

15	30	24	27	33	25	38	37	17	23
16	25	30	17	39	29	46	30	24	19

(a) Represent the data using an ordered stem-and-leaf diagram. [2]

(b) Calculate the mean pocket money of the teenagers.

Answer (b) $ _____ [1]

(c) Calculate the median pocket money of the teenagers.

Answer (c) $ _____ [1]

(d) If one student is selected at random, find the probability that the pocket money of this student is greater than or equals to $33.

Answer (d) _____ [1]

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14 A group of x teachers and y students watcheda musical at the Esplanade Concert Hall.

(a) Given that a total of 28 teachers and students went for the concert, form an equation involving x, y and 28.

Answer (a) _____ [1]

(b) A ticket for teacher costs $\$20$ while a ticket for studentcosts $\$15$. Given that the total cost of all tickets is $\$435$, form an equation in x and y. Show that it reduces to $4x+3y=87$. [1]

(c) Using the equations in **(a)** and **(b)**, findthe values of x and y.

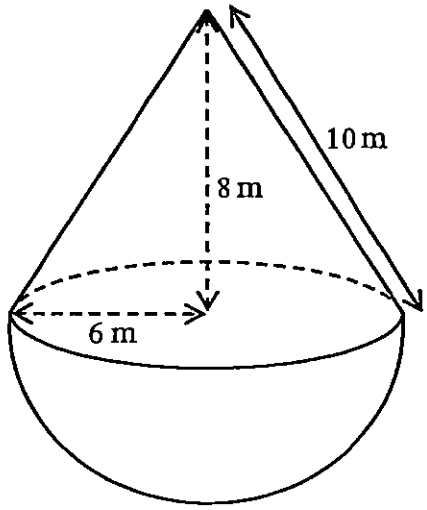
Answer (c) $x=$ _____

$y=$ _____ [2]

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15 A contractor has been tasked to construct the structure as given in the diagram below. The structure is made up of a hemisphere and a cone. The vertical height of the cone is 8 m, the slant height of the cone is 10 m and the radius of the cone is 6 m.

[Surface area of sphere = $4\pi r^2$, curved surface area of cone = πrl]



(a) Find the outer surface area of the structure.

Answer (a) _____ m^2 [3]

(b) The contractor is asked to paint the outer surface of the structure red. A can of paint can be used to paint an area of $30\,m^2$. What is the minimum number of cans of paint needed to paint this structure?

Answer (b) _____ cans [2]

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Answer Key

Qns No.	Answer	Qns No.	Answer
1	136.8	10a	5.2
2a	$2gh-2eg-3he$	10b	$4\frac{15}{26}$
2b	$6x^2-13x+5$	11a	$v=\frac{(2a-b)^2}{3}$
3a	$(9a-2)(a+3b)$	11b	$v=65\frac{1}{3}$
3b	$2(2x-5y)(2x+5y)$	12a	$n=40$
4a	$4200=2^3\times3\times5^2\times7$	12b	4.5
4b	$m=350$	13a	Stem | Leaf 1 | 5 6 7 7 9 2 | 3 4 4 5 5 7 9 3 | 0 0 0 3 7 8 9 4 | 6
4c	$p=33$	13b	\$27.20
5a	$(2c-7)(3c+1)$	13c	\$26
5b	$\frac{2}{3c+1}$	13d	$\frac{1}{4}$
6a	$AC^2=(6.5\times2)^2=169$; $BC^2+AB^2=(5^2+12^2)=169$	14a	$x+y=28$
	Since $AC^2=BC^2+AB^2$, by the converse of Pythagoras' Theorem, ΔABC is a right-angled triangle.	14c	$x=3$ and $y=25$
6b	33.4	15a	415
7	28	15b	14
8	$\frac{1}{m(2m-n)}$		
9a	54°		
9b	$n=22$		

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HILLGROVE SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2014

Secondary 2 Express

MATHEMATICS

Paper 2

24 September 2014

Additional Material: Graph Paper

Time: 7.50 a.m. —9.05 a.m. Duration: 1 hour and 15 minutes

INSTRUCTIONS TO STUDENTS:

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Write in dark blue or black pen.
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The total number of marks for this paper is 50.

Name of Student: _____ ( )

Class/Band: _____/_____

Parent's Signature: _____

Marks
50

Setter: Mrs Quek -AngXue Si

This question paper consists of 8 printed pages, including thecover page.

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Answer all the questions.

1 The first four terms of a sequence are $1, 8, 27$ and 64.

(a) Write down the 8^{th} term of the sequence. [1]

(b) Find an expression, in terms of n, for the n^{th} term of the sequence. [1]

(c) Hence, or otherwise, find an expression, in terms of n, for the n^{th} term of another sequence whose first four terms are $3, 10, 29$ and 66. [1]

---

2 Express the following as a single fraction in its simplest form.

(a) $\frac{3(x-1)}{4x^2}-\frac{5}{x^2}$, [2]

(b) $\frac{5}{(p+2q)^2}+\frac{3}{2(p+2q)}$. [2]

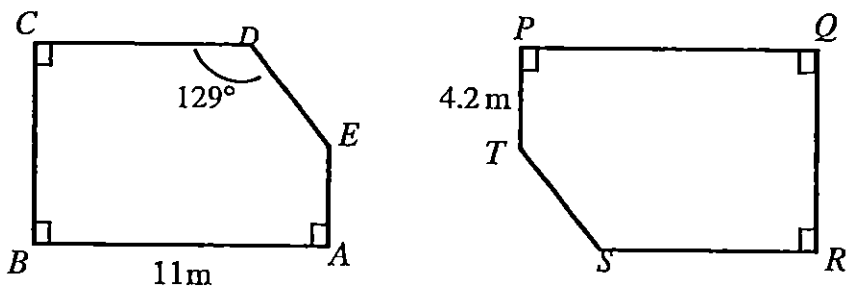
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3 All the hearts are removed from a standard pack of 52 playing cards. A card is drawn at random from the remaining cards. Find the probability that the card drawn is

(a) a black card, [1]
(b) an ace of heart. [1]

---

4 $ABCDE$ is congruent to $PQRST$. Obtuse $C\hat{D}E = 129°$, $AB = 11$ m, $TP = 4.2$ m.
$A\hat{B}C = B\hat{C}D = E\hat{A}B = Q\hat{R}S = P\hat{Q}R = T\hat{P}Q = 90°$.



(a) Find the length of PQ. [1]
(b) Find reflex $R\hat{S}T$. [1]
(c) Given that the perimeter of $ABCDE$ is 45 m, Damien says that the total length of QR, RS and ST is 29.8 m. Do you agree with him? Explain your answer. [2]

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5 It is given that t is proportional to the cube of s and $t = 6$ when $s = 2$.

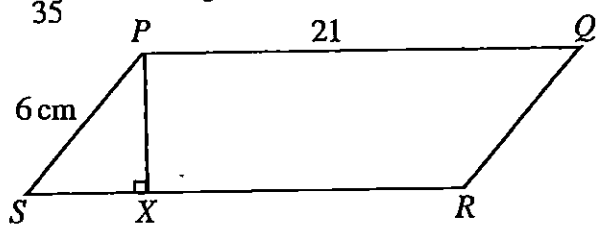
(a) Write an equation connecting t and s. [2]

(b) Find the value of s when $t = 30$. [2]

---

6 The area of the parallelogram $PQRS$ is $100.8\,\text{cm}^2$.

The length of XS is $\frac{6}{35}$ of the length of RS.



(a) Show that the length of $PX = 4.8\,\text{cm}$. [1]

(b) Calculate

(i) $\cos R\hat{S}P$, leaving your answer as a fraction in its simplest form, [2]

(ii) $S\hat{P}X$. [2]

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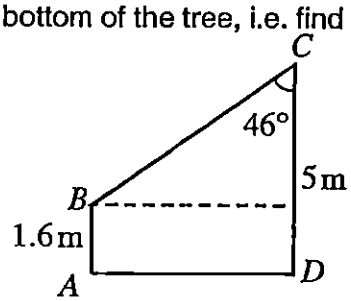
7 **(a)** Solve the following equations.

(i) $y^2 - 8y = 0$, [1]

(ii) $2p^2 + p = 55$. [2]

(b) If $a - b = -8$ and $ab = 33$, find the value of $a^2 + b^2$. [2]

8 Marianne is 1.6 m tall. She stood directly in front of a 5 m tall tree. In the diagram below, AB represents Marianne's height while CD represents the height of the tree. The line BC shows Marianne's line of sight when she looks at the top of the tree. Calculate how far away is Marianne from the bottom of the tree, i.e. find the distance AD. [2]



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9 The weights, in kg, of 40 students are given in the table below.

Weight, w (kg)	$40 \le w < 50$	$50 \le w < 60$	$60 \le w < 70$	$70 \le w < 80$	$80 \le w < 90$
Number of Students	15	x	7	4	1

(a) Calculate the value of x. [1]
(b) State the modal class interval for the weight of the students. [1]
(c) Calculate the estimated mean weight of the students. [2]
(d) Why is the answer calculated in **(c)** an estimated mean? [1]

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10 The pyramid $ABCDE$ has a square base of length 10 cm. The vertical height of the pyramid is 12 cm.

(a) Show that the slant height, EG, of the pyramid is 13 cm. [1]

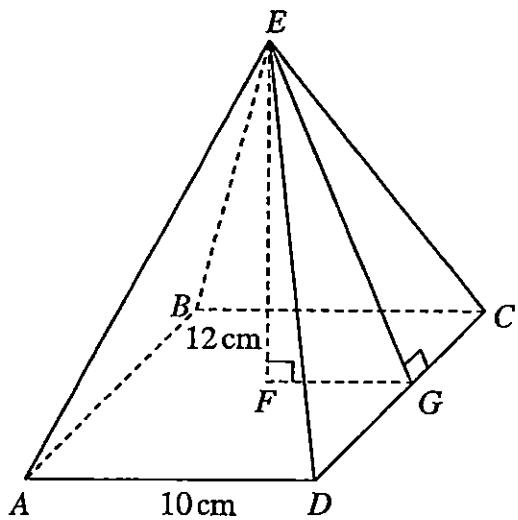
(b) Calculate

(i) the surface area of the pyramid, [2]

(ii) the volume of the pyramid. [2]

(c) The pyramid $ABCDE$ is melted and remoulded into spheres of radius 2 cm.

Assuming there is no wastage of materials in the process of melting and remoulding, what is the maximum number of such spheres that can be created? [2]



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11 30 workers can paint 16 houses in 28 days.

(a) How many days would it take 12 workers to paint 24 houses? [2]

(b) The workers draw an hourly wage of \$15 and they work for the same duration daily. If the boss paid a total of \$151200 to the 12 workers for painting the 24 houses, how many hours does each worker work daily? [2]

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

12 Benny kicks a soccer ball vertically upwards. The height, h metres, of the ball from the ground after t seconds is given by $h = 7t - t^2$. The table below shows the values of h for the values of t from 0 to 7.

t	0	1	2	3	3.5	4	5	6	7
h	0	6	10	12	12.25	12	10	6	0

(a) Using a scale of 2 cm to 1 unit, draw a horizontal t-axis for $0 \le t \le 7$.
Using a scale of 2 cm to 2 units, draw a vertical h-axis for $0 \le h \le 14$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(b) Use your graph to find

(i) the maximum height reached by the ball, [1]

(ii) the second time when the ball reached a height of 8 m above the ground. [1]

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Answer Key

Qns. No	Answer	Qns. No	Answer
1a	512	7aii	$p=-5.5$ or $p=5$
1b	n^{th}term $= n^3$	7b	$a^2+b^2=130$
1c	n^{th}term $= n^3+2$	8	3.52 m
2a	$\frac{3x-23}{4x^2}$	9a	$x=13$
2b	$\frac{10+3p+6q}{2(p+2q)^2}$	9b	$40 \le w < 50$
3a	$\frac{2}{3}$	9c	55.75 kg
3b	0	10bi	360 cm^2
4a	11 m	10bii	400 cm^3
4b	231°	10c	11
5a	$t=\frac{3}{4}s^3$	11a	105 days
5b	$s \approx 3.42$	11b	8 hours
6bi	$\frac{3}{5}$	12bi	12.25 m
6bii	36.9°	12bii	$t=5.6$ s
7ai	$y=0$ or $y=8$		

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HILLGROVE SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2014

Secondary 2 Express

MATHEMATICS

Paper 1

1 October 2014

Time: 7.50 a.m. — 8.50 a.m. Duration: 1 hour

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Class/Band: _____/_____

Parent's Signature: _____

Marks
50

Setter: Mrs Quek - Ang Xue Si

This question paper consists of 9 printed pages including the cover page.

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Answer all the questions.

1 Convert 38 m/s to km/h.

$38\text{ m/s} = \frac{38\text{m}}{1\text{s}}$

$= \frac{(38 \div 1000)\text{ km}}{(1 \div 60 \div 60)\text{ h}}$

$= 136.8\text{ km/h}$

Answer 136.8 [A1] (Accept $136\frac{4}{5}$) km/h [1]

---

2 Expand and simplify the following expressions.

(a) $g(h-2e)-h(-g+3e)$.

$= gh - 2eg + hg - 3he$

$= 2gh - 2eg - 3he$

Answer (a) $2gh - 2eg - 3he$ [A1] [1]

(b) $(5-3x)(-2x+1)$.

$= -10x + 5 + 6x^2 - 3x$ [M1] (any 2 out of 4 terms)

$= 6x^2 - 13x + 5$

Answer (b) $6x^2 - 13x + 5$ [A1] [2]

---

3 Factorise the following completely.

(a) $9a^2+27ab-6b-2a$,

$= 9a(a+3b) - 2(a+3b)$ [M1]

$= (9a-2)(a+3b)$

Answer (a) $(9a-2)(a+3b)$ [A1] [2]

(b) $8x^2-50y^2$.

$= 2(4x^2 - 25y^2)$ [M1]

$= 2(2x-5y)(2x+5y)$

Answer (b) $2(2x-5y)(2x+5y)$ [A1] [2]

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4 Expressed as a product of its prime factors, $1188 = 2^2 \times 3^3 \times 11$.

(a) Express 4200 as a product of its prime factors, leaving your answers in index notation.

$$\begin{array}{r|l} 2 & 4200 \\ 2 & 2100 \\ 2 & 1050 \\ 5 & 525 \\ 5 & 105 \\ 3 & 21 \\ 7 & 7 \\ & 1 \end{array}$$

[M1] students extract non-prime factors ~ mark is not awarded if

Answer (a) $4200 = \underline{2^3 \times 3 \times 5^2 \times 7}$ [A1] [2]

(b) Find the smallest integer m such that $1188m$ is a multiple of 4200.

Method 1:

LCM of 1188 and 4200 $= 2^3 \times 3^3 \times 5^2 \times 7 \times 11$

$= 415800$ [M1]

$1188m = 415800$

$m = 350$

Method 2:

$m = 2 \times 5^2 \times 7$ [M1]

$= 350$

Answer (b) $m =$ 350 [A1] [2]

(c) Find the smallest positive integer p such that $1188p$ is a square number.

$p = 3 \times 11$

$= 33$

Answer (c) $p =$ 33 [A1] / [B1] [1]

---

5 **(a)** Factorise $6c^2 - 19c - 7$.

$6c^2 - 19c - 7 = (2c - 7)(3c + 1)$

$2c$	-7	$-21c$
$3c$	$+1$	$+2c$
$6c^2$	-7	$-19c$

[M1]

Answer (a) $(2c - 7)(3c + 1)$ [A1] [2]

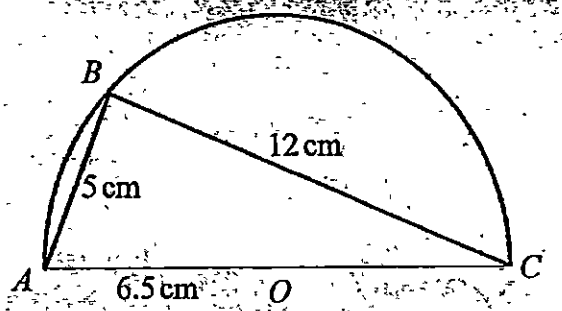
(b) Hence, simplify $\dfrac{4c - 14}{6c^2 - 19c - 7}$.

$$\frac{4c-14}{6c^2-19c-7} = \frac{2(2c-7)}{(2c-7)(3c+1)} = \frac{2}{3c+1}$$

Answer (b) $\dfrac{2}{3c+1}$ [A1] [1]

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6 The diagram below shows a semi-circle centred at O, the radius of the semi-circle is 6.5 cm, $AB = 5$ cm and $BC = 12$ cm.



(a) Prove that ΔABC is a right-angled triangle.

Answer (a) [2]

$AC = 6.5 \times 2$
$= 13$
$AC^2 = 13^2$
$= 169$
$BC^2 + AB^2 = 5^2 + 12^2$
$= 169$

*NOTE: Do not award if students equate $AC^2 = BC^2 + AB^2$ straightaway.

Either AC^2 or $BC^2 + AB^2$ calculation, award [M1]

By converse of Pythagoras' theorem, since $AC^2 = BC^2 + AB^2$, ΔABC is a right angled triangle. [A1]

(b) Find the perimeter of the semi-circle $ABCO$.

Perimeter of $ABCO = \frac{\pi \times 13}{2} + 13$
$= 33.420\,852\,25$
≈ 33.4 cm (3sf)

If $\pi = 3.142$ ↓ 33.423 [A1]

Answer (b) 33.4 or _____ cm [1]

---

7 There are 7 red balls and y black balls in a bag. Given that the probability of drawing a black ball is $\frac{3}{4}$, find the total number of balls in the bag.

$P(\text{black ball}) = \frac{3}{4}$
$\frac{y}{y+7} = \frac{3}{4}$ [M1].
$4y = 3y + 21$
$y = 21$
Total no. of balls $= 7 + 21$
$= 28$.

Answer 28 [A1] balls [2]

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8 Simplify $\frac{2}{m^2-mn} \times \frac{m-n}{4m-2n}$.

$\frac{2}{m^2-mn} \times \frac{m-n}{4m-2n}$

$= \frac{2}{m(m-n)} \times \frac{m-n}{2(2m-n)}$ [M1]

$= \frac{2}{2m(2m-n)}$

$= \frac{1}{m(2m-n)}$

factorisation of either
$m^2-mn = m(m-n)$
or $4m-2n = 2(2m-n)$

Answer $\frac{1}{m(2m-n)}$ [A1] [2]

---

9 Five of the interior angles of a n sided polygon are 126°, 143°, 147°, 161° and 167°. The remaining interior angles are 168° each.

(a) Find the size of the largest exterior angle of this polygon.

Size of largest ext. $\angle = 180° - 126°$
$= 54°$ (adj. $\angle$s on str. line)

Answer (a) 54 [A1] ° [1]

(b) Find the value of n.

Method 1:

$126° + 143° + 147° + 161° + (n-5) \times 168° = (n-2) \times 180°$ [M1]

$744 + 168n - 840 = 180n - 360$

$180n - 168n = 744 - 840 + 360$

$n = 22$

Method 2:

$54 + 37 + 33 + 19 + 13 + (n-5) \times 12 = 360$ [M1]

$156 + 12n - 60 = 360$

$12n = 360 - 96$

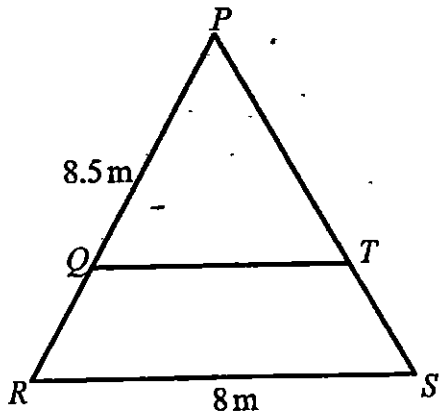
$n = \frac{264}{12}$

$= 22$

Answer (b) $n =$ 22 [A1] [2]

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10 ΔPQT is similar to ΔPRS, $PQ = 8.5$ m and $RS = 8$ m.



Given that the ratio of the length of $QT : RS$ is $13 : 20$, find

(a) the length of QT,

$\frac{\text{Length of } QT}{RS} = \frac{13}{20}$

$QT = \frac{13(8)}{20}$

$= 5.2$ m.

Answer (a) 5.2 [A1] m [1]

Accept $5\frac{1}{5}$.

(b) the length of QR,

$\frac{PQ}{PR} = \frac{QT}{RS}$

$\frac{8.5}{PR} = \frac{5.2}{8}$ [M1]

$PR = \frac{8(8.5)}{5.2}$

$= 13\frac{1}{13}$

$QR = 13\frac{1}{3} - 8.5$

$= 4\frac{15}{26}$ m

Answer (b) $4\frac{15}{26}$ [A1] m [2]

(cannot accept rounded off answer)

---

11 Given that $2a - b = \sqrt{3v}$,

(a) express v in terms of a and b,

$2a - b = \sqrt{3v}$

$(2a-b)^2 = 3v$ [M1]

$v = \frac{(2a-b)^2}{3}$

Answer (a) $v =$ $\frac{(2a-b)^2}{3}$ [A1] [2]

(b) find the value of v when $a = 8$ and $b = 2$.

Method 1:

$v = \frac{(2(8)-2)^2}{3}$ [M1]

$= 65\frac{1}{3}$

Method 2:

$2a - b = \sqrt{3v}$

$2(8) - 2 = \sqrt{3v}$ [M1]

$14^2 = 3v$

$v = 65\frac{1}{3}$

Answer (b) $v =$ $65\frac{1}{3}$ [A1] [2]

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12 Raymond just purchased a 4-room flat and he wants to renovate it. He went to an interior designer who drew the scale drawing of his house using a scale of $1:n$. Raymond measured the actual width of the living room of his flat and found that it was 3.2 m. On the scale drawing, the width of the living room is only 8 cm.

(a) Find the value of n.

$n = \frac{3.2 \times 100}{8}$ OR 8 cm : 3.2 m
8 cm : 320 cm
1 : 40
$= 40$ $n = 40$

Answer (a) $n =$ 40 [A1] [1]

(b) Raymond wants to put a fish tank in his flat. According to his measurements, the fish tank takes up an area of 0.72 m^2. Find in square centimetres, the area representing the fish tank on the scale drawing that the interior designer drew.

8 cm : 3.2 m
$(8\text{cm})^2 : (3.2\text{m})^2$ [M1]
$64\text{cm}^2 : 10.24\text{m}^2$
$4.5\text{cm}^2 : 0.72\text{m}^2$

award for indication of conversion to scale of area
eg $(1\text{cm})^2 : (0.4\text{m})^2$ or $(1\text{cm})^2 : (40\text{cm})^2$

Area representing fish tank on layout = 4.5cm^2.

Answer (b) 4.5 [A1] cm^2 [2]

---

13 The data below shows the weekly pocket money ($) of 20 teenagers.

15	30	24	27	33	25	38	37	17	23
16	25	30	17	39	29	46	30	24	19

(a) Represent the data using an ordered stem-and-leaf diagram. [2]

Stem	Leaf
1	5 6 7 7 9
2	3 4 4 5 5 7 9
3	0 0 0 3 7 8 9
4	6

Key : 4|6 means $46.

1m : ≤ 5 mistakes for leaf
2m : All 20 leaf stated correctly.
*note: key is encouraged.

(b) Calculate the mean pocket money of the teenagers.

Mean pocket money = (15 + 16 + 17×2 + 19 + 23 + 24×2 + 25×2 + 27 + 29 + 30×3 + 33 + 37 + 38 + 39 + 46) ÷ 20
= $27.20

Answer (b) $ 27.20 [A1] [1]
(cannot accept 27.2)

(c) Calculate the median pocket money of the teenagers.

Median = $\frac{25+27}{2}$
= $26

Answer (c) $ 26 [B1] [1]

(d) If one student is selected at random, find the probability that the pocket money of this student is greater than or equals to $33.

P(pocket money greater than or equal to $33) = $\frac{5}{20}$
= $\frac{1}{4}$

Answer (d) $\frac{1}{4}$ [B1] [1]

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14 A group of x teachers and y students watched a musical at the Esplanade Concert Hall.

(a) Given that a total of 28 teachers and students went for the concert, form an equation involving x, y and 28.

Answer (a) $x+y=28$ [B1] [1]

(b) A ticket for teacher costs \$20 while a ticket for student costs \$15. Given that the total cost of all tickets is \$435, form an equation in x and y. Show that it reduces to $4x+3y=87$. [1]

$20x+15y=435$

$5(4x+3y)=5(87)$

$4x+3y=87$ (shown) [A1]

(c) Using the equations in **(a)** and **(b)**, find the values of x and y.

$x+y=28$ — (1)

$4x+3y=87$ — (2)

(1) × 3

$3x+3y=84$ — (3)

(3) − (2)

$(3x+3y)-(4x+3y)=84-87$ [M1: either substitution or elimination method]

$-x=-3$

$x=3$

Sub $x=3$ into (1)

$3+y=28$

$y=28-3$

$=25$

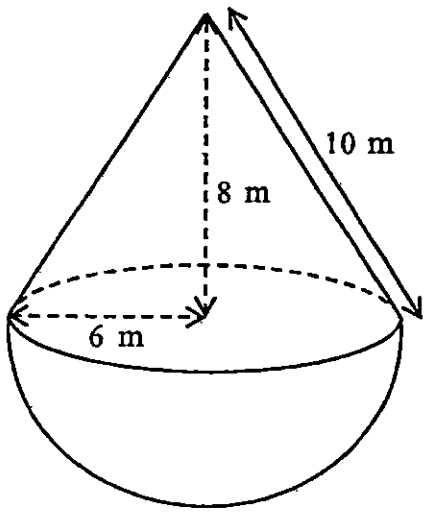
Answer (c) $x=$ 3 } [A1] for both

$y=$ 25 [2]

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15 A contractor has been tasked to construct the structure as given in the diagram below. The structure is made up of a hemisphere and a cone. The vertical height of the cone is 8 m, the slant height of the cone is 10 m and the radius of the cone is 6 m.

[Surface area of sphere = $4\pi r^2$, curved surface area of cone = πrl]



(a) Find the outer surface area of the structure.

Outer surface area of cone = πrl

$= \pi(6)(10)$ [M1]

$= 60\pi$

Outer surface area of hemisphere $= \frac{4\pi r^2}{2}$

$= 2\pi(6)^2$ [M1]

$= 72\pi$

Outer surface area of structure $= 60\pi + 72\pi$

$= 132\pi$

$\approx 415\ m^2$

414.744 or $414\frac{93}{125}$ if $\pi = 3.142$

Answer (a) 415 [A1] m^2 [3]

(b) The contractor is asked to paint the outer surface of the structure red. A can of paint can be used to paint an area of 30 m^2. What is the minimum number of cans of paint needed to paint this structure?

No. of cans needed $= \frac{132\pi}{30}$ or $\frac{414.744}{30}$ or $414\frac{93}{125} \div 30$ [M1]

$= 13.902300768$ or 13.8248

Minimum no. of cans needed = 14

Answer (b) 14 [A1] cans [2]

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HILLGROVE SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2014

Secondary 2 Express

MATHEMATICS

Paper 2

24 September 2014

Additional Material: Graph Paper

Time: 7.50 a.m. — 9.05 a.m. Duration: 1 hour and 15 minutes

INSTRUCTIONS TO STUDENTS:

Write your name, index number and class on the question paper.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions in the spaces provided in the question paper.
If working is needed for any question, it must be shown in the space below the question.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
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, unless the question requires the answer in terms of π.

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.

Name of Student: _____ ( )

Class/Band: _____/_____

Parent's Signature: _____

Marks
50

Setter: Mrs Quek - Ang Xue Si

This question paper consists of 8 printed pages, including the cover page.

[Turn over

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Answer all the questions.

1 The first four terms of a sequence are 1, 8, 27 and 64.

(a) Write down the 8^{th} term of the sequence. [1]

(b) Find an expression, in terms of n, for the n^{th} term of the sequence. [1]

(c) Hence, or otherwise, find an expression, in terms of n, for the n^{th} term of another sequence whose first four terms are 3, 10, 29 and 66. [1]

(a) 8th term = 512 [B1]

(b) n^{th} term = n^3 [B1]

(c) n^3+2 [B1]

---

2 Express the following as a single fraction in its simplest form.

(a) $\frac{3(x-1)}{4x^2}-\frac{5}{x^2}$, [2]

(b) $\frac{5}{(p+2q)^2}+\frac{3}{2(p+2q)}$. [2]

(a) $\frac{3(x-1)}{4x^2} - \frac{5}{x^2}$

$= \frac{3(x-1)}{4x^2} - \frac{5(4)}{4x^2}$ [M1]

$= \frac{3x-3-20}{4x^2}$

$= \frac{3x-23}{4x^2}$ [A1]

(b) $\frac{5}{(p+2q)^2} + \frac{3}{2(p+2q)}$

$= \frac{5(2) + 3(p+2q)}{2(p+2q)^2}$ [M1]

$= \frac{10+3p+6q}{2(p+2q)^2}$ [A1]

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3 All the hearts are removed from a standard pack of 52 playing cards. A card is drawn at random from the remaining cards. Find the probability that the card drawn is

(a) a black card, [1]
(b) an ace of heart. [1]

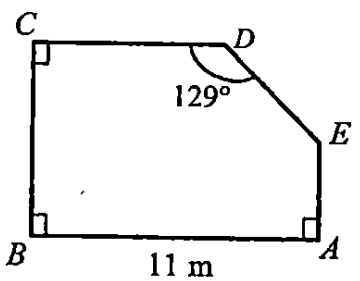
(a) P(black card) = $\frac{26}{39}$

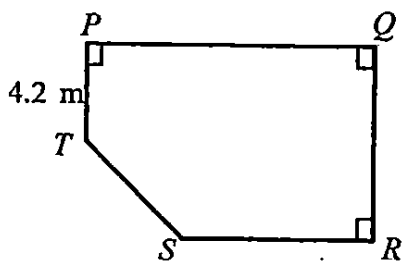
= $\frac{2}{3}$ [B1]

(b) P(an ace of heart) = 0. [B1]

---

4 $ABCDE$ is congruent to $PQRST$. Obtuse $C\hat{D}E = 129°$, $AB = 11$ m, $TP = 4.2$ m.
$A\hat{B}C = B\hat{C}D = E\hat{A}B = Q\hat{R}S = P\hat{Q}R = T\hat{P}Q = 90°$.





(a) Find the length of PQ. [1]
(b) Find reflex $R\hat{S}T$. [1]
(c) Given that the perimeter of $ABCDE$ is 45 m, Damien says that the total length of QR, RS and ST is 29.8 m. Do you agree with him? Explain your answer. [2]

(a) Length of PQ = Length of AB

= 11 m [B1]

(b) Obtuse $R\hat{S}T$ = 129°

Reflex $R\hat{S}T$ = 360° − 129° (∠s at a point)

= 231° [A1]

(c) Yes I agree. [B1]

ABCDE is congruent to PQRST, hence, QR = BC, RS = CD, corresponding lengths are equal, ie

ST = DE and AE = PT = 4.2m.

BC + CD + DE = 45 − 11 − 4.2

= 29.8 m.

∴ QR + RS + ST = 29.8 m [A1].

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5 It is given that t is proportional to the cube of s and $t = 6$ when $s = 2$.

(a) Write an equation connecting t and s. [2]

(b) Find the value of s when $t = 30$. [2]

(a) $t \propto s^3$

$t = ks^3$

$(6) = k(2)^3$ [M1]

$k = \frac{6}{8}$

$= \frac{3}{4}$

$t = \frac{3}{4}s^3$ [A1]

(b) $t = \frac{3}{4}s^3$

$30 = \frac{3}{4}s^3$

$s^3 = 30 \div \frac{3}{4}$ [M1]

$s = \sqrt[3]{40}$

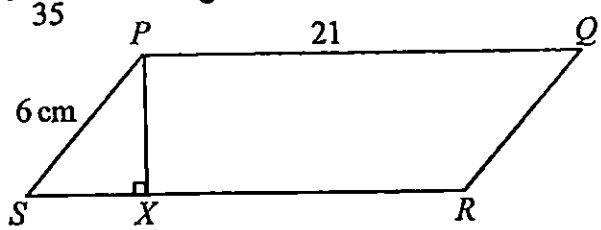
$= 3.419951893$

≈ 3.42 (3sf) [A1]

---

6 The area of the parallelogram $PQRS$ is $100.8\,\text{cm}^2$.

The length of XS is $\frac{6}{35}$ of the length of RS.



(a) Show that the length of $PX = 4.8$ cm. [1]

(b) Calculate

(i) $\cos R\hat{S}P$, leaving your answer as a fraction in its simplest form, [2]

(ii) $S\hat{P}X$. [2]

(a) Area of $\parallel$gram $= PX \times SR$

$100.8 = PX \times 21$

$PX = 100.8 \div 21$

$= 4.8$ cm (shown) [A1]

(b) (i) $SX = \frac{6}{35} \times 21$

$= 3.6$cm [M1]

or $SX^2 = 6^2 - 4.8^2$ [M1]

$SX = \sqrt{6^2 - 4.8^2}$

$= 3.6$cm

or $\cos R\hat{S}P = \frac{SX}{PS}$

$= \frac{3.6}{6} = \frac{3}{5}$ [A1]

(b) (ii) $\cos S\hat{P}X = \frac{4.8}{6}$ [M1]

$S\hat{P}X = \cos^{-1}\left(\frac{4.8}{6}\right)$

$\approx 36.9°$ (1dp)

or $\sin S\hat{P}X = \frac{3.6}{6}$ [M1] [A1]

$S\hat{P}X \approx 36.9°$ [A1]

or $\tan S\hat{P}X = \frac{3.6}{4.8}$ [M1]

$S\hat{P}X \approx 36.9°$ [A1]

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7 **(a)** Solve the following equations.

(i) $y^2 - 8y = 0$, [1]

(ii) $2p^2 + p = 55$. [2]

(b) If $a - b = -8$ and $ab = 33$, find the value of $a^2 + b^2$. [2]

(a) (i) $y^2 - 8y = 0$

$y(y-8) = 0$

$y = 0$ or $y = 8$ [A1]

(ii) $2p^2 + p = 55$

$2p^2 + p - 55 = 0$ [M1]

$(2p + 11)(p - 5) = 0$

$2p = -11$ or $p = 5$

$p = -5\frac{1}{2}$ or $p = 5$ [A1 for both]

(b) $(a-b)^2 = a^2 - 2ab + b^2$

$(a-b)^2 = (-8)^2$ [M1]

$= 64$

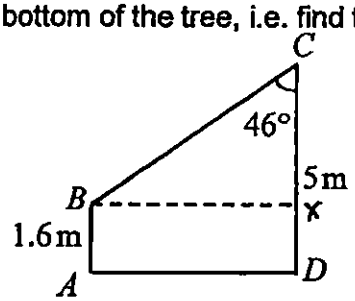
$a^2 + b^2 = (a-b)^2 + 2ab$

$= 64 + 2(33)$

$= 130$ [A1]

---

8 Marianne is 1.6 m tall. She stood directly in front of a 5 m tall tree. In the diagram below, AB represents Marianne's height while CD represents the height of the tree. The line BC shows Marianne's line of sight when she looks at the top of the tree. Calculate how far away is Marianne from the bottom of the tree, i.e. find the distance AD. [2]



$\tan 46° = \frac{BX}{(5 - 1.6)}$ [M1]

$BX = 3.4 \tan 46°$

$AD \approx 3.52$ m (3sf) [A1]

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9 The weights, in kg, of 40 students are given in the table below.

Weight, w (kg)	$40 \le w < 50$	$50 \le w < 60$	$60 \le w < 70$	$70 \le w < 80$	$80 \le w < 90$
Number of Students	15	x	7	4	1

(a) Calculate the value of x. [1]
(b) State the modal class interval for the weight of the students. [1]
(c) Calculate the estimated mean weight of the students. [2]
(d) Why is the answer calculated in **(c)** an estimated mean? [1]

(a) $x = 40 - 15 - 7 - 4 - 1$
$= 13$ [B1]

(b) Modal class interval: $40 \le w < 50$ [B1]

(c) Estimated mean weight $= \dfrac{45 \times 15 + 55 \times 13 + 65 \times 7 + 75 \times 4 + 85 \times 1}{40}$ [M1] or $\dfrac{2230}{40}$
$= 55.75$ kg (or $55\frac{3}{4}$ kg) [A1]

(d) It is calculated based on mid values of weight of each class interval, thus the answer in (c) is an estimated mean. [B1].

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10 The pyramid $ABCDE$ has a square base of length 10 cm. The vertical height of the pyramid is 12 cm.

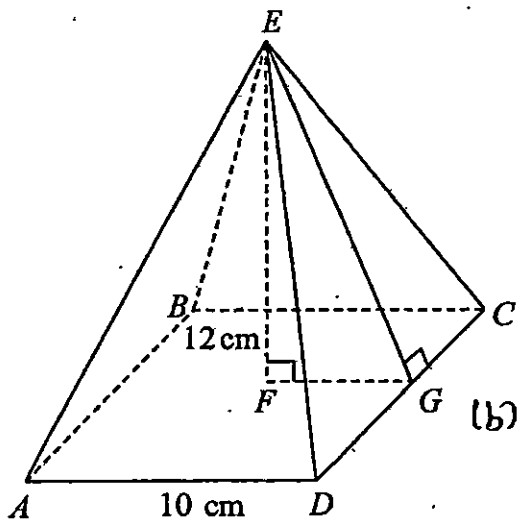
(a) Show that the slant height, EG, of the pyramid is 13 cm. [1]

(b) Calculate

(i) the surface area of the pyramid, [2]

(ii) the volume of the pyramid. [2]

(c) The pyramid $ABCDE$ is melted and remoulded into spheres of radius 2 cm. Assuming there is no wastage of materials in the process of melting and remoulding, what is the maximum number of such spheres that can be created? [2]



(a) By Pythagoras' Theorem,

$EG^2 = EF^2 + FG^2$

$EG^2 = 12^2 + 5^2$

$EG = \sqrt{12^2+5^2}$

$= 13$ cm (shown) [A1]

(b) (i) Surface area of each slant triangular face $= \frac{1}{2} \times 13 \times 10$ [m1]

$= 65$

Surface area of pyramid $= 10 \times 10 + 4 \times 65$

$= 360 \text{ cm}^2$ [A1]

(b) (ii) Vol. of pyramid $= \frac{1}{3} \times (10 \times 10) \times 12$ [m1]

$= 400 \text{ cm}^3$ [A1].

(c) Vol. of one sphere $= \frac{4}{3}\pi r^3$

$= \frac{4}{3}\pi (2)^3$ [m1]

$= 10\frac{2}{3}\pi$

No. of spheres that can be created $= 400 \div 10\frac{2}{3}\pi$

$= 11.9366\ldots$

Maximum no. of spheres $= 11$ [A1]

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11 30 workers can paint 16 houses in 28 days.

(a) How many days would it take 12 workers to paint 24 houses? [2]

(b) The workers draw an hourly wage of \$15 and they work for the same duration daily. If the boss paid a total of \$151200 to the 12 workers for painting the 24 houses, how many hours does each worker work daily? [2]

(a) 30 workers 16 houses 28 days

1 worker 16 houses (28 × 30) days [M1: for showing correctly inverse relationship between workers & days, or direct r/s between house & days].

1 worker 1 house (840 ÷ 16) days

1 worker 1 house 52.5 days

12 workers 1 house (52.5 ÷ 12) days

12 workers 24 houses (4.375 × 24) days

No. of days needed = 105 days [A1]

(b) No. of work hours of 12 workers = $\frac{151200}{15}$ [M1]

= 10080

No. of hours each worker works per day = $\frac{10080}{105 \times 12}$

= 8 hours [A1]

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

12 Benny kicks a soccer ball vertically upwards. The height, h metres, of the ball from the ground after t seconds is given by $h = 7t - t^2$. The table below shows the values of h for the values of t from 0 to 7.

t	0	1	2	3	3.5	4	5	6	7
h	0	6	10	12	12.25	12	10	6	0

(a) Using a scale of 2 cm to 1 unit, draw a horizontal t-axis for $0 \le t \le 7$.
Using a scale of 2 cm to 2 units, draw a vertical h-axis for $0 \le h \le 14$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(b) Use your graph to find

(i) the maximum height reached by the ball, [1]

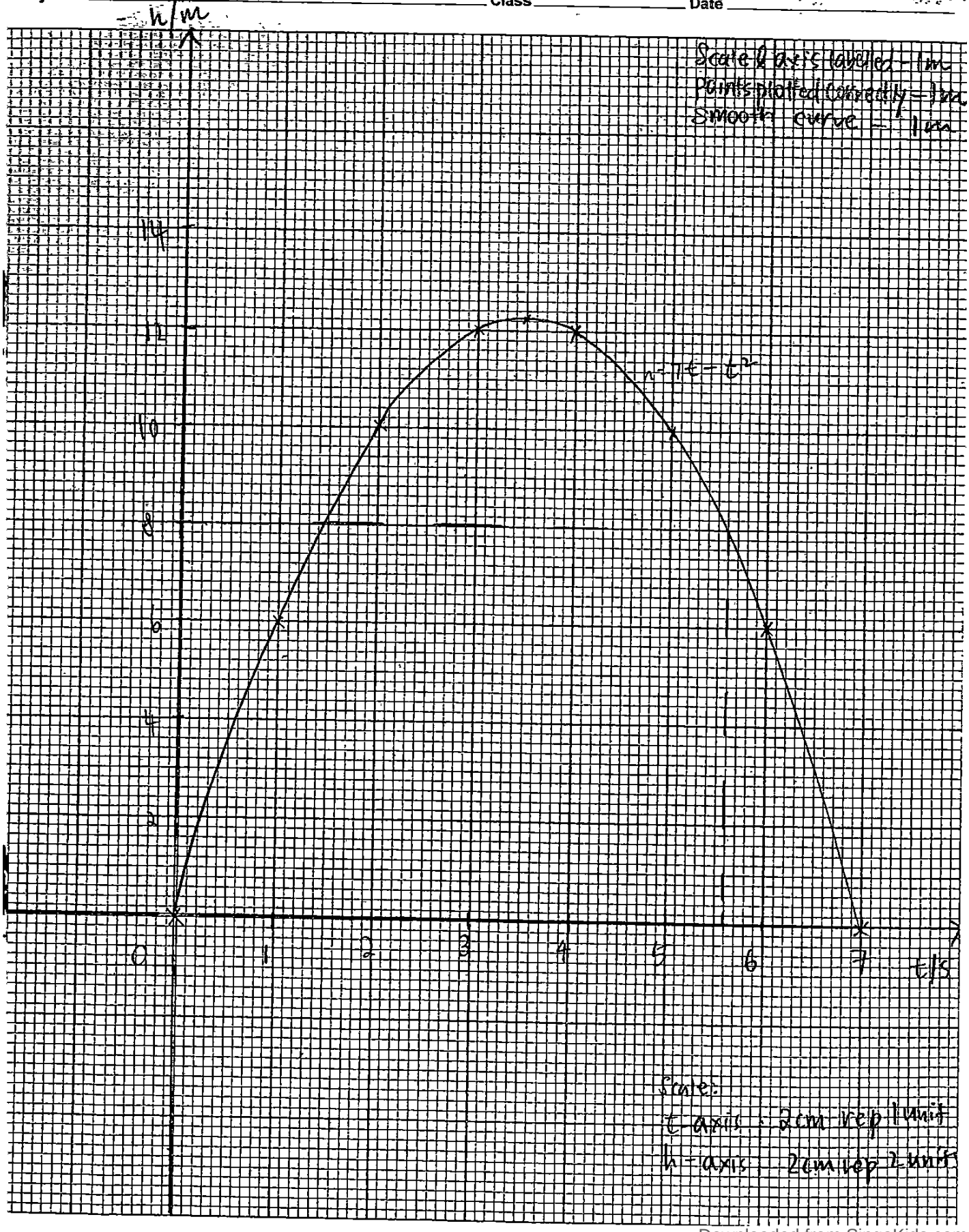
(ii) the second time when the ball reached a height of 8 m above the ground. [1]

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Scale & axis labelled - 1m
Points plotted correctly - 1m
Smooth curve - 1m

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(b) (i) $h = 12.25\ m$ [B1]

(ii) $t = 5.6\ s$ [B1] (Accept: 5.5 s, 5.55 s, 5.65 s, 5.7 s)

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