Sydney Boys High School

MOORE PARK, SURRY HILLS

YEAR 9 ADVANCED MATHEMATICS

Yearly Examination 2016

General Instructions:

- All questions may be attempted.
- **Marks may be deducted for careless or badly arranged work.**
- All working and answers are to be written in this test booklet.
- If you wish to rewrite an answer, draw a line through your faulty answer and rewrite your answer on the back page of this booklet. **Show the number and part of the answer being rewritten.**
- Leave your answers in the simplest exact form, unless otherwise stated.
- Board approved calculators may be used.
- Clearly indicate your class by placing an ✕ next to your class.

Time Allowed: 90 minutes

Examiner: JM

Name: _____

Class	Teacher	
9**A**	Mr Boros	
9**B**	Ms Chan	
9**C**	Ms Evans and Ms Kilmore	
9**P**	Ms Ward	
9**L**	Mr Choy	
9**U**	Mr Wang	
9**S**	Mr Gainford	

Question	Marks
1	/ 16
2	/ 16
3	/ 16
4	/ 16
5	/ 15
6	/ 14
7	/ 14
Total	/ 107

Question 1 (16 Marks)

(a) Calculate $54-8\times 7+14\div(-2)$ **1**

(b) Express your answer to $\dfrac{57.7-\sqrt{298.3}}{9+4^2}$ correct to 3 significant figures. **1**

(c) Express $2a^{-1}$ with a positive index. **1**

(d) Express as a single fraction $\dfrac{x}{3}+\dfrac{3-x}{2}$, in the simplest form. **2**

(e) Simplify the expression $4x-3(x+5)$. **1**

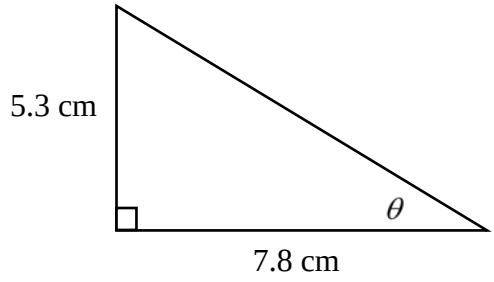
(f) Simplify $5x^0+2$. **1**

(g) Solve and graph your solution on a number line to $2x-5>1$. **2**

(h) Evaluate pq^2 for $p=-3$ and $q=4$. **1**

(i) Expand and simplify $(2x-5)(3-x)$. **2**

(j) Calculate the size of angle θ, correct to the nearest minute. **2**



(k) Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5? **2**

End of Question 1

Question 2 (16 Marks)

(a) Solve:

(i) $4x-6=3(1-x)$. **2**

(ii) $\frac{x}{3}+2=\frac{x}{2}$. **2**

(b) In a normal week Jonathan works 35 hours. When he works 5 hours' overtime at time and a half he earns \$850 for that week. How much is he normally paid per hour? **2**

(c) A set of golf clubs valued at \$800 is sold at a discount of 22%. Find the selling price of the golf clubs? **2**

(d) Simplify $\frac{12m^3n^2}{2mn^4} \div \frac{3m^3}{mn^2}$. **2**

(e) Find the exact distance between points $(-1, 2)$ and $(3, 7)$. **2**

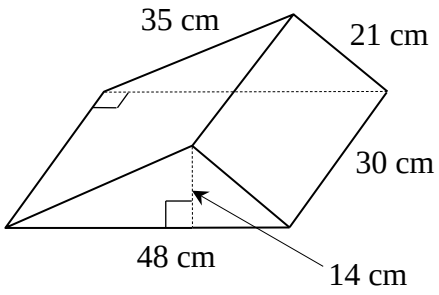
(f) What was the original cost of a notebook computer with a GST-included price of \$1850? The rate of GST is 10%. Answer correct to the nearest cent. **2**

(g) Sydney and Melbourne are 713 km apart. They are represented on a map which has a scale of 1:2 000 000. How far apart are Sydney and Melbourne on the map, correct the nearest millimetres? **2**

End of Question 2

Question 3 (16 Marks)

(a) Calculate the surface area and volume of the triangular prism, correct to 2 decimal places. **3**



(b) If $\sin\theta = \frac{3}{4}$, find the exact value of $\tan\theta$. **2**

(c) A cylinder with base radius of 13 cm has volume 9556.7 cm^3. Find the height of the cylinder, correct to the nearest centimetre. **2**

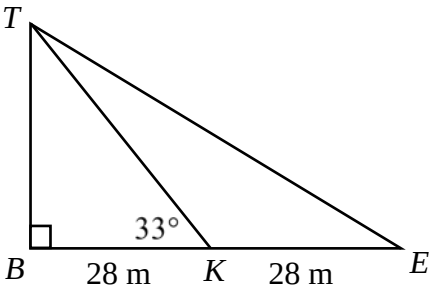
(d) Lachlan earns \$81 500 in a year. His allowable deductions total \$4 000. Using the table below, calculate his total tax payable? **3**

Taxable Income	Tax Payable
0 - \$18 200	Nil
\$18 201 - \$37 000	19c for each \$1 over \$18,200
\$37 001 - \$87 000	\$3 572 plus 32.5c for each \$1 over \$37 000
\$87 001 - \$180 000	\$19 822 plus 37c for each \$1 over \$87 000
\$180 001 and over	\$54 232 plus 47c for each \$1 over \$180 000

(e) At Bathurst High School, a total of 36 students are on either the baseball team, the hockey team, or both. If there are 25 students on the baseball team and 19 students on the hockey team, what is the probability that a student plays both sports? **2**

(f) The angle of elevation of the top of a lighthouse (*T*), from where Keno stands at *K*, 28 metres from the base *B* of the lighthouse, is shown in the diagram below. Keno's brother Edison stands at point *E*, twice as far from the base of the lighthouse as Keno.

NOT TO SCALE



(i) Find the height of the lighthouse. Answer correct to the nearest metre. **2**

(ii) Hence, what is the angle of elevation of the top of the lighthouse from point *E*? Give your answer correct to the nearest degree. **2**

End of Question 3

Question 4 (16 Marks)

(a) Completely factorise the following expressions:

(i) $x^2 + x - 72$. **1**

(ii) $5x^2 - 7x - 24$. **2**

(b) Solve simultaneously $3y - 5x = 2$ and $y + 2x + 3 = 0$. **3**

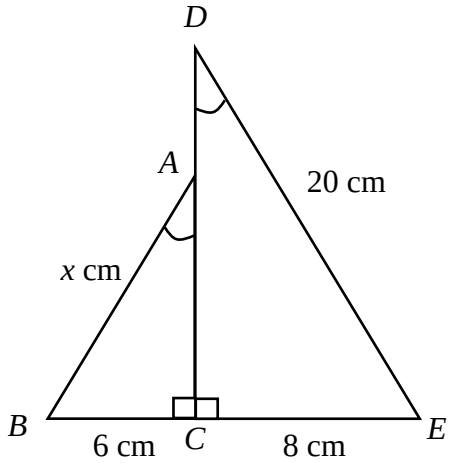
(c) Make v the subject in each of the following formulae:

(i) $F = kv^2$. **2**

(ii) $\frac{1}{s}=\frac{1}{t}+\frac{1}{v}$. **3**

(d) Using the diagram to the right:

NOT TO SCALE



(i) Prove that ΔABC is similar to ΔDEC, giving reasons. **2**

(ii) Hence, find the value of x. **2**

(e) If $x^2yz^3 = 7^4$ and $xy^2 = 7^5$, then xyz equals 7 to what index? **1**

End of Question 4

Question 5 (15 Marks)

(a) The line *AB* has the equation $3x - y - 10 = 0$.

(i) What is the gradient of the line *AB*? **1**

(ii) Find the equation of the line parallel to *AB* and passing through (4,5). (Leave your answer in general form). **2**

(b) Cameron invested some money 2 years ago at a simple interest rate of 6% p.a. He now has $3 360 in his account. How much did he invest 2 years ago? **2**

(c) Determine the value of *k* in order that the lines $tx - 2y + k = 0$ and $3x + y - t = 0$ intersect at $(-2,\ 1)$. **3**

(d) Hayden runs 16 km in 1.5 hours. He runs the first 10 km at an average speed of 12 km/h. What is his average speed for the last 6 km? **2**

(e) A line through the points $A(3,\ 9)$ and $B(-1,\ 3k)$ has a slope of -6. What is the value of k? **2**

(f) The height above the ground, in metres, of a person's eyes varies directly with the square of the distance, in kilometres, that the person can see to the horizon. A person whose eyes are 1.6 m above the ground can see 4.5 km out to sea. How high above the ground, in metres, would a person's eyes need to be to see an island that is 15 km out to sea? Give your answer correct to one decimal place. **3**

End of Question 5

Question 6 (14 Marks)

(a) Completely factorise $x^2 - y^2 + 6y - 9$. **3**

(b) Jasper bought 45 stamps, some for 10c and some for 18c. If he spent \$6.66 altogether, how many 10c stamps did he buy? **2**

(c) The speed (v), in km/h, of a ski lift is inversely proportional to the weight (w kg) it carries. A ski lift carrying a weight of 320 kg can travel at 16 km/h. What is the speed of the ski lift if weight decreases to 250 kg? **3**

(d) A yacht race consists of three legs. The race starts at A and the first leg is 14 nautical miles to B, on a bearing of $125°$. From B the second leg is 12 nautical miles on a bearing of $215°$ to C. The third leg is from C back to A. Find the distance from C to A and the bearing of A from C. **3**

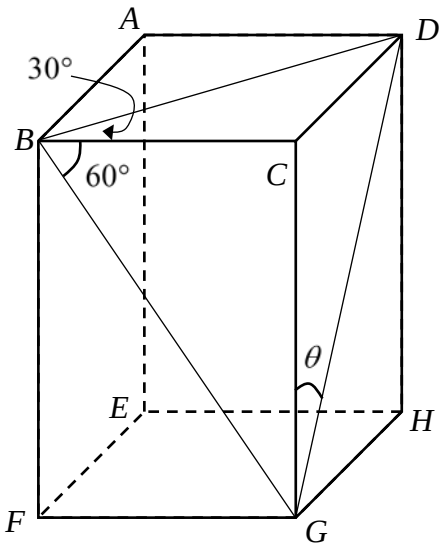
(e) If the line $y = 3x + 1$ is reflected about the line $y = 4$. What is the equation of the resulting line? **3**

End of Question 6

Question 7 (14 Marks)

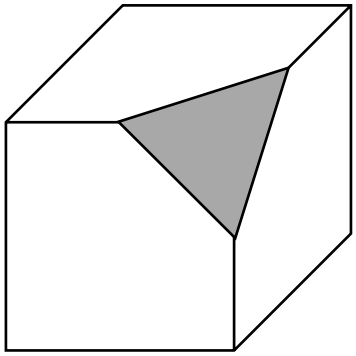
(a) The figure shows a rectangular prism, with $\angle DBC = 30°$, $\angle GBC = 60°$, and $\angle CGD = \theta$. Find the exact value of $\tan\theta$. **3**

NOT TO SCALE



(b) It takes a boat 2 minutes to travel 2 kilometres when going with the current. When the boat is going against the current it takes 4 minutes. The current is always constant. How long would it take the boat to do the same journey in slack water, where there is no current at all? **4**

(c) A cube with side lengths 4 cm is to be cut in the following manner: the corner of the cube is removed by making a cut through the midpoints of three adjacent sides. **3**



The diagram shows the resulting figure after the first cut. Similar cuts are made at each of the remaining corners of the cube. Determine the increase or decrease in total surface area as a result of slicing the eight corners off the original cube.

(d) Box 1 contains one gold marble and one black marble. Box 2 contains one gold marble and two black marbles. Box 3 contains one gold marble and three black marbles. Whenever a marble is chosen randomly from one of the boxes, each marble in that box is equally likely to be chosen. A marble is randomly chosen from Box 1 and placed in Box 2. Then a marble is randomly chosen from Box 2 and placed in Box 3. Finally, a marble is randomly chosen from Box 3. What is the probability that the marble chosen from Box 3 is gold? **4**

Extra Working Page 1

End of Exam

Sydney Boys High School

MOORE PARK, SURRY HILLS

YEAR 9 ADVANCED MATHEMATICS

Yearly Examination 2016

Suggested Solutions

Question	Marker
1	AMG / DH
2	AW
3	EC
4	AYW
5	BK
6	JWC
7	RB

Question 1 (16 Marks)

(a) Calculate $54-8\times7+14\div(-2)$ **1**

-9 ✓ Right or wrong

(b) Express your answer to $\dfrac{57.7-\sqrt{298.3}}{9+4^2}$ correct to 3 significant figures. **1**

1.62 ✓ 1.617 ½ 1.620 ✓ not penalised

(c) Express $2a^{-1}$ with a positive index. **1**

$\frac{2}{a}$ ✓ Right or wrong

(d) Express as a single fraction $\dfrac{x}{3}+\dfrac{3-x}{2}$, in the simplest form. **2**

No denominator No marks.

$\frac{2x}{6}+\frac{3(3-x)}{6}=\frac{2x+9-3x}{6}$ ✓ Lost 1 per error

$=\frac{9-x}{6}$ ✓ Ignored subsequent error.

(e) Simplify the expression $4x-3(x+5)$. **1**

$4x-3x-15$

$=x-15$ $x+15$ ½ mark

(f) Simplify $5x^0+2$. **1**

7 ✓ Right or wrong

(g) Solve and graph your solution on a number line to $2x-5>1$. **2**

$2x>6$

$x>3$ ✓ $2x>6$ ½



✓

1 mark or No marks.

If did $x<3$ above and graph correct CFPA 1

(h) Evaluate pq^2 for $p=-3$ and $q=4$. **1**

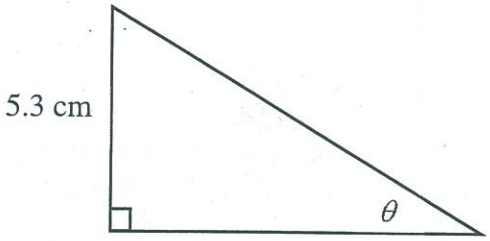
$-3\times16=-48$ ✓ Right or wrong

(i) Expand and simplify $(2x-5)(3-x)$. **2**

$6x-2x^2-15+5x$ ✓

$=-2x^2+11x-15$. ✓ Lost 1 per error

(j) Calculate the size of angle θ, correct to the nearest minute. **2**

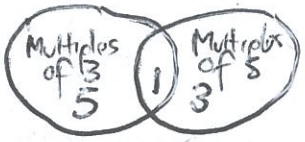


$\tan\theta=\frac{5.3}{7.8}$ ✓

$\theta=34°12'$ ✓

$34°11'$ ½ mark.

(k) Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5? **2**



$\frac{9}{20}$ ✓✓

Lost 1 per error.

End of Question 1

Question 2 (16 Marks)

(a) Solve:

(i) $4x-6=3(1-x)$. **2**

$4x-6=3-3x$

$7x=9$

$x=9/7$

-1 for incorrect expansion
-1 for incorrect collecting of like terms

(ii) $\frac{x}{3}+2=\frac{x}{2}$. **2**

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

$\frac{2x-3x}{6}=-2$

$-x=-12$ $\therefore x=12$

-1 for incorrect manipulation of fractions

(b) In a normal week Jonathan works 35 hours. When he works 5 hours' overtime at time and a half he earns \$850 for that week. How much is he normally paid per hour? **2**

$35x+5(1.5x)=850$

$42.5x=850$

$x=\frac{850}{42.5}$

$\therefore x=20$

so \$20/hr

-1 for incorrect equation
-1 for incorrect hours

(c) A set of golf clubs valued at \$800 is sold at a discount of 22%. Find the selling price of the golf clubs? **2**

\$800 - 22% of 800

$800-0.22\times 800$

$=\$624$

-1 for using 88%

(d) Simplify $\frac{12m^3n^2}{2mn^4} \div \frac{3m^3}{mn^2}$. 2

$\frac{6 m^3 n^2}{m n^4} \times \frac{m n^2}{3 m^3}$

$= 2$

-1 incorrect cancelling & numbers or pronumeral

(e) Find the exact distance between points $(-1, 2)$ and $(3, 7)$. 2

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

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

$= \sqrt{16 + 25}$

$= \sqrt{41}$

$-\frac{1}{2}$ if both approximation + exact value given

$-\frac{1}{2}$ for approximation

(f) What was the original cost of a notebook computer with a GST-included price of \$1850? The rate of GST is 10%. Answer correct to the nearest cent. 2

\$1850 = 110%

1% = 16.81

100% = \$1681.82 (nearest cent)

$-\frac{1}{2}$ rounding error

(g) Sydney and Melbourne are 713 km apart. They are represented on a map which has a scale of 1:2 000 000. How far apart are Sydney and Melbourne on the map. correct the nearest millimetres? 2

$1 : 2{,}000{,}000$

$= x : 713{,}000{,}000$

$x = \frac{713{,}000{,}000}{2{,}000{,}000}$

$x = 356.5$

$= 357$ mm (nearest mm)

$-\frac{1}{2}$ for not nearest mm

End of Question 2

(Solution) + Marking Scheme for Q(3) Yr 9 Exam 2016

(Band) Answer (0)

(a)

$S = (35 \times 30) + (21 \times 30) + 48 \times 30$

$= 3792 \text{ cm}^2$ (1.5)

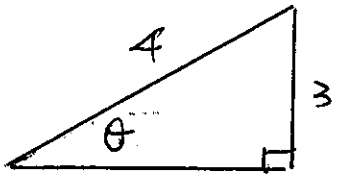
$V = A \times 'h'$

$= \left(\frac{1}{2} \times 48 \times 14\right) \times 30$

$= 10080 \text{ cm}^3$ (1.5)

- Correct Soln + Working AW (3)
- Band Answer AW (0)
- ISE
- Minus (0.5) for incorrect rounding.

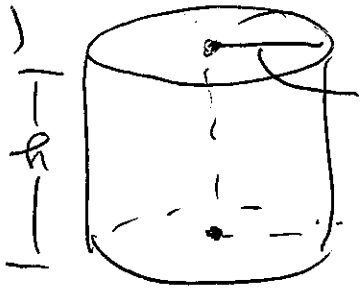
(b)



$\sqrt{16-9} = \sqrt{7}$

- Diagram (1 mark).
- Correction in solution (2 marks)
- Find sin θ or tan θ (0 mark).

(c)



$V = \pi r^2 h$

$\therefore 9556.7 = 169 \pi h$

$\therefore h = \frac{9556.7}{169 \pi}$

- Incorrect round off (−0.5 mk)
- Correct Substitution into formula with correct answer (AW 2 marks)
- Incorrect Subst for 'r' or V but with correct soln (1 mark)

(d)

(i) Taxable Income
$= \$81500 - \$4000$
$= 77500$ (1 mark).

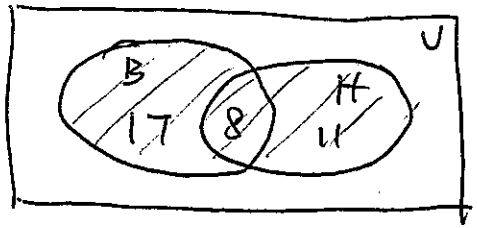
(ii) $77500 - 37000$
$= 40500 \times (0.325)$
$= 13162.50$
(1 mark)

(iii) Total tax payable
$= 13162.50 + 3572$
$= \$16734.5$ (1 mark)

Any incorrect steps
— 1 or 1.5
or two steps — (2).

(e)

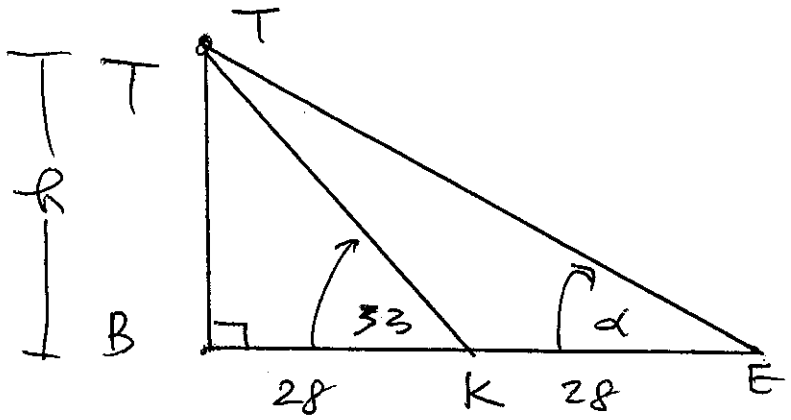
- Venn Diagram (AW 1).
With correct number of students marked and worked out
8 students plays both sports
(AW 1)



- $\text{prob} = \frac{8}{36} = \frac{2}{9}$ (AW 1)
no marks deducted for not simplify fraction or converted to percentages

- ISE.

(f)



Let TB = h

(i) In △TBK, $\frac{h}{28} = \tan 33^\circ$

$\therefore h = 28 \tan 33^\circ$

$= 18.183$.

AW 2 For correct Soln or with diagram Show $\tan 33^\circ$.

(−0.5) for not Correct to the nearest metre

(ii) $\frac{h}{56} = \tan\alpha$. (AW 1 mark)

(AW 1) for correct expression.

$\therefore h = 56 \tan\alpha$

i.e $18.183 = 56 \tan\alpha$

$\Rightarrow \tan\alpha = \frac{18.183}{56}$

$\doteq 18^\circ$ (AW 1 mark)

(−0.5w) for not correct to nearest degree unless deduction have been made in the previous section

Question 4 (16 Marks)

(a) Completely factorise the following expressions:

(i) x^2+x-72. **1**

$(x+9)(x-8)$ (1)

(ii) $5x^2-7x-24$. **2**

$P = 120 \quad S = -7$

$= \dfrac{(5x-15)(5x+8)}{5}$

$= \dfrac{5(x-3)(5x+8)}{5}$

$= (x-3)(5x+8)$

Correct
(1) Working out, even listing out cross method.
(1) Correct Factorisation

(b) Solve simultaneously $3y-5x=2$ and $y+2x+3=0$. **3**

$y = -2x-3$ (1)

$3y-5x=2$ (2)

Sub (1) into (2)

$3(-2x-3)-5x=2$

$-6x-9-5x=2$

$-11x=11$

$x=-1$

$\therefore y = -2(-1)-3$

$= -1$

$\therefore (-1,-1)$

(1) Using one method of solving simultaneous Equation
(1) Correct steps
(1) Correct answer

(c) Make v the subject in each of the following formulae: **2**

(i) $F=kv^2$.

$v^2 = \dfrac{F}{k}$ (1)

$v = \pm\sqrt{\dfrac{F}{k}}$ (1)

important.

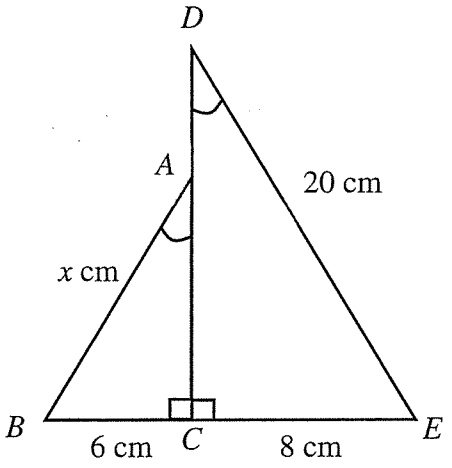
(ii) $\frac{1}{s}=\frac{1}{t}+\frac{1}{v}$. **3**

$\frac{1}{v} = \frac{1}{s} - \frac{1}{t}$ (1)

$\frac{1}{v} = \frac{t-s}{st}$ (1)

$v = \frac{st}{t-s}$ (1)

(d) Using the diagram to the right:



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(i) Prove that ΔABC is similar to ΔDEC, giving reasons. **2**

In $\triangle ABC$ and $\triangle DEC$

$\angle BAC = \angle EDC$ (given)

$\angle BCA = \angle ECD$ (given)

$\therefore \triangle ABC \,|||\, \triangle DEC$ (Equiangular)

(ii) Hence, find the value of x. **2**

(1) $\frac{x}{20} = \frac{6}{8}$ (corresponding sides of similar $\triangle$'s are proportional)

$x = \frac{20 \times 6}{8} = 15\text{cm}$. (1)

(e) If $x^2yz^3 = 7^4$ and $xy^2 = 7^5$, then xyz equals 7 to what index? **1**

$(x^2yz^3)(xy^2) = x^3y^3z^3$

$7^4 \times 7^5 = 7^9$

$(xyz)^3 = 7^9$

$\therefore xyz = 7^3$

$\therefore$ Index $= 3$ (1)

End of Question 4

Year 7

Q5.

(a)(i) $3x - y - 10 = 0$

$y = 3x - 10$

$m = 3$ ✓ (1)

(ii) $m = 3$ and $P(4, 5)$

$y - 5 = 3(x - 4)$ ✓

$y - 5 = 3x - 12$

$3x - y - 7 = 0$ ✓ (2)

(b) $I = Prt$ and $A = P + I$

$I = P \times .06 \times 2$

$I = .12P$ ✓

Then $A = P + .12P = \$3360$

$1.12P = 3360$

$P = \$3000$ ✓ (2)

(c) $tx - 2y + k = 0$ (1)
$3x + y - t = 0$ (2) intersect at $(-2, 1)$

Sub in (1) $\Rightarrow -2t - 2 + k = 0$

$\Rightarrow -2t = 2 - k$ (3) ✓

Sub in (2) $\Rightarrow -6 + 1 - t = 0$

$\Rightarrow t = -5$ (4) ✓

Sub (4) in (3) $\Rightarrow 10 = 2 - k$

$k = -8$ ✓ (3)

Q5.

(d) Total $D = 16$ km Total time $T = 1.5$ h.

10 km	6 km
$s_1 = 12$ km/h	$s_2 = ?$

$$T = t_1 + t_2$$

$$1.5 = \frac{10}{12} + \frac{6}{s_2} \quad \checkmark$$

$$\Rightarrow \frac{6}{s_2} = \frac{3}{2} - \frac{5}{6}$$

$$= \frac{9-5}{6}$$

$$\frac{6}{s_2} = \frac{2}{3} \quad \checkmark$$

$$\Rightarrow s_2 = 9 \text{ km/h}.$$

2

(e) $A(3,9)$ $B(-1,3k)$ $m = -6$, $k = ?$

Then $m_{AB} = \frac{3k-9}{-1-3} = -6$ ✓

$$3k - 9 = 24$$

$$3k = 33$$

$$k = 11 \quad \checkmark$$

2

(f) $h \propto d^2 \Rightarrow h = kd^2$ ✓

When $h = 1.6$, $d = 4.5$

$$\Rightarrow 1.6 = k(4.5)^2$$

$$k = \frac{1.6}{20.25} \quad \checkmark \quad (0.0790123\ldots)$$

Find h if $d = 15$.

$$\Rightarrow h = \frac{1.6}{20.25} \times 225$$

$$= 17.7$$

$h = 17.8$ m to 1 dp ✓

3

14

AW1 for $(x+y)(x-y)+3($

Question 6 (14 Marks)

(a) Completely factorise x^2-y^2+6y-9. **3**

$x^2-(y^2-6y+9)$

$x^2-(y-3)^2$ ✓

$(x+(y-3))(x-(y-3))$

$(x+y-3)(x-y+3)$

show
(1) diff of 2 sq
(1) for each fact

$\boxed{(x+y-3)(x-y+3)}$ ✓ ✓

(b) Jasper bought 45 stamps, some for 10c and some for 18c. If he spent \$6.66 altogether, how many 10c stamps did he buy? **2**

(1) logical working not sub ion
(1) answer.

let x = 10¢ stamps

$\therefore$ $45-x$ = 18¢ stamps

$10x+18(45-x)=666$ ✓

$10x+810-18x=666$

$810-666=8x$

$x=18$

$\therefore$ He bought 18 10¢-stamps.

$\boxed{18 \text{ stamps}}$ ✓

(c) The speed (v), in km/h, of a ski lift is inversely proportional to the weight (w kg) it carries. A ski lift carrying a weight of 320 kg can travel at 16 km/h. What is the speed of the ski lift if weight decreases to 250 kg? **3**

$V=\frac{k}{w}$, $16=\frac{k}{320}$

$k=5120$

(1) $k=5120$
(1) working
(1) answer.

$\therefore V=\frac{5120}{w}$

$V=\frac{5120}{250}$

$\therefore V=20.48$ km/h

$\boxed{20.48 \text{km/h}}$

$\frac{(18\times45-666)}{18-10}$

or

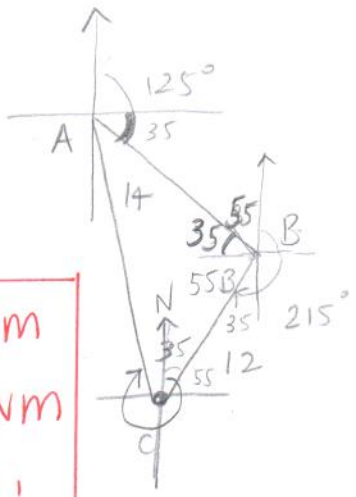
$18x+10(45-x)=666$

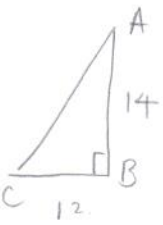
$\frac{666-450}{18-10}$

$=27$

½ for not exact. It is ok not to simplify surds

(d) A yacht race consists of three legs. The race starts at A and the first leg is 14 nautical miles to B, on a bearing of 125°. From B the second leg is 12 nautical miles on a bearing of 215° to C. The third leg is from C back to A. Find the distance from C to A and the bearing of A from C. **3**





① length of AC (exact)

① ∠ACB = 49°24' or equivalent working

① correct bearing

$AC = \sqrt{12^2+14^2}$

$= \sqrt{340}$

$\therefore AC = 2\sqrt{85}$

$\tan \angle ACB = \frac{14}{12}$

$\angle ACB = 49°24'$

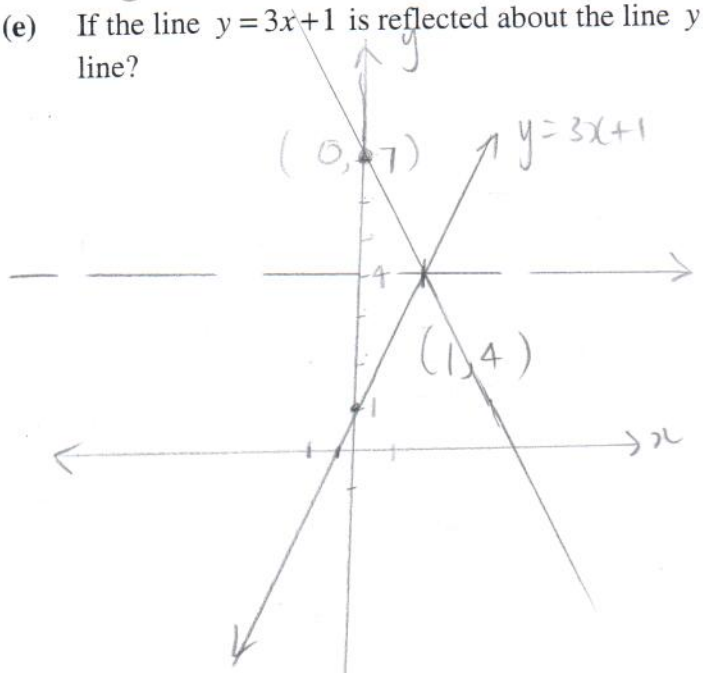
Bearing A from C = $360 - 49°24' + 35° = 345°36'$

$AC = 2\sqrt{85} = \sqrt{340}$ NM

$\doteq 18.439$ NM

Bearing = 345°36'

(e) If the line $y = 3x+1$ is reflected about the line $y = 4$. What is the equation of the resulting line? **3**



$4 = 3x+1$

$3 = 3x$, $x = 1$

POI = (1, 4)

$m = \frac{7-4}{0-1} = \frac{+3}{-1} = -3$

$y - 4 = -3(x-1)$

$y - 4 = -3x + 3$

$3x + y - 7 = 0$

$3x + y - 7 = 0$

or $y = -3x + 7$

① POI (1, 4) or y-int working out or explanation / diagram (0, 7)

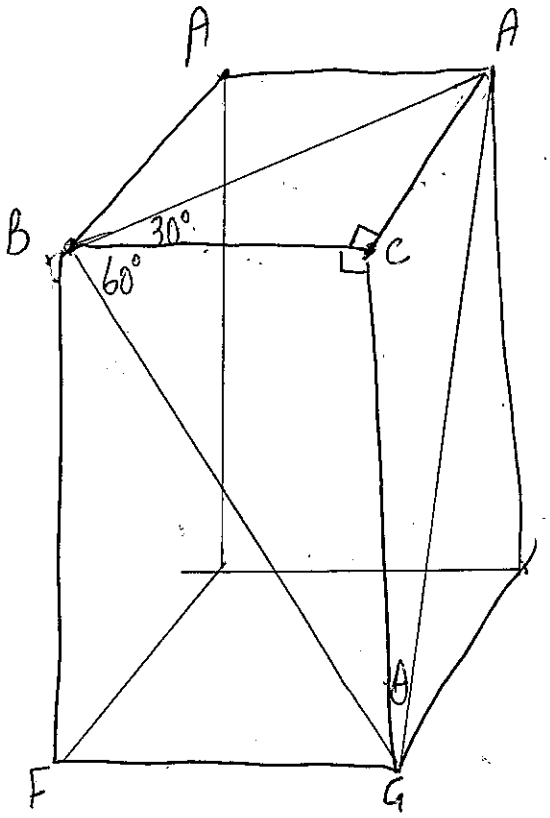
① m = −3

① eqn → cm for incorrect 'm'

working out/explanation / suitable diagram to show m = 3

End of Question 6

7 (a)



$\triangle ABC$, $\tan 30^\circ = \frac{AC}{BC}$

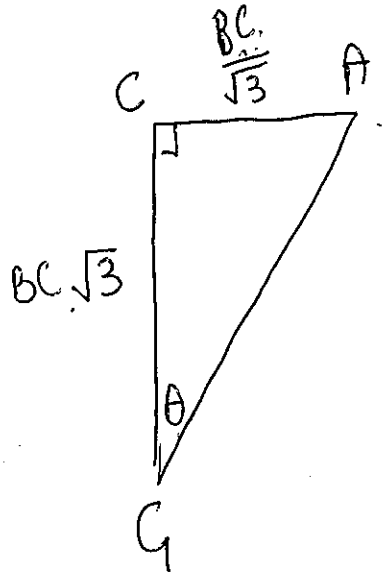
$\frac{1}{\sqrt{3}} = \frac{AC}{BC}$

$BC = \sqrt{3}\,AC$ and $AC = \frac{BC}{\sqrt{3}}$ (1)

$\triangle BCG$, $\tan 60^\circ = \frac{CG}{BC}$

$\frac{\sqrt{3}}{1} = \frac{CG}{BC}$

$CG = BC\sqrt{3}$ (1)



In $\triangle ACG$

$$\tan\theta = \frac{\frac{BC}{\sqrt{3}}}{\frac{BC\sqrt{3}}{1}} = \frac{BC}{\sqrt{3}} \cdot \frac{1}{BC\sqrt{3}}$$

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

7 (b) let current be x.
let speed boat be y.

$$S = \frac{d}{t}$$

$$x + y = \frac{2}{\frac{1}{30}} \text{ km/h}$$

$$2m = \frac{2}{60} \text{ hr} = \frac{1}{30}$$

$$4m = \frac{4}{60} = \frac{2}{30} \text{ hr}$$

① $x + y = 60$

$$y - x = \frac{2}{\frac{2}{30}} = 2 \cdot \frac{30}{2}$$

① $y - x = 30$ km/h.

$2y = 90$

$y = 45$ km/h.

45 km = 60 mins

1 km = $\frac{60}{45}$ mins

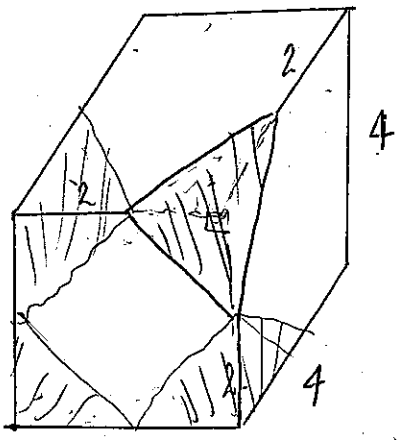
2 km = $\frac{2 \times 60}{45}$ mins

$= 2\frac{2}{3}$ mins ②

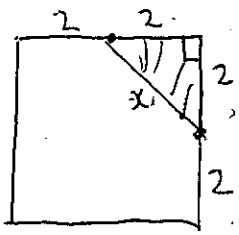
= 2 mins 40 secs.

total (4)

(c)



S.A original cube $6 \times 4 \times 4 = 96 \text{cm}^2$ ✓ (1)

Front. 

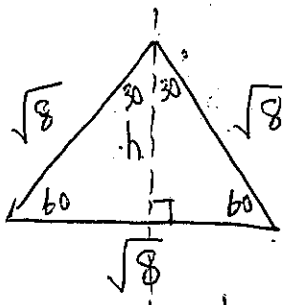
area shaded $\frac{1}{2} \times 2 \times 2 = 2 \text{cm}^2$

Each face has 4 of the shaded removed
so $6 \times 4 \times 2 = 48 \text{cm}^2$ removed ✓ (1)

but the flat piece left $x^2 = 2^2 + 2^2$

$x^2 = 4 + 4$

$x = \sqrt{8}$



$\sin 60^0 = \frac{h}{\sqrt{8}}$

$h = \sqrt{8} \times \frac{\sqrt{3}}{2} = \frac{2\sqrt{2} \times \sqrt{3}}{2} = \sqrt{6}$

total (3)

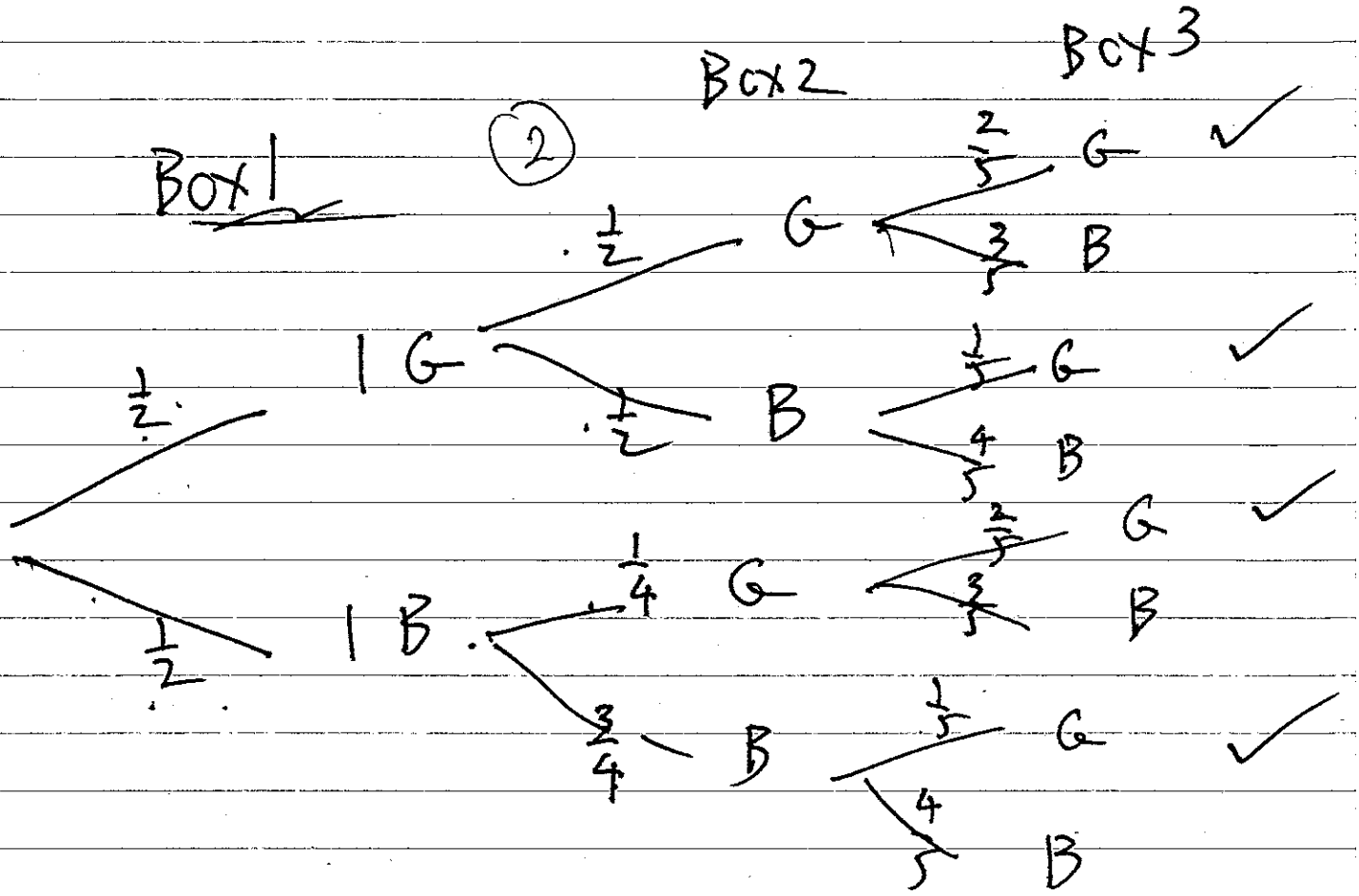
area flat piece is $\frac{1}{2} \times 2\sqrt{2} \times \sqrt{6} = \sqrt{12} = 2\sqrt{3} \text{ cm}^2$

$48 - 16\sqrt{3}$

$8 \times 2\sqrt{3} = 16\sqrt{3} \text{ cm}$

So 96cm^2 compared to $96 - 48 + 16\sqrt{3} = 48 + 16\sqrt{3} \doteq 75.7$ (1)
decreased by $\doteq 20.3 \text{ cm}^2$

(d)



(1) $\frac{1}{2} \times \frac{1}{2} \times \frac{2}{5} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{5} + \frac{1}{2} \times \frac{1}{4} \times \frac{2}{5} + \frac{1}{2} \times \frac{3}{4} \times \frac{1}{5}$

$\frac{1}{10} + \frac{1}{20} + \frac{1}{20} + \frac{3}{40} = \frac{11}{40}$ (1) total (4)

As we move 1 gold from Box1 to Box2 we have new prob for box 2. As we move 1 black from Box1 to Box2 we have new prob for Box2. As we move 1 gold from Box2 to Box3 we have new prob for Box3. As we move 1 black from Box2 to Box3 we have new prob for box3. The ticked parts of the prob tree will be multiplied and the parts (4 of them) added.