

Name: _____
Teacher: BC · CT · ISM



KAMBALA
MATHEMATICS

YEAR 9 ADVANCED
YEARLY EXAMINATION
NOVEMBER 2002

Time Allowed: 1½ hours plus 5 minutes reading time

INSTRUCTIONS:

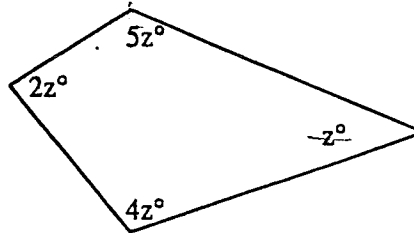
- This examination contains three sections:
 - Section A (20 marks):** 20 Multiple choice questions
 - Section B (20 marks):** 20 Short answer questions
 - Section C (60 marks):** 6 Multi-part free response questions each of 10 marks
- Allow approximately *15-20 minutes* for Section A. Answer on the multiple choice answer sheet provided.
- Allow approximately *15-20 minutes* for Section B. Answer all questions in Section B on the examination paper.
- Allow approximately *50-60 minutes* for Section C. Answer all questions on the paper provided. Label your questions carefully and show all necessary working.
- Marks may be deducted for careless or badly arranged work.

SECTION A: Answer on the answer sheet provided [20 marks]

1. Simplify $7a - 6 + 3(2 - a)$
- (A) $4a - 3$ (B) $10a - 1$ (C) $4a$ (D) $10a - 3$

2. $(2a^2b)^3$
- (A) $6a^5b^3$ (B) $8a^5b^3$ (C) $8a^6b^3$ (D) $6a^6b^3$

3. In the diagram, $z =$



- (A) 15 (B) 7.5
(C) 30 (D) 18

4. $a^b \times b^a =$

- (A) $(ab)^{ab}$ (B) $(ab)^{a+b}$ (C) $(a+b)^{a+b}$ (D) $a^b b^a$

5. When simplified, the expression $\sqrt{8} - \sqrt{2}$ becomes:

- (A) $\sqrt{6}$ (B) $\sqrt{2}$ (C) $4\sqrt{2}$ (D) $3\sqrt{2}$

6. The number 0.0003745 can be expressed in scientific notation as:

- (A) 3.745×10^{-3} (B) 3.745×10^3 (C) 3.745×10^{-4} (D) 3.745×10^4

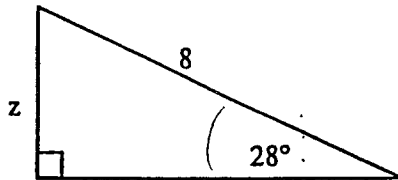
7. Simplify $(3a + 4) - 3(5 - a)$

- (A) -1 (B) $6a - 11$ (C) -11 (D) $6a - 4$

8. Which one of the following is NOT equal to $\sqrt{a^3}$

- (A) $a\sqrt{a}$ (B) $\sqrt[3]{a}$ (C) $a^{\frac{3}{2}}$ (D) $(\sqrt{a})^3$

9. In the diagram,



- (A) $z = 8\sin 28^\circ$ (B) $z = 8\cos 28^\circ$
 (C) $z = \frac{8}{\sin 28^\circ}$ (D) $z = \frac{8}{\cos 28^\circ}$

10. Expand the expression $(2x-3)(2x+3)$

$4x^2 - 9$

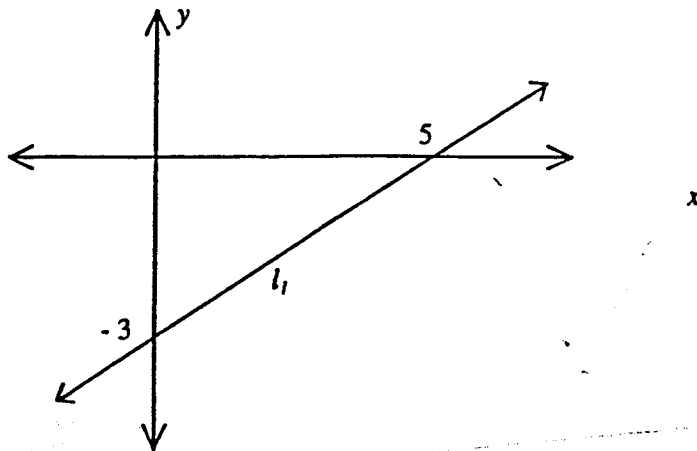
- (A) $4x^2 + 9$ (B) $4x^2 - 6x + 9$ (C) $4x^2 + 6x - 9$ (D) $4x^2 - 9$

11. The solution to $2x - 3 = 5 - 3x$ is:

- (A) $x = \frac{5}{8}$ (B) $x = -8$ (C) $x = \frac{8}{5}$ (D) $x = -\frac{2}{5}$

12. The gradient m of the line l_1 in the diagram is

- (A) $m = \frac{3}{5}$
 (B) $m = -\frac{3}{5}$
 (C) $m = \frac{5}{3}$
 (D) $m = -\frac{5}{3}$



13. Express $\frac{3^{-2}}{16^{-\frac{1}{2}}}$ as a simple fraction:

(A) $\frac{9}{4}$

(B) $\frac{8}{9}$

(C) $\frac{4}{9}$

(D) $-\frac{3}{4}$

14. Which one of the following is NOT a correct factorisation:

~~(A)~~ $x^2 - 6x = x(x - 6)$

(B) $ax + ay - bx - by = (a - b)(x + y)$

(C) $x^2 - 5x - 6 = (x - 3)(x - 2)$

~~(D)~~ $4x^2 - 9 = (2x - 3)(2x + 3)$

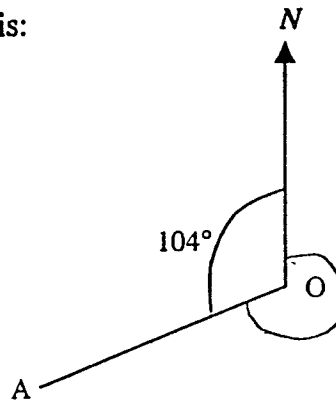
15. In the diagram, the bearing of A from O is:

(A) 256°N

(B) 104°N

(C) $\text{S}14^\circ\text{W}$

(D) 076°S



$\frac{A}{4\pi} = r^2$

16. When r is made the subject of the formula $A = 4\pi r^2$ we get:

(A) $r = \sqrt{\frac{A}{4\pi}}$

(B) $r = \sqrt{4\pi A}$

(C) $r = \frac{\sqrt{a}}{4\pi}$

(D) $r = \frac{a}{4\pi}$

17. $\frac{6}{5\sqrt{3}}$ with a rational denominator becomes:

(A) $\frac{\sqrt{18}}{15}$

(B) $\frac{2\sqrt{3}}{5}$

(C) $\frac{6\sqrt{3}}{5}$

(D) $\frac{5\sqrt{3}}{6}$

18. The midpoint M of a line segment that starts at A(5, -2) and ends at B(-2, 2) is:

(A) $M\left(\frac{3}{2}, 0\right)$

(B) $M(3, 0)$

(C) $M\left(\frac{7}{2}, 0\right)$

(D) $M(-9, 6)$

19. $6x^2 + x - 2$ can be factorised as:

(A) $(2x-1)(3x+2)$

(B) $(6x-1)(x+2)$

(C) $(2x+1)(3x-2)$

(D) $(3x-1)(3x+2)$

20. Constance thinks the solution below that she gave for the inequality $\frac{3x}{2} - 5 > 1 - 4x$ may have mistakes in it. Indicate what you think by choosing A, B, C or D

$$\frac{3x}{2} - 5 > 1 - 4x$$

$$3x - 10 > 2 - 8x$$

$$-5x - 10 > 2$$

$$-5x > 12$$

$$x < \frac{12}{5}$$

line 1

line 2

line 3

line 4

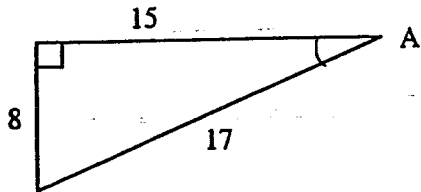
- (A) There are no mistakes at all
(B) A mistake appears in *line 1*
(C) Mistakes appear in *line 2* and *line 3*
(D) Mistakes appear in *line 2* and *line 4*
-

End of Section A

Section B **Answer in the spaces provided** **[20 marks]**

1. Find the value of $\frac{6.3-2.1}{8.5+4.4}$ (to 4 decimal places)

2. From the diagram, write down the value of $\tan A$ as a fraction



3. Factorise $x^2 - 5x + 6$

4. Simplify $5x(2-x) - 3(2x-1)$

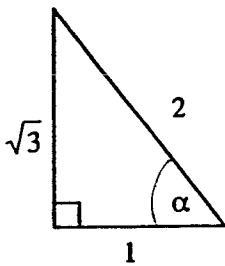
5. Find the distance between the points (5,3) and (2,-1)

6. Simplify $\sqrt{200}$ (do not leave as a decimal)

7. $(x+3)^2 - (x-3)^2 = 12x$ True or false? Show your working!

8. The line $y = 5x + b$ passes through the point $(1, 4)$. What is the value of b ?

9. Find the size of angle α (to the nearest degree if necessary)



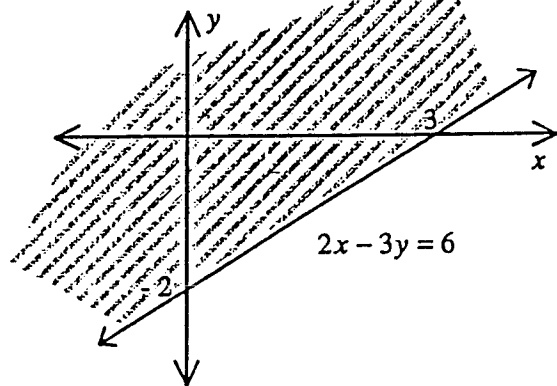
10. Write the expression $\frac{1}{\sqrt[3]{x}}$ in the form $x^{\frac{p}{q}}$

11. Are the two lines $2x + y + 4 = 0$ and $y = -2x - 1$ parallel? Give a reason for your answer.

12. Expand and simplify $(\sqrt{3} - \sqrt{2})^2$

13. Write as one fraction $\frac{1}{x-1} + \frac{1}{x+1}$

14. Write the inequality that is represented by the shade region below:



15. Simplify $\frac{3^{-2}x^{-2}}{5^{-1}x^{-7}}$ leaving your answer as a fraction with positive indices

16. What can be said about the relationship between the lines $3x - 4y = 7$ and $y = -\frac{4}{3}x + 1$ by looking at their gradients? Explain your answer.

17. Anthea is three times as old as Georgie and in two years time she will be twice as old as Georgie. What is Georgie's age at the moment?

18. The point of intersection of the lines $2x + 5y = 7$ and $ax + 7y = 10$ is $(-1, 2)$. What is the value of a in the second equation?

19. Circle the one statement below that is NOT true:

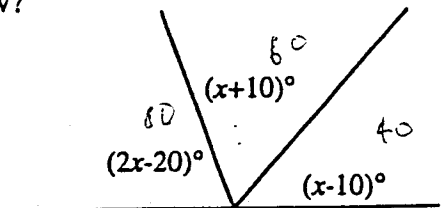
(A) $\sin 45^\circ = \cos 45^\circ$

(B) $(2\sqrt{2} - \sqrt{3})(2\sqrt{2} + \sqrt{3}) = 4 - 3 = 1$

(C) $\frac{1 + \frac{1}{x}}{1 - \frac{1}{x}} = \frac{1 + x}{x - 1}$

(D) A bearing of $N35^\circ W$ is the same as $325^\circ N$

20. What is the value of the smallest angle in the diagram below?



end of Section B

Section C

[60 marks]

- Answer on the paper provided
- Marks may be deducted for careless or badly arranged work

Question 1:

Start a new page

[10 marks]

Simplify the following:

(i) $\frac{x^2 - 5x}{x^2 - 25}$ [2]

(ii) $\frac{x^2 - 6x + 8}{x^2 - 4} \times \frac{2x^2 + 4x}{x^2 - 4x}$ [3]

(iii) $\frac{1}{x} + \frac{3}{2x} + \frac{5}{4x}$ [2]

(iii) $\frac{2}{x+2} - \frac{3}{2x+3}$ [3]

Question 2:

Start a new page

[10 marks]

(a) Solve:

(i) $\frac{2x-1}{3} - 2 = 3+x$ [2]

(ii) $5 - 2(3-x) > 4x - 3$ [2]

(b) Simplify (i) $2\sqrt{50} - 3\sqrt{8}$ [1]

(ii) $\sqrt{a^3b^4} + \sqrt{a^5b^2}$ [1]

(iii) $\frac{3\sqrt{75}}{5\sqrt{27}}$ [1]

(c) Rationalise the denominator of the expression $\frac{\sqrt{2}}{\sqrt{2}-1}$ [3]

Question 3:

Start a new page

[10 marks]

- (a) Two lines $y = 2x - 1$ and $y = x + 1$ intersect at a point P.
On a suitably labelled set of axes:
- (i) Sketch and label both lines [4]
- (ii) Indicate on your axes the point P and label its coordinates [1]
- (iii) Check that your coordinates for P are correct by solving the two equations $y = 2x - 1$ and $y = x + 1$ simultaneously to find the point of intersection algebraically [3]
- (c) What is the equation of a line through $(-1, 5)$ and gradient $m = \frac{2}{3}$? [2]

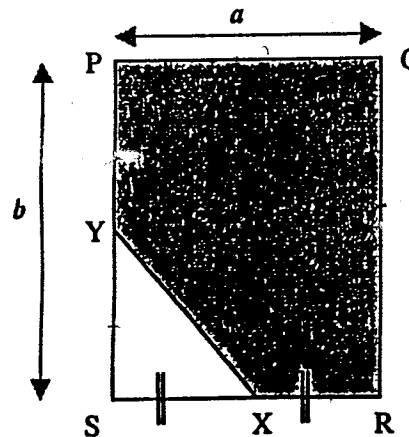
Question 4:

Start a new page

[10 marks]

- (a) PQRS is a rectangle of width a and length b .

Y is the midpoint of PS and
X is the midpoint of SR.



- (i) Show that the area A of the shaded region can be expressed as

$$A = \frac{7ab}{8} \quad [2]$$

- (ii) If $b = 2a$ find an expression for the perimeter of the pentagon PQRXY in terms only of a (hint: Pythagoras) [3]

- (b) Temperature measurements can be converted from the Celsius scale ($^{\circ}\text{C}$) to the Fahrenheit scale ($^{\circ}\text{F}$) using the formula $F = \frac{9C}{5} + 32$

At what temperature would the two scales read the same temperature? [2]

- (c) Solve the pair of simultaneous equations for x and y

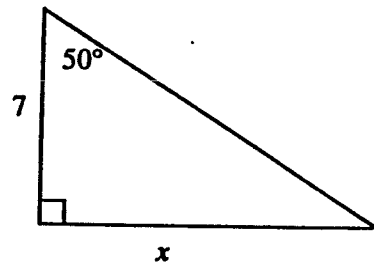
$$3x + 2y = 4$$

$$x - 2y = 8$$

[3]

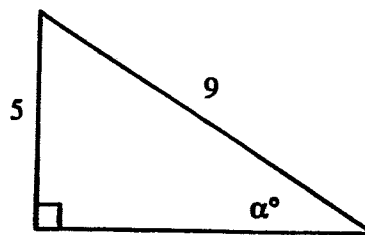
Question 5:*Start a new page***[10 marks]**

- (a) Find the value of x in the diagram (to 2 dp)



[2]

- (b) Find the size of α (to the nearest minute)

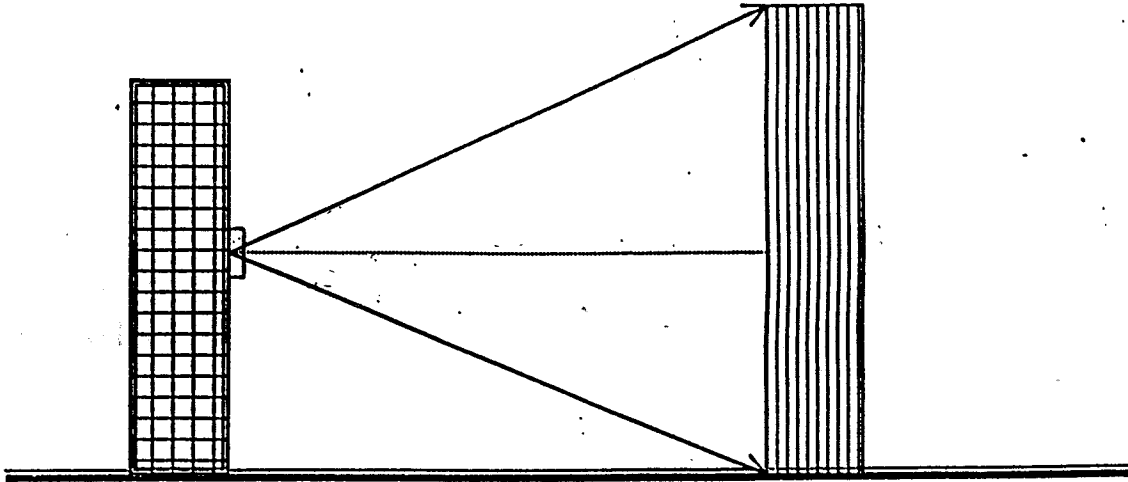


[2]

- (c) While out kayaking, Harriet notices her friend Antonia up on a cliff. She estimates that the angle of elevation of the top of the cliff to be 28° and the height of the cliff to be 45 metres. How far out from the cliff is she?

[2]

- (d) Lena is in a glass elevator going up the side of a building, and she looks across at the building opposite, noticing that the angle of depression of the base of the building opposite is 30° and the angle of elevation of the top of the building is 25° . She knows that the two buildings are 380 metres apart, and they both stand on level ground.



- (i) Calculate the height of the elevator when Lena looked out [2]
- (ii) What is the height of the building opposite? (to the nearest metre) [2]

Question 6:

Start a new page

[10 marks]

- (a) Ashley decides she is going to invent a new mathematical operation called 'smiling' and gives it the symbol \odot . She defines 'smiling' in the following way:

$$a \odot b = a^b + b^a$$

so if $a = 3$ and $b = 2$, then $3 \odot 2 = 3^2 + 2^3$

- (i) Find $4 \odot \frac{1}{2}$ [1]
- (ii) If $2 \odot x = 100$, what is the value of x ? [2]

Name: Su-Min Lim

Teacher : BC CT **ISM**

MATHEMATICS
YEAR 9 ADVANCED
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Section A
Multiple Choice Answer Sheet

Answer each question by circling the correct letter.

- | | | | | | | | | | |
|----|----------|----------|----------|----------|----|----------|----------|----------|----------|
| 1 | A | B | C | D | 11 | A | B | C | D |
| 2 | A | B | C | D | 12 | A | B | C | D |
| 3 | A | B | C | D | 13 | A | B | C | D |
| 4 | A | B | C | D | 14 | A | B | C | D |
| 5 | A | B | C | D | 15 | A | B | C | D |
| 6 | A | B | C | D | 16 | A | B | C | D |
| 7 | A | B | C | D | 17 | A | B | C | D |
| 8 | A | B | C | D | 18 | A | B | C | D |
| 9 | A | B | C | D | 19 | A | B | C | D |
| 10 | A | B | C | D | 20 | A | B | C | D |

No correct answer - correct answer is 30°

20

Section C

[60 marks]

- Answer on the paper provided
- Marks may be deducted for careless or badly arranged work

Question 1:

Start a new page

[10 marks]

Simplify the following:

(i) $\frac{x^2 - 5x}{x^2 - 25}$ $\frac{x(x-5)}{(x+5)(x-5)} = \frac{x}{x+5}$ [2]

(ii) $\frac{x^2 - 6x + 8}{x^2 - 4} \times \frac{2x^2 + 4x}{x^2 - 4x}$ $\frac{(x-4)(x-2)}{(x-2)(x+2)} \times \frac{2x(x+2)}{x(x-4)} = 2$ [3]

(iii) $\frac{1}{x} + \frac{3}{2x} + \frac{5}{4x}$ $\frac{4}{4x} + \frac{6}{4x} + \frac{5}{4x} = \frac{15}{4x}$ [2]

(iii) $\frac{2}{x+2} - \frac{3}{2x+3}$ $= \frac{2(2x+3) - 3(x+2)}{(x+2)(2x+3)} = \frac{4x+6-3x-6}{(x+2)(2x+3)} = \frac{x}{(x+2)(2x+3)}$ [3]

$\frac{x}{(x+2)(2x+3)}$

10

Question 2:

Start a new page

[10 marks]

(a) Solve:

(i) $\frac{2x-1}{3} - 2 = 3+x$ $2x-1-6 = 9+3x$
 $2x-7 = 3x+9$
 $x = -16$ [2]

(ii) $5 - 2(3-x) > 4x - 3$ $x < 1$ [2]

$5 - 6x + 2x > 4x - 3$
 $5 - 4x > 4x - 3$
 $8 > 8x$

(b) Simplify

(i) $2\sqrt{50} - 3\sqrt{8} - 10\sqrt{2} - 6\sqrt{2} = 4\sqrt{2}$ [1]

(ii) $\sqrt{a^3b^4} + \sqrt{a^5b^2}$ $ab^2\sqrt{a} + a^2b\sqrt{a} = (ab^2+a^2b)\sqrt{a}$ [1]

(iii) $\frac{3\sqrt{75}}{5\sqrt{27}} = \frac{15\sqrt{3}}{15\sqrt{3}} = 1$ [1]

(c) Rationalise the denominator of the expression

$\frac{\sqrt{2} \times (\sqrt{2}+1)}{\sqrt{2}-1 \times (\sqrt{2}+1)} = \frac{\sqrt{2}(\sqrt{2}+1)}{2-1}$ [3]

$= \frac{2+\sqrt{2}}{1}$



10

Question 3:

Start a new page

[10 marks]

- (a) Two lines $y=2x-1$ and $y=x+1$ intersect at a point P.
On a suitably labelled set of axes:

- (i) Sketch and label both lines [4]
 (ii) Indicate on your axes the point P and label its coordinates $P=(2,3)$ [1]
 (iii) Check that your coordinates for P are correct by solving the two equations $y=2x-1$ and $y=x+1$ simultaneously to find the point of intersection algebraically

$y=2x-1$ (1)
 $y=x+1$ (2)
 Sub. (2) into (1)
 $x+1=2x-1$ $\therefore x=2$ ✓
 [3] Sub $x=2$ in (2)
 $y=2(2)-1$
 $\therefore y=3$ ✓

- (c) What is the equation of a line through $(-1, 5)$ and gradient $m=\frac{2}{3}$? [2]

$y=mx+b$ ($m=\frac{2}{3}$)
 $5=\frac{2}{3}(-1)+b$
 $5=-\frac{2}{3}+b$
 $b=5+\frac{2}{3}$
 $\therefore \text{equation} = y=\frac{2}{3}x+5\frac{2}{3}$ ✓
 Can you express this in GENERAL FORM?

Question 4:

Start a new page

[10 marks]

- (a) PQRS is a rectangle of width a and length b .

Y is the midpoint of PS and X is the midpoint of SR.

Area of PQRS:
 $l \times b = a \times b$
 Area of unshaded part =
 $\frac{1}{2}l \times b = \frac{1}{4}a \times \frac{1}{2}b = \frac{a}{4} \times \frac{b}{2}$ ✓
 $= \frac{ab}{8}$

$\therefore \text{shaded part} = \text{Area of PQRS} - \text{unshaded area}$
 $= \frac{8ab}{8} - \frac{ab}{8} = \frac{7ab}{8}$

- (i) Show that the area A of the shaded region can be expressed as

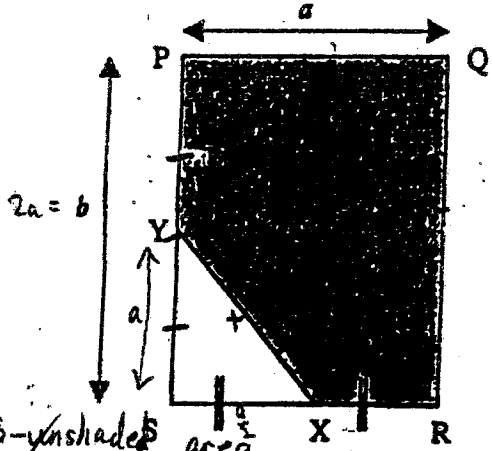
$$A = \frac{7ab}{8}$$

[2]

- (ii) If $b=2a$ find an expression for the perimeter of the pentagon PQRXY in terms only of a (hint: Pythagoras)

[3]

$(XY)^2 = (SY)^2 + (SX)^2$
 $= \left(\frac{1}{2}b\right)^2 + \left(\frac{1}{2}a\right)^2$
 $= \frac{a^2}{1} + \frac{a^2}{4}$
 $= \frac{4a^2 + a^2}{4} = \frac{5a^2}{4}$
 $\therefore XY = \sqrt{\frac{5a^2}{4}} = \frac{\sqrt{5}a}{2}$



$\therefore P = a + 2a + \frac{a}{2} + XY + a$
 $= \frac{4a}{2} + \frac{a}{2} + \frac{\sqrt{5}a}{2}$ 10
 $= \frac{(8a + a + \sqrt{5}a)}{2}$
 $= \frac{9a + \sqrt{5}a}{2}$

(b) Temperature measurements can be converted from the Celsius scale ($^{\circ}\text{C}$) to the Fahrenheit scale ($^{\circ}\text{F}$) using the formula $F = \frac{9C}{5} + 32$ Let $F = C = x$

At what temperature would the two scales read the same temperature? [2]

$$\therefore 5x = \frac{9x}{5} + 32 \times 5 \quad \therefore -4x = 160$$

$$\frac{-4x}{-4} = \frac{160}{-4}$$

$$\therefore x = -40$$

✓ \therefore two scales would read the same temp. at -40°

(c) Solve the pair of simultaneous equations for x and y

$$3x + 2y = 4 \quad \text{--- (1)}$$

$$x - 2y = 8 \quad \text{--- (2)}$$

$$\text{(1) + (2): } \frac{4x}{4} = \frac{12}{4}$$

$$\therefore x = 3$$

Sub $x = 3$ in (1)

$$3(3) + 2y = 4$$

$$-9 - 9$$

$$\frac{2y}{2} = \frac{-5}{2}$$

$$\therefore y = -2\frac{1}{2}$$

[3]

Question 5:

Start a new page

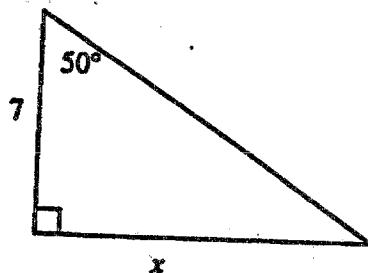
[10 marks]

(a) Find the value of x in the diagram (to 2 dp)

$$\tan 50^{\circ} = \frac{x}{7}$$

$$\therefore x = 7 \tan 50^{\circ}$$

$$= 8.34 \text{ (to 2dp)}$$



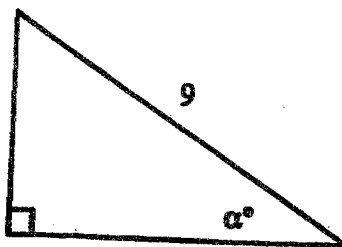
[2]

(b) Find the size of α (to the nearest minute)

$$\sin a = \frac{5}{9}$$

$$\therefore a = \sin^{-1}(5/9)$$

$$= 33^{\circ} 45' \text{ (to nearest minute)}$$



[2]

(c) While out kayaking, Harriet notices her friend Antonia up on a cliff. She estimates that the angle of elevation of the top of the cliff to be 28° and the height of the cliff to be 45 metres.

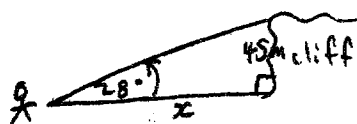
How far out from the cliff is she?

$$\tan 28 = \frac{45}{x}$$

$$\therefore x \tan 28 = 45$$

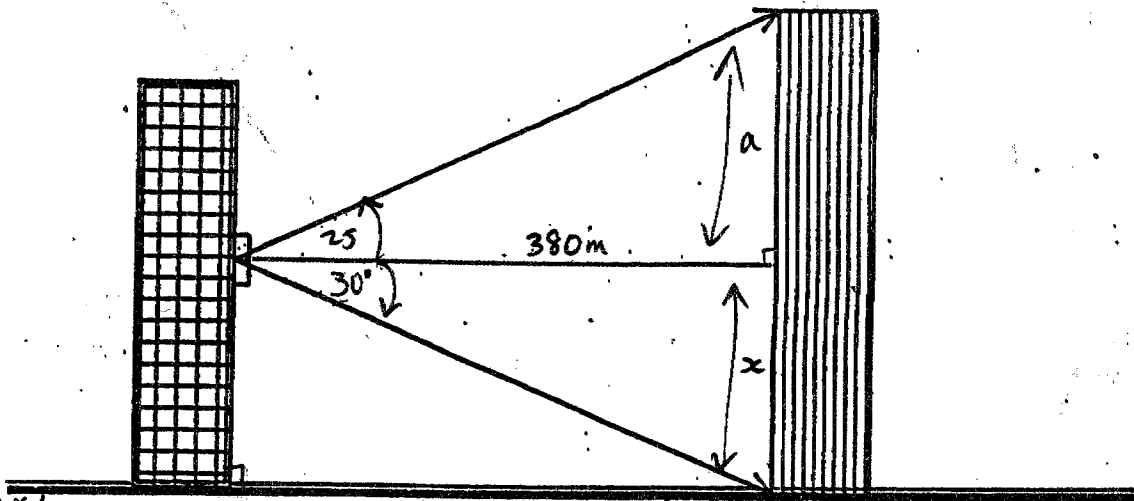
$$\frac{x \tan 28}{\tan 28} = \frac{45}{\tan 28}$$

$$\therefore x = 84.63 \text{ m (to 2dp)}$$



[2]

(d) Lena is in a glass elevator going up the side of a building, and she looks across at the building opposite, noticing that the angle of depression of the base of the building opposite is 30° and the angle of elevation of the top of the building is 25° . She knows that the two buildings are 380 metres apart, and they both stand on level ground.



$$380 \times \tan 30^\circ = \frac{x}{380} \times 380$$

$$\therefore 380 \tan 30^\circ = x$$

$$\therefore x = 219.39 \text{ (to 2 dp)}$$

\therefore height of elevator when Lena looked out was 219.39m

(i) Calculate the height of the elevator when Lena looked out [2]

(ii) What is the height of the building opposite? (to the nearest metre)

$$380 \times \tan 25^\circ = \frac{a}{380} \times 380$$

$$\therefore a = 380 \tan 25^\circ$$

$$\therefore a = 177 \text{ m (to nearest m)}$$

\therefore height of opp building is a metres + x metres

$$= 177.20 + 219.39 = 396.59 \approx 397 \text{ m}$$

Question 6:

Start a new page

[10 marks]

(a) Ashley decides she is going to invent a new mathematical operation called 'smiling' and gives it the symbol \odot . She defines 'smiling' in the following way:

$$a \odot b = a^b + b^a$$

so if $a = 3$ and $b = 2$, then $3 \odot 2 = 3^2 + 2^3$

(i) Find $4 \odot \frac{1}{2} = 4^{\frac{1}{2}} + (\frac{1}{2})^4 = 2 + \frac{1}{16} = 2\frac{1}{16}$ [1]

(ii) If $2 \odot x = 100$, what is the value of x ? [2]

$$2^2 + x^2 = 100$$

$$4 + x^2 = 100$$

$$-4 \quad -4$$

$$\sqrt{x^2} = \sqrt{96}$$

$$\therefore x = 9.8 \text{ (to 1 dp)}$$

$$2^x + x^2 = 100$$

Try $x = 5$: $32 + 25 = 57$

Try $x = 6$: $64 + 36 = 100$

$$\therefore x = 6$$

- (b) On the same set of axes, sketch the inequalities and shade the region in the plane which satisfies all three of the inequalities [4]

$$x+y < 6 \quad \rightarrow x+y=6$$

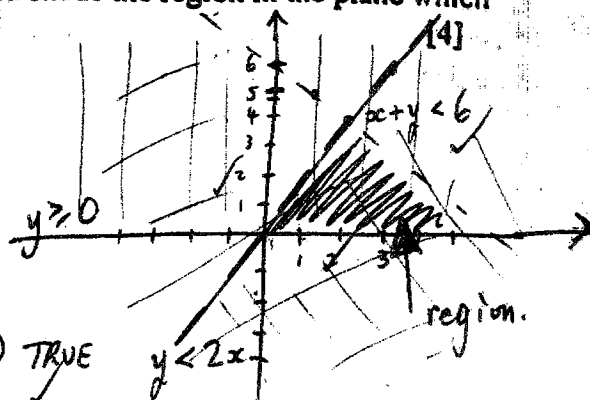
$$x \geq 0 \quad x=0, y=6$$

$$y < 2x \quad x=1, y=5$$

$$y = 2x \quad x=2, y=4$$

$$x=3, y=6$$

$$\text{test } (3,1) \quad 1 < 2(3) \text{ TRUE}$$

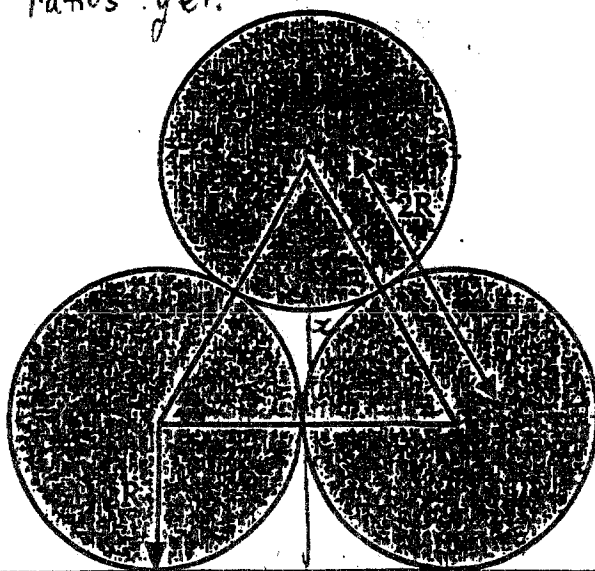


$$x+y < 6$$

$$\text{test } (0,0) \quad 0+0 < 6 \text{ TRUE}$$

- (c) The ends of three identical cylinders with radius R are shown, stacked on top of each other. Find the exact height h of the stack in terms of R . [3]

Haven't learnt exact ratios yet.



$$\sin 60^\circ = \frac{x}{2R}$$

$$\frac{\sqrt{3}}{2} = \frac{x}{2R}$$

$$2R \frac{\sqrt{3}}{2} = x$$

$$h = R + R + x$$

$$= 2R + \sqrt{3}R$$

$$= (\sqrt{3} + 2)R$$

End of Section C