| INTERNATIONAL BACCALAURÉAT BACHILLERATO | | BACCALAUREATE INTERNATIONAL INTERNACIONAL |

MATHEMATICAL STUDIES

Standard Level

Thursday 4 November 1999 (afternoon)

Paper 1   1 hour 30 minutes

A

Candidate name:	Candidate category & number:

This examination paper consists of 20 questions.
The maximum mark for each question is 4.
The maximum mark for this paper is 80.

INSTRUCTIONS TO CANDIDATES

Write your candidate name and number in the boxes above.

Do NOT open this examination paper until instructed to do so.

Answer ALL of the questions in the spaces provided.

Unless otherwise stated in the question, all numerical answers must be given exactly or to three significant figures as appropriate.

B

QUESTIONS ANSWERED
ALL

C

EXAMINER	TEAM LEADER
TOTAL /80	TOTAL /80

D

IBCA
TOTAL /80

EXAMINATION MATERIALS

Required:
IB Statistical Tables
Calculator
Ruler and compasses

Allowed:
A simple translating dictionary for candidates not working in their own language

FORMULAE

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

Cosine rule:
$$a^2 = b^2 + c^2 - 2bc\cos A \qquad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

Arithmetic sequences:
$$u_n = a + (n-1)d \qquad S_n = \frac{n}{2}(a+l) = \frac{n}{2}\{2a+(n-1)d\}$$

Geometric sequences:
$$u_n = ar^{n-1} \qquad S_n = \frac{a(r^n - 1)}{r - 1}, \quad r \neq 1$$

Simple interest:
$$I = \frac{Crn}{100}$$

Compound interest:
$$I = C\left(1 + \frac{r}{100}\right)^n - C$$

Statistics: If $(x_1, x_2, \ldots, x_n)$ occur with frequencies $(f_1, f_2, \ldots, f_n)$ then the mean m and standard deviation s are given by

$$m = \frac{\Sigma f_i x_i}{\Sigma f_i} \qquad s = \sqrt{\frac{\Sigma f_i (x_i - m)^2}{\Sigma f_i}}, \qquad i = 1, 2, \ldots, n$$

Maximum marks will be given for correct answers. Where an answer is wrong, some marks may be given for a correct method provided this is shown by written working. Working may be continued below the box, if necessary, or on extra sheets of paper provided these are securely fastened to this examination paper.

1. (a) A girl's height is 1.623 m . Write her height **to the nearest cm** .

    (b) The time taken to fill a tank was 2 hours 43 minutes. Write this time **to the nearest 5 minutes**.

    (c) The attendance at a show was 2591 people. How many people, **to the nearest 100** , were at the show?

    (d) The mean distance of the Moon from the Earth is approximately 384 403 km . Write this distance in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$.

Working:

Answers:

(a) _____

(b) _____

(c) _____

(d) _____

2. The table shows the number of children in 50 families.

Number of children	Frequency	Cumulative frequency
1	3	3
2	m	22
3	12	34
4	p	q
5	5	48
6	2	50
	T	

(a) Write down the value of T.

(b) Find the values of m, p and q.

Working:

Answers:

(a) _____

(b) _____

3. Functions f and g are defined as follows:

$$\left. \begin{array}{l} f : x \mapsto -2x - 3 \\ g : x \mapsto 6 - x \end{array} \right\} x \in \mathbb{R}$$

(a) Write down the image of –2 under the function f.

(b) Find

   (i) $(f \circ g)(x)$;

   (ii) $f^{-1}(x)$.

Working:

Answers:

(a) _____

(b) (i) _____

   (ii) _____

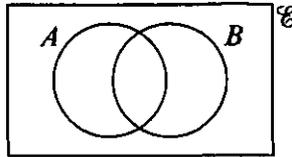**4.** Given $M = \begin{pmatrix} 3 & 2 \\ 7 & 5 \end{pmatrix}$,

find a matrix M^{-1} such that $MM^{-1} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$.
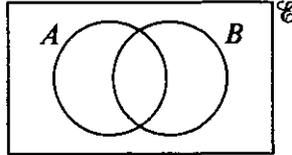
Working:

Answer:

889-301

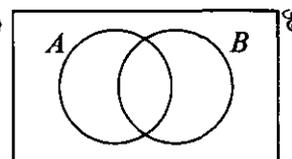5.   In each of the Venn diagrams, shade the region indicated.
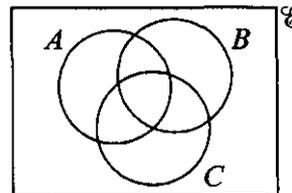
(a) $A \cap B$

(b)   The complement of $(A \cap B)$

(c)   The complement of $(A \cup B)$

(d) $A \cup (B \cap C)$

Working:

6. The gradients of several lines are as follows:

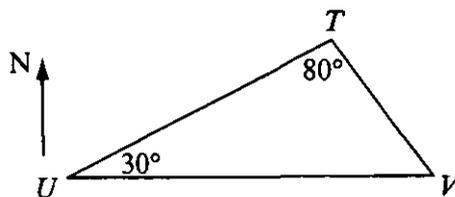| Line	a	b	c	d	e	f	g	h
Gradient	-3	$\dfrac{-5}{2}$	$\dfrac{1}{3}$	0.5	$\dfrac{3}{6}$	$\dfrac{-2}{5}$	$\dfrac{5}{-2}$	0.4

(a) Find two pairs of lines that are parallel to each other.

(b) Find any two pairs of lines that are at right angles to each other.

Working:

Answers:

(a) _____

(b) _____

7. This diagram shows three airports, U, T, and V. V is due East of U.

(a) What is the bearing of T from U?
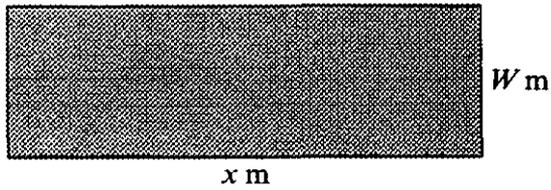
(b) Calculate the bearing of T from V.

Working:

Answers:

(a) _____

(b) _____

Turn over

8. The perimeter of this rectangular field is 220 m . One side is x m as shown.

W m

x m

(a) Express the width (W) in terms of x .

(b) Write an expression, in terms of x only, for the area of the field.

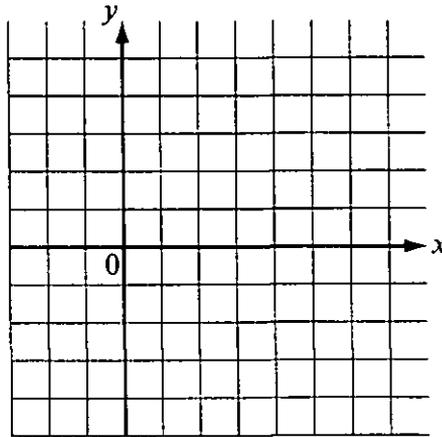(c) If the length (x) is 70 m , find the area.

Working:

Answers:

(a) _____

(b) _____

(c) _____

9. A region is defined completely by these three inequalities:

$$x \geqslant 0, \qquad y \leqslant 4, \qquad \text{and} \qquad y \geqslant 2x - 4$$

On the grid, indicate this region by **shading**.

Working:

10. A bag contains 2 red, 3 yellow and 5 green sweets.

Without looking, Mary takes one sweet out of the bag and eats it. She then takes out a second sweet.

(a) If the first sweet is green, what is the probability that the second sweet is also green?

(b) If the first sweet is not red, what is the probability that the second sweet is red?

Working:
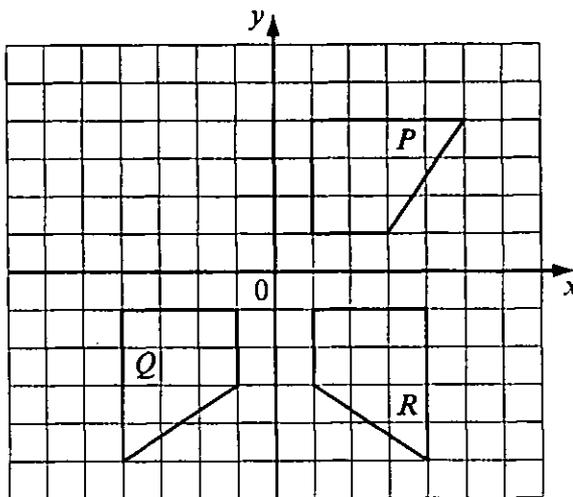
Answers:

(a) _____

(b) _____

11. Two sides of a rectangle were measured to the nearest mm , as 6.3 cm and 4.1 cm . Find

   (a)   the least possible value of the perimeter for this rectangle;

   (b)   the greatest value of the area for this rectangle, correct to two decimal places.

Working:

Answers:

(a) _____

(b) _____

12. The diagram shows 3 shapes, *P*, *Q* and *R*.

(a) The shape *P* is reflected to *Q*, as shown.

(i) On the grid, draw the line of reflection.

(ii) What is the equation of the line of reflection?

(b) What transformation maps *P* onto *R* ?

Working:

Answers:

(a) (ii) _____

(b) _____

13. To celebrate its centenary a primary school decides to hire a train for an excursion for teachers and children.

It is decided that the following conditions will apply:

    (i)   the total number of people travelling should not exceed 200

    (ii) the fare for an adult is US$ 16 and for a child US$ 10

    (iii) enough people must travel in order to cover the cost, US$ 1600 , of hiring the train.

If x represents the number of children and y the number of teachers who go on the excursion, write down **two** inequalities, other than $x > 0$ and $y > 0$, that x and y must satisfy.

Working:

Answers:

14. Tony invested CHF 500 in a bank account at a constant rate of interest. The bank calculates his balance at the end of each year, **rounded to two decimal places**, as shown in the table below.

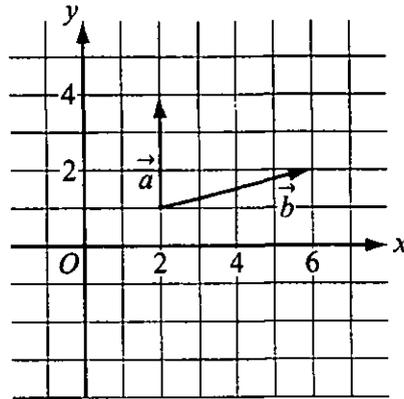| Year	Value at beginning of year	Value at end of year
1st	CHF 500	CHF 540
2nd	CHF 540	CHF 583.20
3rd	CHF 583.20	CHF 629.86
4th	CHF 629.86	CHF 680.25
5th	CHF 680.25	
6th		

(a) What is the rate and type of interest?

(b) Complete the table for the fifth and sixth year of investment.

Working:

Answer:

(a) _____

15. The diagram shows two vectors $\vec{a}$ and $\vec{b}$.

(a) Write the vectors $\vec{a}$ and $\vec{b}$ in the form $\begin{pmatrix} p \\ q \end{pmatrix}$.

(b) Find in the form $\begin{pmatrix} p \\ q \end{pmatrix}$

   (i) $\vec{OC} = \dfrac{1}{2}(\vec{a} + \vec{b})$;

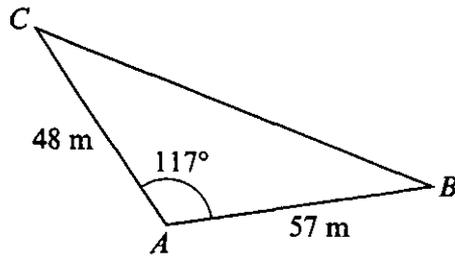   (ii) $\vec{OD} = \vec{a} - \vec{b}$.

Working:

Answers:

(a) _____

(b) (i) _____

   (ii) _____

Turn over

16. The diagram shows the plan of a playground with dimensions as shown.

Calculate

(a) the length BC ;

(b) the area of triangle ABC .

Working:

Answers:

(a) _____

(b) _____

17. Three propositions p, q and r are defined as follows:

p : the water is cold. q : the water is boiling. r : the water is warm.

(a) Write one sentence, in words, for the following logic statement:

$$(\neg\, p \wedge \neg\, q) \Rightarrow r$$

(b) Write the following sentence as a logic statement using symbols only.

"The water is cold if and only if it is neither boiling nor warm"
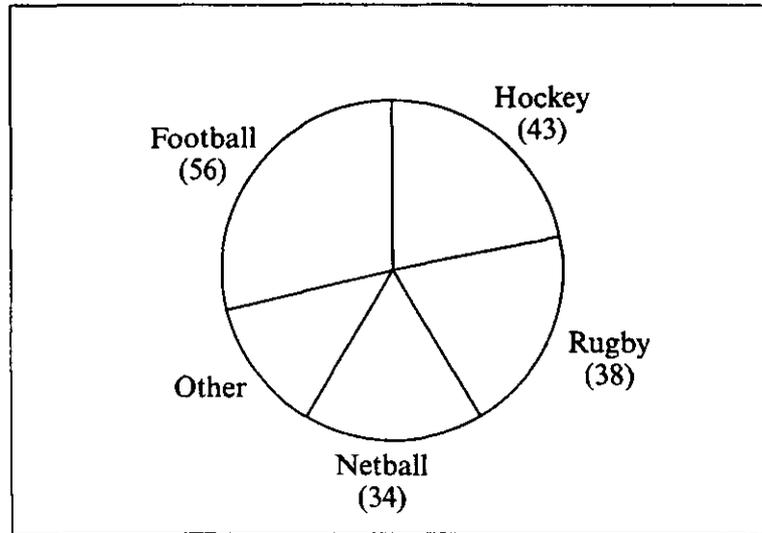
Working:

Answers:

(a) _____

(b) _____

Turn over

18. In a school, 180 pupils are asked which is their favourite outdoor sport in winter. The pie chart shows the result of the survey. The diagram is **not** accurately drawn.

Football
(56)

Hockey
(43)

Rugby
(38)

Other

Netball
(34)

(a) Calculate the angle of the sector representing rugby.

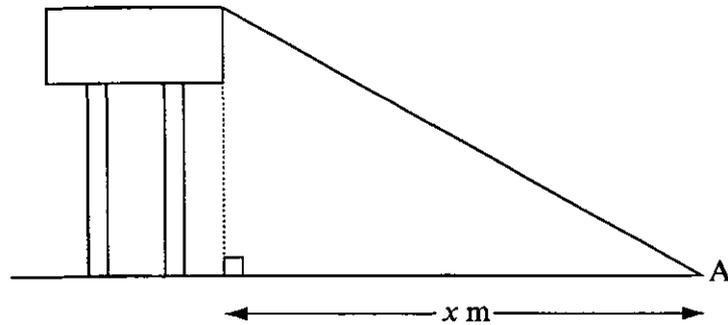(b) Estimate the probability that a pupil's favourite outdoor sport in winter will be hockey.

Working:

Answers:

(a) _____

(b) _____

19. The diagram shows a water tower standing on horizontal ground. The height of the tower is 26.5 m .

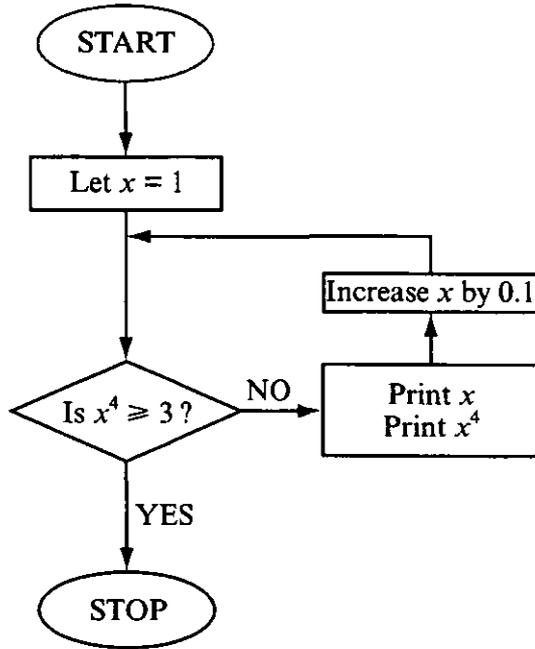From a point A on the ground the angle of elevation to the top of the tower is 28° .

(a) On the diagram, show and label the angle of elevation, 28° .

(b) Calculate, **correct to the nearest metre**, the distance *x* m .

Working:

Answer:

(b) _____

Turn over

20. This flow chart produces "the greatest number (to **one** decimal place) which is less than the fourth root of 3 ".

(a) Use the grid below to construct a table of values printed.

x					
x^4					

(This question continues on the following page)

(Question 20 continued)

(b) What is the largest value of x for which $x^4 \leqslant 3$?

Working:

Answer:

(b) _____