IBO IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

MATHEMATICAL METHODS
STANDARD LEVEL
PAPER 1

Candidate number

Tuesday 4 November 2003 (afternoon)

1 hour

INSTRUCTIONS TO CANDIDATES

- Write your candidate number in the box above.
- Do not open this examination paper until instructed to do so.
- Answer all the questions in the spaces provided.
- Unless otherwise stated in the question, all numerical answers must be given exactly or to three significant figures.
- Write the make and model of your calculator in the appropriate box on your cover sheet *e.g.* Casio *fx-9750G*, Sharp EL-9600, Texas Instruments TI-85.

Maximum marks will be given for correct answers. Where an answer is wrong, some marks may be given for correct method, provided this is shown by written working. Working may be continued below the box, if necessary. Solutions found from a graphic display calculator should be supported by suitable working e.g. if graphs are used to find a solution, you should sketch these as part of your answer.

1.   A student measured the diameters of 80 snail shells. His results are shown in the following cumulative frequency graph. The lower quartile (LQ) is 14 mm and is marked clearly on the graph.
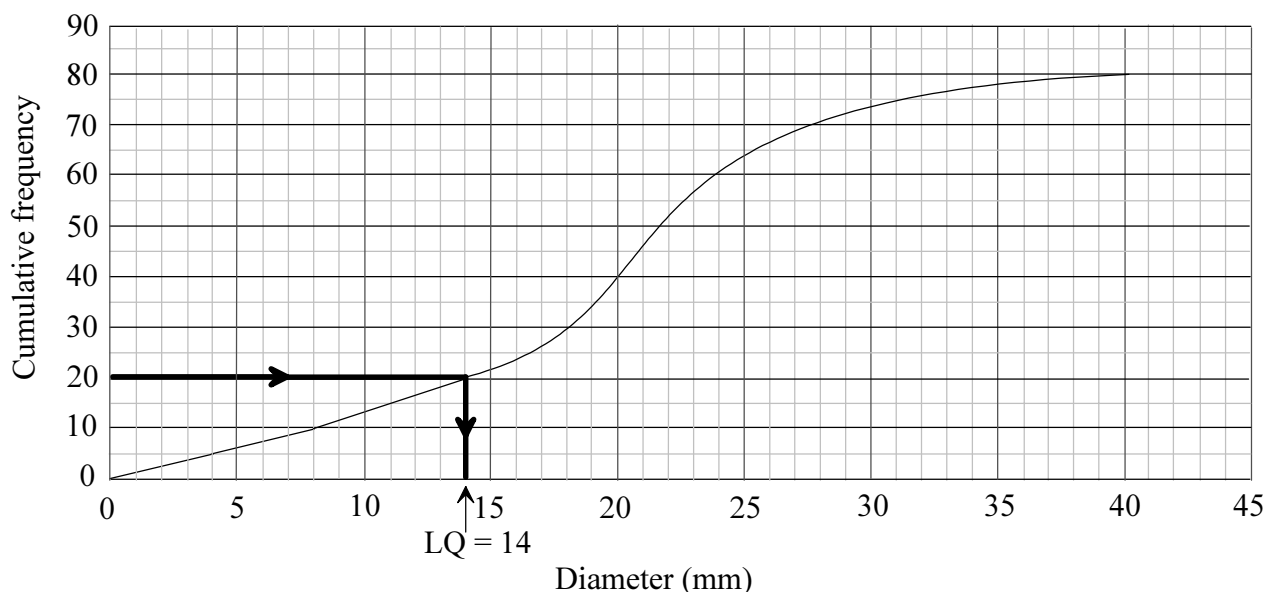
(a)   On the graph, mark clearly in the same way and write down the value of

(i)   the median;

(ii)   the upper quartile.

(b)   Write down the interquartile range.

Working:

Answer:

(b) _____

2.   The graph of the function $f(x) = 3x - 4$ intersects the *x*-axis at A and the *y*-axis at B.

(a)   Find the coordinates of

(i)   A;

(ii)   B.

(b)   Let O denote the origin. Find the area of triangle OAB.

Working:

Answers:

(a) (i) _____

(ii) _____

(b)   _____

0315

3. The equation $kx^2 + 3x + 1 = 0$ has exactly one solution. Find the value of k.

Working:

Answer:
....

4. A painter has 12 tins of paint. Seven tins are red and five tins are yellow. Two tins are chosen at random. Calculate the probability that both tins are the same colour.

Working:

Answer:
....

0415

5. Complete the following expansion.

$$(2 + ax)^4 = 16 + 32ax + ...$$

Working:

Answer:

6. Arturo goes swimming every week. He swims 200 metres in the first week. Each week he swims 30 metres more than the previous week. He continues for one year (52 weeks).

(a) How far does Arturo swim in the final week?

(b) How far does he swim altogether?

Working:

Answers:

(a) _____

(b) _____

7.   A vector equation for the line L is $r = \begin{pmatrix} 4 \\ 4 \end{pmatrix} + t \begin{pmatrix} 3 \\ 1 \end{pmatrix}$.

Which of the following are also vector equations for the same line L?

A. $r = \begin{pmatrix} 4 \\ 4 \end{pmatrix} + t \begin{pmatrix} 2 \\ 1 \end{pmatrix}$.

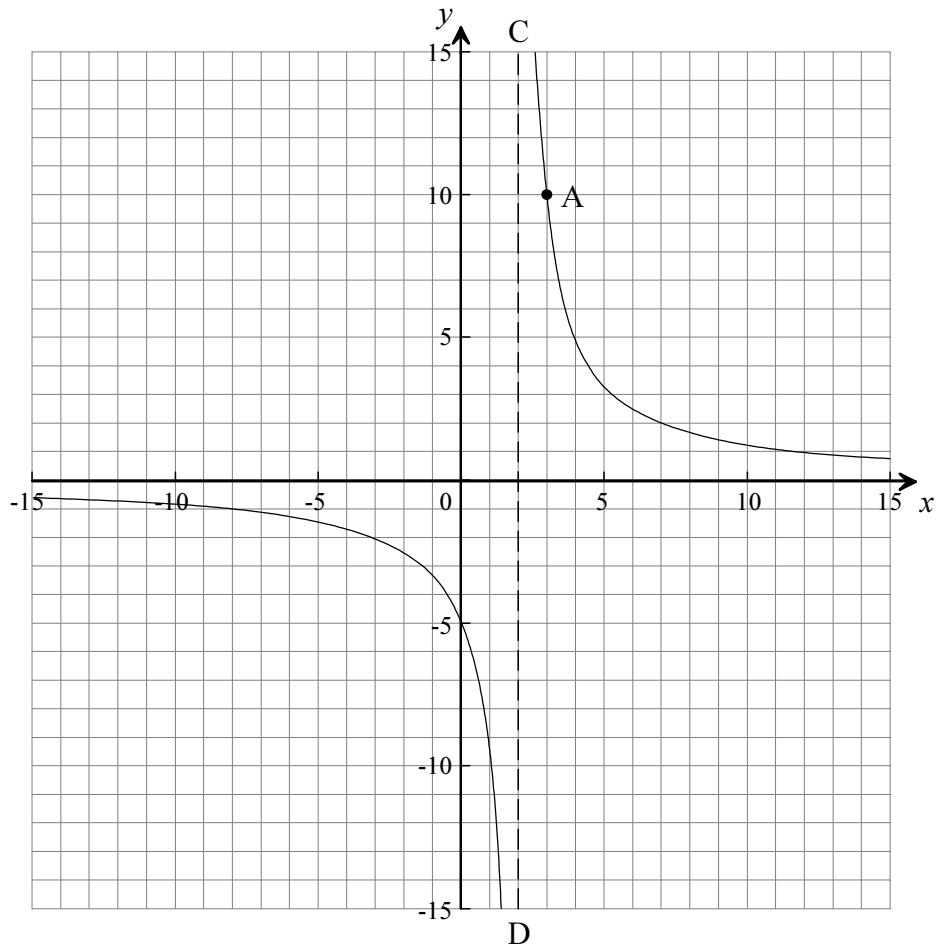B. $r = \begin{pmatrix} 4 \\ 4 \end{pmatrix} + t \begin{pmatrix} 6 \\ 2 \end{pmatrix}$.

C. $r = \begin{pmatrix} 0 \\ 1 \end{pmatrix} + t \begin{pmatrix} 1 \\ 3 \end{pmatrix}$.

D. $r = \begin{pmatrix} 7 \\ 5 \end{pmatrix} + t \begin{pmatrix} 3 \\ 1 \end{pmatrix}$.

Working:

Answers:

0715

8.   (a)   The diagram shows part of the graph of the function $f(x) = \dfrac{q}{x-p}$.   The curve passes

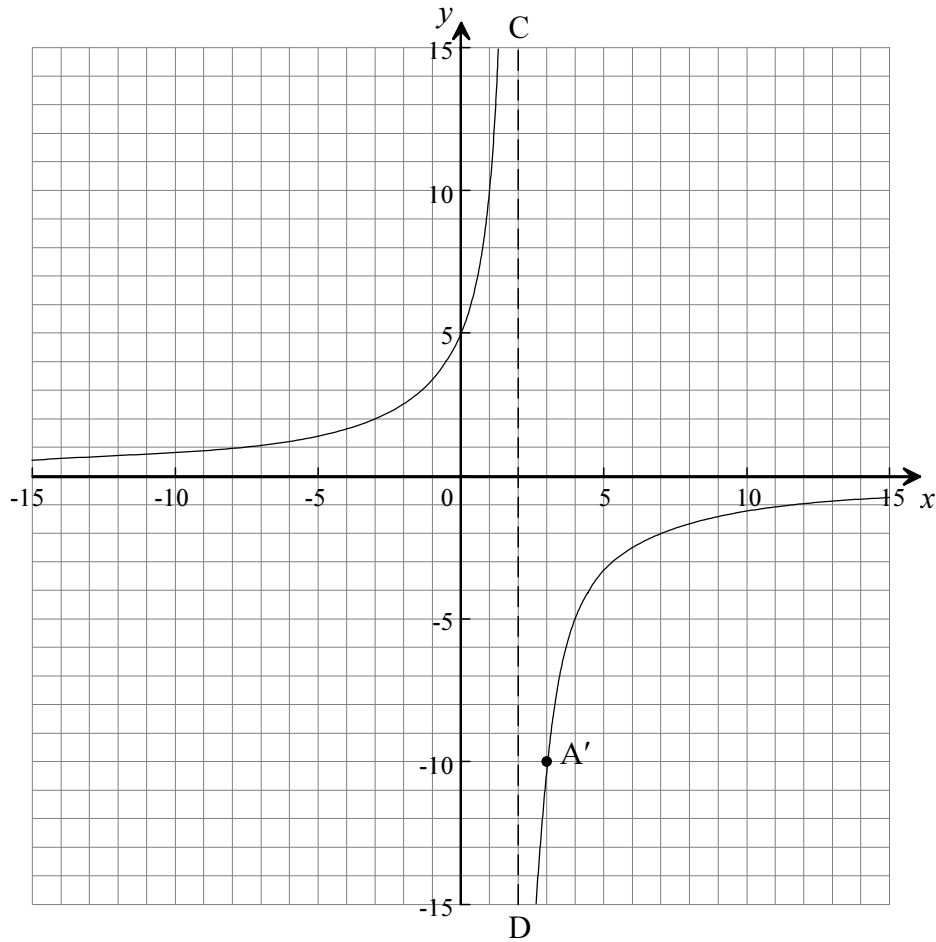through the point $A(3,10)$. The line (CD) is an asymptote.

Find the value of

   (i) p;

   (ii) q.

(This question continues on the following page)

(Question 8 continued)

(b)   The graph of $f(x)$ is transformed as shown in the following diagram. The point A is transformed to A$'\,(3, -10)$.

Give a full geometric description of the transformation.

Working:

Answers:

(a) (i) _____

(ii) _____

(b) _____

Turn over

9. (a) Find the scalar product of the vectors $\begin{pmatrix} 60 \\ 25 \end{pmatrix}$ and $\begin{pmatrix} -30 \\ 40 \end{pmatrix}$.

(b) Two markers are at the points $P(60, 25)$ and $Q(-30, 40)$. A surveyor stands at $O(0, 0)$ and looks at marker P. Find the angle she turns through to look at marker Q.

Working:

Answers:

(a) _____

(b) _____

1015

10. The mass m kg of a radio-active substance at time t hours is given by

$$m = 4e^{-0.2t}.$$

(a) Write down the initial mass.

(b) The mass is reduced to 1.5 kg. How long does this take?

Working:

Answers:

(a) _____

(b) _____

11. It is given that $\dfrac{dy}{dx} = x^3 + 2x - 1$ and that $y = 13$ when $x = 2$.

Find y in terms of x.

Working:

Answer:

_____

1115

Turn over

12. The function f is given by $f(x) = x^2 - 6x + 13$, for $x \geq 3$.

    (a)   Write $f(x)$ in the form $(x-a)^2 + b$.

    (b)   Find the inverse function f^{-1}.

    (c)   State the domain of f^{-1}.

Working:

Answers:

(a) _____

(b) _____

(c) _____

13. (a) Factorize the expression $3\sin^2 x - 11\sin x + 6$.

(b) Consider the equation $3\sin^2 x - 11\sin x + 6 = 0$.

(i) Find the two values of $\sin x$ which satisfy this equation.

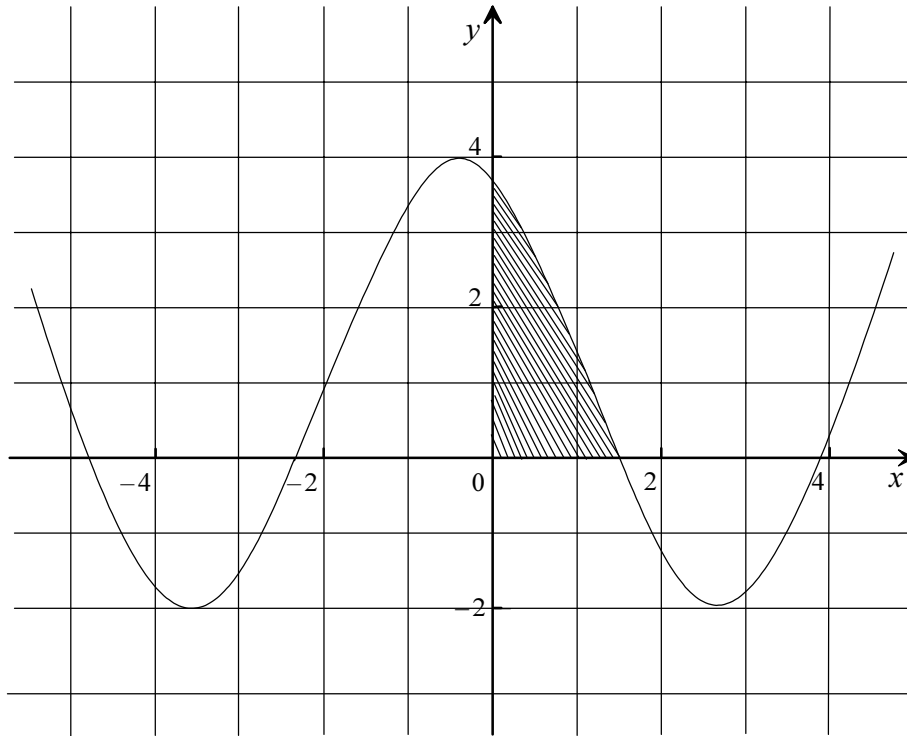(ii) Solve the equation, for $0° \leq x \leq 180°$.

Working:

Answers:

(a) _____

(b) (i) _____

(ii) _____

1315

14. (a) Find $\int\left(1+3\sin\left(x+2\right)\right)dx$.

(b) The diagram shows part of the graph of the function $f(x)=1+3\sin\left(x+2\right)$.

The area of the shaded region is given by $\int_0^a f(x)dx$.

Find the value of a.

Working:

Answers:

(a) _____

(b) _____

1415
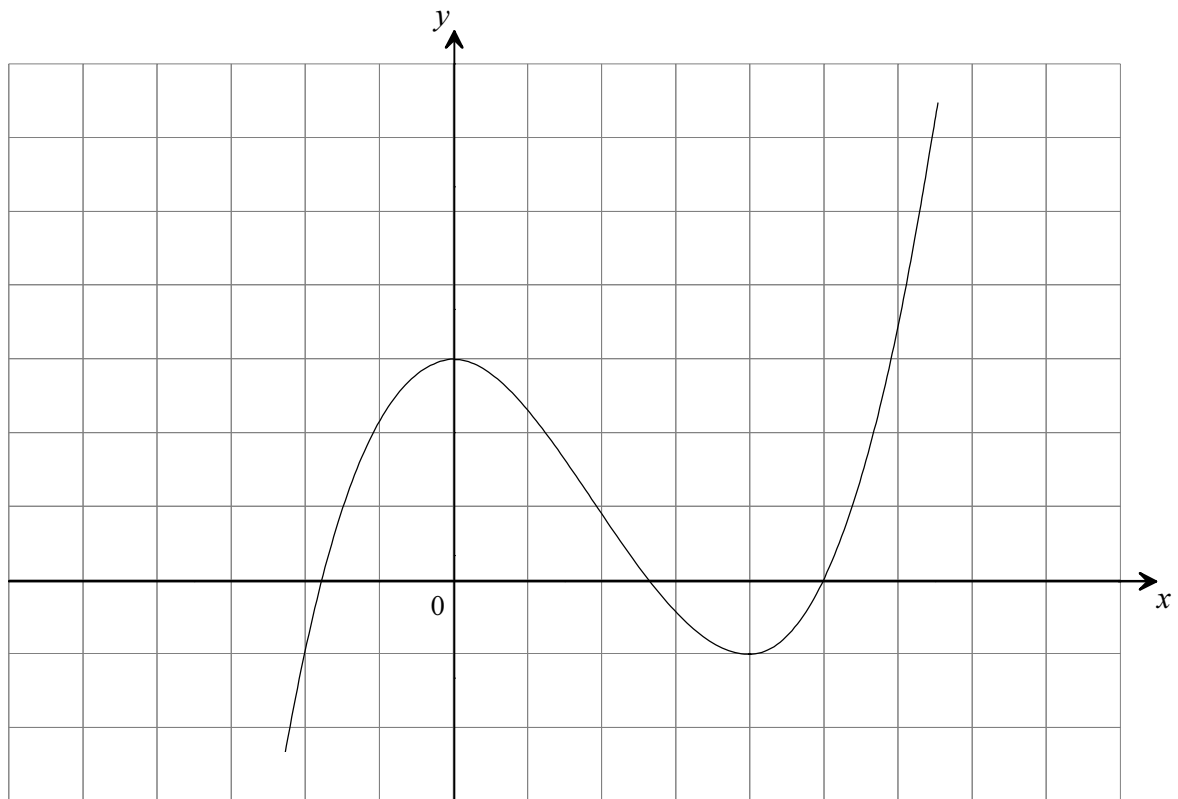
15. The diagram shows the graph of $y = f(x)$.

On the grid below sketch the graph of $y = f'(x)$.

1515