*Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. In particular, 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. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.*

SECTION A

*Answer **all** the questions in the spaces provided. Working may be continued below the lines, if necessary.*

1. *[Maximum mark: 5]*

The following diagram is a box and whisker plot for a set of data.
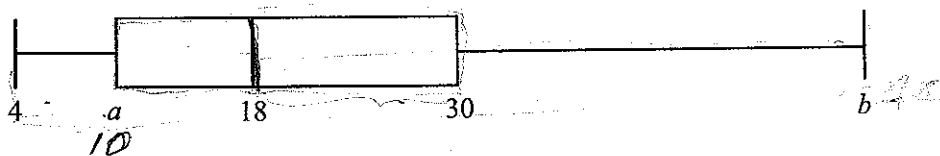
The interquartile range is 20 and the range is 40.

(a) Write down the median value.   *[1 mark]*
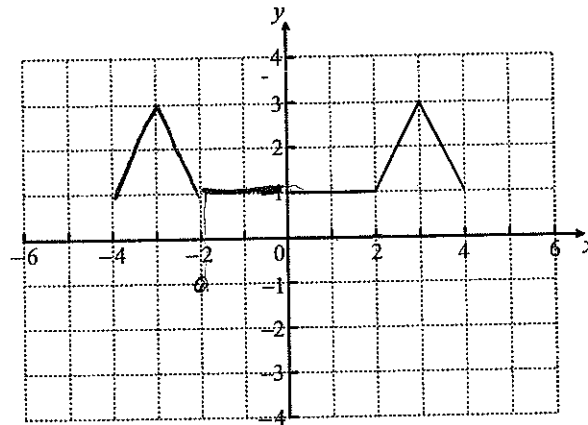
(b) Find the value of

   (i) a;

   (ii) b.   *[4 marks]*

b(i) $a = 10$
(ii) $b = 44$

0313

2.   *[Maximum mark: 6]*

Consider the graph of f shown below.

(a)   On the **same** grid sketch the graph of $y = f(-x)$.   *[2 marks]*

(This question continues on the following page)

(Question 2 continued)

The following four diagrams show **images** of f under different transformations.

Diagram A

Diagram B

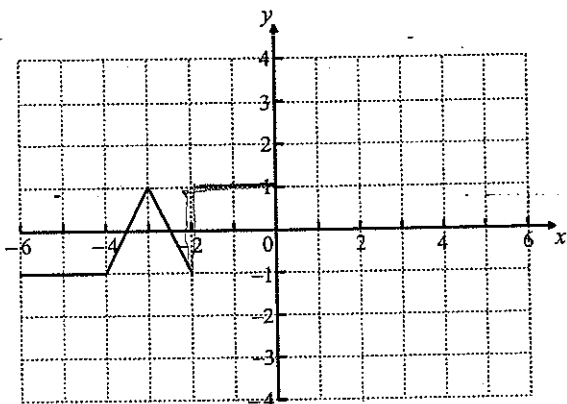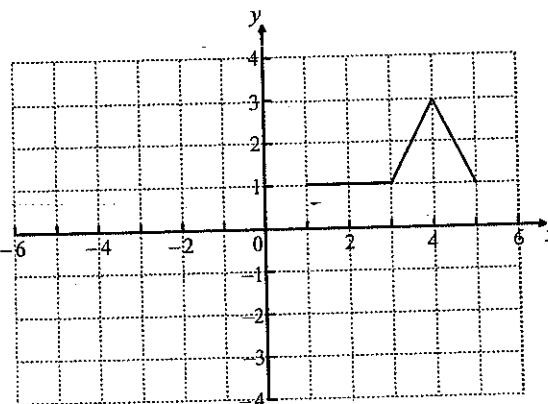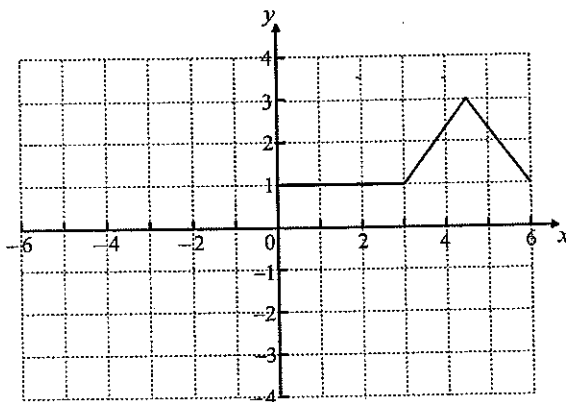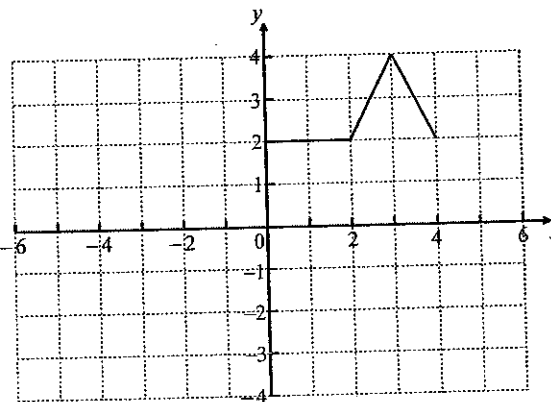Diagram C

Diagram D

(b)   Complete the following table.   [2 marks]

Description of transformation	Diagram letter
Horizontal stretch with scale factor 1.5	C
Maps f to $f(x)+1$	D

(c)   Give a full geometric description of the transformation that gives the image in Diagram A.   [2 marks]

...translation using $\begin{bmatrix} -2 \\ 2 \end{bmatrix}$ ....

....

....

....

0513

3. *[Maximum mark: 5]*

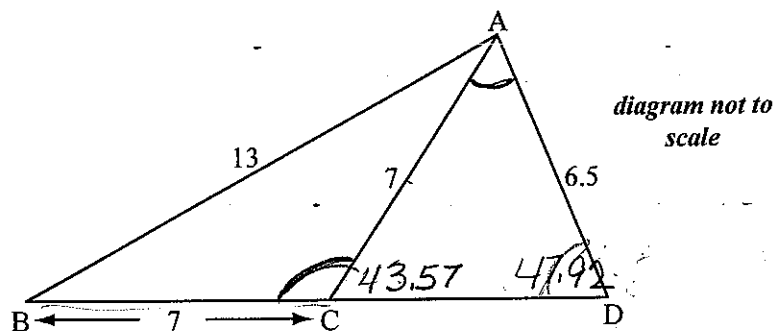Solve the equation $e^x = 4\sin x$, for $0 \le x \le 2\pi$.

$e^x = 4\sin x$ This is paper 2 so use your calculator

$x = 1.37$ or $.371$

4.   *[Maximum mark: 8]*

The diagram below shows a triangle ABD with $AB = 13$ cm and $AD = 6.5$ cm.
Let C be a point on the line BD such that $BC = AC = 7$ cm.

diagram not to scale

(a)   Find the size of angle ACB.   *[3 marks]*

(b)   Find the size of angle CAD.   *[5 marks]*

$$\cos C = \frac{c^2 - b^2 - a^2}{-2bc} \qquad \cos C = \frac{13^2 - 49 - 49}{-2 \cdot 49}$$

$$136°$$

$$\frac{\sin 43.57}{6.5} = \frac{\sin D}{7}$$

$$CAD = 4.33° \text{ or } 88.51°$$

5.   *[Maximum mark: 7]*

(a)   Expand $\sum_{r=4}^{7} 2^r$ as the sum of four terms.   *[1 mark]*

(b)   (i)   Find the value of $\sum_{r=4}^{30} 2^r$.

(ii)   Explain why $\sum_{r=4}^{\infty} 2^r$ cannot be evaluated.   *[6 marks]*

a) $2^4 + 2^5 + 2^6 + 2^7$

Geometric w/ $r = 2$

b(i) $S_n = \frac{u_1(r^n - 1)}{r - 1} = \frac{16(2^{27} - 1)}{1} =$

2147483632

(ii) = because it is continuing to get infinitely larger without bounds therefore you will never reach the u_∞ term when $r > |1|$

6. *[Maximum mark: 7]*

Consider the curve $y = \ln(3x - 1)$. Let P be the point on the curve where $x = 2$.

(a) Write down the gradient of the curve at P.   *[2 marks]*

(b) The normal to the curve at P cuts the x-axis at R. Find the coordinates of R.   *[5 marks]*

$y' = \dfrac{3}{(3x-1)}$

$f'(2) = \dfrac{3}{3(2)-1} = 3/5$

$x = 2 \quad y = \ln(5.)$

$\ln(5) = -5/3(2) + b$

$4.94 = b$

$0 = -5/3(x) + 4.94$

$-4.94 = -5/3(x)$

$2.964 = x \qquad R\ (2.96, 0)$

7. *[Maximum mark: 7]*

The quadratic equation $kx^2 + (k-3)x + 1 = 0$ has two equal real roots.

(a) Find the possible values of k.

[5 marks]

(b) **Write down** the values of k for which $x^2 + (k-3)x + k = 0$ has two equal real roots.

[2 marks]

a) $Kx^2 + (K-3)x + 1 = 0$

$a = K \quad b = K-3 \quad c = 1$

$b^2 - 2ac = 0$

$(K-3)^2 - 2(K)(1) = 0$

$K^2 - 6K + 9 - 2K = 0$

$K^2 - 8K + 9 = 0$

$(K -)(K) = 0$

$a = 1 \quad b = -8 \quad c = 9$

$\dfrac{8 \pm \sqrt{64 - 36}}{2} = \dfrac{8 \pm \sqrt{28}}{2} \quad \dfrac{8 \pm 2\sqrt{7}}{2}$

$K = 4 \pm \sqrt{7}$

b) $x^2 + (1 \pm \sqrt{7})x + 4 \pm \sqrt{7} = 0$

then graph

$\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

*Do **NOT** write on this page.*

9.   *[Maximum mark: 13]*

A van can take either Route A or Route B for a particular journey.

If Route A is taken, the journey time may be assumed to be normally distributed with mean 46 minutes and a standard deviation 10 minutes.

If Route B is taken, the journey time may be assumed to be normally distributed with mean μ minutes and standard deviation 12 minutes.

(a)   For Route A, find the probability that the journey takes **more** than 60 minutes.   *[2 marks]*

.08

(b)   For Route B, the probability that the journey takes **less** than 60 minutes is 0.85. Find the value of μ.   *[3 marks]*

– use chart to find z score then use z-score to find μ

(c)   The van sets out at 06:00 and needs to arrive before 07:00.

(i)   Which route should it take?   A

(ii)   Justify your answer.   *[3 marks]*

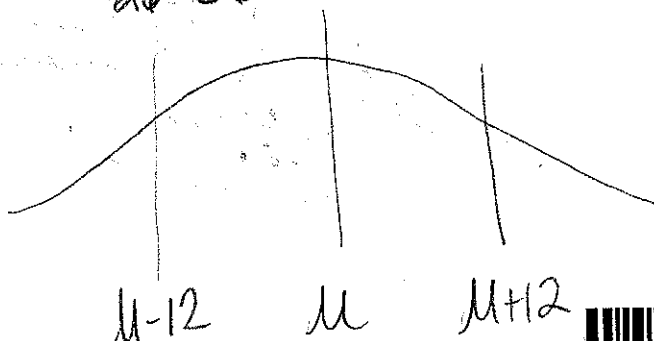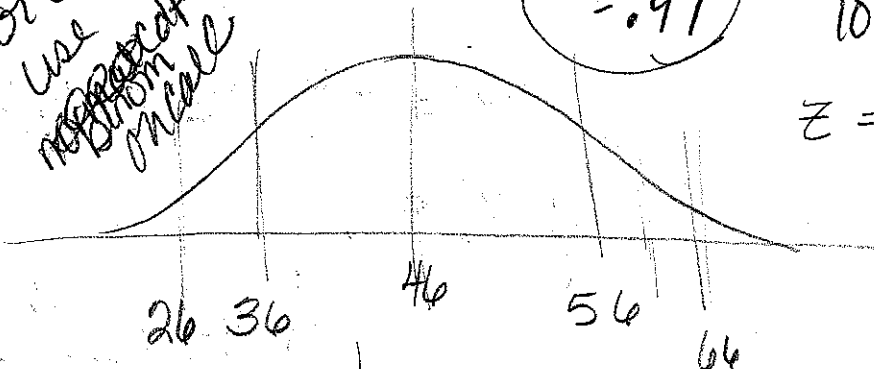P (A ≤ 60) = 92%
P (B ≤ 60) = 85% these are b and b above in a and b

(d)   On five consecutive days the van sets out at 06:00 and takes Route B. Find the probability that   *[5 marks]*

(i)   it arrives before 07:00 on all five days;

$.85^5 = .44$

(ii)   it arrives before 07:00 on at least three days.

= .97

$C_3^5 .85^3 \times .15^2 + C_4^5 .85^4 \times .15^1 +$
10 .138   .392   + .44
.85^5

$z = \frac{60-46}{10} = \frac{14}{10} = 1.4$

or could use ncdf from mean

26 36   46   56   64

μ-12 μ μ+12

Do **NOT** write on this page.

10. *[Maximum mark: 18]*

Let $f(x) = 3\sin x + 4\cos x$, for $-2\pi \le x \le 2\pi$.

(a) Sketch the graph of f. *[3 marks]*

(b) Write down

 (i) the amplitude; 5

 (ii) the period; 6

 (iii) the x-intercept that lies between $-\dfrac{\pi}{2}$ and 0. $-.927$ *[3 marks]*

(c) Hence write $f(x)$ in the form $p\sin(qx+r)$. $5\sin\left(\frac{\pi}{3}x + .927\right)$ *[3 marks]*

(d) Write down one value of x such that $f'(x) = 0$. -1.281 *[2 marks]*

(e) Write down the two values of k for which the equation $f(x) = k$ has exactly two solutions. $k = 3\sin x + 4\cos x$ $\pm 5 = 5$, *[2 marks]*

(f) Let $g(x) = \ln(x+1)$, for $0 \le x \le \pi$. There is a value of x, between 0 and 1, for which the gradient of f is equal to the gradient of g. Find this value of x. *[5 marks]*

$\dfrac{2\pi}{B} = 6$

$f'(x) = -\dfrac{5\pi}{3}\cos\left(\dfrac{\pi}{3}x + .927\right)$

$g'(x) = \dfrac{1}{x+1}$

$-\dfrac{5\pi}{3}\cos\left(\dfrac{\pi}{3}x + .927\right) = 0$

graph each & find intersection

using $x \doteq .72$

$\cos\left(\dfrac{\pi}{3}x + .927\right) = 0$

$\dfrac{\pi}{3}x + .927 = \dfrac{\pi}{2}$

$\dfrac{\pi}{3}x = \left(-.927 + \pi/2\right)3/\pi$

$+2.781 + 3/2 = +1.281$