SURNAME .... FIRST NAME .... Aʌʌ
(Block capitals, please)
JUNIOR SCHOOL .... SENIOR SCHOOL ....

ISEB

Independent Schools
Examinations Board
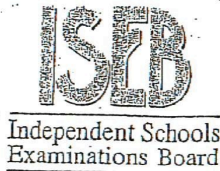
COMMON ENTRANCE EXAMINATION AT 13+

MATHEMATICS

PAPER 4

Calculator Paper

Tuesday 1 March 2005

ase read this information before the examination starts.

- This examination is 60 minutes long.

- All questions should be attempted.

- A row of dots .... denotes a space for your answer.

- Where answers are not exact they should be given to three significant figures, unless specified otherwise.

- The π button on the calculator should be used for calculations involving π.

1. (i) Writing down all the figures shown on your calculator, find the value of

$$\frac{6.34+3.91}{2.66-1.98}$$

Answer: ......15.07352941........... (2)

(ii) Write your answer to part (i) correct to 2 decimal places.

Answer: ......15.07........... (1) (A:1)

(iii) Write your answer to part (i) correct to 3 significant figures.

Answer: ......15.1........... (1) (A:1)

(iv) (a) Rewrite the calculation in part (i) with each of the numbers correct to 1 significant figure.

Answer: $\dfrac{6 + 4}{3 - 2}$ (1) (A:1)

(b) Calculate the value of your answer to part (iv)(a). $\frac{10}{1}$

Answer: ......10........... (1) (A:1)

2. (a) Hamish lives 21 miles from school and the journey by car each morning takes 28 minutes.

Calculate the average speed of the car in miles per hour.

$S = \frac{D}{T} = \frac{21}{28} \times 60$

SCHCOL

Answer: ......45........... mph (2)

(b) A train, travelling from London, averages 84 miles per hour for the first 1 hour and 20 minutes of its journey.

(i) Calculate the distance which the train travels during that time.

$D = S \times T$

$= 84 \times 1\frac{1}{3}$ or $84 \times \frac{80}{60}$

$= 112$ miles $= 112$ miles

Answer: ......112...... miles (2)

The train takes 2 hours 30 minutes for the next 256 miles.

(ii) What was the average speed of the train for the whole journey?

$A.S. = \frac{TD}{TT} = \frac{112 + 256}{1\,hour\,20mins + 2\,hours\,30mins} = \frac{368}{3\,hours\,50mins} = \frac{368}{3\frac{5}{6}} = 96$

(M:1 A:1 for 368 miles in 3h 50 min)

Answer: ....96...... mph (3) (A:1 for answer)

3.

potatoes	grapefruit	tomatoes	carrots
5 kg £2.70	45p each	£2.40 per kg	40p per kg
10 kg £4.20	3 for the price of 2		

At the greengrocers, I ask for

5 kg of potatoes   3 grapefruit   and   500 g of tomatoes.

(i) What is the total cost of these items?

Potatoes : £2·70
3 grapefruits : £0·90
500g Tomatoes : £1·20 (2·40÷2).
£4·80

Answer: £ ......4·80...... (2)

I then decide to buy some carrots.

I pay for everything with a £10 note and receive £4.72 change.

(ii) How many kilograms of carrots do I buy?

£10 - £4·72 = £5·28 spent in total.

£5·28 - £4·80 = 48p spent on carrots

∴ 48p ÷ 40 = 1·2kg

Answer: ......1·2...... kg (2)

4. At noon on 1 January the recorded temperature in five capital cities was:

Moscow	−21.5 °C
London	−5.5 °C
New York	−19.4 °C
Cape Town	+27.6 °C
Rio de Janeiro	+33.8 °C

(i) What was the difference in temperature between London and

(a) New York

$-5.5°c$ to $-19.4°c$

Answer: .....13·9... degrees (1)

(b) Cape Town?

$-5.5°c$ to $+27.6°c$

Answer: ......33·1... degrees (1)

(ii) Calculate the range of temperature for the data.

Moscow   to   Rio de Janeiro
$-21.5°c$ $+33.8°c$

Answer: ......55·3... degrees (2)

(iii) After a rise of 3.5 degrees in Moscow and a fall of 5.5 degrees in Cape Town, what was the difference between the temperatures in these two cities?

Moscow: $-21.5°c + 3.5°c = -18$
Cape Town : $+27.6°c - 5.5°c = 22.1$

-18 to 22.1

Answer: ...40·1... degrees (2)

The mean temperature in Cape Town for the first five days of January was 32.6 °C.

(iv) What was the temperature on 6 January if the mean for the first six days was 31.4 °C?

First five days : $32.6 \times 5 = 163$
First six days : $31.4 \times 6 = 188.4$

∴ $188.4 - 163 = 25.4°c$

Answer: ......25·4...... °C (2)

5. (a) A sequence of numbers follows the rule:

  double then add one

The first term of the sequence is 5

(i) Find the next three terms of the sequence.

$$5 \times 2 = 10 + 1 = \underline{11}$$
$$11 \times 2 = 22 + 1 = \underline{23}$$
$$23 \times 2 = 46 + 1 = \underline{47}$$

Answer: ....11..., ...23..., ..47.... (2)

(ii) What is the first term of the sequence which is not a prime number?

$$5, 11, 23, 47$$
$$\therefore 47 \times 2 = 94 + 1 = 95$$

Answer: .....95 - the 5th term.. (1)

(b) (i) Describe the rule for the sequence:

  1, 2, 5, 14, 41, ...

Answer: ...multiply by 3 and subtract 1............ $(\times 3 - 1)$ $\begin{pmatrix} A:1 \text{ for } \times 3 \\ A:1 \text{ for } -1 \end{pmatrix}$ (2)

(ii) What is the value of the 7th term of the sequence?

6th term $41 \times 3 = 123 - 1 = 122$
7th term $122 \times 3 = 366 - 1 = 365$

Answer: ....365............ (1) $\begin{pmatrix} A:1 \end{pmatrix}$

(c) In another sequence the terms are:

  $x, \ 2x - 1, \ 4x - 3, \ 8x - 7, \ ....$

Write down the 6th term of this sequence.

$$x_1, \ 2x - 1, \ 4x - 3, \ 8x - 7, \ 16x - 15, \ 32x - 31$$

Answer: ......$32x - 31$......... (2) $\begin{pmatrix} A:1 \text{ for } 32x \\ A:1 \text{ for } -31 \end{pmatrix}$

Total page (8)

6. The line $3y = 2x - 6$ crosses the x axis at point A and the y axis at point B.

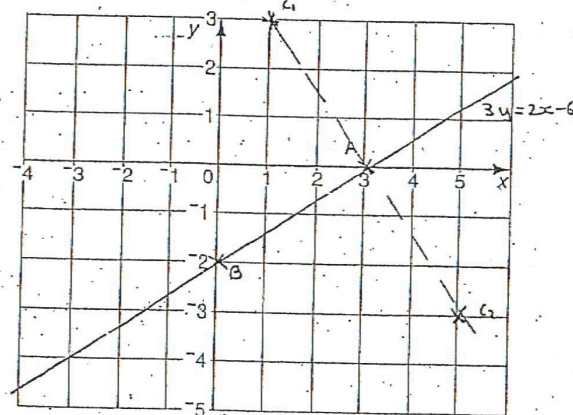(i) Fill in the table below for the line $3y = 2x - 6$

x	0	3
y	-2	0

(1) $\begin{pmatrix} A:1 \end{pmatrix}$

(ii) On the 1 centimetre square grid below,

(a) plot and label points A and B (1) $\begin{pmatrix} A:1 \end{pmatrix}$

(b) draw the line $3y = 2x - 6$ (1) $\begin{pmatrix} A:1 \end{pmatrix}$

(iii) Calculate the distance from A to B.
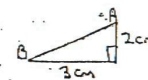
Pythagoras.

$$AB^2 = 3^2 + 2^2$$
$$AB^2 = 9 + 4$$
$$AB^2 = 13$$
$$AB = \sqrt{13}$$
$$AB = 3.61$$

$\begin{pmatrix} M:1 \text{ for Pythagoras} \\ A:1 \text{ for } 3^2 + 2^2 \\ A:1 \text{ for answer} \end{pmatrix}$
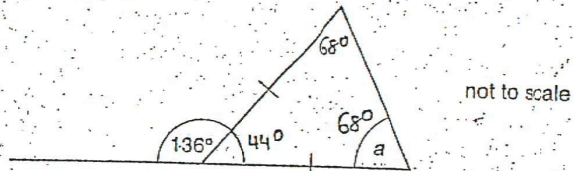
Answer: ....3.61......... cm. (3)

(iv) AC is perpendicular to AB and of equal length.
Write down the co-ordinates of a possible position of point C.

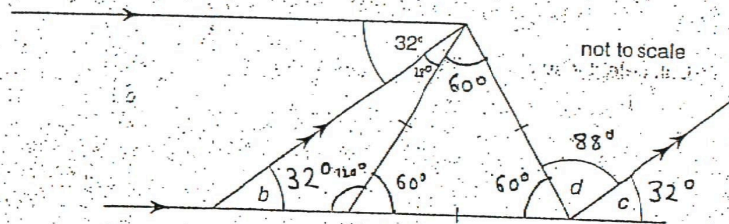Answer: (....1...., ...3....) (2)
or
$(5 \ , -3)$ Total page

7. Calculate the size of each of the angles marked *a, b, c* and *d.*

not to scale

68°
68°
136° 44° *a*

$180 - 44 = 136$

∴ $136 \div 2 = 68°$

Answer: *a* = _____68_____ (2)

32°
12° 60°
not to scale
88°
b 32° 120° 60° 60° *d* *c* 32°

(Alternate)

Answer: *b* = _____32_____ ° (1) (A¹¹)

(Corresponding) or (angles
c = _____32_____ ° (1)(A¹¹) su)

(Angs on a straight Line)

d = _____88_____ (2) (alt to 88°)
cot 22

8. *ABCDE* is part of a <u>regular</u> polygon with rotational symmetry of order 15

A ─────────────── E
36°   36° *y*
156°   156° 24
156°   156°   *x*
B   D
C   not to scale
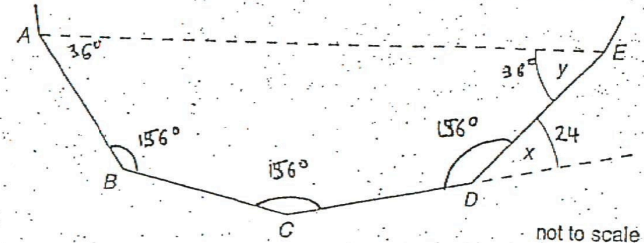
(i) How many lines of symmetry has the regular polygon?

Answer: _____15_____ (1)

(ii) Calculate the size of the exterior angle *x.*

$$\frac{360}{15} = 24$$

Answer: *x* = _____24_____ (2)

(iii) Calculate the sum of the interior angles of this regular polygon.

Ext angle = 24°
∴ Int angle = 180 − 24 = 156°   or $180(n-2)$
Sum of Int angles = 156 × 15 = 2340° $180(15-2)$
                                                                   180 × 13
                                                                   = 2340°.

Answer: _____2340_____ ° (2)

(iv) Calculate the size of the angle *y.*

5 sided shape ∴ $180(n-2) = 180(5-2)$
                                        $= 180 × 3 = 540°$

3 interior angles : 156 × 3 = 468°

∴ 540 − 468 = 72°

72 ÷ 2 = 36

Answer: *y* = _____36_____ (3)

9. For two temperature scales, Celsius and Fahrenheit,

   0° Celsius = 32° Fahrenheit
   and 100° Celsius = 212° Fahrenheit .

Fahrenheit
(°F)

Celsius (°C)

(A:1 for scales
A:1 for plot
A:1 for line)
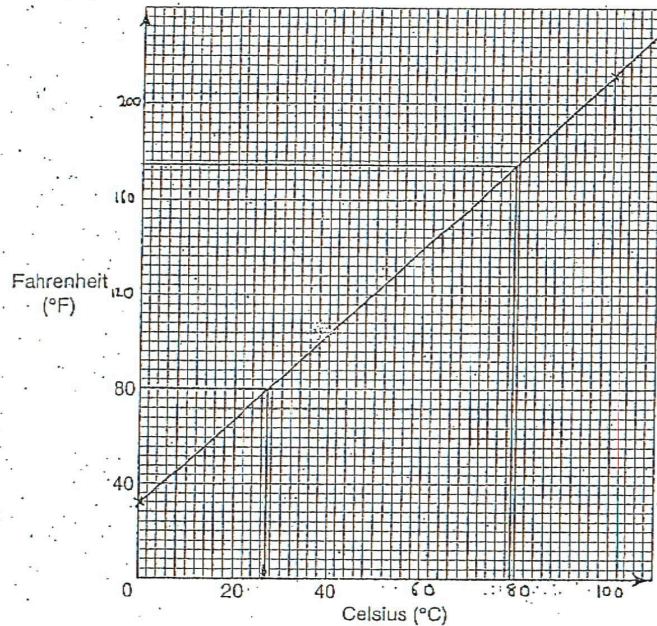
(i) Complete the scales on the axes above and draw the conversion graph to convert degrees Celsius to degrees Fahrenheit.   (3)

(ii) Use your graph to answer the following questions, showing clearly where you take your readings.

(a) The temperature on my garden thermometer reads 80° Fahrenheit.
   What is the temperature in degrees Celsius?

   Answer: ....26·7.......... °C   (2)

   (Allow 26 - 28)

(b) The boiling point of alcohol is 78.4° Celsius.
   What is the temperature in degrees Fahrenheit?
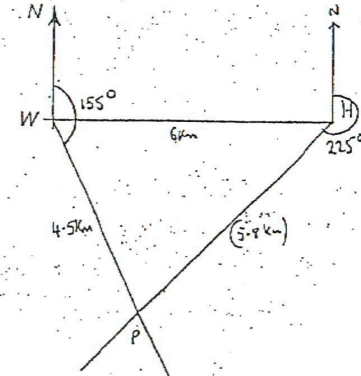
   Answer: ....173.......... °F   (2)

   (Allow 170 to 176)

   Total
   page

10. Westbury (W) is 6 kilometres due west of Hometon (H).

(i) Using a scale of 1 cm : 1 km, plot the position of H.   (2)
   (A:1 for 6cm
   CA:1 for 90°)

Pitburn (P) is on a bearing of 155° from Westbury and 225° from Hometon.   (A:1 for 155°
CA:1 for 225°)

(ii) Plot the position of Pitburn on your diagram.   (2)

(iii) From your diagram, find the distance from Westbury to Pitburn.   (A:1)

   Answer: ....4·5km.......... km   (1)
   (Accept sensible answer)

(iv) What is the bearing of Hometon from Pitburn?   (A:1)

   Answer: ....045.......... °   (1)
   (Accept sensible answer
   Accept 45°)

Paula runs from Westbury to Hometon to Pitburn and back to Westbury.

(v) If she runs at 15 km/h, how long does she take?
   Give your answer in hours and minutes, correct to the nearest minute.

   Distance = 6 + 5·8 + 4·5 = 16·3 km

   $T = \dfrac{D}{S} = \dfrac{16·3}{15} = 1·086$ hours   (x60 = 65mins)
   = 1 hr 5mns

   (A:1 for 16·3km)
   (CA:1 for 1·086h)
   (A:1 for answer)
   ACCEPT SENSIBLE
   ANSWER

   Answer: ....1.......... h ....5.......... min   (3)
   (Give marks if used correct
   measurements from an
   incorrectly drawn diagram). Total Page
   (9)

$c + 2c = 3c$

11. On Rankin Byre's farm there were c cows and twice as many sheep. He also had p pigs on the farm.

The total number of cows, sheep and pigs on the farm was 76

(i) Form an equation to show this information.

Answer: ....$3c + p = 76$........ (2)

$2c - c = c$

$p + p = 2p$

On market day, Rankin sells half his sheep and buys p more pigs.
The total number of cows, sheep and pigs has now increased by 4

$c \qquad c \qquad 2p$

(ii) Form another equation to show this information.

Answer: ....$2c + 2p = 80$........ (2)

(iii) Solve the equations simultaneously to find the number of cows which Rankin has on his farm.

$3c + p = 76 \ (\times 2) \qquad 6c + 2p = 152$
$2c + 2p = 80 \qquad$ subt $\ 2c + 2p = 80$
$\qquad\qquad\qquad (\div 4) \ \dfrac{4c = 72}{c = 18}$

$\left(\begin{array}{l}\text{M:1 A:1 for}\\\text{Sorting equation}\\\text{A:1 for answer}\end{array}\right)$
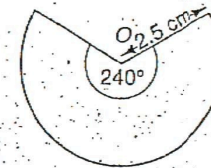
Answer: $c =$ ....18........ (3)

(iv) How many pigs in total does Rankin have after going to market?

$2c + 2p = 80$
$(2 \times 18) + 2p = 80$ $\qquad \therefore P$ pigs on farm $= 22$.
$\underset{(-36)}{36 + 2p = 80}$ $\qquad$ He buys P more $\therefore +22$
$\qquad 2p = 44 \qquad\qquad 22 + 22 = 44$
$\qquad p = 22$

$(A:1)$

Answer: ....44........ (1)

Total
Page
(8)

12. The diagram shows a sector of a circle of angle 240°.

The sector has a radius of 2.5 centimetres; O is its centre.

O 2.5 cm

240°

not to scale

$\dfrac{240}{360} = \dfrac{2}{3}$

(i) Calculate the area of the sector.

$Area = \dfrac{2}{3} \times \pi r^2 = \dfrac{2 \times \pi \times 2.5^2}{3} = 13.1$

Answer: ....13.1........ cm² (2)

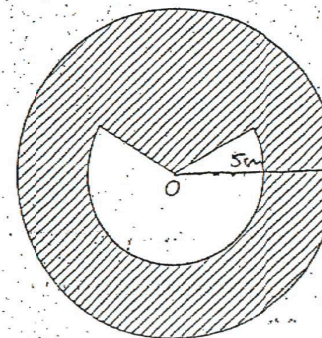(ii) Calculate the perimeter of the sector.

$(C = 2\pi r) \qquad C = \dfrac{2}{3} \times 2\pi r = \dfrac{2 \times 2 \times \pi \times 2.5}{3} = 10.5$

$Perimeter = 10.5 + 2.5 + 2.5 = 15.5$

Answer: ....15.5........ cm (2)

The sector is cut out of a circle with centre O.
The radius of the circle is twice the radius of the sector.

O

$5cm$

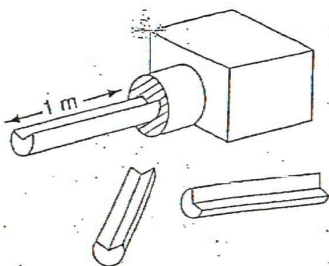not to scale

(iii) Calculate the area of the shaded section.

Area of circle $= \pi r^2$
$= \pi \times 5 \times 5$
$= 78.5 \, cm^2$

$\therefore$ Area of Shaded Section $=$ Area of Circle $-$ Area of sector
$= 78.5 - 13.1$
$= 65.4$

(M:1 for 78?)
(A:1 for 78?)
(A:1 for answer)

Answer: .... 65.4 .... cm² (3)

The sector in part (i) is used to make plastic mouldings.

If 1 metre of moulding is produced every 15 seconds,

(iv) find the volume of plastic moulding produced in 1 minute, correct to the nearest 10 cm³.

1 minute $= 60$ seconds

$\therefore$ 60 seconds $\div$ 15 $= 4$ metre produced every minute.
(400cm)

Vol $=$ Area of front face $\times$ length   or $\begin{pmatrix} 13.1 \times 100 \times 4 \\ = 5240 \end{pmatrix}$
$= 13.1 \times 400$
$= 5240$

$\begin{pmatrix} M:1 \\ A:1 \end{pmatrix}$
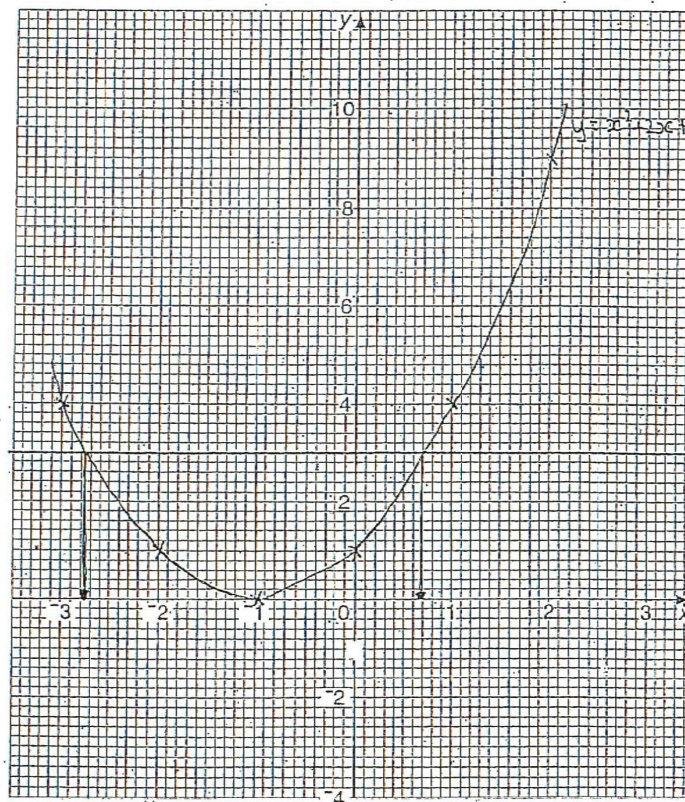
Answer: .... 5240 .... cm³ (2)

Total page
(5)

13. (i) By substituting values for x into the equation $y = x^2 + 2x + 1$, complete the table of values for y.

x	-3	-2	-1	0	1	2
y	4	1	0	1	4	9

9-6+1 4-4+1 1-2+1 0+0+1 1+2+1 4+4+1

$\begin{pmatrix} \frac{1}{2} \text{ off for} \\ \text{each error} \\ \text{rounded} \\ \text{down} \\ (3) \end{pmatrix}$

(ii) On the graph paper below, draw the graph of $y = x^2 + 2x + 1$ (2)

$\begin{pmatrix} A:1 \text{ for plot,} \\ CA:1 \text{ for} \\ \text{accuracy} \\ \text{of curve} \end{pmatrix}$

$y = 3$

Total
Page
(5)

(iii) Draw and label the line $y = 3$ (A:1)

(iv) Write down the co-ordinates of the points of intersection of the two graphs.

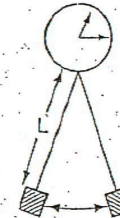Answer: (0.73 , 3), (-2.73 , 3) (2)

(A:1 for each x value.
Allow $x \pm 0.1$)

14. When I set the pendulum in my grandfather clock to a one-second swing, I use the formula

$$T = 2\pi\sqrt{\frac{L}{981}}$$

where T is the time in seconds and L is the length in centimetres.

I wish to find L when $T = 1$

Complete the table of values by using a method of trial and improvement and give your answer for L to the nearest centimetre.

Target 1

L (cm)	$\dfrac{L}{981}$	$\sqrt{\dfrac{L}{981}}$	$T = 2\pi\sqrt{\dfrac{L}{981}}$ (sec)	
50	0.051	0.226	1.42	
40	0.0408	0.202	1.27	
30	0.0306	0.175	1.10	
28	0.0285	0.169	1.06	(A:1 M:1)
26	0.0265	0.163	1.02	
25	0.0255	0.1596	1.003	
24	0.0245	0.156	0.982	(Too Small)
24.5	0.02497	0.1580	0.993	(Too Small) (A:1)

(Too Small)

Answer: $L =$ 25 cm (4)

(A:1)

(Total marks: 100)

Total Pce (3)