Mark Scheme with Examiners’ Report
IGCSE Mathematics Papers 3H & 4H (4400)

June 2005
Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel International centres receive the support they need to help them deliver their education and training programmes to learners.

For further information please call our International Customer Services Unit:

Tel  +44 (0) 190 884 7750
Fax  +44 (0) 207 190 5700

www.edexcel-international.org

June 2005
Order Code: UG017215
All the material in this publication is copyright
© Edexcel Limited 2005
<table>
<thead>
<tr>
<th>Q</th>
<th>Working</th>
<th>Answer</th>
<th>Mark</th>
<th>Notes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\frac{5.8}{3.12}$</td>
<td>$1.8589\ldots$</td>
<td>M1</td>
<td>For first 5 figures</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>$10x + 15 = 30$ or $2x + 3 = 6$</td>
<td>$1\frac{1}{2}$</td>
<td>M1</td>
<td>For isolating $x$ term in $ax + b = c$</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>$10x = 30 - 15$ or $2x = 6 - 3$</td>
<td></td>
<td>M1</td>
<td>For $1\frac{1}{2}$ oe inc $\frac{3}{2}$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$\frac{15}{18} - 8$</td>
<td>$\frac{7}{18}$</td>
<td>M1</td>
<td>For clear attempt to express with common denominator - at least one correct cao</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>correct enlargement</td>
<td></td>
<td>B3</td>
<td>B2: for translation of correct shape or 2 vertices correct B1: for one side correct length or for enlargement scale factor 2, centre (2,1)</td>
<td>3</td>
</tr>
</tbody>
</table>
5. (a) $0.45 + 0.12$
   \[0.57\]
   2 M1 For $0.45 + 0.12$ or $1 - (0.45 + 0.12)$ or $1 - 0.45 - 0.12$ or $0.43$
   A1 For $0.57$ oe as final answer
   (b) $250 \times 0.12$ or $250 \times 0.1$
   \[30\]
   2 M1 For $250 \times 0.12$ or $250 \times 0.1$
   A1 cao
   Total 4 marks

6. (a) $3(3p + 5)$
   1 B1 cao
   (b) $q(q - 4)$
   1 B1 cao
   (c) $(x + 2)(x - 5)$
   2 B2 (B1 for one correct factor or signs reversed)
   Total 4 marks

7. (a) \[\left(\frac{9 + 5}{2}\right) \times 6\]
   \[42\]
   2 M1
   A1 cao
   (b) "42" $\times 15$
   \[630\]
   2 M1 ft from (a)
   A1
   Total 4 marks
8. (a) \[ \frac{15}{100} \times 240 = 36 \]
\[ 240 - "36" \]
\[ \text{eg} \]
\[ M1 \] 3
\[ \text{Or M2 for } \frac{100 - 15}{100} \times 240 \]
\[ 3 \text{ B1} \]
\[ M1 \]
\[ \text{dep on first M1} \]
\[ A1 \]
\[ \text{cao} \]
\[ 204 \]

(b) \[ \frac{663}{0.85} \]
\[ 780 \]
\[ 3 \]
\[ M1 \]
\[ \text{For } \frac{663}{0.85} \text{ or } \frac{663}{1 - 0.15} \]
\[ 3 \]
\[ A1 \]
\[ \text{cao} \]

Total 6 marks

9. (a) \[ 2x < 8 \]
\[ x < 4 \]
\[ 2 \]
\[ M1 \]
\[ \text{For } x < 4 \text{ as final answer} \]
\[ 2 \]
\[ A1 \]
\[ \text{(B1 for two correct and none wrong} \]
\[ \text{or three correct and one wrong) } \]

Total 4 marks

10. (a) \[ 15 \times 8 + 25 \times 38 + 35 \times 28 + 45 \]
\[ x \times 4 + 55 \times 2 \]
\[ = 120 + 950 + 980 + 180 + 110 \]
\[ = 2340 \]
\[ 2340 \div 80 \]
\[ 29.25 \]
\[ 4 \]
\[ M1 \]
\[ \text{For products m x f where m is} \]
\[ \text{consistent inc end points} \]
\[ M1 \]
\[ \text{(dep) for use of midpoints (15,25...} \]
\[ \text{or 15.5,25.5,...)} \]
\[ M1 \]
\[ \text{(dep on 1st M1) for adding and } \times 80 \]
\[ \text{Accept 29, 29.2, 29.3 if first two M1s} \]
\[ A1 \]
\[ \text{scored (if 15.5,25.5... used,} \]
\[ \text{mean } = \frac{2380}{80} = 29.75) \]

Total 4 marks
(b) 8, 46, 74, 78, 80 1 B1 cao

(c) Points correct Curve or line segments 2 B1 B1 ±½ sq ft from sensible table ft from points if 4 or 5 points correct or if points are plotted consistently within each interval at the correct heights

(d) use of 40 (or 40.5) on graph or 40th (or 40.5th) stated 2 M1 A1 For use of 40 (or 40.5) on graph or 40th (or 40.5th) stated If M1 scored, ft from cumulative frequency graph If no working, follow through only from correct curve

Total 9 marks

11. \[ h^2 = \frac{W}{I} \]

\[ lh^2 \]

2 M1

A1

Total 2 marks

12. (a) 30 : 1200 or 1200 : 30 oе

3 M2 For 30 : 1200 or 1200 : 30 oе [M1 for 12(00...) : 30(00...) or 30(00...) : 12(00...) oе]

Accept 1 : 0.025, 1 : \(\frac{1}{40}\) oе, \(n = 40\) ft if M1 scored

SC B2 for 1 : 2.5, 1 : 4, 1 : 0.4,

1 : 400, 1 : 25, 1 : 250
13. (a) \[ \frac{360}{18} \]

(b) “20” \( \times (180 - 18) \) or (“20” \( \times (180 - 2) \) \( \times 180 \)

38

(b) \[ 95 \times \text{“40” or 3800} \]

“3800” + 100

OR \[ \frac{95}{30} \times 12 \]

38

3 M1

M1

A1 ft from their n

3 M1 (dep)

M1

A1

Total 6 marks

2 M1

A1 cao

2 M1

A1 ft from (a)

Total 4 marks
14. \[2 \times (x - 1) + 2x + 3 = 4\]

or \[2(x - 1) + 2x + 3 = 1\]

or \[\frac{2(x - 1)}{4} + \frac{2x + 3}{4} = 1\]

or \[\frac{2x - 2 + 2x + 3}{4} = 1\]

or \[\frac{2x - 2 + 2x + 3}{4} = 1\]

or \[4x = 3\]

4 \[\text{M1} \quad \text{Clear attempt to multiply both sides by 4 (or multiple) or expressing LHS with a denominator of 4 or a multiple of 4}\]

or \[\text{M2 for } \frac{x - \frac{1}{2} + \frac{2x + 3}{4}}{1} = 1\]

\(\text{(M1 if one error)}\)

or \[\frac{2x}{4} = 1 + \frac{1}{2} - \frac{3}{4}\]

\[\text{A1 oe}\]

Total 4 marks

15. (a) \[\frac{10 \sqrt{5}}{\sqrt{5} \times \sqrt{5}}\]

\[2 \sqrt{5}\]

\[\text{M1 Accept } 10 = k5 \text{ or } \sqrt{20}\]

(b) \[25 + (5 \sqrt{3}) + (5 \sqrt{3}) + (\sqrt{3})^2\]

\[28 + 10 \sqrt{3}\]

\[\text{A1 Accept } a = 28, b = 10\]

Total 4 marks
16. (a) Angle of elevation identified
50 tan 19°                  
17.2                          
(b) \[50^2 + 27^2\] or 56.8(2...)  
or \[50^2 + "17.2"^2\] or value  
rounding to 52.88...           
\[\sqrt{56.8^2 + "17.2"^2}\]  
or \[\sqrt{52.9^2 + 27^2}\]     
59.3 - 59.4                   
3 B1 M1 A1
On diagram or implied by working
17.2 or better (17.2163...)

17. (a) \[(x + 4)(x + 1) - 15 = 35\]  
\[x^2 + 5x + 4 - 15 = 35\]          
\[x^2 + 5x - 11 = 35\]            
3 M1
For \((x + 4)(x + 1) - 15 = 35\)  
or \((x + 1)(x + 4) = 50\)          
B1
For \(x^2 + 5x + 4\) or \(x^2 + x + 4x + 4\)  
A1
For \(x^2 + 5x + 4 - 15 = 35\)  
or \(x^2 + 5x + 4 = 50\) or simpler  
OR \[(x + 1)(x - 1) + 5(x - 2) = 35\]  
\[x^2 + x - x - 1 + 5x - 10\]     
\[x^2 + 5x - 11 = 35\]            
3 M1
For \((x + 1)(x - 1) + 5(x - 2) = 35\)  
B1
For \(x^2 + x - x - 1 + 5x - 10\) or simpler  
A1
For \(x^2 + 5x - 1 - 10 = 35\)
(b) \[\frac{-5 \pm \sqrt{5^2 - 4 \cdot -46}}{2}\]  
\[\frac{-5 \pm \sqrt{209}}{2}\]     
4.73                           
3 M1
May be implied by an answer of 4.75  
For 4.73 or better (4.7284...)
A1
Accept 4.73 and -9.73 or better

Total 6 marks

Total 6 marks
18. (a) \[ \frac{9.4}{\sin 123^\circ} = \frac{AC}{\sin 35^\circ} \]
\[ AC = \frac{9.4 \sin 35^\circ}{\sin 123^\circ} \]
\[ \text{AC} = 6.43 \]

(b) \[ \frac{1}{2} \times 9.4 \times 6.43 \times \sin x^\circ \]
\[ \text{or} \frac{1}{2} \times AB \times 6.43 \times \sin 123^\circ \]
\[ \text{or} \frac{1}{2} \times AB \times 9.4 \times \sin 35^\circ \]

\[ \text{AC} = 11.3 \]

19. (a) \[ \frac{3 \times 2}{6} \]
\[ \frac{6}{6} \]

\[ = \frac{6}{36} \]

(b) \[ \frac{1}{6} \times \frac{1}{6} + \frac{3}{6} \times \frac{3}{6} + \frac{2}{6} \times \frac{2}{6} \]
\[ = \frac{1}{36} + \frac{9}{36} + \frac{4}{36} \]

\[ = \frac{14}{36} \]

Total 6 marks
20. (a) 

\[ x^3 - 7x + 9 = 11 - x \]

or \[ -x + 11 \]

seen

\[ x + y = 11 \]

-2.3, 0.3, 2.6

(b) \[ \frac{2512}{157} \text{ or } 16 \text{ or } \frac{157}{2512} \text{ or } 0.0625 \]

\[ \sqrt{16} \text{ or } 4 \text{ or } \frac{1}{4} \]

\[ 6.5 \]

List of all 36 combinations

M3

M2 for 1 omission

M1 for 15 or more combinations

Total 6 marks

21. (a) 

\[ \frac{2512}{157} \text{ or } 16 \text{ or } \frac{157}{2512} \text{ or } 0.0625 \]

\[ \sqrt{16} \text{ or } 4 \text{ or } \frac{1}{4} \]

\[ 6.5 \]

Total 4 marks

cao
22. \[
\frac{2}{x-1} + \frac{x-11}{(x-1)(x+4)} = \frac{2(x+4) + (x-11)}{(x-1)(x+4)}
\]

For factorising \(x^2 + 3x - 4\)

For correct single fraction even if unsimplified, or for correct sum of two fractions with the same denominator ft from incorrect factorisation

For expanding brackets correctly in numerator

For simplifying their numerator

For factorising a correct numerator

\[
\frac{2(x+4) + x-11}{(x-1)(x+4)} = \frac{2x+8+x-11}{(x-1)(x+4)} = \frac{3x-3}{(x-1)(x+4)}
\]

\[
\frac{3}{x+4}
\]

Total 6 marks

TOTAL FOR PAPER: 100 MARKS
Q. Working

1. Correctly collect \( p \) terms in eqn
   Correctly collect constants in eqn
   
   \( \frac{1}{2} \text{ oe} \)

   
   Mark \( \text{M1} \)

   Notes eg \( 4p + 3 = 5 \) (not \( 7p - 3p + 3 = 5 \)),
   \( \text{M1} \)
   \( \text{A1} \)

   Total 3 marks

2. \( 14.9422 
   611-182 = 429 
   "429" \times 0.0704 \text{ or } 30.2016 
   "14.9422" + "30.2016" \text{ or } 45.1438 
   "45.1438" \times 5/100 \text{ or } 2.25719 
   "45.1438" + "2.25719" 

   \( 47.40(099) \)

   Mark \( \text{B1} \)

   Notes Allow working to 3 s.f.,
   \( \text{B1} \)
   or better throughout
   \( \text{M1} \)
   M marks can be implied
   \( \text{M1} \)
   \( \text{M1} \)
   \( \text{M1} \)
   45.14 \times 1.05 or 47.50 or 2.25
   \( \text{M1} \)
   Can be awarded in previous line
   \( \text{A1} \)
   At least 2 d.p.

   Total 7 marks

3. (a) \( 50^\circ \)

   Mark \( \text{B3} \)

   Notes If B3 not gained: \( PQS = 70^\circ / \)
   \( \angle PTR = 60^\circ / \text{ext } \angle PTR = 120^\circ : \text{B2} \)
   If B2 not gained: \( \angle PST = 60^\circ : \text{B1} \)

   (b) \( \angle s \) on a straight line = \( 180^\circ \) or
   \( \angle \text{sum of triangle } = 180^\circ \) or
   \( \text{ext } \angle \text{ of } \Delta = \text{sum of int opp } \angle s \)
   \( \text{AND} \)
   Corresponding \( \angle s \) or alternate
   \( \angle s \) or allied or supp or included
   or interior or co-interior \( \angle s \)

   Mark \( \text{B1} \)

   Total 5 marks
4. (a) (i) \( p^4 
-3a + 4b - 7 \)
(ii) \( q^6 \)
(iii) \( 2x^2 + 3x \)
(b) \( y^2 + 2y - y - 2 \)
(c) \( y^2 + y - 2 \)

5. (a) 10-19
(b) 42/59 or 0.71(...) or 71(...)%
(c) 8x4.5 + 20x14.5 + 14x24.5 + 5x34.5 + 12x44.5
Midpoints 4.5 (or 5 or 4) etc
1375(.5) or 1376

6. No or not necessarily
Some are (or may be) both

Total 8 marks
Total 6 marks
Total 2 marks
7. (a) \[ 8^2 + 15^2 \text{ or } 289 \text{ seen} \]
\[
\text{17cm}
\]
(b) \[15/8 \text{ or } 1.875 \text{ or } 1.88 \text{ seen} \]

3 M1 \[ \tan x = 15/8 \text{ dep on x used} \]
M1 \[ \text{dep } 8/\cos x \]
A1 \[ \text{Answer rounds to 17.0} \]

Total 4 marks

8. (a)
\[ \text{Kitchen chairs} \]
\[ \text{belonging to Angela or “her”} \]

2 B1 \[ \text{Or equivalent. Must be clear that overlap is intended} \]
\[ \text{eg “chairs that are part of /} \]
\[ \text{common to kitchen furniture” “furniture that is both a chair} \]
\[ \text{and in the kitchen”} \]

(b) (i) \[1, 2, 3, 4, 5, 6, 7, 8, 9 \]
(ii) \[ \text{Yes - no common members} \]

2 B2 \[ -B1 \text{ each omission or extra} \]
\[ \text{Any order, in a single list} \]
\[ \text{Ignore negative odd numbers} \]
1 B1 \[ \text{Or eg “No odd numbers in P.”} \]
\[ \text{“P is even numbers,} \]
\[ \text{or Q is odd numbers.”} \]
\[ \text{Must refer to sets or odd or even} \]

Total 5 marks

9. \[ 19.8 = 2\pi \times r \times 2.1 \text{ or} \]
\[ 19.8 / (2\pi \times 2.1) \]
\[ \text{OR } 2\pi \times 19.8 \times 2.1 \]

1.5 or better

2 M1A1 \[ \text{Or } 19.8 = 2\pi \times 1.5 \times 2.1 \]

Total 2 marks
10. (a)  9.905 \times 10^7 \text{ or } 99 \, 050 \, 000 \text{ or } 9.91 \times 10^7 \text{ or } 99 \, 100 \, 000

(b)  9.7/100 \times 9.72 \times 10^7

(c)  \text{Total} = 5.988 \times 10^8 \text{ or } 598800000
    \left(4.98 \times 10^6 / \text{her } 5.988 \times 10^8\right) \times 100
    \text{ or } 9.43 \times 10^6 \text{ or } 9.430 \, 000 \, \text{ or better}
    \text{or better}
    \text{83% or better}

2  B2  \text{ B1 for digits 9905 or 991}

2  M1  A1

3  B1  Or 599000000
    M1  \text{dep total clearly attempted}
    A1

11. (a)  3 \times (i) \text{ or otherwise equalize coeffs}

(b)  \frac{1}{2}, 1

1  B1f

1  A1A1

3  M1  \text{Whole equations correct}
    T & I: 3 or 0

Total 7 marks

12. (a)  49

(b) (i)  2.5 \times 3/2 \, \text{ oe}

(ii)  1.5 \times 2/3 \, \text{ oe}

1  B1

2  M1  cao
    A1

2  M1  Or 1.5 - 0.5
    A1  cao

Total 5 marks

Total 4 marks
13. (a) \[ 2(-4) - 3 = -11 \]

(b) \[ 2a - 3 = 5 \text{ or } (5 + 3)/2 \]

(c) \[ \sqrt{(2 \times 6 - 3) + 1} \]

(d) \[ y = 1 + \sqrt{x} \]
\[ x = (y - 1)^2 \]
\[ f_x + 1 \]
becomes \(-1, (\cdot)^2 \)

(e) \[ g^1: x \rightarrow (x - 1)^2 \text{ or } y = (x - 1)^2 \]

Total 10 marks

14. (a) \[ x(28 - 2x) \text{ seen} \]

(b) (i) \[ 28 - 4x \]

(ii) “28 - 4x” = 0

(iii) negative coeff. of \(x^2\) or \(\cap\) shape
or \[ \frac{d^2y}{dx^2} = -4, \text{ which is negative} \]

(c) \[ 28 \times 7 - 2 \times 7^2 \]

98

Total 8 marks
15. (a) \( \pi \times 12^2 \times \frac{110}{360} \)

\[ \frac{2\pi r + 2r}{3} \]

2 M1 Or \( \pi \times 12^2 \times 0.31 \),

\[ \frac{2\pi r + 2r}{3} \]

A1 Or \( \pi \times 12^2 \div 3.3 \) or better

3 M1 Or equivalent explanation

M1 A1

Total 5 marks

16. (a) (i) 
(ii) 
(iii)

(b) \(-a + b\) oe

2a oe

-2a + 2b oe

1 B1 } Simplification not required

1 B1 } Allow plain \( a, b \)

1 B1 }

2 B1 (b) marks dep (a)(i)&(iii) correct B1 Without vector symbols unless “length” stated.

Total 5 marks

17. (a) One block of correct height, or \( \frac{20}{5} \) or \( \frac{14}{5} \) or \( \frac{8}{20} \) seen

Correct blocks, height & width

4 M1 8cm, 5.6cm or 0.8cm, any width

A1A1A1

2 M1 Value “7” or “2” not enough

A1

Total 6 marks
18. (a) \( \frac{2}{5} \) and \( \frac{3}{5} \) correctly placed
\( \frac{3}{4} \) and \( \frac{1}{4} \) correctly placed
Correct structure includes labels

(b) \( \frac{3}{5} \times \frac{3}{4} \) or \( \frac{9}{20} \)
\( + \frac{3}{5} \)
\( \frac{17}{20} \) or 0.85 oe

3 B1 Allow even if extra branches B1
3 M1 dep
A1

19. 5.1 - 0.5i or 51.1 - 5.1i or 51.1 - 0.5i
23/45 or 46/90 or 460/900 oe

2 M1 Or 1/90 seen
A1

Total 6 marks
Total 2 marks

TOTAL FOR PAPER: 100 MARKS
MATHEMATICS 4400, CHIEF EXAMINER'S REPORT

General Comments

The papers proved to be accessible and gave candidates the opportunity to show what they knew, an opportunity taken by the vast majority at both tiers. There were few cases of entry for the Higher Tier when Foundation would have been more appropriate but the marks of many Foundation candidates were far above the grade C threshold. Clearly, these candidates had the satisfaction of demonstrating positive achievement in the examination and, in their entry policies, centres must weigh this against the grade C ceiling.

Paper 3H

This paper gave candidates the opportunity to demonstrate positive achievement and many gained high marks. All questions proved to be accessible and there was a particularly high success rate on the easier questions in the first half of the paper. On the other hand, only the best candidates were successful on Question 20 (cubic graph), Question 21 (similarity) and Question 22 (algebraic fraction).

Although a minority sacrificed marks by showing insufficient working, most made their methods clear and so could be given credit, even when their answers were wrong. Some candidates lost marks because their calculators were set in the wrong mode.

Question 1
The majority performed the calculation accurately. Those who did not could still score 1 mark by evaluating either 9.5 - 3.7 or 1.3 x 2.4 correctly. A significant minority gave rounded answers despite the instruction but this was not penalised if it was preceded by the full calculator display. The only wrong answer seen with any regularity was 2.6692..., obtained by working out 9.5 - 3.7 ÷ 1.3 x 2.4.

Question 2
Most candidates solved the equation correctly, usually by expanding the brackets first.

Question 3
Errors were rare; the frequent absence of working suggesting that the use of calculators was widespread. There were occasional errors in arithmetic; for example 9 x 6 being evaluated as 45 or 56.

Question 4
There were many correct enlargements but translations of the correct triangle were not uncommon, especially the one with the right angle at the centre of enlargement. Enlargements with a scale factor of 2, centre (2, 1) also appeared occasionally.

Question 5
Overall, both parts were well answered. In part (a), the product 0.45 x 0.12 was sometimes found. Candidates who summed 0.45 and 0.12 and then went on to subtract their sum from 1 (quite common) or divide it into 1 (quite unusual) were penalised for the extra step. Part (b) was usually correct, although a small minority worked out 250 ÷ 0.12, 250 x 0.45 or 250 x 0.57. If the final answer was \(\frac{30}{250}\), only 1 mark out of 2 was scored.
Question 6
Factorisation was clearly a routine process for the majority of candidates and many scored full marks. It was, however, surprising that errors were as likely to occur in the first part as in the last part. In part (a), \(3(p + 5)\) was probably the most common error. Part (b) was seldom wrong. In part (c), the signs were sometimes reversed; those candidates who showed the factorisation correctly and then proceeded to solve \(x^2 - 3x - 10 = 0\) were not penalised. A significant number of candidates solved the quadratic \(x^2 - 3x - 10 = 0\) and then quoted the correct factors. The minority of candidates who did not appreciate what was required sometimes gave an answer of \(x(x - 3) - 10\).

Question 7
Apart from an occasional misinterpretation of the formula for the area of a trapezium, this question proved very straightforward. A significant minority attempted to find the total surface area in part (a). This was not penalised if the area of a trapezium was found correctly.

Question 8
In the first part, a small minority found 15% of £240 but failed to subtract it from £240. In the second part, the two most popular wrong answers were £563.55, obtained by finding 15% of £663 and subtracting it from £663, and £576.52, resulting from £663 / 1.15.

Question 9
Although the inequality sign was occasionally reversed, part (a) was very well answered. Those who used \(\leq\) rather than \(<\) received no credit. Part (b) was somewhat less well answered, the most common errors being the omission of 1 and the inclusion of 0.

Question 10
There was variation between centres but most candidates were clearly familiar with using halfway values to find an estimate for the mean, although the interval containing the mean was sometimes given as the final answer. Finding the median from a cumulative frequency graph was also well understood but the points were sometimes plotted above mid-interval values. It is advisable to indicate how the graph has been used to find the median, and most candidates did so.

Question 11
The subject of this formula was almost always changed correctly. A minority realised that squaring was needed but squared only the right hand side, obtaining \(h = \frac{W}{I}\).

Question 12
There were many completely correct solutions but errors in converting between centimetres and metres were quite common. This, rather than any lack of knowledge of ratio, was usually the reason if marks were lost.

Question 13
10 \(\frac{180}{18}\) appeared with some regularity in the first part. 180 and 360 were quite popular wrong answers for the second part and interior angles of 342° (360° - 18°) appeared regularly. In general, though, this was well answered.
Question 14
Many candidates dealt with the fractions successfully, usually either by multiplying both sides by 4 or by expressing the left hand side with a denominator of 4. Whichever method was used, if a mistake were made, it was often the failure to multiply the right hand side appropriately. It was quite common to see candidates multiply by 2 and then by 4 giving incorrectly \( x - 1 + 2x + 3 = 1 \times 2 \times 4 \).

Question 15
There was considerable variation in candidates' familiarity with surds. An answer of \( \frac{10 \sqrt{5}}{5} \) for the first part showed understanding but was not in the form specified in the question so gained only 1 mark. Some candidates multiplied by \( \frac{\sqrt{5}}{\sqrt{5}} \) but went on to write the resulting denominator as 2 instead of 5. In the second part, the two \( 5\sqrt{3} \) terms were sometimes omitted. The use of a calculator sometimes led to a correct answer in part (a) but hardly ever in part (b).

Question 16
The first part was very well answered but the second part proved much more demanding. Taking \( \angle ACT \) or \( \angle TBC \) as 71° or \( \angle ACT \) as 19° doomed the attempts of some candidates from the start. Others used either Pythagoras or trigonometry to find either \( AC \) or \( BT \) and then either gave that as their final answer or used it in an incorrect application of the cosine rule.

Question 17
The majority produced a convincing algebraic argument for the first part and most were able to use the quadratic formula accurately in the second part. When errors were made in using the formula, it was likely to be with the sign of the -46, division by 2 or by premature approximation of the \( \sqrt{209} \) to 14.5. The original intention had been that candidates should give only the value of \( x \) which was physically meaningful but it was decided to award full marks to those who gave both solutions correctly.

Question 18
The success rate for this question was high, especially for part (a) in which, apart from occasional errors in rearranging, the sine rule was used effectively. Nevertheless, it was noticeable that some candidates omitted the sine in the sine rule, giving \( \frac{AC}{35} = \frac{9.4}{123} \), often then going on to approach the second part correctly.

Although it was still well answered, a substantial number of candidates did not appreciate in part (b) that, in \( \frac{1}{2} \) \( \text{absinC} \), the included angle must be used. Some unnecessarily found the length of \( AB \) and, while this was not penalised if it was subsequently used correctly, if approximated prematurely it ultimately led to the loss of the final accuracy mark. The incorrect assumption that the triangle was isosceles was not uncommon.
Question 19
The first part was usually correct but in the second part, while a high proportion of candidates was successful, many omitted the case of the letter B being taken twice. Most candidates wrote down just the relevant products in part (b) but a few drew tree diagrams or used lists or tables. All these approaches were equally acceptable. A minority misread the question and answered it as if it were "without replacement". In these cases, the method marks were still available i.e. 4 marks out of 6 could still be gained. A few candidates were confused as to when multiplication of probabilities was appropriate and when addition was needed.

Question 20
Only strong candidates appreciated the requirements of this question but there were many of these: they found accurate solutions. With weaker candidates, non-integer values appeared regularly in part (a), as did answers of 9 (the y coordinate of the point where the graph cuts the y-axis) and 22 (the y coordinate of the highest point on the graph). Some candidates used calculus in the first part, although the fact that it was only worth 1 mark should have suggested that a simpler approach was expected.
In part (b), candidates who were struggling sometimes attempted to use the quadratic formula or calculus, while others with some understanding used the graph of \( y = x + 11 \). Even some who correctly isolated 11 - x went on to draw the graph of \( y = 11 \) or drew a graph with a positive gradient.

Question 21
While there was a fair proportion of correct answers, a large number of candidates showed little understanding of this topic. Consequently, while most were able to calculate the volume factor \( \left( \frac{2512}{157} \right) = 16 \), many used it to obtain answers of 1.625 \( \left( \frac{26}{16} \right) \) for part (a) and 2080 \( (130 \times 16) \) for part (b).

Question 22
The quality of attempts varied greatly from the concise and elegant to the totally misconceived. Those who eventually scored full marks almost invariably started by factorising \( x^2 + 3x - 4 \) and used a denominator of \((x + 4)(x - 1)\). Those who used a denominator of \((x - 1)(x^2 + 3x - 4)\) were much more likely to make an error in algebra and much less likely to obtain a final expression in a sufficiently simple form. Misconceptions about cancelling factors were the cause of many false steps. For example, it was not unusual to see \( \frac{2}{x - 1} + \frac{x - 11}{(x - 1)(x + 4)} \) become \( 2 + \frac{x - 11}{(x + 4)} \) after "cancelling". It was also quite common for the denominator to disappear at some stage, often resulting in an answer of \( 3x^2 - 6x + 3 \).
Paper 4H

Most candidates found plenty of opportunity to display their knowledge and skills. Some gained extremely high marks, showing a very high standard of facility with even the more complex areas of mathematics. However, a small number was unable to tackle any but the most elementary questions. These candidates would have benefited by entering Foundation Tier.

Non-numerical, written answers were sometimes given in a roundabout or verbose manner. Many candidates failed to use the appropriate mathematical language and therefore risked a penalty for lack of clarity.

Some candidates’ algebra was excellent; others was rather suspect. On the whole, however, algebra was better than other aspects of the paper.

Many able candidates seemed to be uncomfortable with fractions and so chose clumsy decimal methods, often losing accuracy through rounding.

It was common for candidates to lose marks because they gave answers with no working. It should be emphasised that if an answer is incorrect, some marks can still be gained, but only if working is shown.

Probabilities were sometimes given in an incorrect form (‘42:59’ or ‘42 in 59’ or ‘42 out of 59’). These attracted a penalty. Candidates should be taught to express probabilities as fractions or, where it is more relevant, decimals. Percentages are also acceptable, although not necessary.

In a few cases it was noticeable that a whole centre was unable to tackle a particular topic, such as calculus or vectors.

Question 1
This was well answered on the whole, although a few candidates added terms which should have been subtracted. Some candidates found $4p = 2$, then gave $p = 2$.

Question 2
This question was well answered. Most candidates showed no working and risked the loss of marks where their method was not clear. Some worked to only two significant figures and therefore lost marks for accuracy. Arithmetic was sometimes a weakness and some candidates lost control of the decimal point. A few subtracted the tax.

Question 3
Part (a) was found to be relatively easy by many candidates. Some candidates used long - but correct - methods. However, a few assumed that one of the triangles was isosceles or even equilateral. Also, disappointingly, a large minority of candidates showed little understanding of parallel line properties and stated, for example, that $\angle PQS = 110^\circ$. Others thought that $\angle RTS = 60^\circ$ because angles $RTS$ and $QST$ were “angles on a straight line”.

Part (b) produced long essays containing much irrelevant description. Candidates tended to describe their arithmetic without reference to the angle properties that justified it. Those who did attempt to state angle properties often included angles on a straight line or angle sum of a triangle although they had clearly not learnt the most precise statements of these properties. Some understood parallel line properties but many lost a mark through failure to use the correct vocabulary (“alternate angles” or “corresponding angles”).
Question 4
Amongst a few centres, common errors were 4p in part (a)(i), 7a and/or -2b in part (a)(ii). A poor knowledge of index laws led to $q^8/q^7 = q$ or an unfinished answer eg $q^{15}/q^7$ in part (a)(iii). In part (b), a few candidates gave $2x + 3x$ or $2x^2 + 3$. Some multiplied out correctly but then took another, incorrect, step eg $2x^2 + 3x = 5x^3$. Many candidates answered part (c) well. A few did not understand that multiplication was required. Others multiplied incorrectly giving, for example, $2y$ instead of $y^2$. Others obtained only two terms. Sign errors were fairly common, particularly in the y term.

Question 5
The vast majority of answers were correct in part (a), although a few candidates gave 20-29 (the middle mark range) or 40-49 (the highest mark range). Some gave just 20. Part (b) was generally correct, although a few candidates had a numerator of 30 or 44. It should be emphasised that the fractional form is perfectly acceptable - in fact this is the preferable form. Changing to a decimal is unnecessary and changing to a ratio is incorrect. In part (c), a few just added the midpoints. Others misread one or two frequencies. Some used the end points instead of the midpoints. Many found the midpoints to be 5, 15 etc instead of the correct values (4.5, 14.5 etc). Perhaps this was due to confusion between discrete and continuous variables. Many candidates used 9 as the x value in all classes. Some candidates found the total and then proceeded to divide by 59 to find the mean. A few candidates interpreted the word “estimate” too flexibly and found, for example, 20 x 59.

Question 6
Most candidates knew that ‘or’ implies add, but very few seemed aware of the need for events to be mutually exclusive. Very many candidates stated “Yes” and gave as their explanation some calculation showing that $3/4$ is indeed the correct answer to $1/2 + 1/4$. Others stated “No” because $1/2 + 1/4 = 2/6 = 1/3$. Very few candidates understood the point that there may be an overlap between the two sets of club members. Some stated that the correct calculation for ‘or’ is multiplication.

Question 7
In part (a), most candidates were comfortable with Pythagoras’ theorem, although some forgot to take the square root. A few used trigonometry to find an angle and then the length. Some just found an angle. Few candidates did what the question asked in part (b). Most found angle x instead. Perhaps they were familiar with the routine trigonometrical method for finding an angle, but did not realise that tan x is a quantity in its own right. These candidates missed the strong hint provided by the fact that only a single mark was allotted to this part rather than the more usual 3 marks for a simple trigonometrical calculation. So long as tan $x = 15/8$ was seen they were not penalised, but many wasted time going beyond this. Some candidates recognised that something different from usual was required and found tan($15/8$). A few found tan $x = 15/8$, but then continued with indecipherable incorrect working. Others stated that tan $x = 8/15$. An answer of 10.77 was common, coming from $[\tan^{-1}(15)] / 8$. 


Question 8
Many candidates did not understand the intersection notation in part (a). Some interpreted $A \cap B$ as a statement, usually $A \cap B = \emptyset$ or $A \subseteq B$. Others described $A \cup B$. Some just described intersection in general, unrelated to the context. Some wrote statements such as “The chairs will not be unified with the kitchen furniture”. Some understood the mathematics but could not satisfactorily transfer this understanding to the context (“where the kitchen chairs overlap with the kitchen furniture”). The majority attempted to describe some relation between chairs and kitchen furniture, but their language was opaque. This question was marked sympathetically, but it was impossible to award the mark when the meaning was simply unclear. Finally only a tiny minority included the word “Angela’s” or the phrase “belonging to Angela”.

Many correct answers were seen in part (b)(i), although a few omitted the 1 and/or the 9, or included 10. It was not unusual to see only 1, 3, 5, 7, 9 be the answer to a different question. Many candidates understood the point in part (b)(ii), but failed to express themselves clearly enough. Again, allowance was made for a poor command of the language, but it was often impossible to award the mark even though it was suspected that the candidate understood the point eg “P and Q do not have the same numbers in their groups”. Clear answers included the following:

“P contains only even numbers and Q contains only odd numbers.”

“P and Q contain no common members.”

“None of the numbers in P are in Q.”

Question 9
The typographical error on the answer line is regretted. Every possible allowance was made for those few candidates who appeared to have been confused by this.

Many candidates wrote a correct first line, $19.8 = 2\pi r \times 2.1$, but could not rearrange this correctly. Others gave the correct answer, but only as embedded in the formula, thus: $2\pi \times 1.5 \times 2.1 = 19.8$. Many correct answers were seen.

Question 10
It is perhaps to the credit of candidates that most attempted to use their understanding of standard form in this question. However, it is noteworthy that all three parts can be done by mechanically typing numbers into the calculator, with no understanding of standard form except for a knowledge of how to enter it into the calculator. In view of this fact, the level of success was disappointing.

Many correct answers were seen in part (a). Some candidates tried various methods by hand. Some added $1.85 + 9.72$ and either added or multiplied the powers of 10. Others converted the numbers into normal format, with varying degrees of success. The majority were able to deal with the difference of 1 between the powers. They arrived at the correct digits 9905, although not necessarily with the correct decimal point or power of 10. A few candidates worked to only two significant figures.

In part (b), some candidates multiplied by $\frac{100}{9.7}$. Others subtracted 9.7 from $9.72 \times 10^3$. A few seemed dazzled by all the 9s and 7s in this part. Most understood what was needed in part (c), although some added incorrectly or lost control of the decimal point. Many divided by the total for only the first three foods.
Question 11
The majority of candidates knew how to solve simultaneous equations, although some made arithmetical errors. Some candidates used substitution, but the most common - and the most productive - method was elimination. Some added or subtracted equations apparently at random. Others used trial and improvement, usually unsuccessfully. Many candidates saw the connection between parts (a) and (b). Some, however, started from scratch in part (b); usually drawing a sketch, and usually arriving at wrong answers. Others solved the simultaneous equations algebraically a second time in part (b), often arriving at a different answer from the correct one found in part (a). As in Question 7(b), the hint provided by the tariff of only one mark often went unheeded.

Question 12
Many candidates did not recognise this as a similar triangles problem but attempted trigonometry. Others subtracted 1 from 49, presumably because $BC = EF - 1$. Some thought $49^\circ$ had to be scaled down by a factor of $\frac{2}{3}$. In part (b), some used trigonometry, while others added 1 to 2.5 in part (i) and subtracted 1 from 1.5 in part (ii). A few who used the correct method resorted to decimals and unnecessarily lost accuracy through rounding.

Question 13
Part (a) was usually correct; in part (b) some candidates found $f(5)$. In part (c), many candidates found $gf(6)$; others found $f(6) \times g(6)$. Few candidates answered part (d) correctly. A common answer was 0. Other answers were seemingly random numbers such as 3 or -1. An almost correct answer was $x < 0$.
Many candidates appeared to guess in part (e) and gave the answer $x^2 - 1$. Others tried to go through the correct process but also arrived at $x^2 - 1$ by incorrect squaring. Some candidates started correctly with $y = 1 + \sqrt{x}$, but then gave $y^2 = 1 + x$. A few attempted the flow chart method. These usually gave the two original operations in the wrong order, or gave the two inverse operations in the wrong order.

Question 14
Part (a) was generally well answered, but a few candidates did not understand what was required. Some omitted the bracket. For the remainder of the question, many candidates seemed to have only a superficial familiarity with calculus. The fact that this was a “problem” rather than a pure calculus example may have hindered some. However, many could not differentiate $28x - x^2$, even though this was asked in isolation without reference to the context. Even those who could differentiate often failed to use the property that $\frac{dy}{dx} = 0$ at a maximum. Some candidates were unmoved by finding a negative value for $x$ and even for the consequent area. In part (iii), many answers suggested confusion about the procedure for distinguishing a maximum from a minimum eg “Substituting $x = 7$ gives a positive answer so it is a maximum”. All that is required is a statement that the coefficient of $x^2$ in the equation of the curve is negative. Some candidates stated merely that “it” is negative and therefore a minimum. A few found the second derivative or considered the value of $y$ or $\frac{dy}{dx}$ either side of the turning point. (These latter methods are not required by the syllabus, but are permitted). Some lost the mark because they merely stated that the second derivative was negative without demonstrating that this is so. In the final part, many candidates failed to realise that the value of $x$ found in part (b)(ii) was the value which gives the largest area.
Question 15
In both parts a few candidates confused area and circumference. Many candidates found $\frac{1}{4}$ of the area of a circle or $0.3 \times$ the area in part (a). Others added $2 \times 12$. Some rounded prematurely. In part (b), many candidates started with the answer and did not know what to do with it. Others tried to turn the question into a numerical example. The concept of a clear sequence of logical steps, starting with what is known and proceeding to what is required to be demonstrated, was unfamiliar to many. Those who did start with the given sector sometimes failed to explain where the term $\frac{2\pi r}{3}$ came from. For full marks, candidates had to start by giving the arc length as $\frac{120}{360}$ (or $\frac{1}{3}$) $\times 2\pi r$, then proceeding to $\frac{2\pi r}{3}$ and finally adding $2r$.

Question 16
There was a clear division between those who understood vectors and those for whom they were unfamiliar. Many correct answers were seen in part (a), with common wrong ones in part (i) being $\mathbf{a} \cdot \mathbf{b}$ and $\mathbf{a} \cdot \mathbf{b}$. Some candidates gave answers such as $\mathbf{ab}$ and $\sin \angle \mathbf{MN}$. Of those who answered part (a) correctly, many gave the fact that $\mathbf{MN}$ and $\mathbf{QR}$ are parallel in part (b). For the second fact, some candidates stated that $\mathbf{MN}$ is halfway between $P$ and $\mathbf{QR}$. Others stated that $\mathbf{QR} = 2\mathbf{MN}$ as their answer, although this is actually only a step towards the answer.

Question 17
There were many good answers to part (a). Some candidates used frequencies instead of frequency densities, others calculated only one of the frequency densities correctly. A few candidates drew three blocks all of width 10. Not many candidates were able to sort out the correct fractions of the frequencies in part (b). Common wrong methods were $\frac{14}{2} + 8$ and $(14 + 8)/2$.

Question 18
In part (a), the majority of candidates added two unwanted branches after the "Pass". A few understood that only one pair was required for the second attempt, but drew these in the middle, rather than following on from the "Fail". In part (b), many candidates simply added $\frac{2}{5} + \frac{3}{4}$. Others multiplied two or three pairs of probabilities. Some who included the unnecessary branches in part (a) nevertheless found the answer to part (b), correctly using $1 - \frac{3}{5} \times \frac{1}{4}$.

Question 19
Working was often poorly expressed even by those who eventually arrived at the correct answer. Candidates fell into four categories. Some read the question as $0.5i$ and gave the answer $\frac{1}{2}i$. Some ignored the dot, giving the answer $\frac{31}{100}$. Others interpreted the dot to mean that the pair of digits recurred. Those who correctly interpreted the dot attempted one of two possible approaches.

The "short cut" method (eg $0.5 + 0.01/0.9$ or $0.5 + 1/99$). These candidates generally failed to reach the correct answer, but showed confusion by writing, for example, $0.31/0.9$. Some started correctly but then, instead of working in fractions, resorted to the calculator and obtained the decimal originally given in the question.

The "multiply and subtract" method (eg $10x - x$). Some candidates had a rough idea of this method, but rounded before subtracting. Thus, for example, they wrote $5.1 - 0.51$ leading to $4.59/9$. Others simply could not handle the subtraction at all or resorted to the calculator to evaluate $5.111111111 - 0.5111111111$, and arrived back at the original decimal. Many candidates who understood this method left their answer in the form $4.6/9$. A few tried $100x - x$, but could not get beyond $50.6/99$. A tiny minority used the most elegant method ($100x - 10x$).
Any correct method is acceptable, but because of the confusion of approaches suitable for different types of recurring decimal, perhaps it is best to teach the “safe” method which works in all cases:

1. Since only one digit recurs, multiply by 10 (rather than 100 or 1000 etc).
2. Subtract $10x - x$ without rounding first.
3. Change the resulting quantity into a proper fraction by multiplying numerator and denominator by 10.

This can be adapted for cases where two or more digits recur.

**MATHEMATICS 4400 PAPERS 3H & 4H, GRADE BOUNDARIES**

**Higher Tier**

<table>
<thead>
<tr>
<th>Grade</th>
<th>A*</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest mark for award of grade</td>
<td>82</td>
<td>64</td>
<td>46</td>
<td>28</td>
<td>17</td>
<td>11</td>
</tr>
</tbody>
</table>

**Note:** Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.