Mark Scheme Summer 2009

IGCSE Mathematics (4400)

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4400 Paper 1F Mark Scheme

Except for questions* where the mark scheme states otherwise, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method. [* Questions 15(b) and 18(b)]

Q		Working	Answer	Mark		Notes
1	a		6012	1	B1	cao
	b		6800	1	B1	cao
	c		tens	1	B1	Accept 80, 10, T
	d		803	1	B1	cao
						Total 4 marks

Q		Working	Answer	Mark		Notes
2	a		54 63	2	B2	B1 each
	b	eg Add 9, multiples of 9, 9 times table		1	B1	
	c		180	1	B1	cao
						Total 4 marks

Q		Working	Answer	Mark		Notes
3	ai		9 40 pm	2	B1	Allow 20 to 10 pm
	ii		21 40		B1	cao
	b		−2	1	B1	cao
	c		−8 indicated	1	B1	Allow $\pm$ ½ division
						Total 4 marks

4	a		75	1	B1	cao
	b		USA	1	B1	Accept any clear indication
	c		bar	1	B1	Accept 25 < bar < 30
						Total 3 marks

5	ai		line	2	B1	
	ii		isosceles		B1	
	b		lines	2	B2	for 4 correct B1 for 2 correct
	ci		octagon	2	B1	
	ii	eg angles not all equal			B1	
	di		0	2	B1	cao
	ii		2		B1	cao
	ei		$\frac{2}{5}$	2	B1	cao
	ii		0.4		B1	ft from (i) if denominator is 3 or 5 but not if denominator is 2 or 4 If (i) is "$\frac{2}{3}$" (ii) must be $0.\dot{6}$ oe or have at least 2 decimal places rounded or truncated
						Total 10 marks

6	ai		22 24	4	B1	cao
	ii		28		B1	cao
	iii		25		B1	cao
	iv		23 or 29		B1	
	bi		$\frac{1}{9}$	3	B1	
	ii		$\frac{5}{9}$		M1 A1	denominator 9 numerator 5
						Total 7 marks

7	ai		2.645751311	2	B1	for at least 5 figures
	ii		2.65		B1	ft from "2.645…" if at least 3 dp
	bi		0.0841	2	B1	cao
	ii		0.08		B1	ft from "0.0841" if of equal difficulty
	c	3.375 + 0.4		2	M1	for 3.375 or 0.4
			3.775		A1	cao
						Total 6 marks

8	a	1 4 4 5 6 10 10 10 10 10 or $\frac{10+1}{2}$ or $5\frac{1}{2}$ or 6, 10		2	M1	for a clear attempt to list in order
			8		A1	cao
	b		9	2	B2	B1 for 1-10, 10 − 1
						Total 4 marks

9	a		$4q$	1	B1	Accept $4{\times}q$, $q4$ etc
	b		$5np$	1	B1	Do not accept $\times$ signs Accept $n5p$, $5pn$, $5(pn)$ etc
	c		7	1	B1	cao
	d	$8y = 5 + 1$ or $8y = 6$		2	M1	May be implied by correct answer
			¾ oe		A1	
						Total 5 marks

10	a	eg 0.666…, 0.7, 0.65, 0.625		2	B2	for $\frac{5}{8}$ $\frac{13}{20}$ $\frac{2}{3}$ $\frac{7}{10}$ or for correct decimal equivalents
			$\frac{5}{8}$ $\frac{13}{20}$ $\frac{2}{3}$ $\frac{7}{10}$			B1 for 3 fractions in correct order or for 2 fractions correctly converted to decimals (at least 2 dp rounded or truncated) or for 2 fractions expressed as equivalent fractions with a denominator of 120
	b	$\frac{9}{12} - \frac{5}{12}$		2	M1	Accept $\frac{18}{24} - \frac{10}{24}$ or $\frac{36}{48} - \frac{20}{48}$
			$\frac{4}{12}$		A1	Accept $\frac{8}{24}$ or $\frac{16}{48}$
						Total 4 marks

11	a	$\dfrac{180 - 48}{2}$		2	M1	
			66		A1	cao
	b	$180 - $ "66" or 114 or $\angle ABC = $ "66°"		3	M1	
		$360 - (69 + 106 + $ "114") or $360 - (106 + 69 + 48 + $ "66")			M1	
			71		A1	ft from "66"
						Total 5 marks

12	a	$80 \times \dfrac{2}{5}$, $2 \times \dfrac{80}{5}$		2	M1	Also award for 80 : 32 or 32 : 80
			32		A1	cao
	b	3 + 1 or 4		2	M1	Also award for 60 : 20 or 20 : 60
			20		A1	cao
						Total 4 marks

13	$\dfrac{180 - 48}{2}$		3	M2	for 40×13.25 oe or $\dfrac{40}{60} \times 795$ oe M1 for $\dfrac{40}{60} \times (13 \times 60 + 15)$ or for 40 × time eg 40 × 13.15 or 526 seen or 40 × 795 or 40 × 13. …
		530		A1	cao
					Total 3 marks

14		correct enlargement vertices (10,10) (15,10) (15,20)	3	B3	B2 for translation of correct shape or 2 vertices correct or for enlargement 1½, centre (0, 0) B1 for one side correct length Allow ½ square tolerance for both vertices and lengths of sides of triangle
					Total 3 marks

15	a	2×(12×7+7×5+12×5) or 2 × (84 + 35 + 60)			2	M1	for correct substn or 179 seen
				358		A1	for correct substn or 179 seen
	b	12*L*+16 = 70 or 8*L* + 4*L* = 54 or 12*L* = 54	6*L* + 8 = 35 or 4*L* + 2*L* = 27 or 6*L* = 27		3	M2	for correctly collecting *L*s or constants or both
							M1 for correct substitution in given formula or in a correct rearrangement of the given formula in which *L* is not the subject
							eg 70=2(4*L* + 2×4 + 2*L*) or 70=2(4*L* + 8 + 2*L*) or 35=4*L*+ 2×4 + 2*L* or 35=4*L*+ 8 + 2*L* or 70 − 2×2×4 = 8*L* + 4*L* or 35 − 2×4 = 4*L* + 2*L*
				4.5 oe		A1	depends on M2
							Total 5 marks

16	a	$\dfrac{14}{100} \times 850$			2	M1	
				119		A1	cao
	b	$\dfrac{266}{760}$ or 0.35			2	M1	
				35		A1	cao
	c	$\dfrac{204}{0.3}$ or $\dfrac{204}{30}$ or 6.8 or $\dfrac{204}{3}$ or 68			2	M1	
				680		A1	cao
							Total 6 marks

17	Examples of complete, correct explanations
	
	(i) 10 × 0.35 or 3.5 seen (may be in $\frac{3.5}{10}$) AND
	   can't have half beads or there must be a whole number of (red) beads
	
	(ii) $3\frac{1}{2}$ red beads is impossible
	
	(iii) $\frac{7}{20}$ AND there are (only)10 beads
	   or you need 20 beads
	
	(iv) The probability of any bead/a red bead must be tenths or must have 1 decimal place or must have 1 significant figure
	
	(v) Gives at least two examples that the probability of taking a red bead is $\frac{n}{10}$ where $2 \le n \le 9$ e.g. states 0.3 and 0.4
		2	B2	for a complete, correct explanation
				B1 for a partially correct explanation
				Examples of partially correct explanations
				
				(i) $\frac{1}{10}$ or 0.1 seen
				
				(ii) Gives one example that the probability of taking a red bead is $\frac{n}{10}$ where $2 \le n \le 9$
				
				(iii) There would be 3.5 red beads.
				(iv) 10 × 0.35 = 3.5
				
				(v) 0.35 = $\frac{7}{20}$
				
				Treat statements like 'Don't know the number of red beads' as irrelevant.

			Total 2 marks

18	a		$p(p + 7)$	2	B2	Also accept $(p + 0)(p + 7)$ for B2 B1 for factors which, when expanded and simplified, give two terms, one of which is correct. SC B1 for $p(p + 7p)$
	b	$5x = 2$ or $-5x = -2$		3	M2	for $5x = 2$ or $-5x = -2$ or $\dfrac{5x}{5} = \dfrac{2}{5}$ M1 for $4 = 5x + 2$ or $5x = 4 - 2$ or $-5x = 2 - 4$ or $5x - 2 = 0$
			$\dfrac{2}{5}$ or 0.4		A1	dep on at least M1
	c		t^9	1	B1	cao
	d	$12y + 15 - 10y - 15$		2	M1	for 3 correct terms inc correct signs or for $12y + 15 - (10y + 15)$
			$2y$		A1	Accept $2y \pm 0$
						Total 8 marks

19		$10 \times 8 + 30 \times 24 + 50 \times 5 + 70 \times 2 + 90 \times 1$ or $80 + 720 + 250 + 140 + 90$ or 1280		4	M1	for finding at least three products $f \times x$ consistently within intervals (inc end points) and summing them
					M1	(dep) for use of halfway values
		$\dfrac{"1280"}{40}$			M1	(dep on 1st M1) for division by 40 or for division by their $8+24+5+2+1$
			32		A1	cao
						Total 4 marks

20	½ × 10 × 12 or 60		3	M1	for area of one triangle	
	13 × 15 + 13 × 15 + 10 × 15 or 195 + 195 + 150 or 540			M1	for 13 × 15 + 13 × 15 + 10 × 15 oe	
		660		A1	cao	
						Total 3 marks

21	a		1 3 9 27	2	B2	−B1 for eeoo or any repetition	
	b	Yes and gives an explanation which either refers specifically to the members of A and their properties eg All the factors of 27 are odd. None of the factors of 27 are even. 2, 4, 6, 8 aren't factors of 27. or gives a general explanation which shows understanding of the statement eg A and C have no members in common. The intersection of A and C is empty.		1	B1	for 'Yes' and an acceptable explanation Do not accept an explanation which merely lists, without comment, the members of both sets. Do not accept an explanation which includes the symbol ∩ with no indication of its meaning.	
							Total 3 marks

22		sin		3	M1	for sin	or M1 for cos and
		$\frac{3.6}{7.9}$ or 0.4556…			A1	for $\frac{3.6}{7.9}$ oe or 0.4556…	$\frac{\sqrt{"49.45"}}{7.9}$ following correct Pythagoras and A1 for 0.8901… or M1 for tan and $\frac{3.6}{\sqrt{"49.45"}}$ following correct Pythagoras and A1 for 0.5119…
							Total 3 marks

4400 Paper 2F Mark Scheme

Q		Working	Answer	Mark		Notes
1	ai		998 1908 1990 1998 2001	1	B1	
	ii		2001	1	B1	
	iii		1908	1	B1	
	iv		1998 – 998	1	B1	B0 for 998-1998
	bi		3478	1	B1	
	ii		8734	2	B2	B1 for 8374
						Total 7 marks

2	ai		kite	1	B1	Allow mis-spellings (any *recognisable* attempt)
	ii		parallelogram	1	B1	Allow mis-spellings (any *recognisable* attempt)
	iii		trapezium	1	B1	Allow mis-spellings (any *recognisable* attempt)
	bi		acute	1	B1	Allow mis-spellings (any *recognisable* attempt)
	ii		reflex	1	B1	Allow mis-spellings (any *recognisable* attempt)
						Total 5 marks

3	i		A at 0.5 ± 2mm	1	B1	If no Xs, mark point on line level with middle of letter A,
	ii		B at 1 ± 2mm	1	B1	B or C
	iii		C > 0 & < 0.25	1	B1	If no letters then no marks
						Total 3 marks

4	a	5 x 4 + 12			M1	
			32	2	A1	cao
	b	(47-12) ÷ 5			M1	M1 for 47-12 or 35 or 47÷5 or 9.4 or 5"n"+12=47
			7	2	A1	cao
						Total 4 marks

5	a		1, 3, 11, 33	2	B2	B2 fully correct (no additions or errors) B1 for any two correct factors 3 correct & 1 wrong = B1
	b		46	1	B1	No embedded answers i.e. $46^2 = 2116$
	c		243	1	B1	
	d		26	1	B1	No embedded answers i.e. $26^3 = 17576$
						Total 5 marks

6		7 x 1.20 + 6 x 0.75　(= 12.9) 20 – "12.9"			M1 M1	condone omission of final zeros dep
			7.1(0)	3	A1	
						Total 3 marks

7	a		6	1	B1	
	b	Attempt to add all the numbers "88" ÷ 8			M1 M1	dep
			11	3	A1	If ans = 76.6(25) M2 A0
	c		11	1	B1	ft (b)
						Total 5 marks

8	a	3 + 5 + 3 + 5　oe			M1	
			16	2	A1	
	b	46.8 ÷ 7.2			M1	
			6.5	2	A1	
						Total 4 marks

9	ai		$^9/_{36}$	1	B1	
	ii		$^4/_{20}$	1	B1	
	b	$^2/_3$ x $^9/_5$			M2	M1 for inverting 2nd fraction i.e. $^9/_5$ oe or M1 for 2 correct fractions with a common denominator of a multiple of 9
		$^x/_9$ and $^y/_9$				
		$^6/_9 \div {}^5/_9$	$^{18}/_{15}$ or $^6/_5$	3	M2 A1	M1 correct numerators and intention to divide Any fraction equivalent to 1 1/5 Do not allow decimal conversions
						Total 5 marks

10	a		12 cm^2 sq cms	3	B2 B1	B1 for 11 to 13 or 3 × 4 ind
	b		Correct $\pm$ 2 mm	2	B2	B1 for any 2 vertices correct $\pm$ 2 mm or correct size, shape & orientation
						Total 5 marks

11	a	(10 + 5) x 4	60	2	M1 A1	brackets necessary unless answer correct
	b	28 ÷ 4 – 5	2	2	M1 A1	allow 23 ÷ 4 or 5.75 (i.e. reverse operations but wrong order)
	c	-8 ÷ 4 – 5 or -2 - 5	-7	2	M1 A1	allow -13 ÷ 4 or -3.25 (i.e. reverse operations but wrong order)
	d		(x + 5) × 4 or 4x + 20 oe	2	B2	B1 for x+5×4 or x+20 or 4 x +5 or "y=" 4x+5 B0 for x=4x+5
						Total 8 marks

12	a	250 x 1.85				M1	
			462.5(0)		2	A1	462 or 463 = M1 A0
	b	320 ÷ 1.85				M1	
			172(.97…)		2	A1	awrt 173
	c	1 ÷ 1.85 oe				M1	e.g "172.97" ÷ 320 or 250 ÷ "462.5"
			0.54		2	A1	awrt 0.54
							Total 6 marks

13	a	90 ÷ 40(=2.25) or 12 ÷ 40(=0.3) or 40 ÷ 12(=3 1/3) then				M1	or M2 for 12 x 90 ÷ 40 M1 for 9 x 12 (=108)
		"2.25" x 12 or "0.3" x 90 or 90 ÷ "3 1/3"				M1	then M1(dep) for "108" / 4
		(scale factors) (students per degree) (degrees per student)		27	3	A1	dep cao
	b	$^{130}/_{240}$ x 360				M1	M1 for $^{130}/_{240}$
			195°		2	A1	cao
							Total 5 marks

14	a		x - 5	1	B1	Accept y=x-5 not x=x-5 or 0=x-5
	bi	3(x – 5) = 39 or 3x-15=39 or x-5=13			M2	M1 for 3x – 5 = 39
	ii	3x = 54 or x - 5 =13			M1	Allow full ft on ax +b =c from bi ans a>1 b,c ≠ 0
			18	4	A1ft	18 no wrong working = M1 A1
						Total 5 marks

15		6 × (-9 + 1) = -48 oe (-54+6)			M1 M1	allow without brackets M1 for -8 numerator correct (or 6/(−2) or (3/8) x -8)
			-3	3	A1	cao
						Total 3 marks

16		$67 \div 2$ or $(67 +1) \div 2$ oe				M1	attempt to find middle of frequencies of people
				7	2	A1	cao look for mean (7.56..) rounded down M0 A0
							Total 2 marks

17	a	$2 \times \pi \times 40$ oe				M1	
				251	2	A1	awrt 251
	b	8×10 or 80				M1	Rectangle area
		$\pi \times 3^2$ (value rounding to 28.3 or 28.2)				M1	Circle area
		"8x10" – "$\pi \times 3^2$"				M1	dep on both M1's
				51.7	4	A1	awrt 51.7
							Total 6 marks

18	a	$1 - (0.3 + 0.1 + 0.4)$				M1	Look for answer in table
				0.2oe	2	A1	Decimals, fractions, % only
	b	$0.3 + 0.4$				M1	
				0.7oe	2	A1	Decimals, fractions, % only
							Total 4 marks

19	a	$5.1^2 + 3.2^2$ $(= 36.25)$				M1	M2 for $5.1/\cos(\tan^{-1}(3.2/5.1))$ or
		$\sqrt{"36.25"}$				M1	$3.2/\sin(\tan^{-1}(3.2/5.1))$
				6.02	3	A1	awrt 6.02
	b	tan selected				M1	$\sin 32^o = {}^{AB}/_{6.5/\cos 32}$
		$(AB =) 6.5 \times \tan 32^o$				M1	$(AB =) \sin 32^o \times {}^{6.5}/_{\cos 32}$
				4.06	3	A1	awrt 4.06
							Total 6 marks

20	12-x=21 or 12-21=x or -x=21-12 [12 - 21 = x] or [-x = 21 – 12] oe			M2	[$-^x/_3 = 7 - ^{12}/_3$] or [$^{12}/_3 - 7 = ^x/_3$] M1 for 12-x=3x7
		-9	3	A1	
					Total 3 marks

21	A product of 3 or more factors of which 2 are from 2,2,3,11			M1	Product can be implied from a factor tree or repeated division
		1,2,2,3,11 or 2,2,3,11 2 x 2 x 3 x 11	3	M2 A1	These combinations can be implied from a factor tree or repeated division cao
					Total 3 marks

22	[$^{80}/_{40}$] or [$^{84}/_{42}$] $\sqrt{36}$ or 6			B1 B1	
		12	3	B1	Dep on both previous b1's (Accept 10 if $^{80}/_{40}$, 6 used)
					Total 3 marks

Total 100 marks

4400 Paper 3H Mark Scheme

Except for questions* where the mark scheme states otherwise, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method. [* Questions 5(b), 11(a), 13(a), 15(d), 20 and 21]

Trial and improvement methods for solving equations score no marks, even if they lead to a correct solution.

Q		Working	Answer	Mark			Notes
1	a	$80 \times \dfrac{2}{5}$, $2 \times \dfrac{80}{5}$		2		M1	Also award for 80 : 32 or 32 : 80
			32			A1	cao
	b	3 + 1 or 4		2		M1	Also award for 60 : 20 or 20 : 60
			20			A1	cao
							Total 4 marks

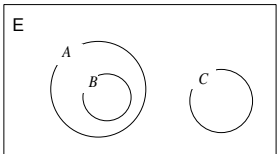| 2		40×13.25 or $\dfrac{40}{60} \times 795$ oe		3	M2	for 40×13.25 oe or $\dfrac{40}{60} \times 795$ oe M1 for $\dfrac{40}{60} \times (13 \times 60 + 15)$ or for 40 × time eg 40 × 13.15 or 526 seen or 40 × 795 or 40 × 13. …
			530		A1	cao
						Total 3 marks

3	correct enlargement vertices (10,10) (15,10) (15,20)	3	B3	B2 for translation of correct shape or 2 vertices correct or for enlargement 1½, centre (0, 0) B1 for one side correct length Allow ½ square tolerance for both vertices and lengths of sides of triangle
				Total 3 marks

4	Examples of complete, correct explanations (i) 10 × 0.35 or 3.5 seen (may be in $\frac{3.5}{10}$) AND can't have half beads or there must be a whole number of (red) beads (ii) $3\frac{1}{2}$ red beads is impossible (iii) $\frac{7}{20}$ AND there are (only)10 beads or you need 20 beads (iv) The probability of any bead/a red bead must be tenths or must have 1 decimal place (v) Gives at least two examples that the probability of taking a red bead is $\frac{n}{10}$ where $2 \leq n \leq 9$ e.g. states 0.3 and 0.4	2	B2	for a complete, correct explanation B1 for a partially correct explanation Examples of partially correct explanations (i) $\frac{1}{10}$ or 0.1 seen (ii) Gives one example that the probability of taking a red bead is $\frac{n}{10}$ where $2 \leq n \leq 9$ (iii) There would be 3.5 red beads. (iv) You can't have half beads (v) 10 × 0.35 = 3.5 (vi) 0.35 = $\frac{7}{20}$ Treat statements like 'Don't know the number of red beads' as irrelevant.
				Total 2 marks

5	a		$p(p + 7)$	2	B2	Also accept $(p + 0)(p + 7)$ for B2 B1 for factors which, when expanded and simplified, give two terms, one of which is correct. SC B1 for $p(p + 7p)$
	b	$5x = 2$ or $-5x = -2$		3	M2	for $5x = 2$ or $-5x = -2$ or $\dfrac{5x}{5} = \dfrac{2}{5}$ M1 for $4 = 5x + 2$ or $5x = 4 - 2$ or $-5x = 2 - 4$ or $5x - 2 = 0$
			$\dfrac{2}{5}$ or 0.4		A1	for 4 correct B1 for 2 correct
	c		t^9	1	B1	cao
	d	$12y + 15 - 10y - 15$		2	M1	for 3 correct terms inc correct signs or for $12y + 15 - (10y + 15)$
			$2y$		A1	Accept $2y + 0$
						Total 8 marks

6	a	$\dfrac{266}{760}$ or 0.35		2	M1	
			35		A1	cao
	b	$\dfrac{204}{0.3}$ or $\dfrac{204}{30}$ or 6.8 or $\dfrac{204}{3}$ or 68		2	M1	
			680		A1	cao
						Total 4 marks

7	sin			3	M1	for sin	or M1 for cos and
	$\dfrac{3.6}{7.9}$ or 0.4556…				A1	for $\dfrac{3.6}{7.9}$ oe or 0.4556…	$\dfrac{\sqrt{"49.45"}}{7.9}$ following correct Pythagoras and A1 for 0.8901… or M1 for tan and $\dfrac{3.6}{\sqrt{"49.45"}}$ following correct Pythagoras and A1 for 0.5119…
		27.1			A1	for answer rounding to 27.1	
							Total 3 marks

8	a		1 3 9 27	2	B2	−B1 for eeoo or any repetition
	b	Yes and gives an explanation which either refers specifically to the members of *A* and their properties eg All the factors of 27 are odd. None of the factors of 27 are even. 2, 4, 6, 8 aren't factors of 27. or gives a general explanation which shows understanding of the statement eg *A* and *C* have no members in common. The intersection of *A* and *C* is empty.		1	B1	for 'Yes' and an acceptable explanation Do not accept an explanation which merely lists, without comment, the members of both sets. Do not accept an explanation which includes the symbol ∩ with no indication of its meaning.
	c			2	B2	B1 for $B \subset A$ B1 for $A \cap C = \varnothing$ and $B \cap C = \varnothing$ Ignore any individual members shown on the diagram. Mark the layout which must be labelled
						Total 5 marks

9	$4.7^2 + 5.9^2$		4	M1	for squaring & adding
	$= 22.09 + 34.81 = 56.9$				
	$\sqrt{4.7^2 + 5.9^2}$			M1	(dep) for square root
	7.5432…			A1	for value which rounds to 7.54
		2.84		A1	for answer which rounds to 2.84 (2.84320…)
					Total 4 marks

10	a	$10{\times}8 + 30{\times}24 + 50{\times}5 + 70{\times}2 + 90 \times 1$ or $80 + 720 + 250 + 140 + 90$ or 1280		4	M1	for finding at least three products $f{\times}x$ consistently within intervals (inc end points) and summing them
					M1	(dep) for use of halfway values
		$\dfrac{"1280"}{40}$			M1	(dep on 1st M1) for division by 40 or division by their 8+24+5+2+1
			32		A1	cao
	b	d = 25 indicated on graph		2	M1	
			12 or13		A1	Accept 12 – 13 inc
	c	10 and 30 or $10\frac{1}{4}$ and $30\frac{3}{4}$ indicated on cumulative frequency axis or stated		2	M1	
			14 - 17 inc		A1	
						Total 8 marks

11	a	10x−15y=45 8x−12y=36 10x+8y=22 15x+12y=33		4	M1	for coefficients of x or y the same followed by correct operation or for correct rearrangement of one equation followed by substitution in the other eg $5x + 4\left(\dfrac{2x-9}{3}\right) = 11$ For both approaches, condone one arithmetical error
		y = −1 x = 3			A1	cao dep on M1
					M1	(dep on 1st M1) for substituting for other variable
			3 −1		A1	cao dep on all preceding marks
	b		3, −1	1	B1	ft from (a)
						Total 5 marks

12	a		1.5×10^8	2	M1	for 1.5×10^m
					A1	if m = 8
	b		7.2×10^{-1}	2	M1	for 7.2×10^n or 0.72 oe with digits 72 eg 72×10^{-2}
					A1	if n = −1
						Total 4 marks

13	a	12L+16 = 70 or 8L + 4L = 54 or 12L = 54	6L + 8 = 35 or 4L + 2L = 27 or 6L = 27			3	M2	for correctly collecting Ls or constants or both
								M1 for correct substitution in given formula or in a correct rearrangement of the given formula in which L is not the subject
								eg 70=2(4L + 2×4 + 2L) or 70=2(4L + 8 + 2L) or 35=4L+ 2×4 + 2L or 35=4L+ 8 + 2L or 70 − 2×2×4 = 8L + 4L or 35 − 2×4 = 4L + 2L
				4.5 oe			A1	depends on M2
	a	alternative method						
		$L = \dfrac{A - 2HW}{2(W + H)}$ oe				3	M1	for making L the subject of the given formula
		eg $\dfrac{70 - 2 \times 2 \times 4}{2(4 + 2)}$					M1	for correct substitution into a correct expression for L
				4.5 oe			A1	depends on both method marks

13	b	$A=2LW+2WH+2HL$ or $\dfrac{A}{2} = LW + WH + HL$		4	M1	for a correct equation following expansion or division by 2 May be implied by second M1
		$A-2HL=2LW+2WH$ or $\dfrac{A}{2} - HL = LW + WH$			M1	for correct equation with W terms isolated
		$A-2HL=2W(L+H)$ or $A-2HL=W(2L+2H)$ or $\dfrac{A}{2} - HL = W(L + H)$			M1	for correct equation with W as a factor
			$\dfrac{A-2HL}{2(L+H)}$ or $\dfrac{A-2HL}{2L+2H}$ or $\dfrac{\dfrac{A}{2} - HL}{L+H}$ oe		A1	
						Total 7 marks

14	ai		47	2	B1	cao
	ii		alternate angles		B1	Award this mark if 'alternate' appears
	b		124	1	B1	cao
	ci		47	2	B1	cao
	ii		angle between a chord and a tangent = angle in the alternate segment		B1	Accept 'alternate segment'
						Total 5 marks

15	a		12	1	B1	cao Do not accept (3, 12)
	b	0.2 3.6 6.1 or 6.2 or values rounding to these		2	B2	for all 3 correct solutions (B1 for 2 correct solutions or for 3 coordinates with correct solutions as *x*-coordinates)
	c	5 seen		2	M1	
			0		A1	cao
	d	tan drawn at (1, 16)		3	M1	tan or tan produced passes between points (0.5, 11 $\leq$ y $\leq$ 13) and (1.5, 19 $\leq$ y $\leq$ 21)
		$\dfrac{\text{vertical difference}}{\text{horizontal diffrerence}}$			M1	finds their $\dfrac{\text{vertical difference}}{\text{horizontal difference}}$ for two points on tan or finds the intercept of their tangent on the *y*-axis and substitutes *y* = 16, *x* = 1 and their *c* into *y* = *mx* + *c* or finds their $\dfrac{\text{vertical difference}}{\text{horizontal difference}}$ for two points on curve, where one of the points has an *x*-coordinate between 0.5 and 1 inc and the other point has an *x*-coordinate between 1 and 1.5 inc
			6–10 inc		A1	dep on both M marks
						Total 8 marks

16	a	$\pi \times 4^2 + \pi \times 4 \times 9$		2	M1	
			163		A1	for ans rounding to 163 ($\pi \rightarrow 163.3628...$ $3.14 \rightarrow 163.28$ $3.142 \rightarrow 163.384$)
	b	$\dfrac{6}{4}$ or 1.5 oe or 6 : 4 oe or $\dfrac{4}{6}$ oe or 4 : 6 oe		2	M1	May be implied by 13.5 or 12.09... Also award for cube of any correct values or cube of correct ratios
			3.375 oe		A1	for 3.375 or $3\dfrac{3}{8}$ or $\dfrac{27}{8}$ oe Accept 3.38 if M1 scored Do not award A1 if slant heights used as h in $v = \dfrac{1}{3}\pi r^2 h$
						Total 4 marks

17	i	$\frac{3}{5} \times \frac{2}{4}$		5	M1		Sample space method – award 2 marks for a correct answer, otherwise no marks
			$\frac{6}{20}$ or $\frac{3}{10}$		A1		
	ii	$\frac{1}{5} \times \frac{1}{4} \times 2 +$ " $\frac{6}{20}$ " or $\frac{2}{5} \times \frac{1}{4} +$ " $\frac{6}{20}$ "			M1	for $\frac{1}{5} \times \frac{1}{4}$ or $\frac{2}{5} \times \frac{1}{4}$	Award M0 M0 A0 for $\frac{1}{5} + \frac{1}{5} = \frac{2}{5}$ Sample space method – award 3 marks for a correct answer, otherwise no marks
					M1	for complete sum	
			$\frac{8}{20}$ or $\frac{2}{5}$ oe		A1		*SC*

SC details:

M1 for $\frac{1}{5} \times \frac{1}{5}$ or $\frac{1}{25}$	
M1 for $\frac{1}{5} \times \frac{1}{5} \times 2 +$ their(i)	Sample space method - award 2 marks for $\frac{11}{25}$ otherwise no marks

Total 5 marks

18	$\dfrac{(5x-1)(x+3)}{2(25x^2-1)}$ $\dfrac{(5x-1)(x+3)}{2(5x+1)(5x-1)}$		4	B1	for factorising numerator as $(5x-1)(x+3)$	
				B1	for factorising denominator as $2(25x^2-1)$	or B2 for factorising denominator as $(5x-1)(10x+2)$ or $(5x+1)(10x-2)$
				B1	for factorising $25x^2-1$ as $(5x+1)(5x-1)$	
		$\dfrac{x+3}{2(5x+1)}$ or $\dfrac{x+3}{10x+2}$		B1		

Total 4 marks

19	$2 \times 6 \sin39°$ or $2 \times 6 \cos51°$ or $6^2 + 6^2 - 2 \times 6 \times 6 \cos78°$ or $\dfrac{6\sin78°}{\sin51°}$		6	M1	
	7.551…			A1	for answer rounding to 7.55
	eg $\dfrac{78}{360} \times \pi \times 12$			M1	for $\dfrac{78}{360}$ oe inc 0.2166… rounded or truncated to at least 3 decimal places or for $\dfrac{360}{78}$ oe inc 4.6153… rounded or truncated to at least 3 decimal places
				M1	for $\pi \times 12$ or for $2\pi \times 6$ ($\pi \rightarrow$ 37.699… 3.14$\rightarrow$ 37.68 3.142$\rightarrow$ 37.704)
	8.16 - 8.17 inc oe inc $\dfrac{13\pi}{5}$, 2.6π oe			A1	for 8.17 or better ($\pi \rightarrow$ 8.168… 3.14$\rightarrow$ 8.164 3.142$\rightarrow$ 8.1692)
		15.7		A1	for ans rounding to 15.7 ($\pi \rightarrow$ 15.7199… 3.14$\rightarrow$15.7158… 3.142$\rightarrow$15.7202…)
					Total 6 marks

20	225 seen		3	B1	
	$\sqrt{225}$ or 15			B1	Award B1 for 15 only if 225 seen
		60		B1	cao Award only if preceding 2 marks scored
					Total 3 marks

21	$(x + 4)^2 = x^2 + (x + 6)^2 - 2x(x + 6)\cos 60°$ or $\cos 60° = \dfrac{(x + 6)^2 + x^2 - (x + 4)^2}{2x(x + 6)}$		5	M1		
	$x^2 + 4x + 4x + 16$ or $x^2 + 8x + 16$ and $x^2 + 6x + 6x + 36$ or $x^2 + 12x + 36$			B1	dep on M1 for correct expansion of $(x + 4)^2$ and $(x + 6)^2$ in correct statement of Cosine Rule	Omitted brackets may be implied by correct subsequent working.
	$x^2 + 8x + 16 = x^2 + x^2 + 12x + 36 − x^2 − 6x$ or $x^2 + 6x = x^2 + 12x + 36 + x^2 − x^2 − 8x − 16$ oe			B1	for correctly dealing with cos 60° and obtaining a correct equation with no fractions and no brackets	
	$2x = 20$ oe			B1	for correct linear equation e.g. $2x = 20$ $−2x = −20$, $4x = 40$, $2x − 20 = 0$	
		10		A1	cao dep on all preceding marks	
						Total 10 marks

Except for questions 9, 11, 21 (where the marking scheme states otherwise), unless clearly obtained by an incorrect method, a correct answer should be taken to imply a correct method.

Trial and improvement methods for solving equations score no marks, even if they lead to correct answers.

Q	Working	Answer	Mark		Notes
1	$\frac{2}{3} \times \frac{9}{5}$			M2	M1 for inverting 2nd fraction i.e. $\frac{9}{5}$
					or
	$\frac{6a}{9a}$ and $\frac{5a}{9a}$				M1 2 correct fractions with common denominators of a multiple of 9
	$\frac{6a}{9a} \div \frac{5a}{9a}$			M2	correct numerators and intention to divide
		$\frac{18}{15}$ or $\frac{6}{5}$	3	A1	any fraction equivalent to $1\frac{1}{5}$
					Do not allow decimal conversions
					Total 3 marks

Q		Working	Answer	Mark		Notes
2	i	3x -15 = 39 or 3(*x* – 5) = 39 or x-5=39/3			B3	do not accept x-5 =13
						B2 for 3*x* – 5 = 39 if x-5 seen otherwise B1
						B1 for x-5 seen B0 for x= 39/3 +5 oe
	ii					ft from any linear equation ax+b=c a>1 b,c ≠ 0
		3x = 54 or x - 5 = 13			M1	ax= c-b or x=c/a – b/a
			18	5	A1	18 with no working for answer in i) or ii) gets M1 A1
						Total 5 marks

3		$6 \times (-9 + 1)$ or -8 seen				M1	allow $6 \times -9 + 1$
		-48 or -54+6				M1	Accept $6/(-2)$ or $(3/8) \times -8$
			-3	3		A1	
							Total 3 marks

4		$67 \div 2$ or $(67 + 1) \div 2$ oe				M1	attempt to find middle of cumulative frequency or listing of people.
			7	2		A1	cao look for mean (7.56..) rounded down (M0 A0)
							Total 2 marks

5	a	$2 \times \pi \times 40$ oe				M1	
			251	2		A1	answer rounding to 251
	b	8 x 10 or 80				M1	
		$\pi \times 3^2$ (awrt 28.2 or 28.3)				M1	
		"8x10" – "$\pi \times 3^2$"				M1	dep on both M1's
			51.7	4		A1	answer rounding to 51.7
							Total 6 marks

6	a	$1 - (0.3 + 0.1 + 0.4)$				M1	
			0.2oe	2		A1	Look for answer in table if missing from answer line
	b	$0.3 + 0.4$				M1	
			0.7oe	2		A1	
							Total 4 marks

7	a		Correct ± 2 mm	2	B2	B1 for any 2 vertices correct ± 2 mm or translation of correct image
	b		Translation $\begin{pmatrix} -4 \\ 5 \end{pmatrix}$	2	B1 B1	translate or translated or -4 in *x* dir'n, or 4 to left or 4 west (not backwards or across) AND 5 in y dir'n or 5 up or 5 north (not (-4,5) or vectors without brackets) penalise contradictions
						Total 4 marks

8	a	$5.1^2 + 3.2^2$ (= 36.25) $\sqrt{}$"36.25"	 6.02	3	M1 M1 A1	M2 for $5.1/\cos(\tan^{-1}(3.2/5.1))$ or $3.2/\sin(\tan^{-1}(3.2/5.1))$ Must be complete methods answer rounding to 6.02
	b	tan selected 6.5 x tan 32°	 4.06	3	M1 M1 A1	$\sin 32° = $"AB"$/_{6.5/\cos 32}$ or "AB"$/\sin 32 = 6.5/\sin 58$ (*AB* =) $\sin 32° \times {}^{6.5}/_{\cos 32}$ or (AB=) $\sin 32 \times 6.5 / \sin 58$ answer rounding to 4.06
						Total 6 marks

9		12 - *x* = 21 or 12-21=x or-x=21-12	 -9	3	M2 A1	or $[-^x/_3 = 7 - {}^{12}/_3]$ or $[{}^{12}/_3 - 7 = {}^x/_3]$ M1 for 12–x=3x7 (Answer only gains no marks)
						Total 3 marks

10		A product of 3 or more factors of which 2 are from 2,2,3,11 1,2,2,3,11 or 2,2,3,11	 2 x 2 x 3 x 11	 3	 M2 A1	M1 can be implied from a factor tree or repeated division M2 can be implied from a factor tree or repeated division product must be stated (not dots for product)
						Total 3 marks

11		$[^{80}/_{40}]$ or $[^{84}/_{42}]$			B1	
		$\sqrt{36}$ or 6			B1	
			12	3	B1	dep on both previous B1's (Accept 10 only if $^{80}/_{40}$, 6 used)
						(Answer only gains no marks)
						Total 3 marks

12	a	$^{v}/_{h}$ in a correct Δ			M1	
			½ oe	2	A1	M1 A0 for ½ x
	b		$y =$ "½"$x + 2$ oe	2	B2	B1 for "½"$x + 2$ or L= "½"$x + 2$
	c		$y =$ "½"$x + c$	1	B1	c any number $\neq 2$ or letter or $y =$ "0.5"x
						or a line parallel to their b)
						Total 5 marks

13	a		60	1	B1	
	b	$^{y}/_{7.5} = ^{4}/_{5}$ oe			M1	correct ratios or correct use of sf (0.8 or 1.25 or 1.5 or 2/3)
			6	2	A1	
	c	$[^{z}/_{5} = ^{3}/_{4}]$ oe or $[^{z}/_{7.5} = ^{3}/_{"6"}]$			M1	allow ft on their "6" or correct use of sf (0.8 or 1.25 etc)
			3.75	2	A1	cao
						Total 5 marks

14	a		$^{1}/_{4}$		B1	P(tail) on lst throw
			binary tree structure		B1	
			all probs & labels correct	3	B1	
	b	"$^{1}/_{4}$" x "$^{1}/_{4}$"			M1	ft their 2 tail branches
			$^{1}/_{16}$ or 0.0625	2	A1	cao
						Total 5 marks

15	a		$3c^7d^5$	2	B2	B1 for c^7 or d^5 Accept 3 x c^7 xd^5
	b		$16x^{12}y^4$	2	B2	B1 for 16 or x^{12} or y^4 Accept 16 x x^{12} x y^4
	c	$\frac{2(x-3)}{x(x-3)}$			M1	either factorisation correct. Accept (x±0) (2±0)
			$\frac{2}{x}$	2	A1	Accept $\frac{2±0}{x±0}$ **Look for incorrect algebra**
						Total 6 marks

16	a		$(2x-3)(x+1)$	2	B2	B1 for one correct factor or $(2x+3)(x-1)$ (integers only)
	b		"1.5" and "-1"	1	B1	both req^d ft (a) if 2 linear factors
						Total 3 marks

17	a		$2x+3$	2	B2	B1 each term (accept $3x^0$)
	b		"-5"	1	B1	ft their $ax+b$ ($a, b \neq 0$)
	c	"$2x+3$" = 0			M1	only ft their $^{dy}/_{dx}$, if $ax+b$ ($a, b \neq 0$)
		$x = -^3/_2$			A1	cao dependent on 2x+3=0
			$(-^3/_2, -^9/_4)$ oe	3	A1	cao Answer dependent on 2x +3 =0 seen
						Total 6 marks

18	a		-x oe	1	B1	can be unsimplified
	b		x + y oe	1	B1	can be unsimplified
	c	Unsimplified expression in terms of x and y for PA or AP (either correct or ft from b) e.g.(AP=) "x+y"+y-½x or (PA=) ½x-y-"x-y"			B2	B1 Correct vector statement with at least 3 terms including AP or PA e.g.PA = PC + CA or AP = AC + CP can include x and/or y
			-0.5x-2y	3	B1	cao
						Total 5 marks

19	a	$^{80}/_{150}$ x 15 or 4 x 2 (small squares) (freq den)		8	2	M1 A1	M1 for any fd value in correct position and no errors or 1 large square=2.5 leaves or 1 small square=1/10 (leaf) oe
	b	Freq 4-5 = 12 and (freq 5-6 = 6 or freq 5-9=24) ½ ×(freq 4-5 + freq 5-6) or (½ x freq 4-5 + 1/8 x freq 5-9)		9	3	M1 M1 A1	12 & 6 seen or 12 & 24 or 60 & 30 (small squares) dep e.g. (0.5 x 12) +(0.5 x 6) or (0.5 x12)+(1/8 x 24) or 1/10 x 90
							Total 5 marks

20	ai	*BM* = 1 or CM =1				B1	(can be marked on diagram) allow cosine rule method
	ii	$(AM^2 =) 2^2 - 1^2$ (= 3) $(AM =) \sqrt{(2^2 - 1^2)}$ (= $\sqrt{3}$)	$^{\sqrt{3}}/_2$ or $\sqrt{¾}$	4		M1 M1 A1	(dependent on 1 line of Pythagoras or sine rule)
	b	$(^{\sqrt{3}}/_2)^2 + (^1/_2)^2$ = ¾ + ¼ oe			2	M1 A1	$(^{\sqrt{3}}/_2)^2$ Must be seen allow 0.75 + 0.25 if M1 gained
							Total 6 marks

21	a	$\dfrac{-3 \pm \sqrt{3^2 - 4 \times 2 \times (-1)}}{2 \times 2}$			M1	allow one sign error
		$\dfrac{-3 \pm \sqrt{17}}{4}$			M1	
			0.281 and -1.78	3	A1	both answers rounding to 0.281 & -1.78 (answer only gains no marks)
	b	$\dfrac{2(x+1)-x}{x(x+1)} = 1$			M1	$\dfrac{2(x+1)}{x} - 1 = x + 1$ or $2 - \dfrac{x}{x+1} = x$
		$2(x+1)-x = x(x+1)$			M1	removal of denominator
		$x^2 - 2 = 0$ oe			M1	correct gathering of terms
			$\pm\sqrt{2}$ or $\pm 1.41...$	4	A1	answer rounding to ± 1.41 (answer only gains no marks)
						Total 7 marks

22	a	$x \times 10^5 + 0.1y \times 10^5 = z \times 10^5$			M1	M1 for $0.1y$ or $(10^x \times 10^4 + y \times 10^4 = 10z \times 10^4)$ or $(10x + y = 10z)$
			$x + 0.1y$ oe	2	A1	
	bi		7.5	1	B1	
	ii	$0.75 \times 10^{n-m} (= a \times 10^p)$			M1	0.75 and $n-m$ seen (even in part i))
			$n - m - 1$	2	A1	
						Total 5 marks

Total 100 marks