

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	



General Certificate of Education  
Advanced Subsidiary Examination  
June 2014

# Statistics

# SS02

## Unit Statistics 2

Tuesday 10 June 2014 9.00 am to 10.30 am

**For this paper you must have:**

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

### Time allowed

- 1 hour 30 minutes

### Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

### Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.



J U N 1 4 S S 0 2 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** Todd is a dentist. Clients at Todd's surgery pay one of three possible fees: £20 for a check-up only, £50 for a check-up followed by minor treatment, and £210 for a check-up followed by major treatment. Experience shows that the probabilities for those needing treatment are as in the table.

	Fee	Probability
Check-up only	£20	
Check-up + minor treatment	£50	0.32
Check-up + major treatment	£210	0.11

- (a) (i) Write down the probability for clients needing a 'Check-up only'. [1 mark]
- (ii) Todd wants to draw a pie chart for his surgery wall to illustrate the data in the table. Calculate, to one decimal place, the angles that he should use for the three sectors. [2 marks]
- (b) Show that the mean amount paid by Todd's clients is £50.50 **and** find the standard deviation of the amount paid. [4 marks]
- (c) At present, Todd sees an average of 90 clients each week. He believes that he will increase this number by 20 per cent if he reduces the charge for a 'Check-up only' to £10, leaving the other fees unchanged.
- Assuming that this belief is true and that the probabilities remain unaltered, find:
- (i) the new mean amount paid by Todd's clients;
- (ii) the increase in Todd's average weekly income from his clients. [3 marks]

QUESTION  
PART  
REFERENCE

**Answer space for question 1**



QUESTION  
PART  
REFERENCE

**Answer space for question 1**

A large rectangular area with horizontal dotted lines for writing an answer.

**Turn over** ►



QUESTION  
PART  
REFERENCE

**Answer space for question 1**

A large rectangular area with horizontal dotted lines for writing an answer.



QUESTION  
PART  
REFERENCE

**Answer space for question 1**

A large rectangular area with horizontal dotted lines for writing an answer.



**Turn over** ►

**2** A specimen of radioactive rock emits  $\alpha$ -particles,  $\beta$ -particles and  $\gamma$ -rays. The  $\alpha$ -particles are detected at an average rate of 3.4 per second, the  $\beta$ -particles at an average rate of 2.6 per second and the  $\gamma$ -rays at an average rate of 4.0 per second. Assume that the numbers of  $\alpha$ -particles,  $\beta$ -particles and  $\gamma$ -rays detected may be modelled by independent Poisson distributions.

**(a)** Find the probability that:

**(i)** during a particular second, fewer than 4  $\alpha$ -particles are detected;

[1 mark]

**(ii)** during a particular period of 5 seconds, more than 10  $\beta$ -particles but fewer than 20  $\beta$ -particles are detected.

[4 marks]

**(b)** Find the probability that:

**(i)** during a particular second, at least one  $\gamma$ -ray is detected;

[2 marks]

**(ii)** during a particular period of 3 seconds,  $\gamma$ -rays will be detected in exactly 2 of the 3 seconds.

[3 marks]

**(c)** The **total** number of  $\alpha$ -particles,  $\beta$ -particles and  $\gamma$ -rays detected during a period of 10 seconds is modelled by a random variable,  $X$ .

State values for the mean and the standard deviation of  $X$ .

[2 marks]

**(d)** It is discovered that one of the constituents of the rock can emit a  $\beta$ -particle followed within a second by an  $\alpha$ -particle.

Explain why this would make your answer to part **(c)** **invalid**.

[1 mark]

QUESTION  
PART  
REFERENCE

**Answer space for question 2**



QUESTION  
PART  
REFERENCE

**Answer space for question 2**

A large rectangular area with horizontal dotted lines for writing an answer.

**Turn over** ►



QUESTION  
PART  
REFERENCE

**Answer space for question 2**

A large rectangular area containing horizontal dotted lines for writing an answer.





QUESTION  
PART  
REFERENCE

**Answer space for question 2**

A large rectangular area with horizontal dotted lines for writing an answer.



**Turn over** ►

**3** The deputy principal of a college kept a daily record of the percentage of students absent. The data for weeks 3 and 4 of the college year are shown in the table below, together with the values of an appropriate moving average.

Week	Day	Percentage absent	Moving average
3	Monday	6.4	
	Tuesday	4.6	
	Wednesday	4.1	6.40
	Thursday	6.5	<i>m</i>
	Friday	10.4	7.88
4	Monday	10.1	8.58
	Tuesday	8.3	9.32
	Wednesday	7.6	10.00
	Thursday	10.2	
	Friday	13.8	

(a) Calculate the value of the missing moving average, *m*. [3 marks]

(b) The values of the percentages absent are plotted on **Figure 1** opposite.

(i) Plot the moving averages on **Figure 1** and draw a trend line by eye. [2 marks]

(ii) Hence describe the variation and trend in percentage absent. [2 marks]

(c) Assuming that the current pattern continued, use the trend line and the seasonal effect for Friday to forecast the percentage absent on the Friday of week 5, showing how you obtained this forecast. [5 marks]

(d) The deputy principal was keen that the current pattern should not continue and so, at the beginning of week 5, introduced incentives to encourage attendance. The percentage absent on the Friday of week 5 was 15.2.

Make **two** comments about the success of the deputy principal's incentives. [2 marks]

QUESTION  
PART  
REFERENCE

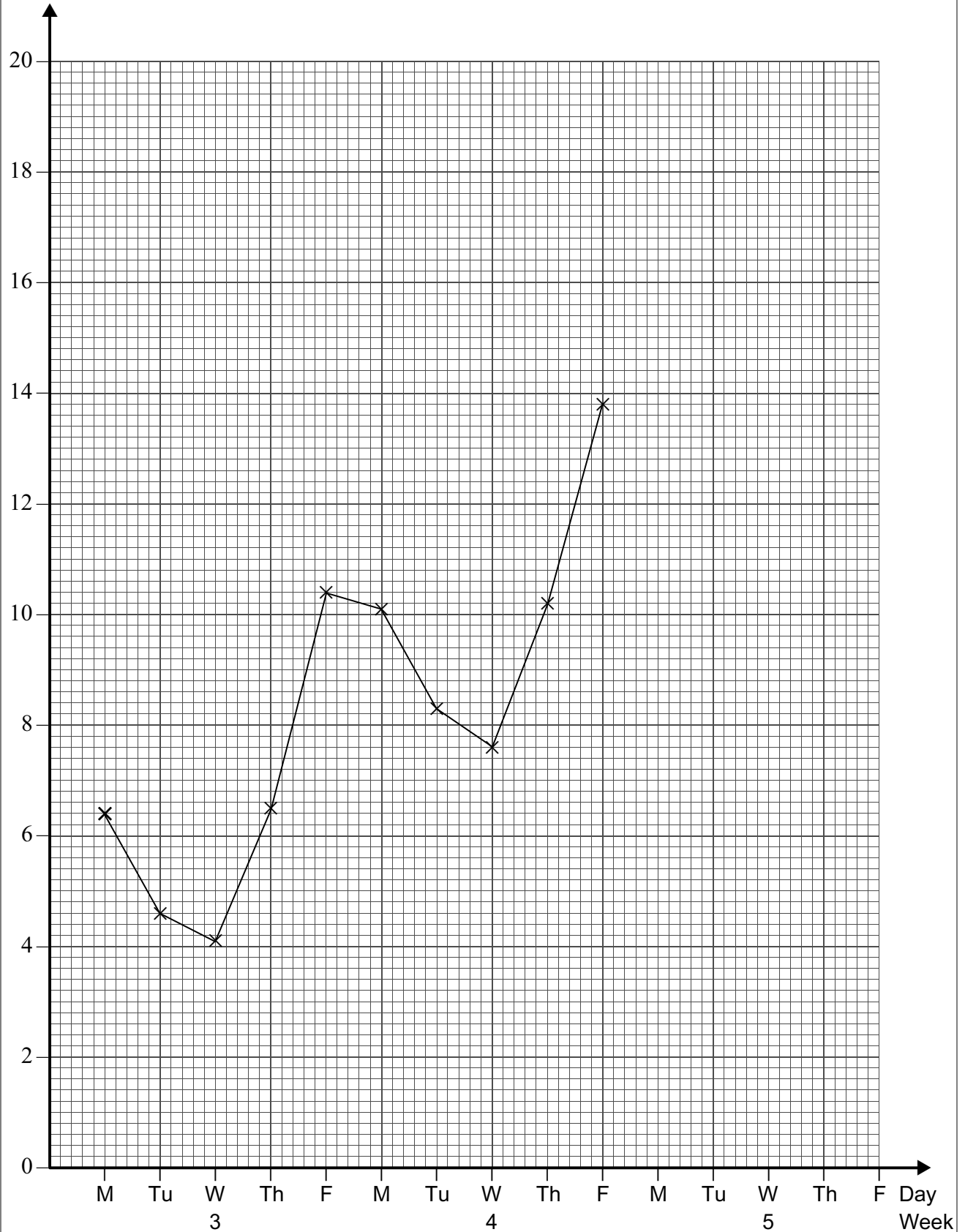
**Answer space for question 3**



Answer space for question 3

Figure 1

Percentage absent



Turn over ►



QUESTION  
PART  
REFERENCE

**Answer space for question 3**

A large rectangular area containing horizontal dotted lines for writing an answer.



QUESTION  
PART  
REFERENCE

**Answer space for question 3**

A large rectangular area with horizontal dotted lines for writing an answer.

**Turn over** ►



**4** A company produces low-energy light bulbs. The bulbs are described as using 9 watts of power. Amir, the production manager, asked Jenny to measure the power used by each of a sample of 120 bulbs from the latest batch produced and to test the hypothesis that the mean for the batch is 9.0 watts. Jenny is to carry out the test at the 5% significance level.

**(a)** What assumption must be made about the sample of 120 bulbs if the result of this test is to be valid?

[1 mark]

**(b)** Jenny found that the mean for the sample was 9.2 watts and that the standard deviation was 1.3 watts. Carry out the test asked for by Amir.

[8 marks]

**(c)** When Jenny reported the conclusion of the test to Amir, he said that he had intended to ask Jenny to test whether the bulbs in the batch use more than 9.0 watts on average.

For the test in part **(b)**, state the effect that this new information would have on:

- (i)** the alternative hypothesis;
- (ii)** the critical value(s);
- (iii)** the conclusion.

[4 marks]

QUESTION  
PART  
REFERENCE

**Answer space for question 4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



QUESTION  
PART  
REFERENCE

**Answer space for question 4**

A large rectangular area with horizontal dotted lines for writing an answer.



QUESTION  
PART  
REFERENCE

**Answer space for question 4**

A large rectangular area containing horizontal dotted lines for writing an answer.





QUESTION  
PART  
REFERENCE

**Answer space for question 4**

A large rectangular area with horizontal dotted lines for writing an answer.

**Turn over** ►



**5** Bronwyn wants to conduct a survey of a sample of 50 pupils in her school in order to collect information about the ways they travel to school. She plans to use a stratified sample to reflect the proportions of boys and girls and also the number of pupils in each year.

The data for the whole school are given in **Table 1**.

**Table 1**

	<b>Year 7</b>	<b>Year 8</b>	<b>Year 9</b>	<b>Year 10</b>	<b>Year 11</b>
<b>Boys</b>	66	71	75	84	87
<b>Girls</b>	61	72	75	80	79

**(a)** Calculate the numbers of boys and girls from each year that Bronwyn should have in her sample and enter them in **Table 2**, below.

**[4 marks]**

**(b)** Bronwyn plans to use systematic sampling to select her sample of pupils from each year. She can produce, on the school computer system, a list of the pupils by year which also identifies them as boy or girl.

**For Year 9:**

**(i)** state how the list should be arranged so that the systematic sample will be stratified for gender;

**(ii)** describe in detail how Bronwyn selects the pupils to be in her sample.

**[4 marks]**

**(c)** Bronwyn might have chosen to select her sample using quota sampling of pupils as they arrive at school.

Give **one** advantage and **one** disadvantage of quota sampling in the context of this question.

**[2 marks]**

QUESTION  
PART  
REFERENCE

**Answer space for question 5**

**(a)**

**Table 2**

	<b>Year 7</b>	<b>Year 8</b>	<b>Year 9</b>	<b>Year 10</b>	<b>Year 11</b>
<b>Boys</b>					
<b>Girls</b>					



QUESTION  
PART  
REFERENCE

**Answer space for question 5**

A large rectangular area with horizontal dotted lines for writing an answer.

**Turn over** ►



QUESTION  
PART  
REFERENCE

**Answer space for question 5**

A large rectangular area with horizontal dotted lines for writing an answer.



QUESTION  
PART  
REFERENCE

**Answer space for question 5**

A large rectangular area containing horizontal dotted lines for writing an answer.

**Turn over** ►



6 **Table 3** contains data about the numbers of live births to mothers of different ages in England and Wales during the period 1961 to 2010.

**Table 3**  
**Live births by age of mother, 1961–2010 England and Wales Numbers**

Year	All ages	Under 20	20–24	25–29	30–34	35–39	40 and over
2010	723 165	40 591	137 312	199 233	202 457	115 841	27 731
2009	706 248	43 243	136 012	194 129	191 600	114 288	26 976
2008	708 711	44 691	135 971	192 960	192 450	116 220	26 419
2007	690 013	44 805	130 784	182 570	191 124	115 380	25 350
2006	669 601	45 509	127 828	172 642	189 407	110 509	23 706
2005	645 835	44 830	122 145	164 348	188 153	104 113	22 246
2004	639 721	45 094	121 072	159 984	190 550	102 228	20 793
2003	621 469	44 236	116 622	156 931	187 214	97 386	19 080
2002	596 122	43 467	110 959	153 379	180 532	90 449	17 336
2001	594 634	44 189	108 844	159 926	178 920	86 495	16 260
2000	604 441	45 846	107 741	170 701	180 113	84 974	15 066
1999	621 872	48 375	110 722	181 931	185 311	81 281	14 252
1998	635 901	48 285	113 537	193 144	188 499	78 881	13 555
1997	643 095	46 372	118 589	202 792	187 528	74 900	12 914
1996	649 485	44 667	125 732	211 103	186 377	69 503	12 103
1995	648 138	41 938	130 744	217 418	181 202	65 517	11 319
1994	664 726	42 026	140 240	229 102	179 568	63 061	10 729
1993	673 467	45 121	151 975	235 961	171 061	58 824	10 525
1992	689 656	47 861	163 311	244 798	166 839	56 650	10 197
1991	699 217	52 396	173 356	248 727	161 259	53 644	9 835
1990	706 140	55 541	180 136	252 577	156 264	51 905	9 717
1989	687 725	55 543	185 239	242 822	145 320	49 465	9 336
1988	693 577	58 741	193 726	243 460	140 974	47 649	9 027
1987	681 511	57 545	193 232	238 929	136 558	46 604	8 643
1986	661 018	57 406	192 064	229 035	129 487	45 465	7 561
1985	656 417	56 929	193 958	227 486	126 185	44 393	7 466
1984	636 818	54 508	191 455	218 031	122 774	42 921	7 129
1983	629 134	54 059	191 852	214 078	120 996	41 277	6 872
1982	625 931	55 435	192 322	211 905	120 758	38 992	6 519
1981	634 492	56 570	194 500	215 760	126 590	34 210	6 860
1980	656 234	60 754	201 541	223 438	129 908	33 893	6 700
1979	638 028	59 143	193 209	222 102	125 664	31 394	6 516
1978	596 418	55 984	182 580	210 598	113 077	27 937	6 242
1977	569 259	54 477	174 544	207 916	100 807	25 527	5 988
1976	584 270	57 943	182 210	220 712	90 791	26 117	6 497
1975	603 445	63 507	190 198	225 990	88 379	28 147	7 224
1974	639 885	68 724	208 084	235 593	89 132	30 308	8 044
1973	675 953	73 270	223 675	243 753	91 800	34 178	9 277
1972	725 440	79 087	249 109	247 676	98 739	39 821	11 008
1971	783 155	82 641	285 703	247 239	109 616	45 224	12 732
1970	784 486	80 975	289 209	238 228	114 086	48 323	13 665
1969	797 538	81 659	289 012	238 381	120 395	52 843	15 248
1968	819 272	82 075	295 946	240 807	125 316	58 083	17 045
1967	832 164	84 542	291 656	243 802	130 279	63 085	18 800
1966	849 823	86 746	285 808	253 743	136 406	67 036	20 084
1965	862 725	81 611	278 874	263 395	144 638	72 022	22 185
1964	875 972	76 734	276 103	270 700	153 513	75 371	23 551
1963	854 055	71 640	267 559	263 241	153 696	74 401	23 518
1962	838 736	67 334	260 882	256 386	153 985	76 219	23 930
1961	811 281	59 786	249 829	248 540	152 286	77 516	23 324

Source: Office for National Statistics



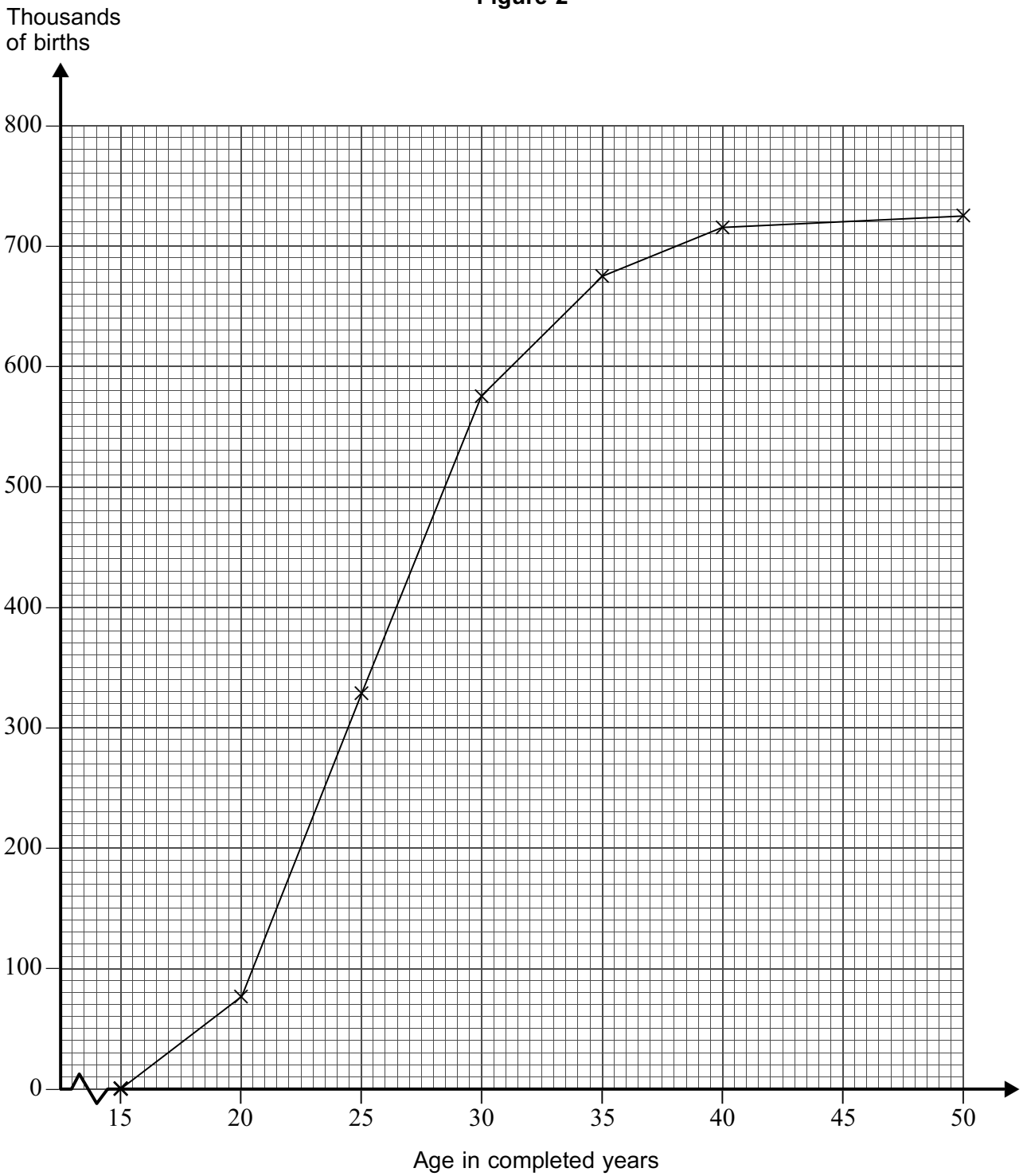






Answer space for question 6(d)

Figure 2



Excerpt from Table 3

Year	All ages	Under 20	20–24	25–29	30–34	35–39	40 and over
2010	723 165	40 591	137 312	199 233	202 457	115 841	27 731

Question 6 continues on the next page

Turn over ►





**Table 3**  
**Live births by age of mother, 1961–2010 England and Wales Numbers**

Year	All ages	Under 20	20–24	25–29	30–34	35–39	40 and over
2010	723 165	40 591	137 312	199 233	202 457	115 841	27 731
2009	706 248	43 243	136 012	194 129	191 600	114 288	26 976
2008	708 711	44 691	135 971	192 960	192 450	116 220	26 419
2007	690 013	44 805	130 784	182 570	191 124	115 380	25 350
2006	669 601	45 509	127 828	172 642	189 407	110 509	23 706
2005	645 835	44 830	122 145	164 348	188 153	104 113	22 246
2004	639 721	45 094	121 072	159 984	190 550	102 228	20 793
2003	621 469	44 236	116 622	156 931	187 214	97 386	19 080
2002	596 122	43 467	110 959	153 379	180 532	90 449	17 336
2001	594 634	44 189	108 844	159 926	178 920	86 495	16 260
2000	604 441	45 846	107 741	170 701	180 113	84 974	15 066
1999	621 872	48 375	110 722	181 931	185 311	81 281	14 252
1998	635 901	48 285	113 537	193 144	188 499	78 881	13 555
1997	643 095	46 372	118 589	202 792	187 528	74 900	12 914
1996	649 485	44 667	125 732	211 103	186 377	69 503	12 103
1995	648 138	41 938	130 744	217 418	181 202	65 517	11 319
1994	664 726	42 026	140 240	229 102	179 568	63 061	10 729
1993	673 467	45 121	151 975	235 961	171 061	58 824	10 525
1992	689 656	47 861	163 311	244 798	166 839	56 650	10 197
1991	699 217	52 396	173 356	248 727	161 259	53 644	9 835
1990	706 140	55 541	180 136	252 577	156 264	51 905	9 717
1989	687 725	55 543	185 239	242 822	145 320	49 465	9 336
1988	693 577	58 741	193 726	243 460	140 974	47 649	9 027
1987	681 511	57 545	193 232	238 929	136 558	46 604	8 643
1986	661 018	57 406	192 064	229 035	129 487	45 465	7 561
1985	656 417	56 929	193 958	227 486	126 185	44 393	7 466
1984	636 818	54 508	191 455	218 031	122 774	42 921	7 129
1983	629 134	54 059	191 852	214 078	120 996	41 277	6 872
1982	625 931	55 435	192 322	211 905	120 758	38 992	6 519
1981	634 492	56 570	194 500	215 760	126 590	34 210	6 860
1980	656 234	60 754	201 541	223 438	129 908	33 893	6 700
1979	638 028	59 143	193 209	222 102	125 664	31 394	6 516
1978	596 418	55 984	182 580	210 598	113 077	27 937	6 242
1977	569 259	54 477	174 544	207 916	100 807	25 527	5 988
1976	584 270	57 943	182 210	220 712	90 791	26 117	6 497
1975	603 445	63 507	190 198	225 990	88 379	28 147	7 224
1974	639 885	68 724	208 084	235 593	89 132	30 308	8 044
1973	675 953	73 270	223 675	243 753	91 800	34 178	9 277
1972	725 440	79 087	249 109	247 676	98 739	39 821	11 008
1971	783 155	82 641	285 703	247 239	109 616	45 224	12 732
1970	784 486	80 975	289 209	238 228	114 086	48 323	13 665
1969	797 538	81 659	289 012	238 381	120 395	52 843	15 248
1968	819 272	82 075	295 946	240 807	125 316	58 083	17 045
1967	832 164	84 542	291 656	243 802	130 279	63 085	18 800
1966	849 823	86 746	285 808	253 743	136 406	67 036	20 084
1965	862 725	81 611	278 874	263 395	144 638	72 022	22 185
1964	875 972	76 734	276 103	270 700	153 513	75 371	23 551
1963	854 055	71 640	267 559	263 241	153 696	74 401	23 518
1962	838 736	67 334	260 882	256 386	153 985	76 219	23 930
1961	811 281	59 786	249 829	248 540	152 286	77 516	23 324

Source: Office for National Statistics

Turn over ►



QUESTION  
PART  
REFERENCE

**Answer space for question 6(e)**

Area with horizontal dotted lines for writing answers.

**END OF QUESTIONS**

Acknowledgement of copyright holders and publishers

Question 6 contains public sector information licensed under the Open Government Licence v1.0

Copyright © 2014 AQA and its licensors. All rights reserved.

