Free-Standing Mathematics Qualification
June 2006
Advanced Level

USING AND APPLYING STATISTICS **6990/2**
Unit 10

Friday 19 May 2006 9.00 am to 10.30 am

For this paper you must have:
- an 8-page answer book
- an answer sheet for use in Questions 1, 5 and 6 (enclosed)
- the booklet of formulae and statistical tables (enclosed)
- a calculator
- a clean copy of the Data Sheet (enclosed)
- a protractor
- a ruler

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book **and** on the top of the answer sheet for Questions 1, 5 and 6. The *Examining Body* for this paper is AQA. The *Paper Reference* is 6990/2.
- Answer **all** questions.
- All necessary working should be shown; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of calculators or tables should normally be given to three significant figures.
- You may **not** refer to the copy of the Data Sheet that was available prior to this examination. A clean copy is available for your use.
- At the end of the examination, remember to hand in both your answer book **and** the answer sheet for Questions 1, 5 and 6.

Information
- The maximum mark for this paper is 60.
- The marks for questions are shown in brackets.
- You may use either a scientific or a graphics calculator.

SECTION A

Answer **all** questions.

Use **Birds** *on page 2 of the Data Sheet.*

1 The length and wingspan data are repeated in the table below.

	Length *l* (cm)	**Wingspan *w* (cm)**
Blackbird	25	36
Blue Tit	11	19
Chaffinch	14	27
Collared Dove	32	51
Dunnock	14	20
Great Tit	14	24
Greenfinch	15	26
House Sparrow	15	23
Magpie	45	56
Robin	14	21
Starling	21	40
Woodpigeon	41	78

(a) Use your calculator to find:

(i) the mean length, $\bar{l}$, and the mean wingspan, $\bar{w}$;

(ii) the correlation coefficient between w and l;

(iii) the equation of the line of best fit. *(5 marks)*

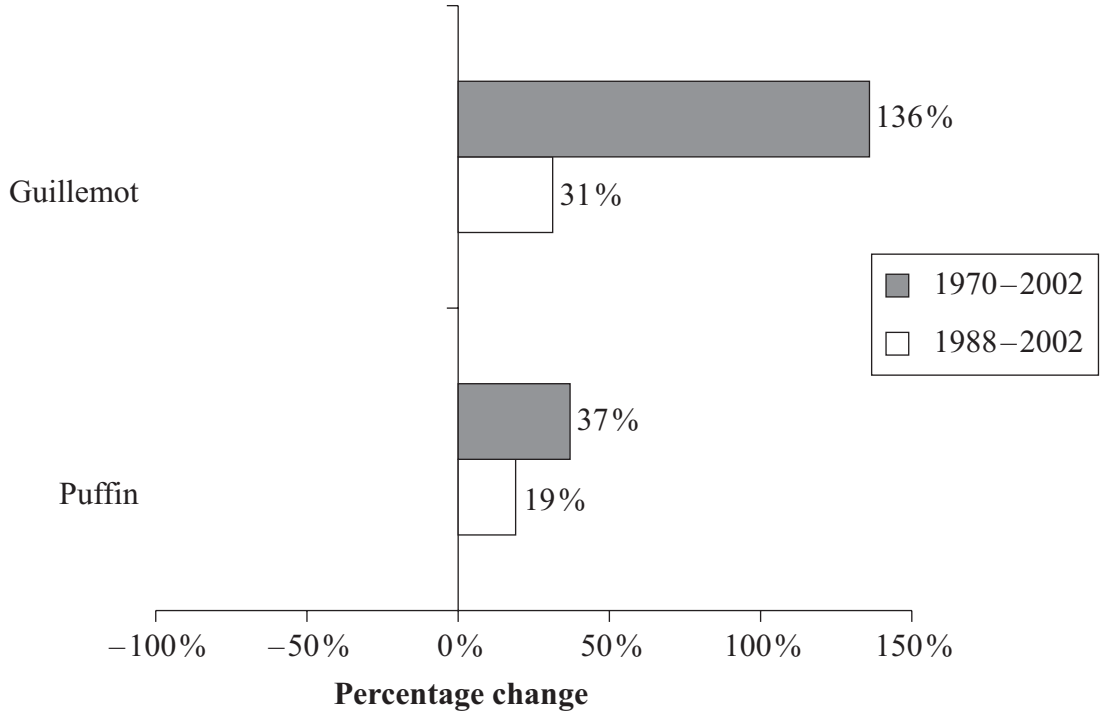
(b) Plot the line of best fit on the scatter diagram on the answer sheet. *(4 marks)*

(c) Briefly interpret the gradient of the line of best fit in terms of the length and wingspan of garden birds. *(2 marks)*

(d) The correlation coefficient between wingspan and length for seabirds is 0.811. Explain what this tells you about the relationship between wingspan and length of seabirds when compared with that of garden birds. *(2 marks)*

2 The bar chart below gives the percentage changes in the numbers of two types of breeding seabird in the UK between 1970 and 2002 and between 1988 and 2002.

Changes in the numbers of breeding seabirds in the UK



(a) Given that there were 601 000 **guillemots** in the UK in 1970, how many were there in:

(i) 2002;

(ii) 1988? *(5 marks)*

(b) Calculate the percentage change in the number of **puffins** between 1970 and 1988. *(4 marks)*

Turn over for the next question

SECTION B

Answer **all** questions.

Use **Road traffic statistics** *on page 3 of the Data Sheet.*

3 (a) Use the pie charts to calculate:

(i) the proportion of vehicles observed on urban roads that were cars;

(ii) the proportion of vehicles observed on motorways that were cars.

(iii) Make a brief comparison of these proportions. *(3 marks)*

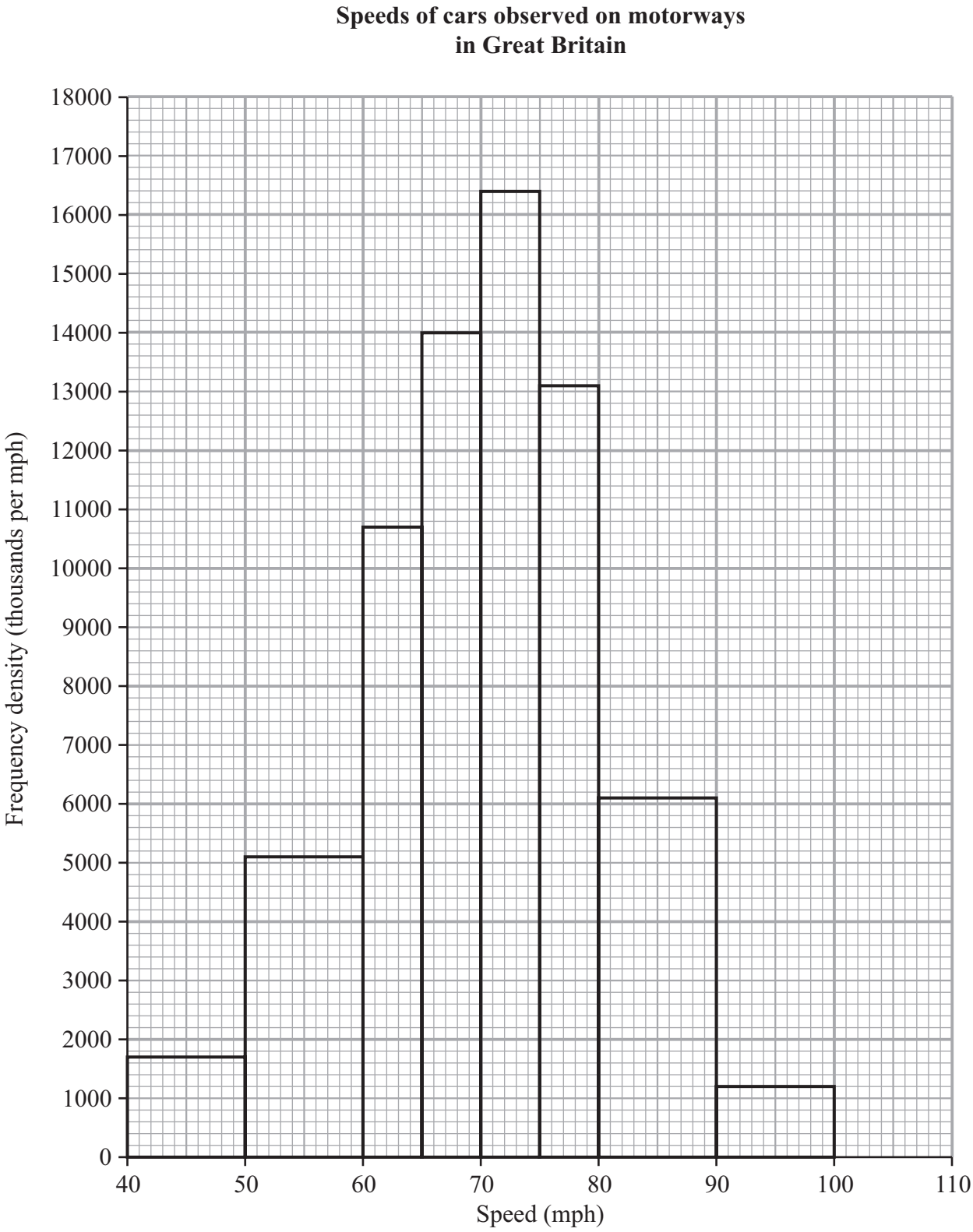
(b) The number of cars observed on motorways was 412 million.

Estimate:

(i) the total number of vehicles observed on motorways;

(ii) the total number of vehicles observed on urban roads. *(5 marks)*

4 The histogram below shows the speeds of the 412 million cars that were observed on motorways.



The speed limit on motorways is 70 miles per hour.

Use the histogram to estimate the percentage of cars observed on motorways that were breaking this speed limit. *(4 marks)*

Turn over ▶

5 The speeds of the 2.5 million motorcycles that were observed on motorways have been used to draw the cumulative frequency graph on the answer sheet.

(a) Use the cumulative frequency graph to find an estimate of:

(i) the median;

(ii) the inter-quartile range;

of the motorcycle speeds.

Show clearly how you find these measures on the graph on the answer sheet. *(3 marks)*

(b) Use the cumulative frequency graph to estimate the percentage of motorcycles observed on motorways that were breaking the 70 mph speed limit. *(3 marks)*

SECTION C

Answer **all** questions.

Use **Height** *on page 4 of the Data Sheet.*

6 The data for the sample of 13-year-old girls are repeated in the table below.

Height (cm)	Number of girls
$90 < x \leq 110$	2
$110 < x \leq 120$	1
$120 < x \leq 130$	6
$130 < x \leq 140$	14
$140 < x \leq 150$	108
$150 < x \leq 160$	438
$160 < x \leq 170$	374
$170 < x \leq 180$	54
$180 < x \leq 200$	3

(a) Complete the table on the answer sheet by using your calculator to estimate:

(i) the mean;

(ii) the standard deviation;

of the heights of the sample of girls aged 13 years. *(4 marks)*

(b) Explain why the values you have found in part (a) are estimates. *(1 mark)*

(c) Using the values in the table on the answer sheet:

(i) interpret what the values of the **mean** tell you about the heights of girls and boys at ages 11, 12 and 13;

(ii) interpret what the values of the **standard deviation** tell you about the heights of **boys** at ages 11 years, 12 years and 13 years. *(5 marks)*

Turn over for the next question

7 Assume that the heights of boys aged 13 years are normally distributed with mean 159.45 cm and standard deviation 11.06 cm.

(a) Calculate the probability that a boy aged 13 years will have a height of more than 170 cm. *(5 marks)*

(b) How many of a random sample of 1000 boys aged 13 years would you expect to be more than 170 cm tall? *(2 marks)*

(c) Comment on your answer to part (b) and the data for the sample of boys aged 13 years on the Data Sheet. *(3 marks)*

END OF QUESTIONS

ACKNOWLEDGEMENT OF COPYRIGHT-HOLDERS AND PUBLISHERS

Bird length and wingspan: Information courtesy of the RSPB

Breeding Seabirds: Joint Nature Conservation Committee, *www.jncc.gov.uk* from Mitchell, Newton, Ratcliffe & Dunn, *Seabird Populations of Britain & Ireland*, 2004 T & AD Poyser, an imprint of A & C Black Publishers Ltd.

Surname		Other Names	
Centre Number						Candidate Number				
Candidate Signature										

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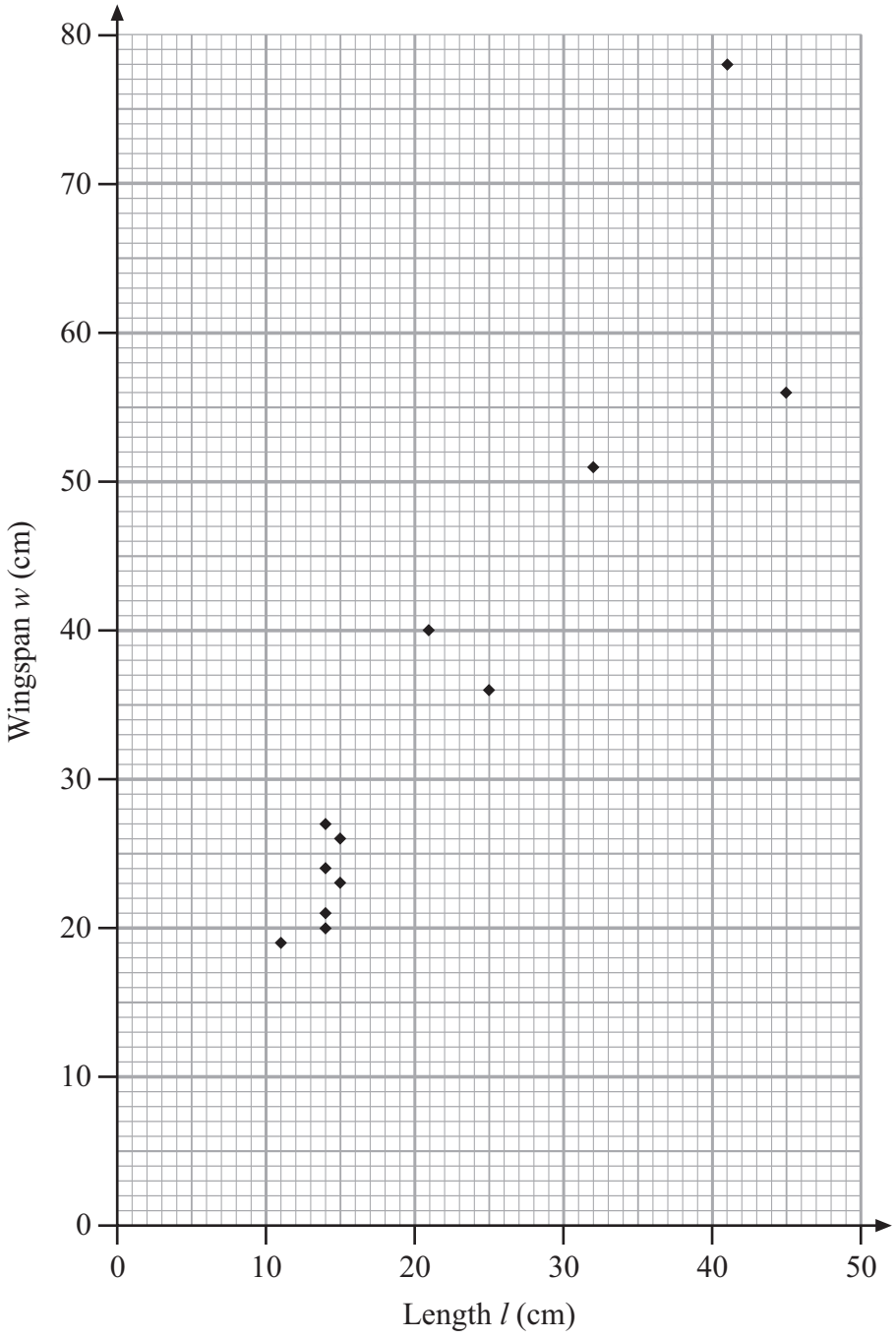
ASSESSMENT and QUALIFICATIONS ALLIANCE

USING AND APPLYING STATISTICS **6990/2AS**
Unit 10

This answer sheet is to be used when answering Questions 1, 5 and 6, as indicated.
Fasten this sheet securely to your answer book.

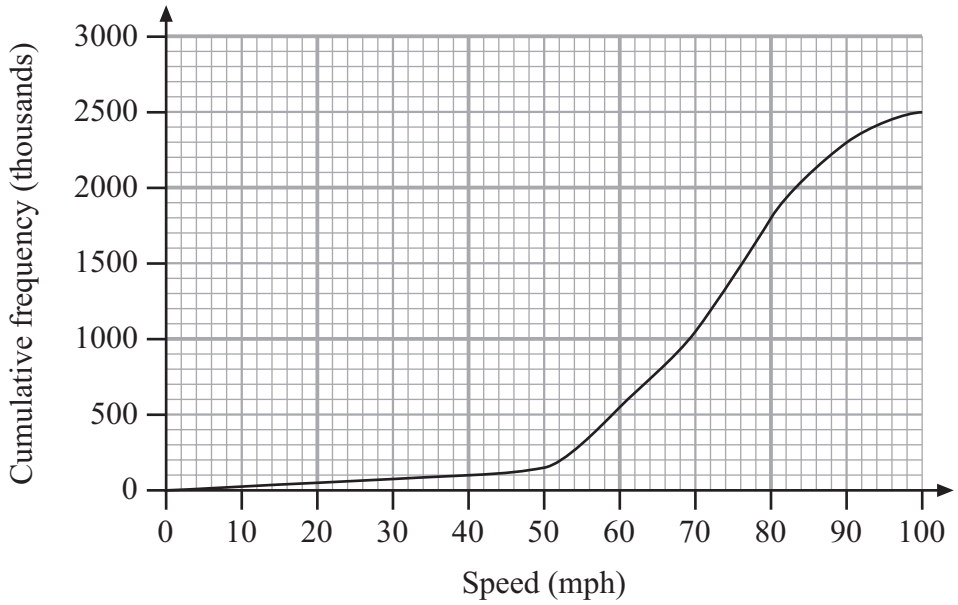
This graph is to be used when answering Question 1(b).

Garden birds
Scatter graph of wingspan against length



This graph is to be used when answering Question 5 parts (a) and (b).

Cumulative frequency graph showing speeds of motorcycles observed on motorways in Great Britain



This table is to be used when answering Question 6(a).

Give values correct to 2 decimal places.

Age	**11 years**		**12 years**		**13 years**	
	Girls	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**
Mean (cm)	148.08	147.20	153.58	152.98		159.45
Standard deviation (cm)	9.29	9.12	9.52	9.71		11.06

END OF ANSWER SHEET

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USING AND APPLYING STATISTICS **6990/2FST**
Unit 10

FORMULAE AND STATISTICAL TABLES

Formulae

The product-moment correlation coefficient for bi-variate data: $r = \dfrac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$,

where $S_{xy} = \sum[(x_i - \bar{x})y_i]$

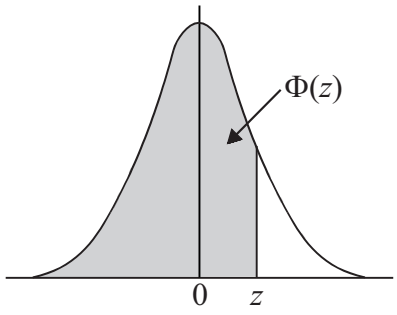
$S_{xx} = \sum[(x_i - \bar{x})x_i]$

$S_{yy} = \sum[(y_i - \bar{y})y_i]$.

Spearman's rank correlation coefficient: $r = 1 - \dfrac{6\sum d^2}{n(n^2 - 1)}$.

Normal Distribution

The tabulated value is $\Phi(z) = P(Z \leq z)$ where Z is the standardised normal random variable.



z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5909	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999

END OF FORMULA SHEET

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