

|   |  |  |   |
|---|--|--|---|
| Write your name here  |  |  |   |
| Surname   |  | Other names  |   |
| <b>Pearson</b><br><b>Edexcel Award</b>  |  | Centre Number  | Candidate Number  |
|   |  | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>Statistical Methods</b><br><b>Level 3</b><br><b>Calculator allowed</b>       |  |  |   |
| Wednesday 14 May 2014 – Morning<br><b>Time: 2 hours</b>                         |  | Paper Reference<br><b>AST30/01</b>   |   |
| <b>You must have:</b><br>Pen, HB pencil, eraser, calculator, ruler, protractor. |  |  | Total Marks<br><br>   |

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- **Calculators may be used.**
- If your calculator does not have a  $\pi$  button, take the value of  $\pi$  to be 3.142 unless the question instructs otherwise.



### Information

- The total mark for this paper is 90
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- Normal distribution tables can be found on the inside of the front cover of this paper.

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

**P43630A**

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PEARSON

# THE NORMAL DISTRIBUTION FUNCTION

The function tabulated below is  $\Phi(z)$ , defined as  $\Phi(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^z e^{-\frac{1}{2}t^2} dt$ .

| $z$  | $\Phi(z)$ | $z$  | $\Phi(z)$ | $z$  | $\Phi(z)$ | $z$  | $\Phi(z)$ | $z$  | $\Phi(z)$ |
|------|-----------|------|-----------|------|-----------|------|-----------|------|-----------|
| 0.00 | 0.5000    | 0.50 | 0.6915    | 1.00 | 0.8413    | 1.50 | 0.9332    | 2.00 | 0.9772    |
| 0.01 | 0.5040    | 0.51 | 0.6950    | 1.01 | 0.8438    | 1.51 | 0.9345    | 2.02 | 0.9783    |
| 0.02 | 0.5080    | 0.52 | 0.6985    | 1.02 | 0.8461    | 1.52 | 0.9357    | 2.04 | 0.9793    |
| 0.03 | 0.5120    | 0.53 | 0.7019    | 1.03 | 0.8485    | 1.53 | 0.9370    | 2.06 | 0.9803    |
| 0.04 | 0.5160    | 0.54 | 0.7054    | 1.04 | 0.8508    | 1.54 | 0.9382    | 2.08 | 0.9812    |
| 0.05 | 0.5199    | 0.55 | 0.7088    | 1.05 | 0.8531    | 1.55 | 0.9394    | 2.10 | 0.9821    |
| 0.06 | 0.5239    | 0.56 | 0.7123    | 1.06 | 0.8554    | 1.56 | 0.9406    | 2.12 | 0.9830    |
| 0.07 | 0.5279    | 0.57 | 0.7157    | 1.07 | 0.8577    | 1.57 | 0.9418    | 2.14 | 0.9838    |
| 0.08 | 0.5319    | 0.58 | 0.7190    | 1.08 | 0.8599    | 1.58 | 0.9429    | 2.16 | 0.9846    |
| 0.09 | 0.5359    | 0.59 | 0.7224    | 1.09 | 0.8621    | 1.59 | 0.9441    | 2.18 | 0.9854    |
| 0.10 | 0.5398    | 0.60 | 0.7257    | 1.10 | 0.8643    | 1.60 | 0.9452    | 2.20 | 0.9861    |
| 0.11 | 0.5438    | 0.61 | 0.7291    | 1.11 | 0.8665    | 1.61 | 0.9463    | 2.22 | 0.9868    |
| 0.12 | 0.5478    | 0.62 | 0.7324    | 1.12 | 0.8686    | 1.62 | 0.9474    | 2.24 | 0.9875    |
| 0.13 | 0.5517    | 0.63 | 0.7357    | 1.13 | 0.8708    | 1.63 | 0.9484    | 2.26 | 0.9881    |
| 0.14 | 0.5557    | 0.64 | 0.7389    | 1.14 | 0.8729    | 1.64 | 0.9495    | 2.28 | 0.9887    |
| 0.15 | 0.5596    | 0.65 | 0.7422    | 1.15 | 0.8749    | 1.65 | 0.9505    | 2.30 | 0.9893    |
| 0.16 | 0.5636    | 0.66 | 0.7454    | 1.16 | 0.8770    | 1.66 | 0.9515    | 2.32 | 0.9898    |
| 0.17 | 0.5675    | 0.67 | 0.7486    | 1.17 | 0.8790    | 1.67 | 0.9525    | 2.34 | 0.9904    |
| 0.18 | 0.5714    | 0.68 | 0.7517    | 1.18 | 0.8810    | 1.68 | 0.9535    | 2.36 | 0.9909    |
| 0.19 | 0.5753    | 0.69 | 0.7549    | 1.19 | 0.8830    | 1.69 | 0.9545    | 2.38 | 0.9913    |
| 0.20 | 0.5793    | 0.70 | 0.7580    | 1.20 | 0.8849    | 1.70 | 0.9554    | 2.40 | 0.9918    |
| 0.21 | 0.5832    | 0.71 | 0.7611    | 1.21 | 0.8869    | 1.71 | 0.9564    | 2.42 | 0.9922    |
| 0.22 | 0.5871    | 0.72 | 0.7642    | 1.22 | 0.8888    | 1.72 | 0.9573    | 2.44 | 0.9927    |
| 0.23 | 0.5910    | 0.73 | 0.7673    | 1.23 | 0.8907    | 1.73 | 0.9582    | 2.46 | 0.9931    |
| 0.24 | 0.5948    | 0.74 | 0.7704    | 1.24 | 0.8925    | 1.74 | 0.9591    | 2.48 | 0.9934    |
| 0.25 | 0.5987    | 0.75 | 0.7734    | 1.25 | 0.8944    | 1.75 | 0.9599    | 2.50 | 0.9938    |
| 0.26 | 0.6026    | 0.76 | 0.7764    | 1.26 | 0.8962    | 1.76 | 0.9608    | 2.55 | 0.9946    |
| 0.27 | 0.6064    | 0.77 | 0.7794    | 1.27 | 0.8980    | 1.77 | 0.9616    | 2.60 | 0.9953    |
| 0.28 | 0.6103    | 0.78 | 0.7823    | 1.28 | 0.8997    | 1.78 | 0.9625    | 2.65 | 0.9960    |
| 0.29 | 0.6141    | 0.79 | 0.7852    | 1.29 | 0.9015    | 1.79 | 0.9633    | 2.70 | 0.9965    |
| 0.30 | 0.6179    | 0.80 | 0.7881    | 1.30 | 0.9032    | 1.80 | 0.9641    | 2.75 | 0.9970    |
| 0.31 | 0.6217    | 0.81 | 0.7910    | 1.31 | 0.9049    | 1.81 | 0.9649    | 2.80 | 0.9974    |
| 0.32 | 0.6255    | 0.82 | 0.7939    | 1.32 | 0.9066    | 1.82 | 0.9656    | 2.85 | 0.9978    |
| 0.33 | 0.6293    | 0.83 | 0.7967    | 1.33 | 0.9082    | 1.83 | 0.9664    | 2.90 | 0.9981    |
| 0.34 | 0.6331    | 0.84 | 0.7995    | 1.34 | 0.9099    | 1.84 | 0.9671    | 2.95 | 0.9984    |
| 0.35 | 0.6368    | 0.85 | 0.8023    | 1.35 | 0.9115    | 1.85 | 0.9678    | 3.00 | 0.9987    |
| 0.36 | 0.6406    | 0.86 | 0.8051    | 1.36 | 0.9131    | 1.86 | 0.9686    | 3.05 | 0.9989    |
| 0.37 | 0.6443    | 0.87 | 0.8078    | 1.37 | 0.9147    | 1.87 | 0.9693    | 3.10 | 0.9990    |
| 0.38 | 0.6480    | 0.88 | 0.8106    | 1.38 | 0.9162    | 1.88 | 0.9699    | 3.15 | 0.9992    |
| 0.39 | 0.6517    | 0.89 | 0.8133    | 1.39 | 0.9177    | 1.89 | 0.9706    | 3.20 | 0.9993    |
| 0.40 | 0.6554    | 0.90 | 0.8159    | 1.40 | 0.9192    | 1.90 | 0.9713    | 3.25 | 0.9994    |
| 0.41 | 0.6591    | 0.91 | 0.8186    | 1.41 | 0.9207    | 1.91 | 0.9719    | 3.30 | 0.9995    |
| 0.42 | 0.6628    | 0.92 | 0.8212    | 1.42 | 0.9222    | 1.92 | 0.9726    | 3.35 | 0.9996    |
| 0.43 | 0.6664    | 0.93 | 0.8238    | 1.43 | 0.9236    | 1.93 | 0.9732    | 3.40 | 0.9997    |
| 0.44 | 0.6700    | 0.94 | 0.8264    | 1.44 | 0.9251    | 1.94 | 0.9738    | 3.50 | 0.9998    |
| 0.45 | 0.6736    | 0.95 | 0.8289    | 1.45 | 0.9265    | 1.95 | 0.9744    | 3.60 | 0.9998    |
| 0.46 | 0.6772    | 0.96 | 0.8315    | 1.46 | 0.9279    | 1.96 | 0.9750    | 3.70 | 0.9999    |
| 0.47 | 0.6808    | 0.97 | 0.8340    | 1.47 | 0.9292    | 1.97 | 0.9756    | 3.80 | 0.9999    |
| 0.48 | 0.6844    | 0.98 | 0.8365    | 1.48 | 0.9306    | 1.98 | 0.9761    | 3.90 | 1.0000    |
| 0.49 | 0.6879    | 0.99 | 0.8389    | 1.49 | 0.9319    | 1.99 | 0.9767    | 4.00 | 1.0000    |
| 0.50 | 0.6915    | 1.00 | 0.8413    | 1.50 | 0.9332    | 2.00 | 0.9772    |      |           |



**Answer ALL questions.**

**Write your answers in the spaces provided.**

**You must write down all stages in your working.**

**1** Poppy wants to investigate the heights of boys and girls.

She is going to select some students from her college to use as a sample for the investigation.

(a) (i) Write down one reason why it is a good idea to take a sample.

.....

.....

(ii) What would be a suitable sampling frame for Poppy to use?

.....

.....

(2)

Poppy uses students from her Maths class as the sample for the investigation.

(b) Give a reason why this may **not** be a good sample.

.....

.....

(1)

**(Total for Question 1 is 3 marks)**



- 2 The table shows information about the numbers of people who attended a local charity event.

|        |        | Age      |          |         |
|--------|--------|----------|----------|---------|
|        |        | Under 20 | 20 to 40 | Over 40 |
| Gender | Male   | 186      | 233      | 135     |
|        | Female | 208      | 260      | 178     |

George is going to take a sample of 60 of these people stratified by gender and by age.

Calculate the number of males aged over 40 that should be in his sample.

(Total for Question 2 is 2 marks)



- 3 Rebecca recorded the time she took to travel to the gym on each of 22 days.  
The table gives information about these times.

| Time ( $x$ minutes) | Frequency ( $f$ ) |
|---------------------|-------------------|
| $0 < x \leq 5$      | 2                 |
| $5 < x \leq 10$     | 4                 |
| $10 < x \leq 15$    | 3                 |
| $15 < x \leq 20$    | 6                 |
| $20 < x \leq 25$    | 5                 |
| $25 < x \leq 30$    | 2                 |

Calculate an estimate for the standard deviation of these times.

You may use  $\Sigma fx^2 = 6587.5$

..... minutes

(Total for Question 3 is 4 marks)



4 Lyndon and Bevan compared the lengths of time they each spent using their mobile phones on 11 evenings.

The following times are the times spent, in minutes, using their mobile phones.

|               |    |    |    |    |    |    |    |
|---------------|----|----|----|----|----|----|----|
| <b>Lyndon</b> | 21 | 23 | 25 | 25 | 26 | 35 | 36 |
|               | 38 | 42 | 43 | 51 |    |    |    |
| <b>Bevan</b>  | 36 | 37 | 44 | 46 | 46 | 52 | 53 |
|               | 54 | 55 | 64 | 68 |    |    |    |

(a) Draw a back-to-back ordered stem and leaf diagram for the times they spent using their mobile phones each evening.

| Lyndon |   | Bevan |
|--------|---|-------|
|        | 2 |       |
|        | 3 |       |
|        | 4 |       |
|        | 5 |       |
|        | 6 |       |

Key

Key

(4)



(b) Compare the distributions of the times they spent using their mobile phones.

Write down three comparisons.

1.....

.....

.....

2.....

.....

.....

3.....

.....

.....

(3)

**(Total for Question 4 is 7 marks)**



5 A farmer records the weights of new born horses.

Here are his results.

|    |      |    |    |      |      |      |      |
|----|------|----|----|------|------|------|------|
| 60 | 39.5 | 64 | 56 | 62   | 65   | 58.5 | 64.5 |
| 64 | 54.5 | 53 | 63 | 56.5 | 60.5 | 52.5 |      |

(a) For these results

(i) find the median,

.....kg

(ii) work out the interquartile range.

.....kg  
(3)

The farmer thinks that the horse that weighed 39.5 kg is underweight.

(b) For these results is 39.5 an outlier?

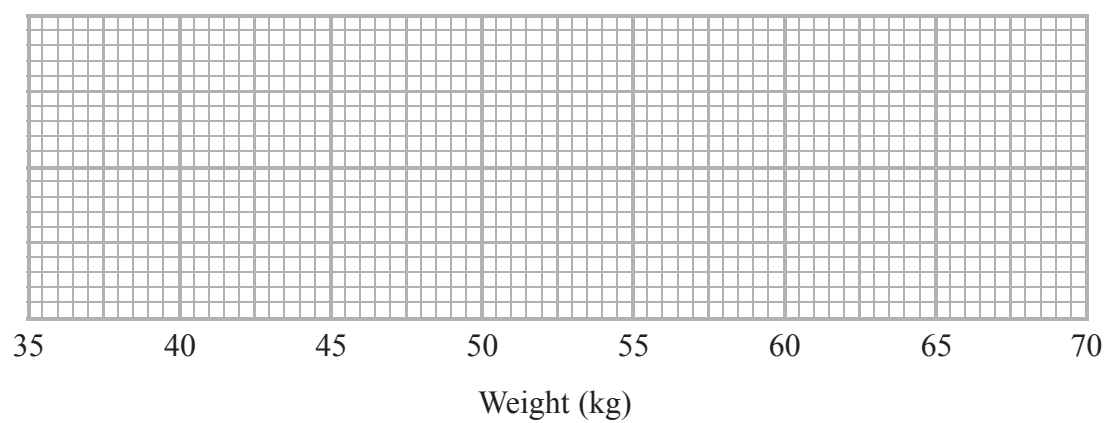
Give a reason for your answer.

.....  
.....  
(2)





(c) On the grid below, draw a box plot for the weights of these 15 horses.



(3)

(Total for Question 5 is 8 marks)



P 4 3 6 3 0 A 0 9 2 4

6 Marcus has two fair 6-sided dice.

He rolls both dice together.

He finds the difference between the two numbers on the tops of the two dice to get his score.

(a) Write down all the combinations that will give him a score of 2

.....

.....

.....

(2)

(b) Find the probability that he gets a score of 2

.....

(1)

Marcus rolls both dice together 180 times.

(c) Find an estimate for the number of times he gets a score of 2

.....

(2)

**(Total for Question 6 is 5 marks)**



7 Beth wants to estimate the number of frogs in a lake.  
She catches a sample of 80 frogs, marks them and puts them back in the lake.  
Later that day, in a second sample of 80 frogs, she finds that 10 of them are marked.

(a) Work out an estimate for the number of frogs in the lake.

.....  
(2)

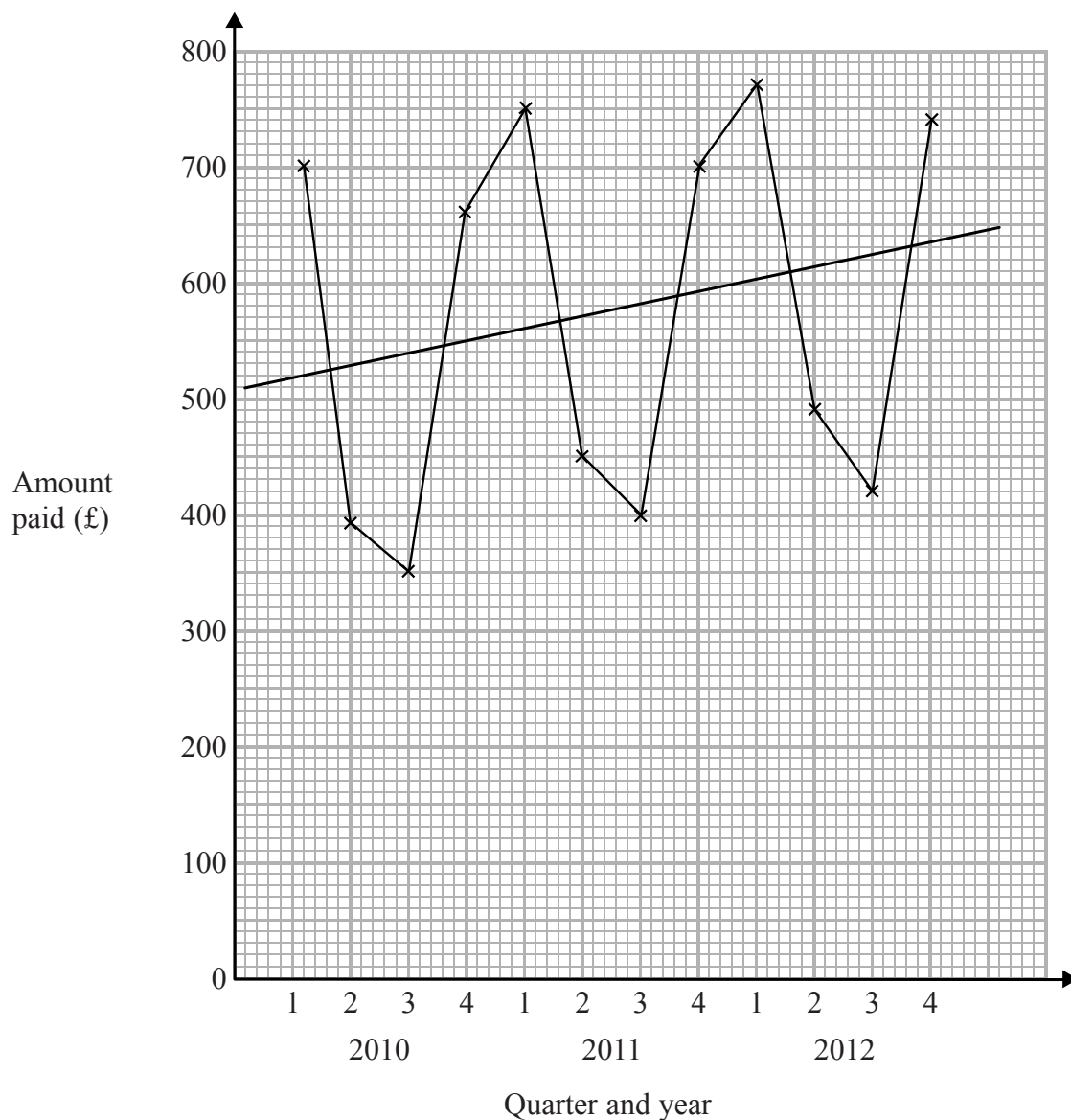
(b) Write down any assumptions you have made.

.....  
.....  
(1)

.....  
**(Total for Question 7 is 3 marks)**



- 8 This time-series graph gives information about the quarterly electricity bills paid by a household from 2010 to 2012.



A trend line has been drawn on the graph.

- (a) Describe the trend.

(1)

- (b) Work out the seasonal variation for quarter 2 of 2012.

(2)

(Total for Question 8 is 3 marks)



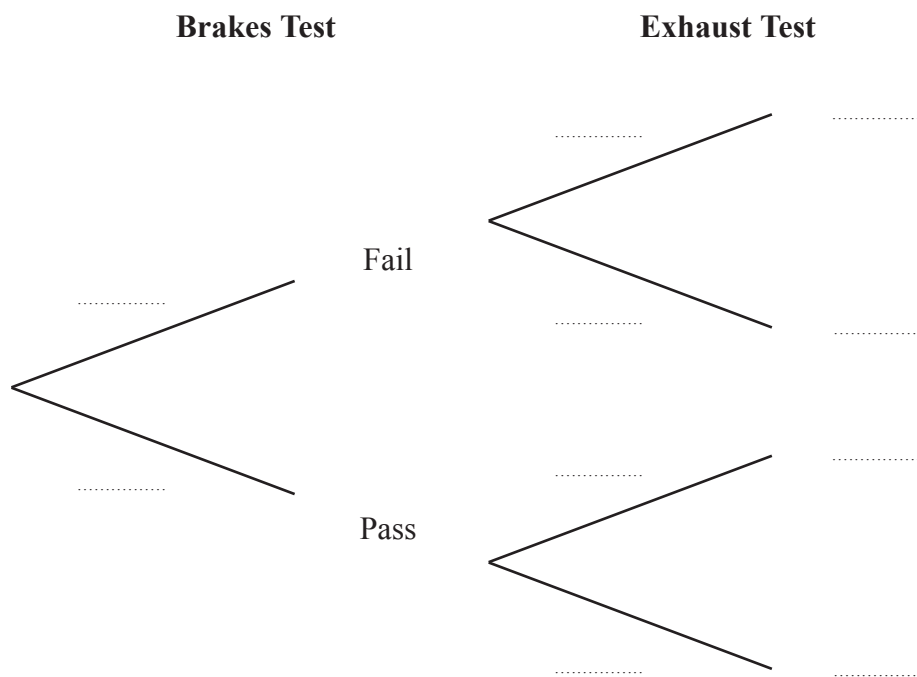
9 A testing station carries out MOT tests on cars.

The testing station's records show that cars independently fail the brakes test and fail the exhaust test.

The probability that a car fails the brakes test is 0.3

The probability that a car fails the exhaust test is 0.2

(a) Complete the probability tree diagram.



(3)

A car is tested at the testing station.

(b) (i) Work out the probability that the car fails both the brakes test and the exhaust test.

.....

(ii) Work out the probability that the car fails only one of these two tests.

.....

(4)

(Total for Question 9 is 7 marks)



10 The table gives information about the heights, in cm, of ten athletes and their positions in a throwing competition.

| Athlete | Height (cm) | Position |  |  |  |
|---------|-------------|----------|--|--|--|
| A       | 112         | 8        |  |  |  |
| B       | 114         | 9        |  |  |  |
| C       | 123         | 7        |  |  |  |
| D       | 128         | 5        |  |  |  |
| E       | 134         | 10       |  |  |  |
| F       | 146         | 3        |  |  |  |
| G       | 148         | 4        |  |  |  |
| H       | 151         | 6        |  |  |  |
| I       | 154         | 1        |  |  |  |
| J       | 158         | 2        |  |  |  |

(a) Work out Spearman’s rank correlation coefficient for these data.

You may use the blank columns in the table to help with your calculations.

(3)

(b) Interpret your answer to part (a).

(1)

(Total for Question 10 is 4 marks)



- 11 The table gives the mean and the standard deviation of the marks in three examinations. The marks in each of these examinations are normally distributed.

|       | Mean | Standard deviation |
|-------|------|--------------------|
| Art   | 70   | 5                  |
| Music | 65   | 2.5                |
| Drama | 58   | 4                  |

Lisa got a mark of 77 in the Art examination and a mark of 70 in the Music examination.

- (a) Calculate Lisa's standardised score in each of these two examinations.

Standardised Art score .....

Standardised Music score .....

(3)

- (b) Did Lisa do better in the Art examination or in the Music examination?  
Give a reason for your answer.

(1)

For the Drama examination, Lisa's standardised score is  $-1.5$

- (c) Calculate Lisa's mark in the Drama examination.

(2)

(Total for Question 11 is 6 marks)



P 4 3 6 3 0 A 0 1 5 2 4

12 The table gives information about the average selling price of a new car over a period of five months.

The table also gives some of the chain base index numbers, correct to 1 decimal place, for this information.

|                         | April  | May    | June   | July   | August |
|-------------------------|--------|--------|--------|--------|--------|
| Average price (£)       | 28 624 | 28 777 | 28 860 | 28 973 | 29 132 |
| Chain base index number |        | 100.5  | 100.3  |        |        |

(a) Explain what the value 100.3 in the table represents.

.....  
.....  
(1)

(b) Calculate, to 1 decimal place, the chain base index numbers for July and August, and write them in the table.

.....  
.....  
(2)

(c) Calculate the geometric mean of the four chain base index numbers.

.....  
.....  
(2)

(d) What does your answer to part (c) tell you?

.....  
.....  
(2)

(Total for Question 12 is 7 marks)

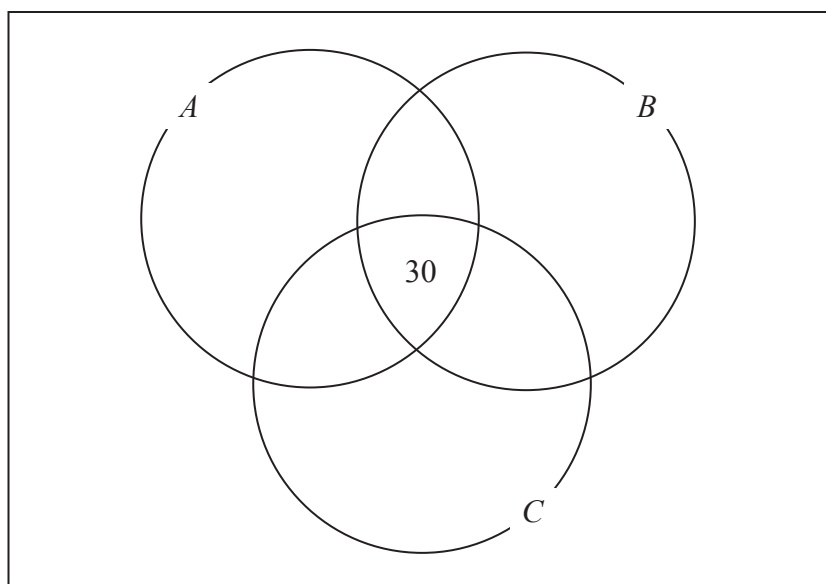




- 13** 140 people were asked in a tasting survey to say which, if any, of three cakes they liked. Here are the results.

86 people liked cake *A*  
93 people liked cake *B*  
76 people liked cake *C*  
52 people liked cakes *A* and *B*  
51 people liked cakes *B* and *C*  
43 people liked cakes *A* and *C*  
30 people liked all three cakes.

- (a) Complete the Venn Diagram to show this information.



(3)

A person is chosen at random from those who took part in the survey.

- (b) Find the probability that this person

(i) did not like any of the three cakes,

(ii) liked cake *A* but not cake *B*.

(3)

(Total for Question 13 is 6 marks)



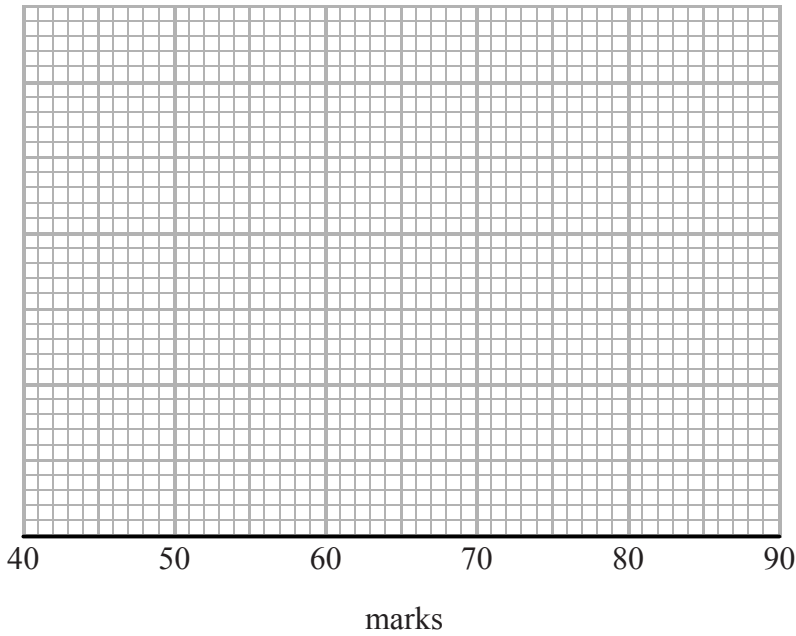
14 A class of students sat examinations in French and in German.

Each examination was marked out of 100 and the marks in each examination are normally distributed.

The mean and the standard deviation of the marks in each of the examinations are given in the table.

|        | Mean | Standard deviation |
|--------|------|--------------------|
| French | 65   | 5                  |
| German | 58   | 3                  |

(a) On the grid, sketch the two normal distributions.



(4)

(b) Compare the two distributions.

You should give **two** comparisons.

.....

.....

.....

.....

(2)

(Total for Question 14 is 6 marks)



- 15** When practising her tennis serves, the probability that any one of Gemma's serves is in court is 0.3

Gemma serves 10 times.

Assuming a binomial distribution, calculate the probability that exactly 6 of these serves are in court.

.....  
(Total for Question 15 is 3 marks)



P 4 3 6 3 0 A 0 1 9 2 4

- 16** The yield of a crop on a farm is thought to depend mainly on the amount of rainfall in the growing season.

The rainfall  $x$  (in centimetres) and the yield  $y$  (in tons per acre) for seven successive years are given in the table below.

|     |      |      |      |      |      |      |      |
|-----|------|------|------|------|------|------|------|
| $x$ | 12.3 | 13.7 | 14.5 | 11.2 | 13.2 | 14.1 | 12.0 |
| $y$ | 6.25 | 8.02 | 8.42 | 5.27 | 7.21 | 8.71 | 5.68 |

It is given that

$$\sum xy = 654.006 \quad \sum x = 91 \quad \sum x^2 = 1191.72 \quad \sum y = 49.56 \quad \sum y^2 = 362.1628$$

- (a) Calculate  $S_{xy}$  for these data.

You may use  $S_{xy} = \sum xy - \frac{\sum x \sum y}{n}$

(1)

- (b) Calculate the product moment correlation coefficient for these data.

You may use  $S_{xx} = 8.72$  and  $S_{yy} = 11.278$

Give your answer correct to 2 decimal places.

(3)

- (c) Describe the relationship between yield of crop and amount of rainfall in the growing season.

(1)

(Total for Question 16 is 5 marks)



17 Two independent events  $A$  and  $B$  are such that  $P(A) = \frac{2}{3}$  and  $P(B) = \frac{3}{4}$

(a) Find  $P(A | B)$

.....  
(1)

(b) Find  $P(A \cap B)$

.....  
(1)

(c) Find  $P(A \cup B)$

.....  
(2)

(Total for Question 17 is 4 marks)



P 4 3 6 3 0 A 0 2 1 2 4

**18** The heights of a group of men are modelled by a normal distribution with mean 178 cm and standard deviation 6.2 cm.

- (a) Using the standard normal distribution tables, find the probability that a man chosen at random from the group is taller than 186 cm.

.....  
(3)

The weights of this group of men are modelled by a normal distribution with mean 82 kg and standard deviation 7.6 kg.

- (b) Using the standard normal distribution tables, find the probability that a man chosen at random from the group weighs less than 89 kg.

.....  
(2)

- (c) Assuming that for these men height and weight are independent, find the probability that a man chosen at random from the group is taller than 186 cm and weighs less than 89 kg.

.....  
(2)

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(Total for Question 18 is 7 marks)

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**TOTAL FOR PAPER IS 90 MARKS**



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