



Surname _____

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Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

A-level MATHEMATICS

Paper 3

7357/3

Friday 12 June 2020 Afternoon

Time allowed: 2 hours

- You must have the AQA Formulae for A-level Mathematics booklet.
- You should have a graphical or scientific calculator that meets the requirements of the specification.

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

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INSTRUCTIONS

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer ALL questions.
- You must answer each question in the space provided for that question.
- Do NOT write on blank pages.
- 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.

INFORMATION

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.

ADVICE

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

DO NOT TURN OVER UNTIL TOLD TO DO SO



SECTION A

Answer ALL questions in the spaces provided.

1 Given that

$$\int_0^{10} f(x) dx = 7$$

deduce the value of

$$\int_0^{10} (f(x) + 1) dx$$

Circle your answer. [1 mark]

−3

7

8

17



2 Given that

$$6 \cos \theta + 8 \sin \theta \equiv R \cos (\theta + \alpha)$$

find the value of R .

Circle your answer. [1 mark]

6

8

10

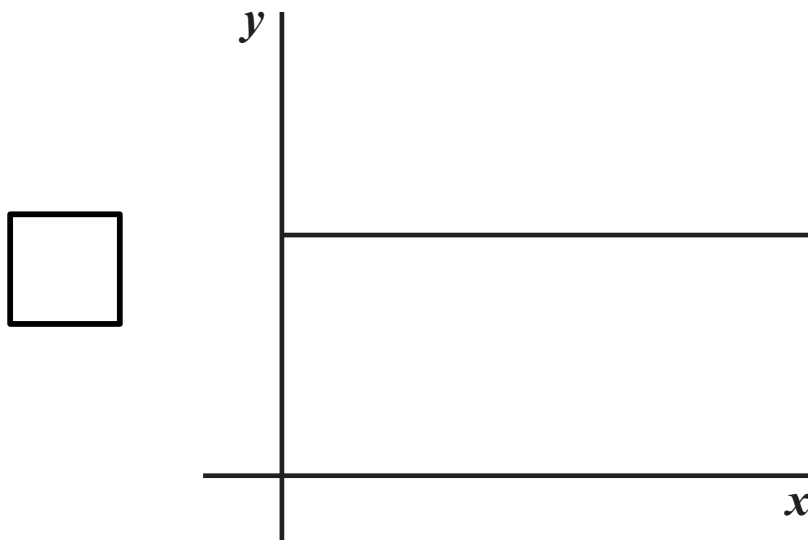
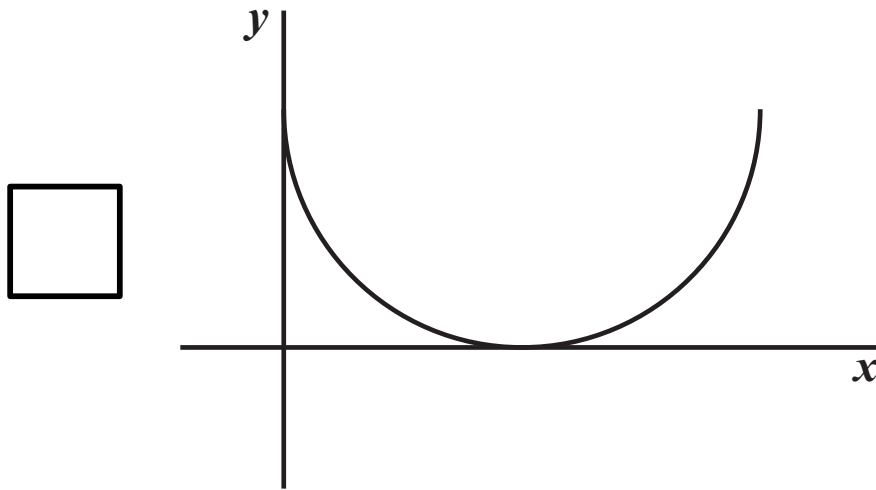
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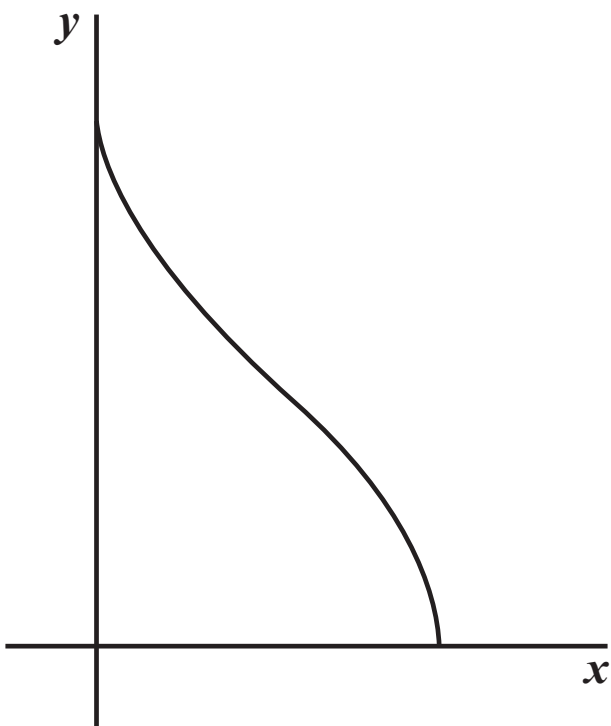
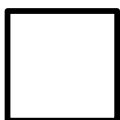
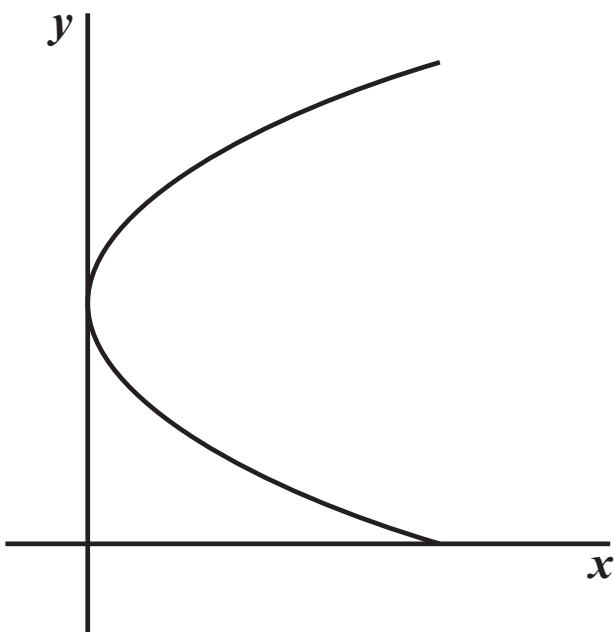
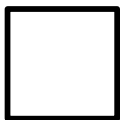
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- 3 Determine which one of these graphs does NOT represent y as a function of x .

Tick (✓) ONE box. [1 mark]





[Turn over]



4 $p(x) = 4x^3 - 15x^2 - 48x - 36$

4 (a) Use the factor theorem to prove that $x - 6$ is a factor of $p(x)$. [2 marks]

4 (b) (i) Prove that the graph of $y = p(x)$ intersects the x -axis at exactly one point. [4 marks]

[Turn over]



4 (b) (ii) State the coordinates of this point of intersection. [1 mark]

[Turn over]



- 5 The number of radioactive atoms, N , in a sample of a sodium isotope after time t hours can be modelled by

$$N = N_0 e^{-kt}$$

where N_0 is the initial number of radioactive atoms in the sample and k is a positive constant.

The model remains valid for large numbers of atoms.

- 5 (a) It takes 15.9 hours for half of the sodium atoms to decay.

Determine the number of days required for at least 90% of the number of atoms in the original sample to decay. [5 marks]



[Turn over]



- 5 (b) Find the percentage of the atoms remaining after the first week.

Give your answer to two significant figures.
[2 marks]

- 5 (c) Explain why the model can only provide an estimate for the number of remaining atoms.
[1 mark]

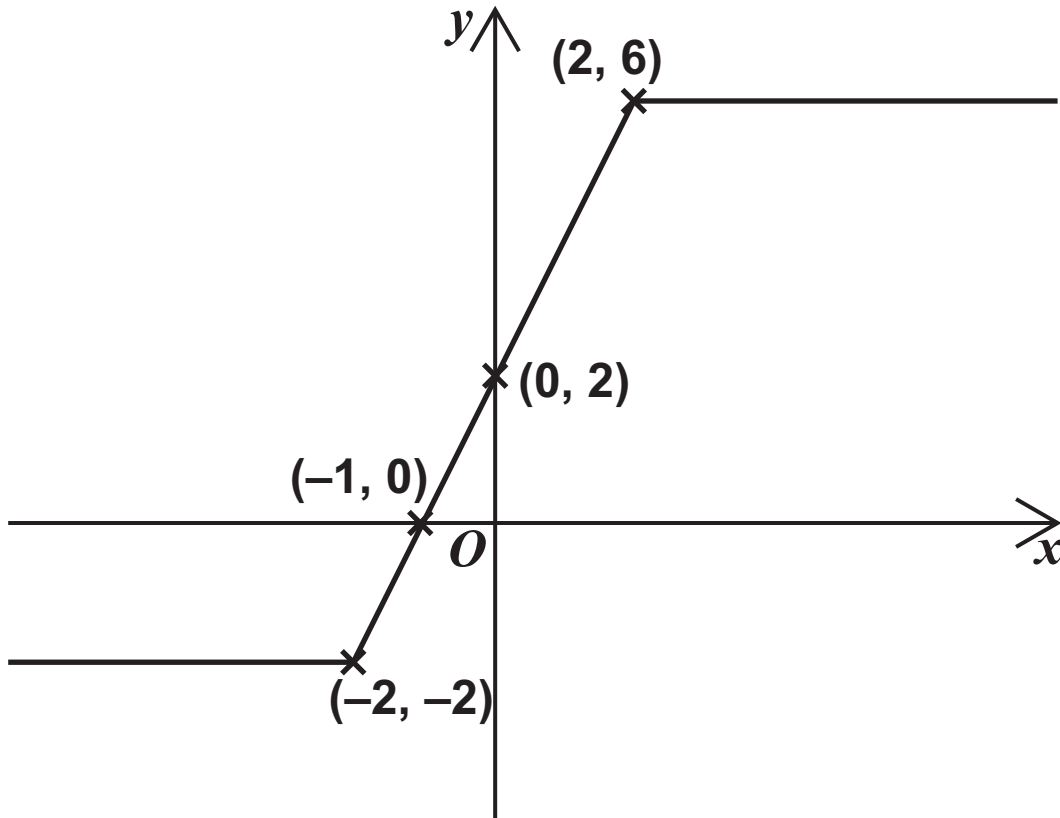


5 (d) Explain why the model is invalid in the long run. [1 mark]

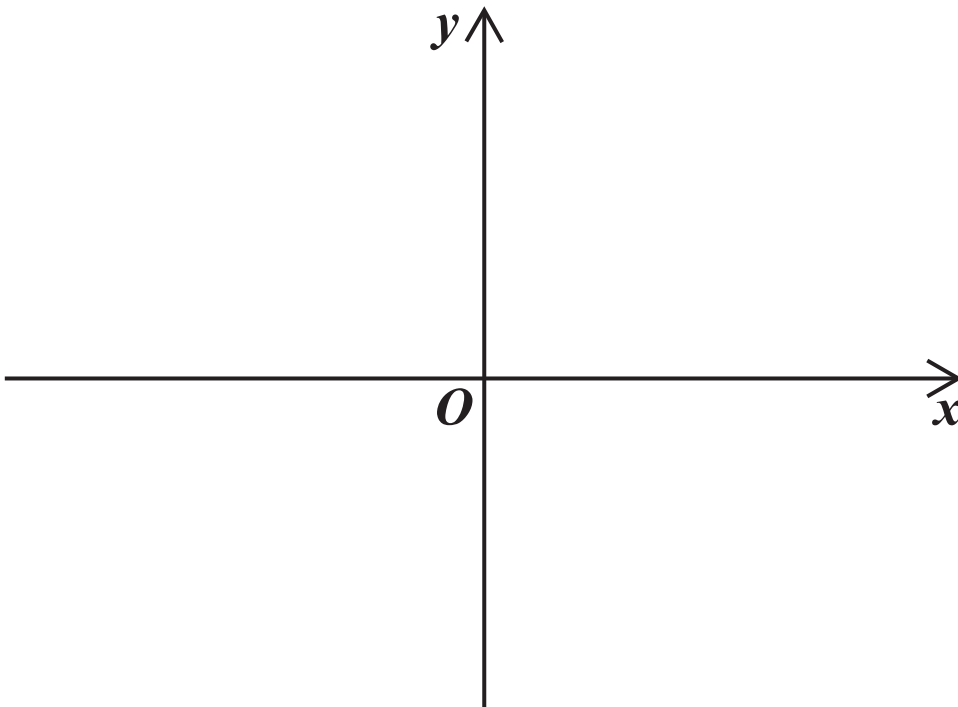
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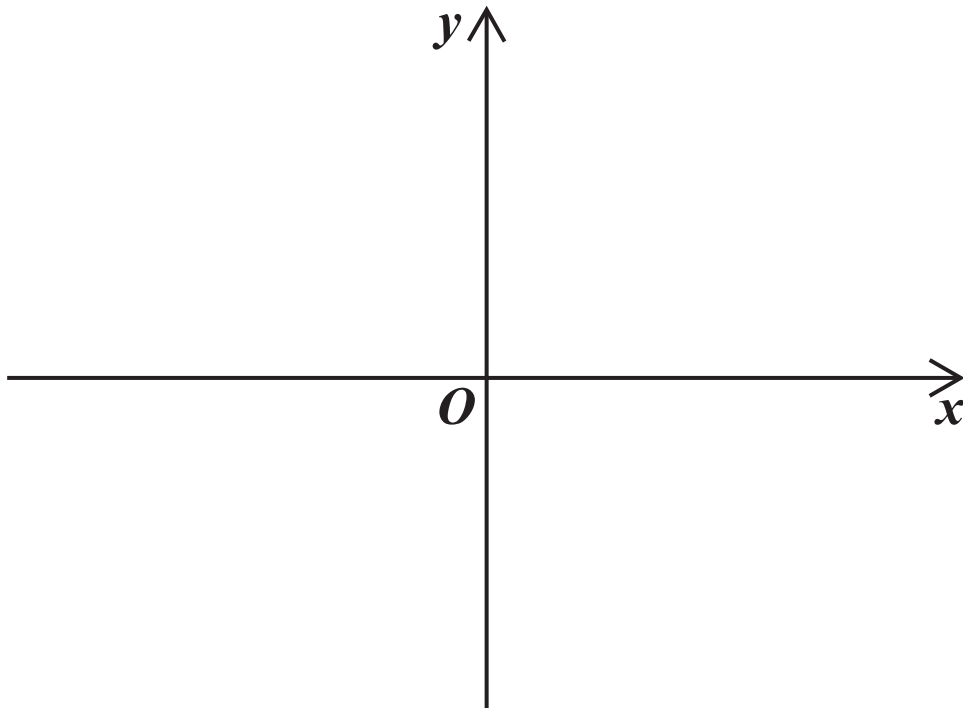
- 6 The graph of $y = f(x)$ is shown below.



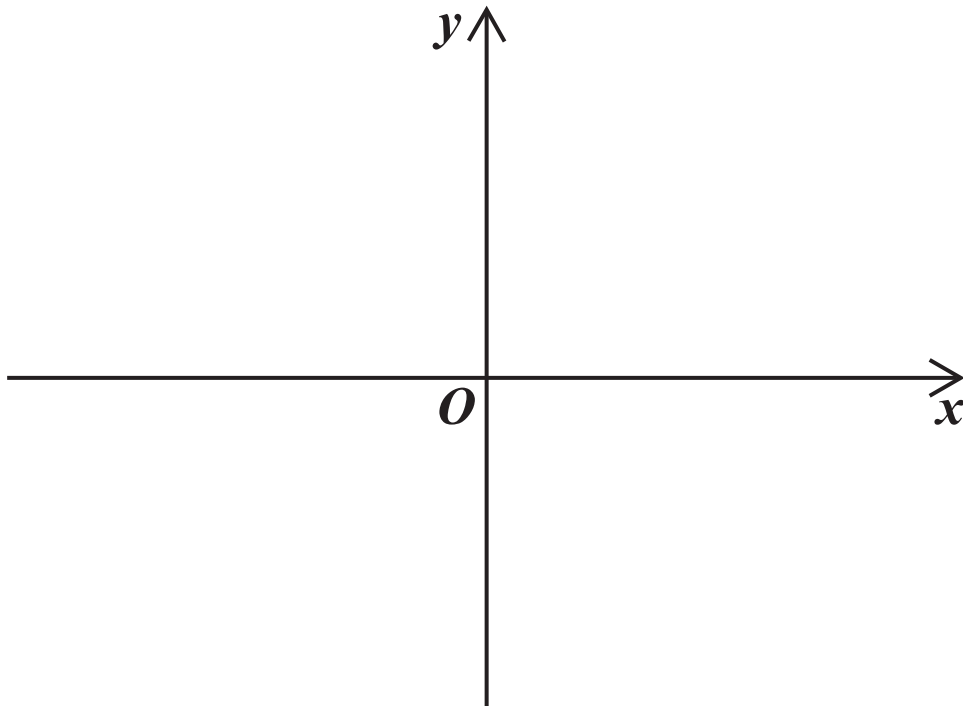
- 6 (a) Sketch the graph of $y = f(-x)$ [2 marks]



6 (b) Sketch the graph of $y = 2f(x) - 4$ [2 marks]



6 (c) Sketch the graph of $y = f'(x)$ [3 marks]



[Turn over]



7 (a) Using ${}^n C_r = \frac{n!}{r!(n-r)!}$ show that

$${}^n C_2 = \frac{n(n-1)}{2}$$

[2 marks]

7 (b) (i) Show that the equation

$$2 \times {}^n C_4 = 51 \times {}^n C_2$$

simplifies to

$$n^2 - 5n - 300 = 0$$

[3 marks]

[Turn over]



8 **The sum to infinity of a geometric series is 96**

The first term of the series is less than 30

The second term of the series is 18

8 (a) Find the first term and common ratio of the series. [5 marks]

[Turn over]



- 8 (b) (i) Show that the n th term of the series, u_n , can be written as

$$u_n = \frac{3^n}{2^{2n-5}}$$

[4 marks]



[Turn over]



8 (b) (ii) Hence show that

$$\log_3 u_n = n(1 - 2 \log_3 2) + 5 \log_3 2$$

[3 marks]

[Turn over]



9 (a) For $\cos \theta \neq 0$, prove that

$$\operatorname{cosec} 2\theta + \cot 2\theta = \cot \theta$$

[4 marks]

[Turn over]



9 (b) Explain why

$$\cot \theta \neq \operatorname{cosec} 2\theta + \cot 2\theta$$

when $\cos \theta = 0$ [1 mark]



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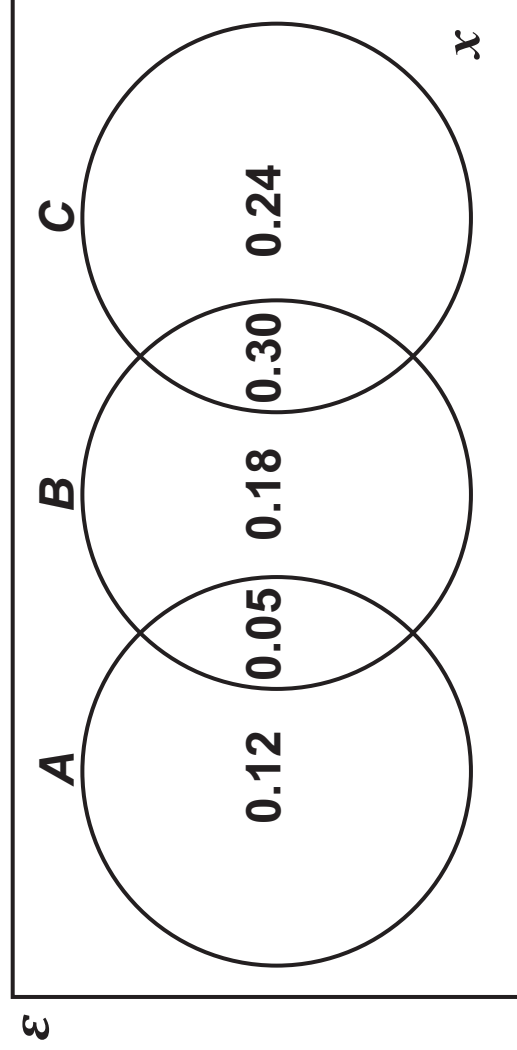


3 2

SECTION B

Answer ALL questions in the spaces provided.

- 10 The probabilities of events A , B and C are related, as shown in the Venn diagram below.



32

Find the value of x .

Circle your answer. [1 mark]

0.11

0.46

0.54

0.89



11

The table below shows the temperature on Mount Everest on the first day of each month.

MONTH	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TEMPERATURE (°C)	-17	-16	-14	-9	-2	2	6	5	-3	-4	-11	-18

Calculate the standard deviation of these temperatures.

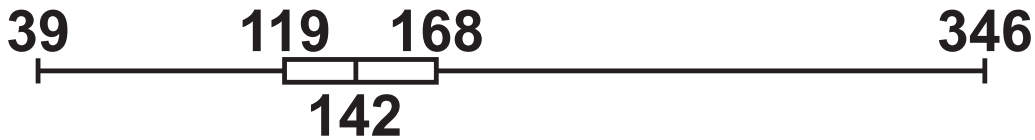
Circle your answer. [1 mark]

- 6.75
- 5.82
- 8.24
- 67.85

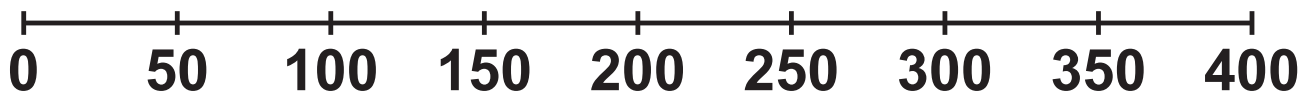
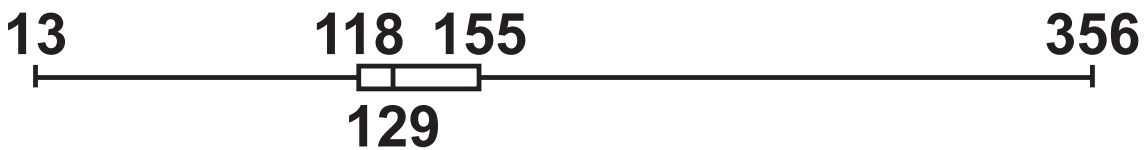
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- 12 The box plot below summarises the CO₂ emissions, in g/km, for cars in the Large Data Set from the London and North West regions.

London



North West



- 12 (a) Using the box plot, give ONE comparison of central tendency and ONE comparison of spread for the two regions. [2 marks]

Comparison of central tendency



Comparison of spread

[Turn over]

- 12 (b) Jaspal, an environmental researcher, used all of the data in the Large Data Set to produce a statistical comparison of the CO₂ and CO emissions in regions of England.

Using your knowledge of the Large Data Set, give TWO reasons why his conclusions may be invalid. [2 marks]



[Turn over]



- 13 Diedre is a head teacher in a school which provides primary, secondary and sixth-form education.

There are 200 teachers in her school.

The number of teachers in each level of education along with their gender is shown in the table below.

	PRIMARY	SECONDARY	SIXTH-FORM
MALE	9	24	23
FEMALE	35	85	24

- 13 (a) A teacher is selected at random. Find the probability that:

- 13 (a) (i) the teacher is female [1 mark]



13 (a) (ii) the teacher is NOT a sixth-form teacher.
[1 mark]

[Turn over]

- 13 (b) Given that a randomly chosen teacher is male, find the probability that this teacher is NOT a primary teacher. [2 marks]

- 13 (c) Diedre wants to select three different teachers at random to be part of a school project.

Calculate the probability that all three chosen are secondary teachers. [2 marks]

[Turn over]



14

It is known that a hospital has a mean waiting time of 4 hours for its Accident and Emergency (A&E) patients.

After some new initiatives were introduced, a random sample of 12 patients from the hospital's A&E Department had the following waiting times, in hours.

4.25	3.90	4.15	3.95	4.20	4.15
5.00	3.85	4.25	4.05	3.80	3.95

Carry out a hypothesis test at the 10% significance level to investigate whether the mean waiting time at this hospital's A&E department has changed.

You may assume that the waiting times are normally distributed with standard deviation 0.8 hours. [7 marks]



15 A political party is holding an election to choose a new leader.

A statistician within the party decides to sample 70 party members to find their opinions of the leadership candidates.

There are 4735 members under 30 years old and 8565 members 30 years old and over.

The statistician wants to use a sample of 70 party members in the survey.

He decides to use a random stratified sample.

15 (a) Calculate how many of each age group should be included in his sample. [2 marks]

[Turn over]



17 The lifetime of Zapple smartphone batteries, X hours, is normally distributed with mean 8 hours and standard deviation 1.5 hours.

17 (a) (i) Find $P(X \neq 8)$ [1 mark]

17 (a) (ii) Find $P(6 < X < 10)$ [1 mark]



17 (b) Determine the lifetime exceeded by 90% of Zapple smartphone batteries. [2 marks]

[Turn over]

18 Tiana is a quality controller in a clothes factory. She checks for four possible types of defects in shirts.

Of the shirts with defects, the proportion of each type of defect is as shown in the table below.

TYPE OF DEFECT	Colour	Fabric	Sewing	Sizing
PROBABILITY	0.25	0.30	0.40	0.05

Shirts with defects are packed in boxes of 30 at random.



18 (a) Find the probability that:

18 (a) (i) a box contains exactly 5 shirts with a colour defect [2 marks]

[Turn over]

18 (a) (ii) a box contains fewer than 15 shirts with a sewing defect [2 marks]

18 (a)(iii) a box contains at least 20 shirts which do NOT have a fabric defect. [3 marks]

[Turn over]



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