

Write your name here

Surname

Other names

**Pearson Edexcel
Level 3 Certificate**

Centre Number

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Candidate Number

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Mathematics in Context

Paper 2: Applications

Wednesday 23 May 2018 – Morning

Time: 1 hour 40 minutes

Paper Reference

7MC0/02

You must have: Ruler graduated in centimetres and millimetres,
pen, HB pencil, eraser, calculator.
Source booklet.

Total Marks



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.**

Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

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 ►

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SECTION A

Answer ALL questions. Write your answers in the spaces provided.

OBESITY

1 A doctor surveys 2000 people who are obese.

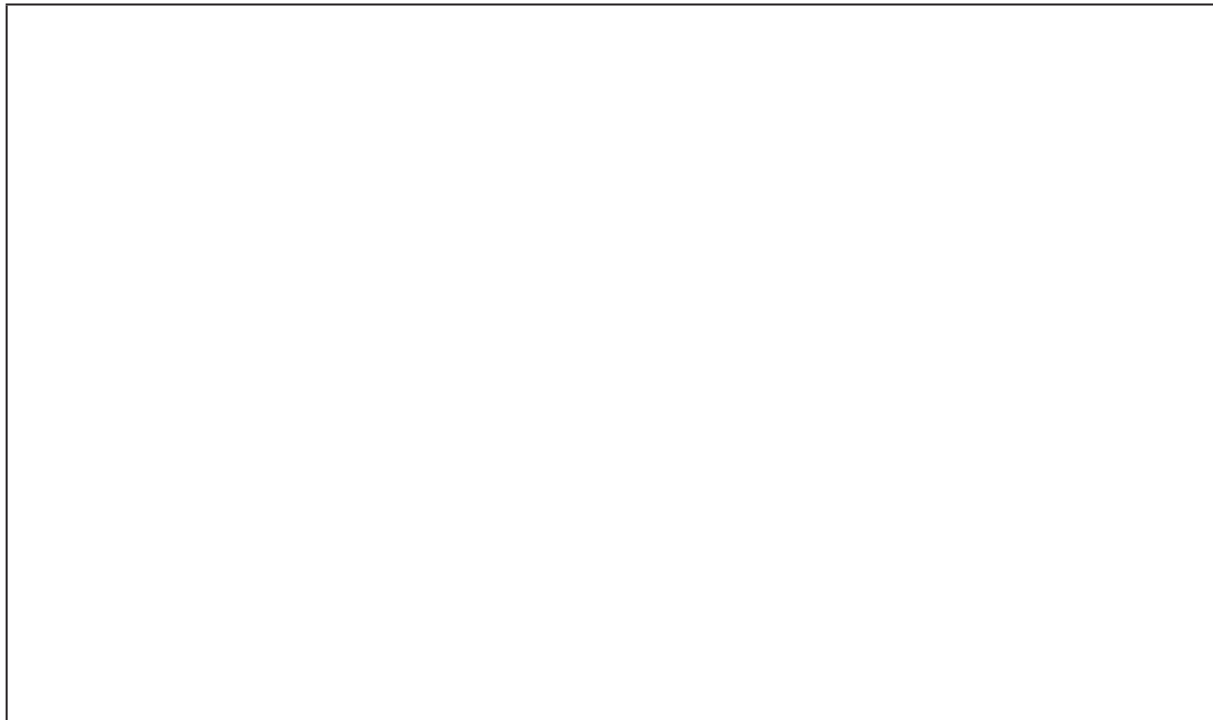
She finds that

- 432 have high blood pressure
- 544 have high cholesterol levels
- 370 have diabetes
- 156 have high blood pressure and high cholesterol levels
- 145 have high blood pressure and diabetes
- 124 have diabetes and high cholesterol levels
- 56 have high blood pressure and diabetes and high cholesterol levels

Let

- \mathcal{E} = {people in the survey}
- B = {people with high blood pressure}
- C = {people with high cholesterol levels}
- D = {people with diabetes}

Draw a Venn diagram to represent this information.



(Total for Question 1 is 5 marks)

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2 Give an interpretation in context of $C \cap D'$

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(Total for Question 2 is 1 mark)

3 One of these 2000 people is chosen at random.

(a) Find the probability that

(i) this person has diabetes,

(1)

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(ii) this person does not have high blood pressure or high cholesterol levels or diabetes,

(1)

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(iii) this person has high blood pressure given that they have diabetes.

(2)

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Pedro claims this survey shows that there is a relationship between a person having high blood pressure and having diabetes.

(b) (i) Determine whether or not having high blood pressure (B) and having diabetes (D) are independent events.

(2)

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(ii) Comment on Pedro's claim with reference to your answer above.

(1)

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(Total for Question 3 is 7 marks)



4 Refer to the **data source**.

(a) Show that the percentage of people in the study who are overweight or obese is 62.9% correct to 3 significant figures.

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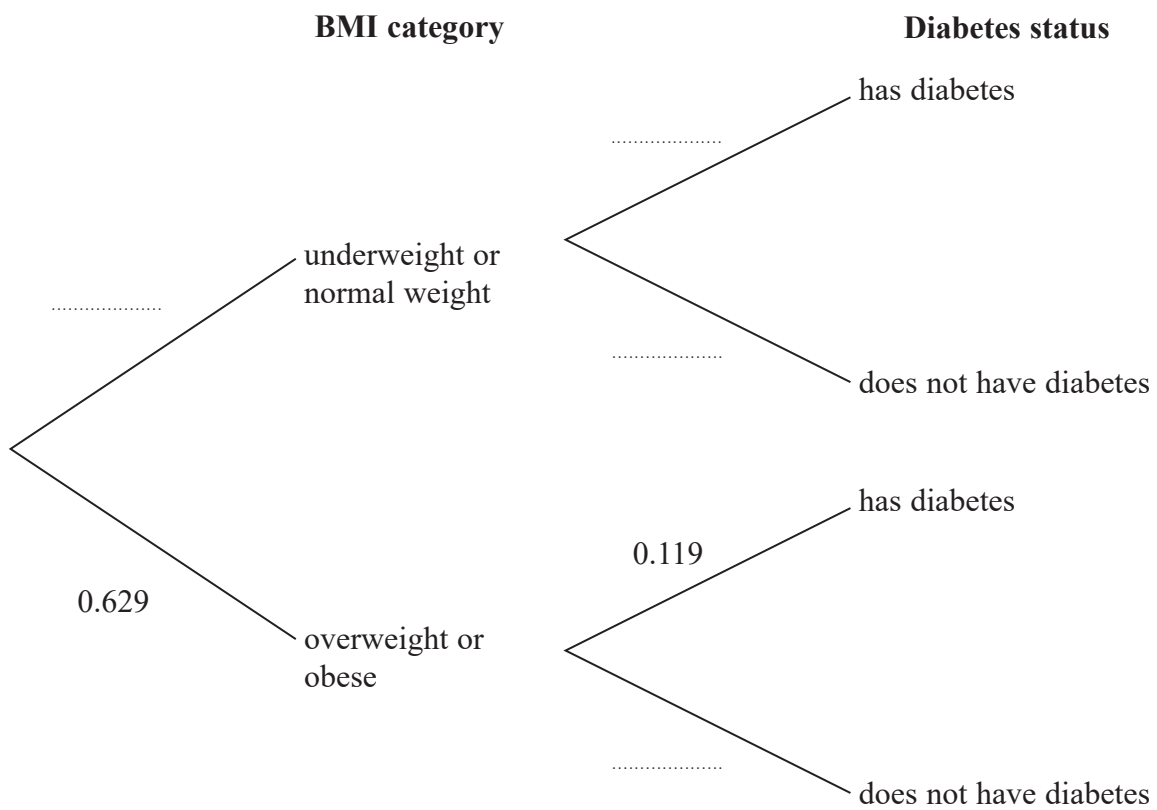
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3.87% of the people in the study who are underweight or normal weight have diabetes.
11.9% of the people in the study who are overweight or obese have diabetes.

One person is selected at random from the people in the study.

(b) Complete the probability tree diagram.

(2)



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The people in the study who have diabetes are put into two groups.

Group A: people in the study who are underweight or normal weight **and** have diabetes.

Group B: people in the study who are overweight or obese **and** have diabetes.

One claim of the study is “A person in this study who has diabetes is about five times more likely to be in group B than in group A.”

(c) Determine whether or not this claim is correct.

Justify your answer.

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(Total for Question 4 is 7 marks)

TOTAL FOR SECTION A IS 20 MARKS

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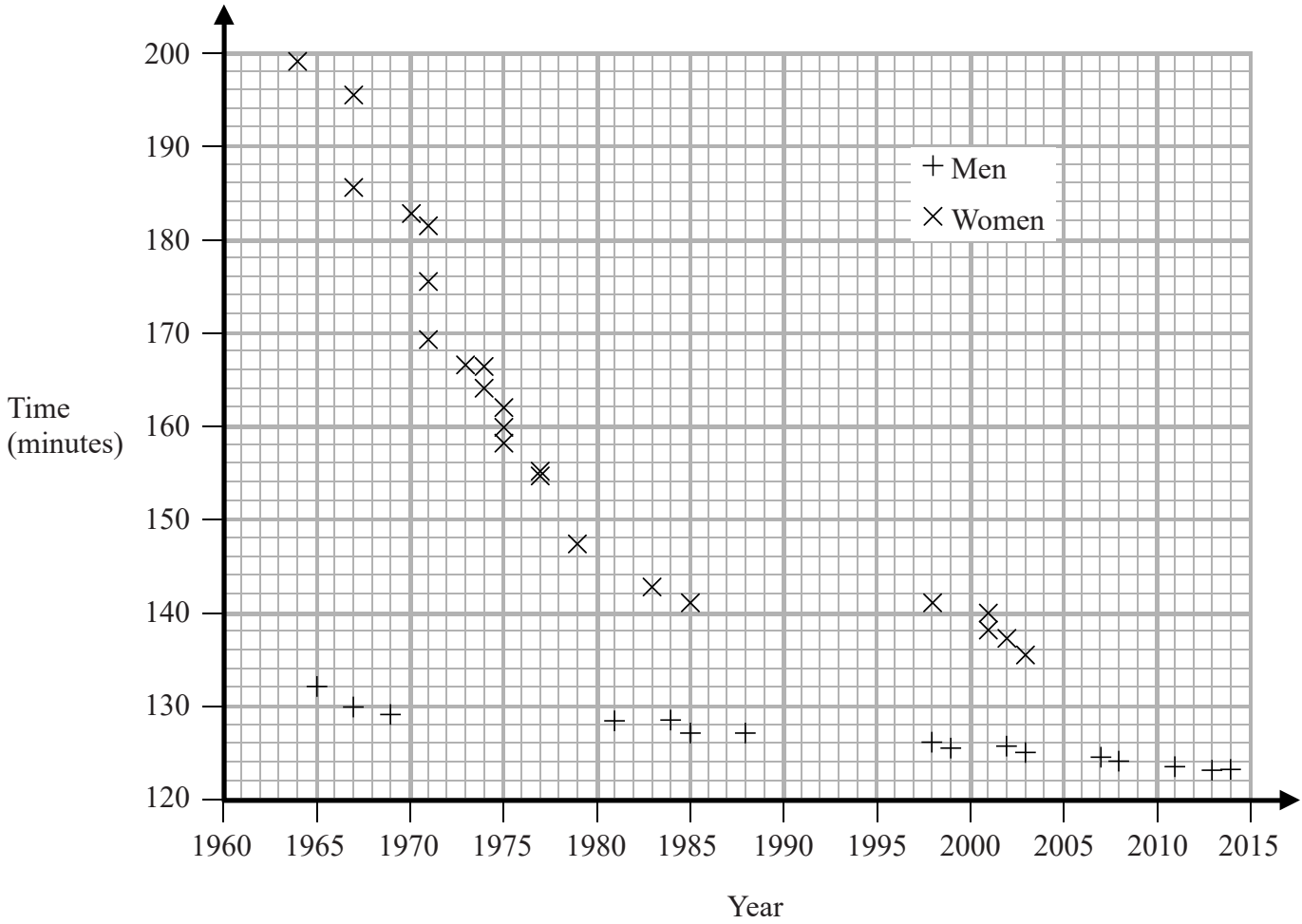


SECTION B

Answer ALL questions. Write your answers in the spaces provided.

TASK 1: MARATHONS

5 The scatter diagram shows information about the marathon world record times for men and for women.



Source: http://www.arrs.net/RecProg/RP_wwr.htm

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Calculate the percentage change for the women's marathon world record times over the period 1964–2003

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(Total for Question 5 is 3 marks)

- 6 Let y_1 minutes be the men's marathon world record time.
Let x be the year in which the record was set.

A linear model is proposed for the men's marathon world record time.
The equation of the regression line of y_1 on x is

$$y_1 = 418 - 0.147x$$

- (a) Interpret, in context, the meaning of -0.147 in the regression equation.

(2)

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- (b) Use the equation of the regression line to show that the men's marathon world record time is predicted to fall below 2 hours during 2027

(2)

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A linear model is also proposed for the women's marathon world record time.

Let y_2 minutes be the women's marathon world record time.

Let x be the year in which the record was set.

$$Sxy_2 = -4590 \quad Sxx = 3403 \quad \Sigma x = 45\,530 \quad \Sigma y_2 = 3703 \quad n = 23$$

(c) Find the equation of the least squares regression line of y_2 on x .

(5)

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(d) Use the equation of the regression line to predict the year in which the women's marathon world record time will first fall below 2 hours.

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(e) Explain why the linear model is not appropriate for predicting the women's marathon world record times.

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(Total for Question 6 is 12 marks)

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7 An alternative model is proposed for the men's marathon world record time.

$$y_1 = 120 + k \times 1.029^{-t}$$

where $t = x - 1965$

and x is the year in which the record was set.

(a) Use the men's marathon world record time for 1965 to calculate a value for k .

(2)

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(b) Calculate the men's marathon world record time predicted by this model for the year 2020

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(c) Explain why, according to this model, the men's marathon world record time cannot fall below 120 minutes.

(1)

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(Total for Question 7 is 5 marks)



TASK 2: STEEL

- 8 A company makes steel bars.
100 steel bars are tested and the percentage of carbon in each steel bar is measured.
The table gives information about these steel bars.

Percentage of carbon (C)	Frequency
$0.6 \leq C < 0.9$	6
$0.9 \leq C < 1.1$	16
$1.1 \leq C < 1.2$	25
$1.2 \leq C < 1.4$	27
$1.4 \leq C < 1.6$	16
$1.6 \leq C < 2.0$	10

- (a) Show that the frequency density for the class interval $0.6 \leq C < 0.9$ is 20 (1)

- (b) On the grid opposite, draw a histogram to represent the data in the table. (3)

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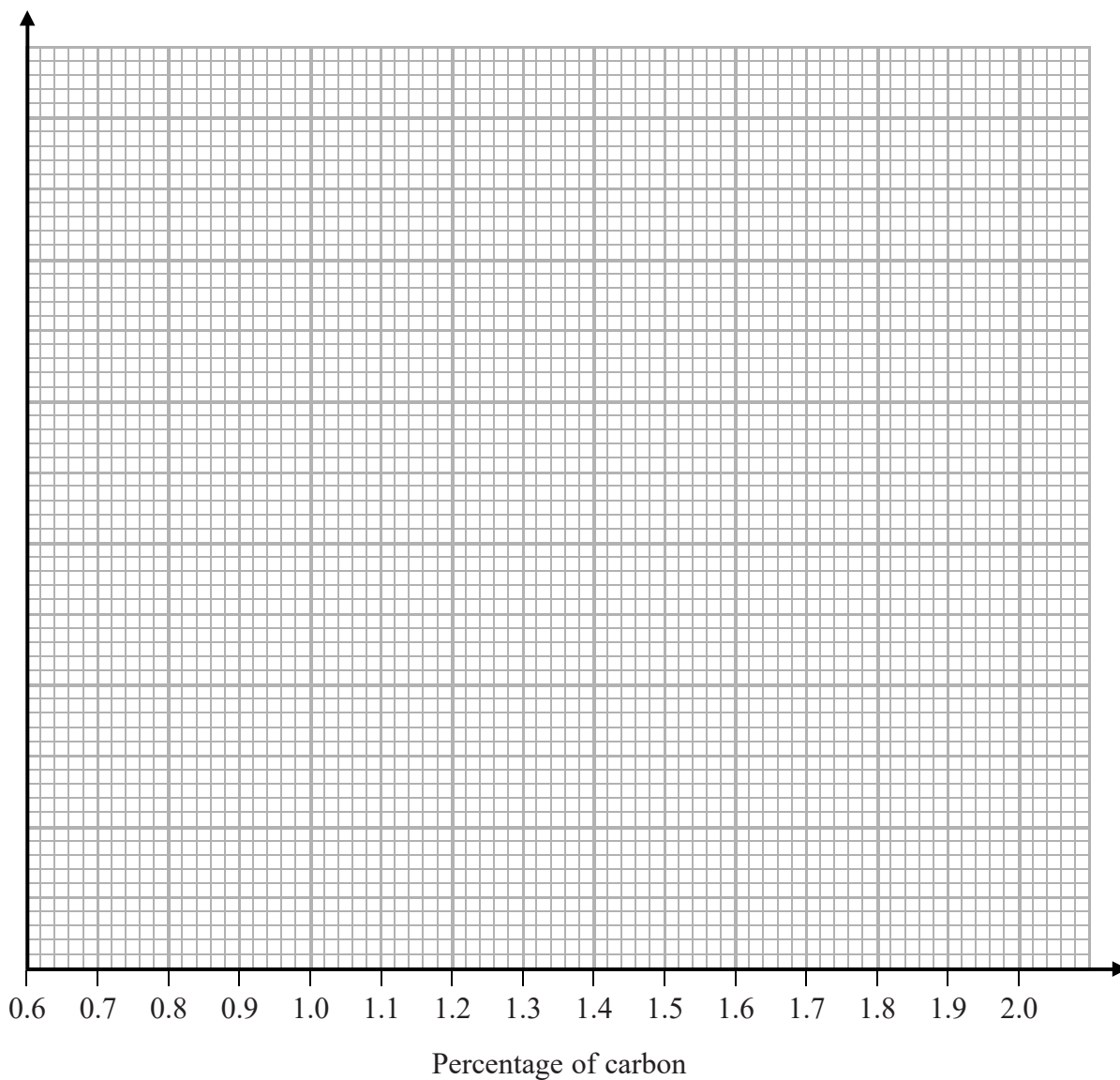
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(c) Estimate the median percentage of carbon present in these steel bars.

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Steel with a percentage carbon content from 0.7% to 1.5% is suitable to make cutlery.

(d) Estimate the number of these steel bars that are **not** suitable to make cutlery.

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(Total for Question 8 is 10 marks)

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9 The table shows the mean and standard deviation of the percentage of carbon present for a different batch of 100 steel bars.

Mean	1.26
Standard deviation	0.261

80 of the bars should have a percentage of carbon within 1.28 standard deviations of the mean percentage of carbon present.

Work out the greatest percentage of carbon and the least percentage of carbon that should be present in these 80 steel bars.

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(Total for Question 9 is 3 marks)

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10 A batch of 100 steel bars has a mean mass of 8.4 kg.
A second batch of 50 steel bars has a mean mass of 7.8 kg.
Calculate the mean mass of the 150 steel bars.

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(Total for Question 10 is 2 marks)

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11 Steel production costs in 2016 were £20 million.
The company expects the production costs to increase by 2% per year.

(a) Calculate the expected production costs in 2025

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(b) Calculate the total expected production costs for the ten year period from 2016 to 2025 inclusive.

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(Total for Question 11 is 5 marks)



TASK 3: TELEVISIONS

12 A manufacturer of TVs makes models in three sizes, 28 inch, 32 inch and 48 inch.

The manufacturer has
 100 hours of assembly time available each day
 £1200 to spend on parts each day.

The number of TVs that can be made each day depends on the amount of assembly time available and the cost of parts.

	28 inch	32 inch	48 inch	Total available per day
Assembly time (hours)	4	4	4	100
Cost of parts (£)	32	50	110	1200

Let x be the number of 28 inch TVs made per day.
 Let y be the number of 32 inch TVs made per day.
 Let z be the number of 48 inch TVs made per day.

(a) Write down two inequalities to represent the information in the table.

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At least 20% of the TVs made have to be 28 inch models.

(b) Show that this gives

$$4x \geq y + z$$

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The profit made on each model of TV is

	28 inch	32 inch	48 inch
Profit (£)	80	100	180

The manufacturer wishes to maximise its daily profit, $\pounds P$.

(c) Write down the objective function, P , in terms of x , y and z .

(1)

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(Total for Question 12 is 6 marks)

13 The manufacturer decides to make the same number of 32 inch TVs as 48 inch TVs.

(a) Show that the linear programming problem becomes

$$\text{Maximise } P = 80x + 280y$$

subject to

$$y \leq 2x$$

$$x + 2y \leq 25$$

$$2x + 10y \leq 75$$

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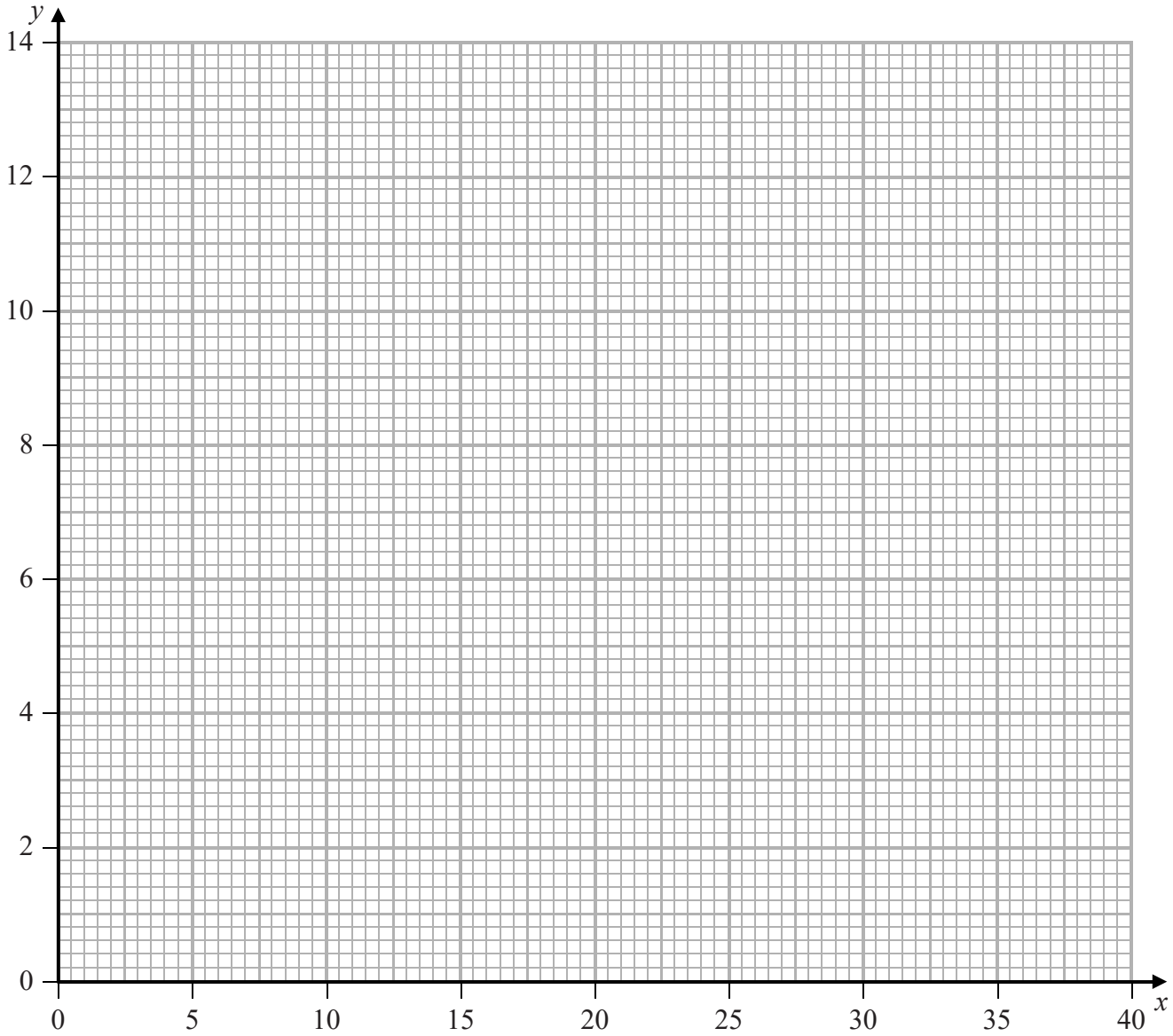
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$$\begin{aligned}y &\leq 2x \\x + 2y &\leq 25 \\2x + 10y &\leq 75\end{aligned}$$

- (b) Represent these inequalities on the grid.
Label the feasible region **R**.

(4)



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$$P = 80x + 280y$$

- (c) Find the exact coordinates of the point giving the maximum value of P .
You must make your method clear.

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- (d) Determine the number of each size of TV that the manufacturer should make each day and the total expected daily profit.

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(Total for Question 13 is 14 marks)

TOTAL FOR SECTION B IS 60 MARKS
TOTAL FOR PAPER IS 80 MARKS



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