



GCE AS/A LEVEL

2300U20-1

FRIDAY, 23 MAY 2025 – AFTERNOON

MATHEMATICS – AS unit 2

APPLIED MATHEMATICS A

**1 hour 45 minutes plus your additional
time allowance**

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 2 _____

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	6	
2	4	
3	11	
4	8	
5	11	
6	6	
7	6	
8	8	
9	4	
10	11	
Total	75	

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- **a Formula Booklet;**
- **a calculator;**
- **statistical tables (RND/WJEC Publications).**

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

(Turn over)

Answer ALL questions.

Take g as 9.8 ms^{-2}

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The maximum mark for this paper is 75.

The number of marks is given in brackets at the end of each question or part-question.

Sufficient working must be shown to demonstrate the MATHEMATICAL method employed.

(Turn over)

4

Answers without working may not gain full credit.

Unless the degree of accuracy is stated in the question, answers should be rounded appropriately.

You are reminded of the necessity for good English and orderly presentation in your answers.

(Turn over)

REMINDER: Sufficient working must be shown to demonstrate the MATHEMATICAL method employed.

SECTION A: STATISTICS

- 1. Financial transactions on a network occur at an average rate of one every 10 minutes. Transactions occur singly, randomly and independently.**
- (a) Stating an appropriate model, calculate the probability that there will be exactly 5 transactions in a randomly selected one-hour period.**
[3 marks]

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7

During a busy period, the average rate of transactions is 10 per hour. The cost per transaction is \$30

- 1 (b) For this busy period, calculate the probability that the total cost of the transactions will be at least \$360 in a randomly selected hour.**

[3 marks]

(Turn over)

2. The probability distribution of a discrete random variable X is given below.

x	2	3	4	5
$P(X = x)$	0.1	0.4	0.3	0.2

Given that X_1 and X_2 are two independent observations of X calculate the probability

that $X_1 + X_2 = 6$ [4 marks]

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- 3. Martin is designing a new question for a multiple-choice quiz. The question has three options, only one of which is correct. Martin designs the question to be misleading and difficult to answer correctly. He claims that people would do better if they select their answer to the question at random rather than trying to work out the correct answer.**
- (a) Write suitable hypotheses to test Martin's claim. [1 mark]**

(Turn over)

Martin decides to carry out a hypothesis test at the 5% level of significance to investigate his claim. He takes a random sample of 63 people and asks them to try to work out the correct answer to the new question, instead of just guessing randomly. He finds that 15 people answer the new question correctly and 48 people answer incorrectly.

3 (b) (i)

Calculate the p -value for Martin's data.

(ii) Complete the hypothesis test at the 5% level of significance and make a conclusion in context. [5 marks]

(Turn over)

15

[illegible]

(Turn over)

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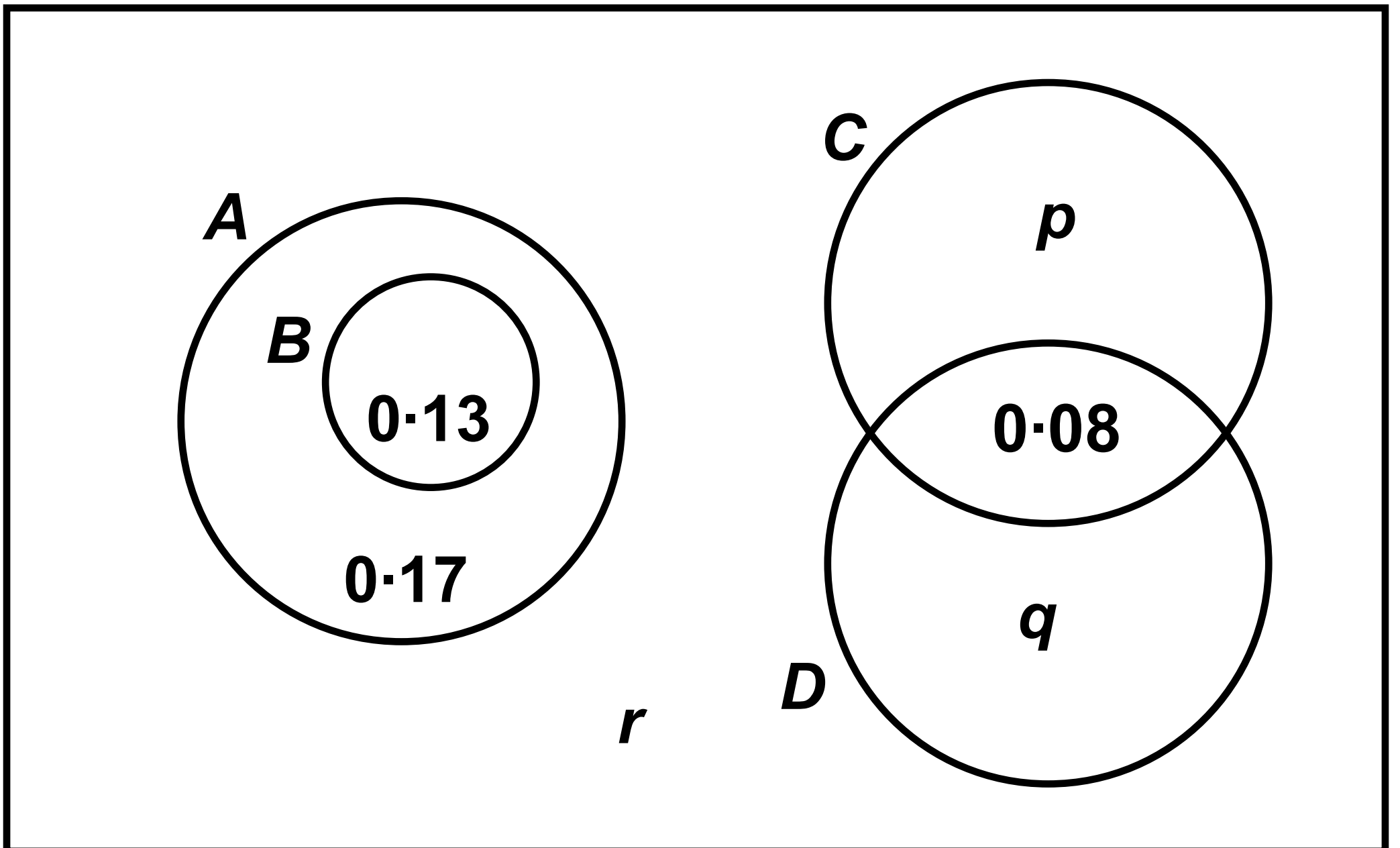
- 3 (c) Now suppose that Martin's new question is such that the true probability that the question is answered correctly is 0.2**
- Calculate the probability of a Type II error in a random sample of size 63**
- Interpret your answer in context.**
- [5 marks]**

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4. The following Venn diagram shows the events A , B , C , D together with some probabilities.



(a) Find:

(i) $P(A)$

(ii) $P(A \cap B)$

[2 marks]

(Turn over)

4 (b) Given that $P(C') = 0.6$ and that the events C and D are independent, calculate p , q and r
[6 marks]

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Country	Life expectancy	Adult mortality	Hepatitis B	Polio	GDP	Population	Years of schooling	Life expectancy
Benin	60	249	82	78	784	13 958 086	10·7	60
Botswana	65·7	256	95	96	6533	2 705 113	12·6	65·7
Comoros	63·5	227	91	92	728	777 424	11·1	63·5
Costa Rica	79·6	AB	92	92	1146	5 235 470	14·2	79·6
Saudi Arabia	74·5	88	98	97	2733		16·1	74·5
Seychelles	73·2	168	98	97	1539	93 419	14·1	73·2

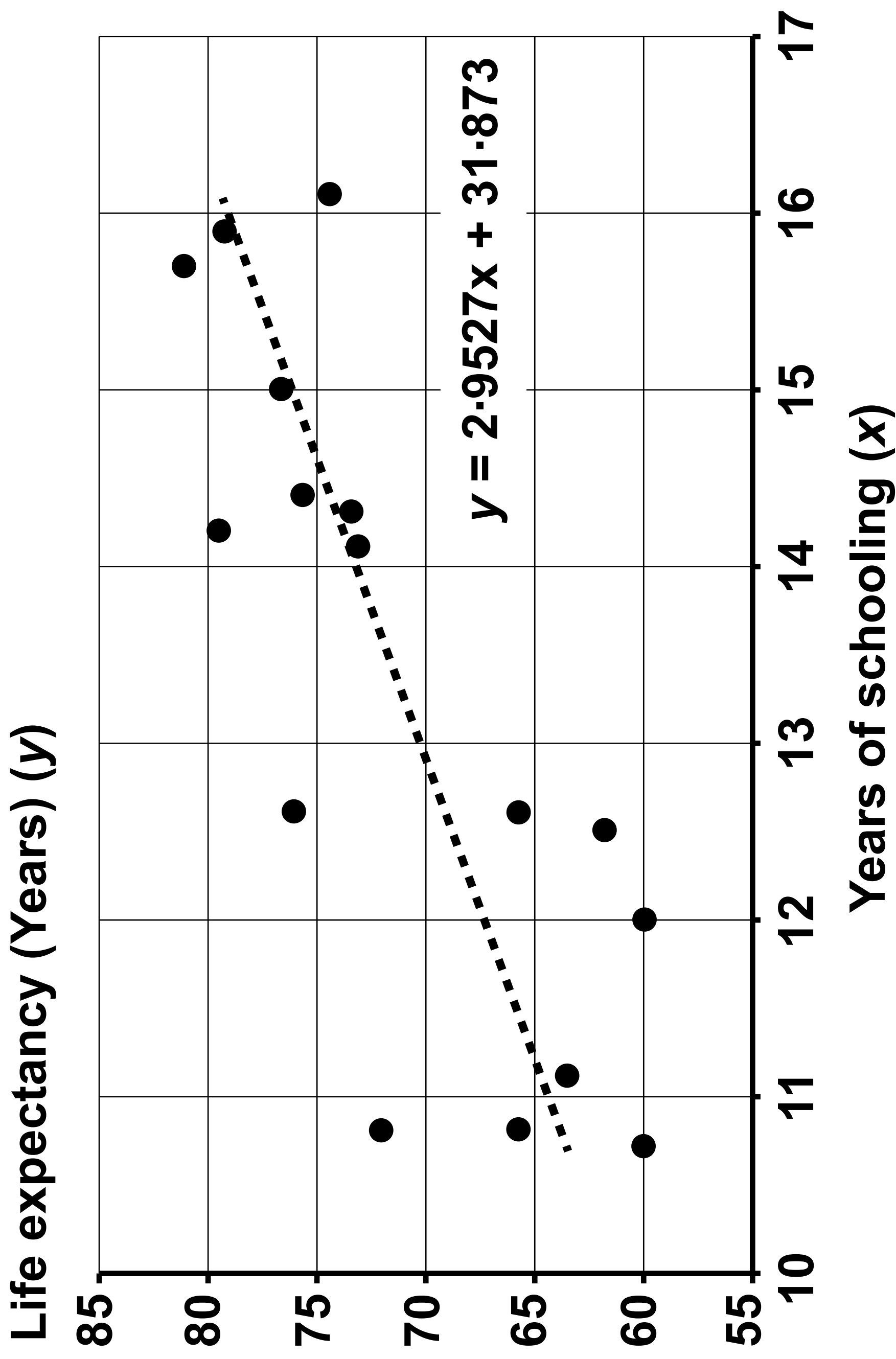
- 5. The World Health Organisation (WHO) compiles data on life expectancy and other factors.**

A hobbyist statistician is exploring the data he collects from the WHO. The screenshot opposite shows part of his work.

- (a) Give TWO ways in which the data could be cleaned. [2 marks]**

(Turn over)

LIFE EXPECTANCY (y) VERSUS YEARS OF SCHOOLING (x)



The graph opposite shows the life expectancy and years of schooling for 16 randomly selected countries.

5 (b) Interpret the gradient of the regression line in context. [1 mark]

5 (c) Comment on the causal nature or otherwise of the correlation.

[1 mark]

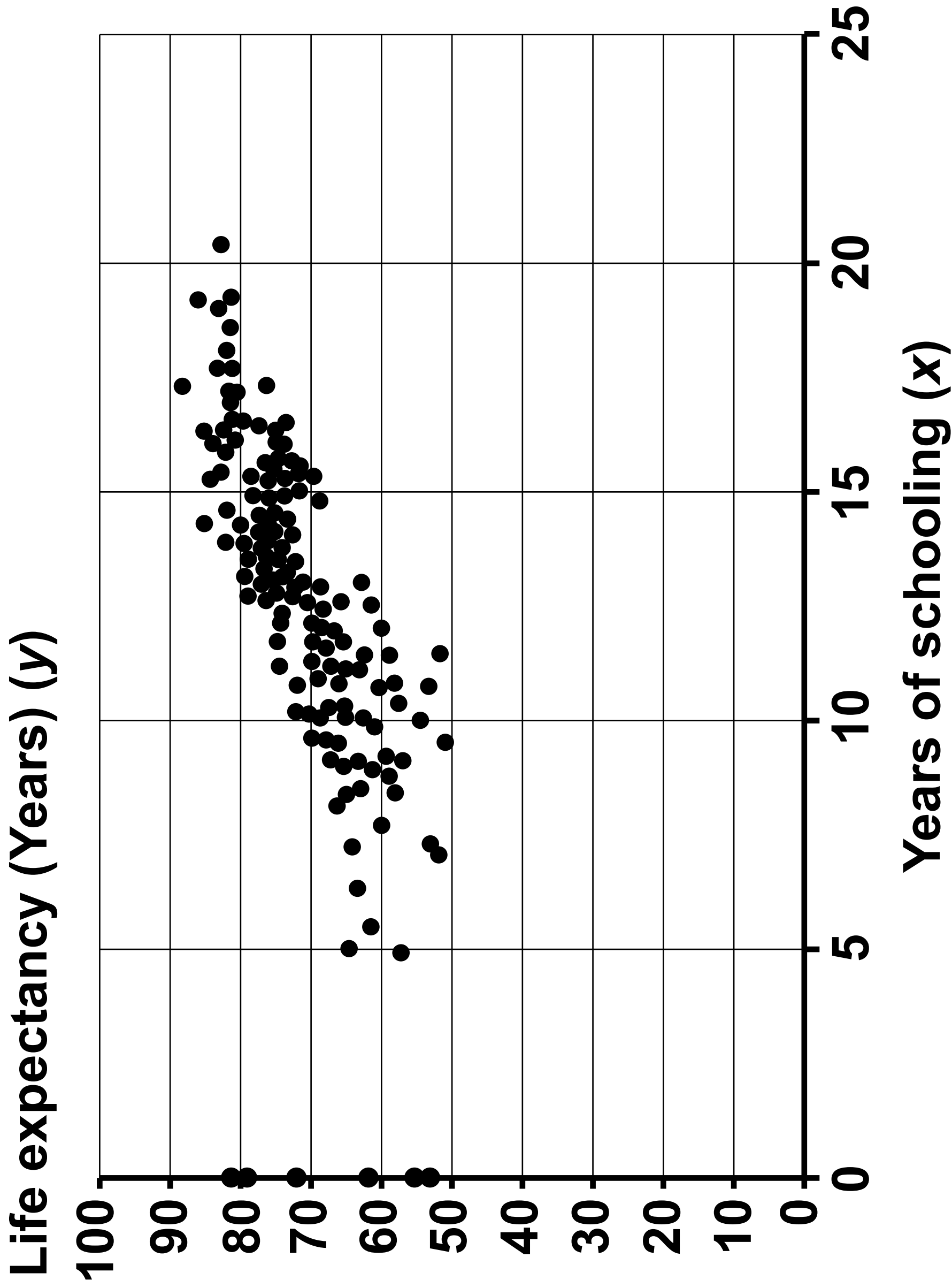
5 (d) (i)

Calculate an estimate of the life expectancy for a country that has 14.6 years of schooling. [1 mark]

(ii) Comment on the reliability of your answer. [1 mark]

(Turn over)

Life expectancy (y) versus Years of schooling (x)



The entire data set was used to produce the scatter diagram opposite.

5 (e) State the curious feature of the graph and what might be done about it. [1 mark]

- 5 (f) The summary data for life expectancy y in years, for the entire data set are given as follows.

$$\sum y = 13\,105.9$$

$$\sum y^2 = 950\,615.47$$

$$n = 183$$

- (i) Show that the mean is **71.6** years, correct to **3** significant figures, and calculate the standard deviation.

[3 marks]

- (ii) The hobbyist statistician claims that **71.6** years represents average global life expectancy. Comment on this claim.

[1 mark]

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SECTION B: MECHANICS

6. Two forces $\underline{G}$ and $\underline{H}$ are given by

$$\underline{G} = (-4\underline{i} + 6\underline{j}) \text{ N}$$

$$\underline{H} = (k\underline{i} - 9\underline{j}) \text{ N}$$

where k is a constant. A particle has a mass of 0.5 kg

- (a) Given that the particle is in equilibrium under the action of the force $3\underline{G} + 2\underline{H}$ show that $k = 6$
[3 marks]

(Turn over)

[illegible]

6 (b) The force $\underline{\mathbf{G}} + \underline{\mathbf{H}}$ acts on the particle. Determine the acceleration vector of the particle. [3 marks]

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7 (a) Using the equations $v = u + at$

and $s = \frac{1}{2} (u + v) t$ show that

$$s = ut + \frac{1}{2} at^2$$
 [2 marks]

[2 marks]

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7 (b) A small object, of mass 0.07 kg is projected vertically upwards from the ground with a speed of 29.4 ms^{-1}

- (i) Find the time taken for the object to return to its point of projection. [3 marks]**
- (ii) State ONE assumption that you have made in your solution. [1 mark]**

(Turn over)

46

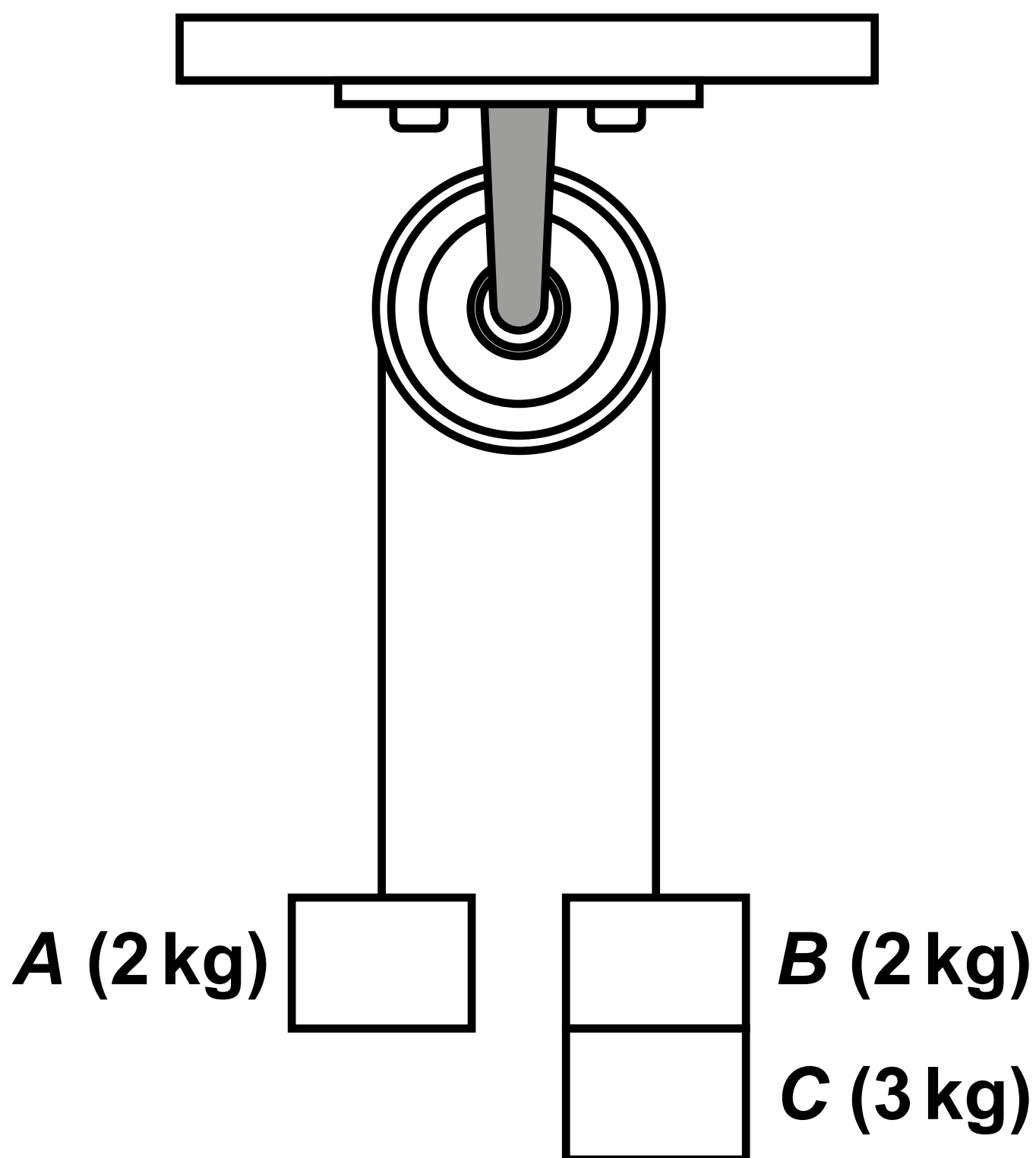
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8. Two objects ***A*** and ***B*** are connected by a light inextensible string passing over a smooth fixed pulley. Object ***A*** has mass **2 kg** and object ***B*** has mass **2 kg**. Another object ***C*** of mass **3 kg** is attached to object ***B*** as shown in the diagram opposite.

Initially, the system is held at rest with the string just taut and the hanging parts of the string vertical.

The system is then released from rest.

- (a) (i) Find the magnitude of the acceleration of ***A*** and the tension in the string. [6 marks]
- (ii) Hence, find the force exerted by the string on the pulley. [1 mark]

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- 8 (b) Object **C** separates from **B** and falls away. Without carrying out any further calculations, write down the acceleration of **A** after the separation. [1 mark]

9. A small toy car, which may be modelled as a particle, is moving along a straight horizontal track as shown below. Two points **A** and **B** are positioned along the track.



The velocity of the car $v \text{ cms}^{-1}$ at time t seconds, is given by

$$v = 50t - 2t^3 \quad \text{for} \quad 0 \leq t \leq 5$$

When $t = 1$ the car passes the point **A**

- (a) Find an expression for the displacement of the car from **A** at time t s
- [3 marks]
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[illegible]

(Turn over)

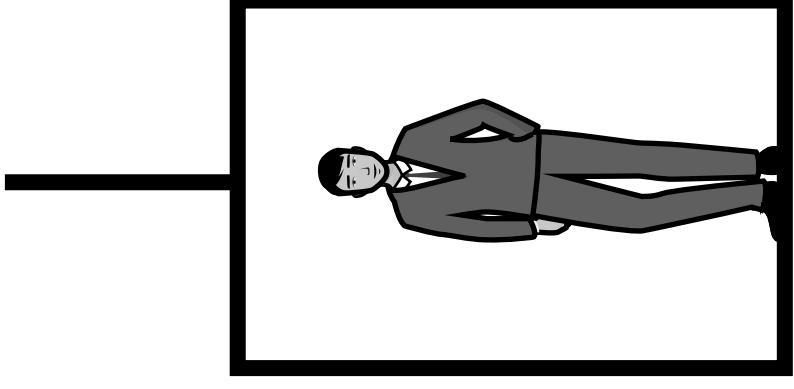
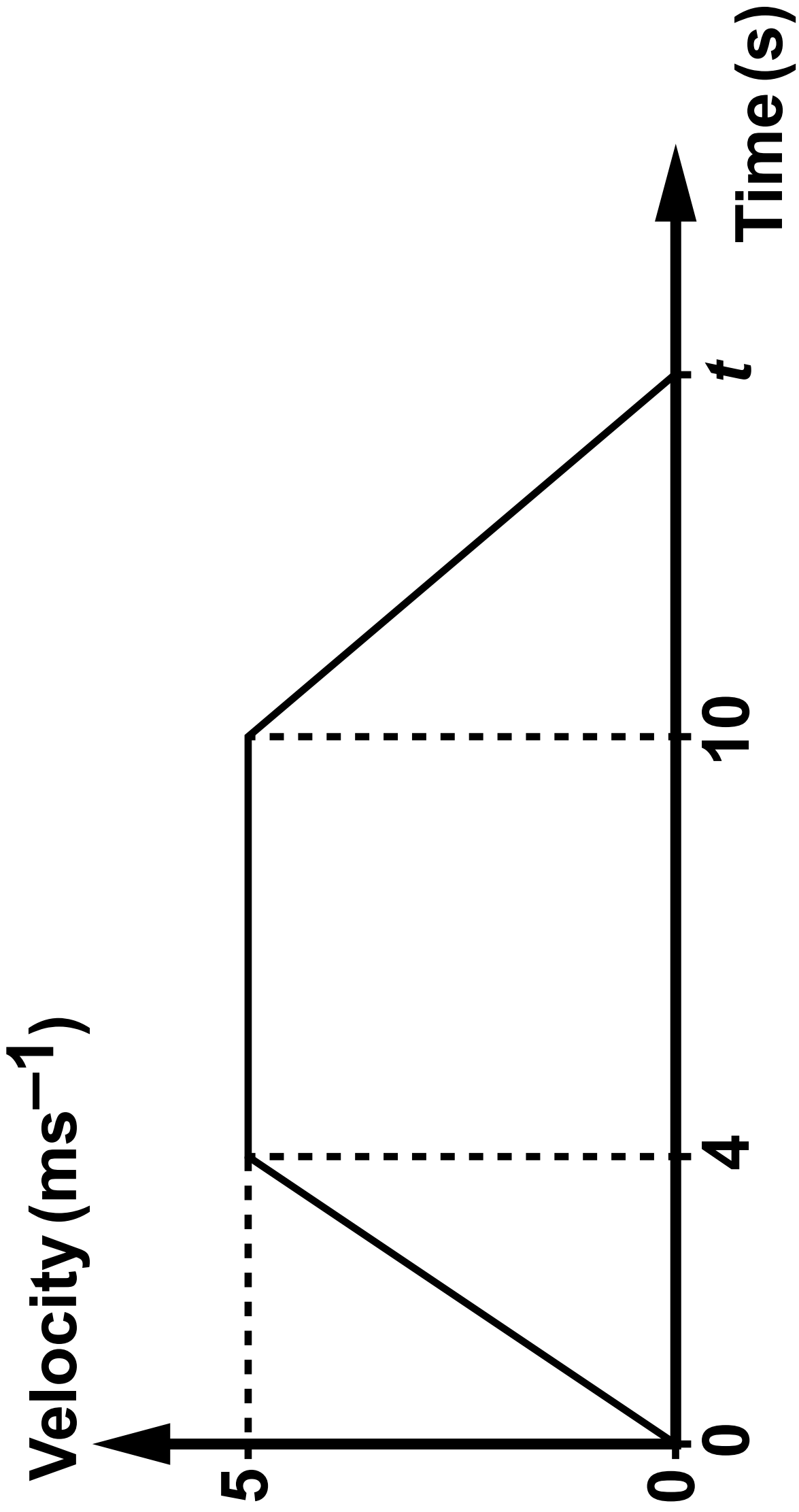
9 (b) When $t = 4$ the car passes the point B

Determine the length of the track

between A and B [1 mark]

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- 10. A lift is pulled upwards by means of a single cable, as shown in the diagram opposite.**
A person of mass 80 kg is standing in the lift. The mass of the lift is 420 kg

The diagram opposite shows a sketch of the velocity-time graph for the journey of the lift for a period of t seconds.

- (a) Find the tension in the cable while the lift is accelerating. [4 marks]**

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10 (b)

While the lift is decelerating, the magnitude of the reaction of the floor of the lift on the person is **704 N**

Determine the deceleration of the lift and hence show that **$t = 15$**

[5 marks]

(Turn over)

(Turn over)

10 (c)

**Calculate the distance travelled
by the lift during the entire 15 s
journey. [2 marks]**

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