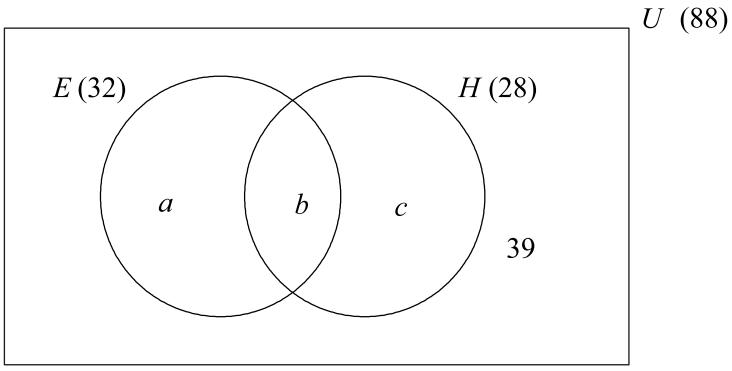
1. Consider the independent events A and B. Given that $P(B) = 2P(A)$, and $P(A \cup B) = 0.52$, find $P(B)$.

(Total 7 marks)

2. In a school of 88 boys, 32 study economics (E), 28 study history (H) and 39 do not study either subject. This information is represented in the following Venn diagram.



(a) Calculate the values a, b, c.

(4)

(b) A student is selected at random.

(i) Calculate the probability that he studies **both** economics and history.

(ii) Given that he studies economics, calculate the probability that he does **not** study history.

(3)

(c) A group of three students is selected at random from the school.

(i) Calculate the probability that none of these students studies economics.

(ii) Calculate the probability that at least one of these students studies economics.

(5)

(Total 12 marks)

3. Let A and B be independent events such that $P(A) = 0.3$ and $P(B) = 0.8$.

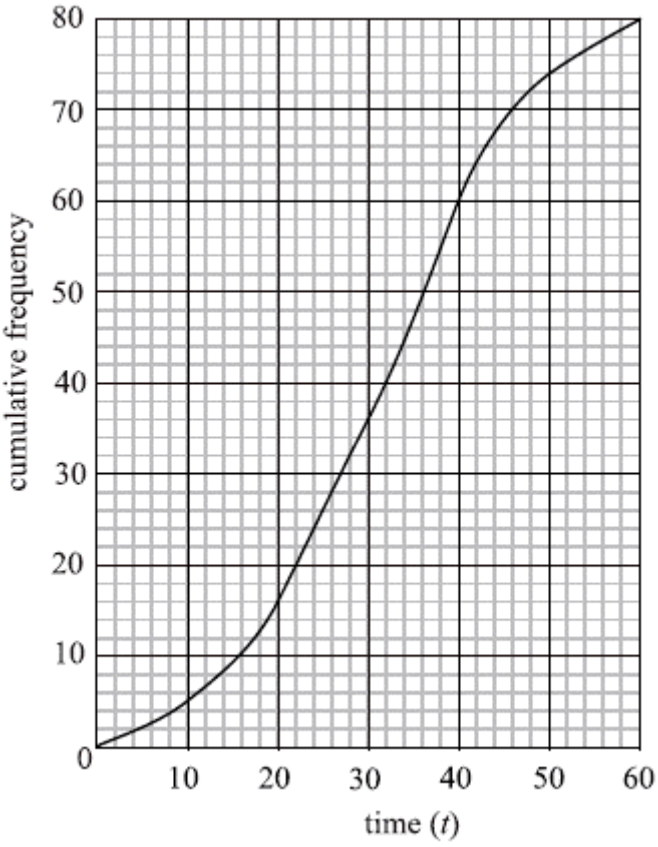
(a) Find $P(A \cap B)$.

(b) Find $P(A \cup B)$.

(c) Are A and B mutually exclusive? Justify your answer.

(Total 6 marks)

4. The following is a cumulative frequency diagram for the time t, in minutes, taken by 80 students to complete a task.



(a) Write down the median.

(1)

(b) Find the interquartile range.

(3)

(c) Complete the frequency table below.

Time (minutes)	Number of students
$0 \leq t < 10$	5
$10 \leq t < 20$	
$20 \leq t < 30$	20
$30 \leq t < 40$	24
$40 \leq t < 50$	
$50 \leq t < 60$	6

(2)
(Total 6 marks)

5. The letters of the word PROBABILITY are written on 11 cards as shown below.

Two cards are drawn at random without replacement.
Let A be the event the first card drawn is the letter A.
Let B be the event the second card drawn is the letter B.

(a) Find P(A).

(1)

(b) Find P($B \mid A$).

(2)

(c) Find P($A \cap B$).

(3)
(Total 6 marks)

6. In a class of 100 boys, 55 boys play football and 75 boys play rugby. Each boy must play at least one sport from football and rugby.

(a) (i) Find the number of boys who play both sports.

(ii) Write down the number of boys who play only rugby.

(3)

(b) One boy is selected at random.

(i) Find the probability that he plays only one sport.

(ii) Given that the boy selected plays only one sport, find the probability that he plays rugby.

(4)

Let A be the event that a boy plays football and B be the event that a boy plays rugby.

(c) Explain why A and B are **not** mutually exclusive.

(2)

(d) Show that A and B are **not** independent.

(3)

(Total 12 marks)

7. In a school with 125 girls, each student is tested to see how many sit-up exercises (sit-ups) she can do in one minute. The results are given in the table below.

Number of sit-ups	Number of students	Cumulative number of students
15	11	11
16	21	32
17	33	p
18	q	99
19	18	117
20	8	125

(a) (i) Write down the value of p.

(ii) Find the value of q.

(3)

(b) Find the median number of sit-ups.

(2)

(c) Find the mean number of sit-ups.

(2)
(Total 7 marks)

8. The table below shows the subjects studied by 210 students at a college.

	Year 1	Year 2	Totals
History	50	35	85
Science	15	30	45
Art	45	35	80
Totals	110	100	210

(a) A student from the college is selected at random.
Let A be the event the student studies Art.
Let B be the event the student is in Year 2.

(i) Find $P(A)$.

(ii) Find the probability that the student is a Year 2 Art student.

(iii) Are the events A and B independent? Justify your answer.

(6)

(b) Given that a History student is selected at random, calculate the probability that the student is in Year 1.

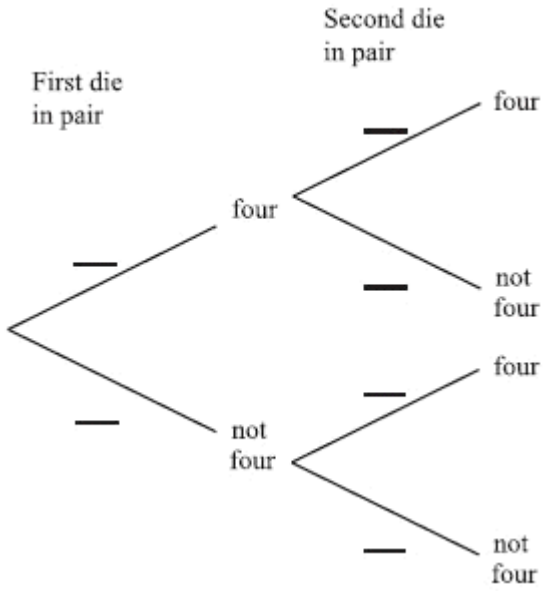
(2)

(c) Two students are selected at random from the college. Calculate the probability that one student is in Year 1, and the other in Year 2.

(4)
(Total 12 marks)

9. A pair of fair dice is thrown.

(a) Copy and complete the tree diagram below, which shows the possible outcomes.



(3)

Let E be the event that **exactly** one four occurs when the pair of dice is thrown.

(b) Calculate P(E).

(3)

The pair of dice is now thrown five times.

(c) Calculate the probability that event E occurs **exactly** three times in the five throws.

(3)

(d) Calculate the probability that event E occurs **at least** three times in the five throws.

(3)

(Total 12 marks)

10. Two restaurants, *Center* and *New*, sell fish rolls and salads.

Let F be the event a customer chooses a fish roll.
Let S be the event a customer chooses a salad.
Let N be the event a customer chooses neither a fish roll nor a salad.

In the *Center* restaurant P(F) = 0.31, P(S) = 0.62, P(N) = 0.14.

(a) Show that P($F \cap S$) = 0.07.

(3)

(b) Given that a customer chooses a salad, find the probability the customer also chooses a fish roll.

(3)

(c) Are F and S independent events? Justify your answer.

(3)

At *New* restaurant, P(N) = 0.14. Twice as many customers choose a salad as choose a fish roll.
Choosing a fish roll is **independent** of choosing a salad.

(d) Find the probability that a fish roll is chosen.

(7)

(Total 16 marks)

11. Consider the events A and B, where $P(A) = \frac{2}{5}$, $P(B') = \frac{1}{4}$ and $P(A \cup B) = \frac{7}{8}$.

(a) Write down $P(B)$.

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

(c) Find $P(A \mid B)$.

(Total 6 marks)

12. A set of data is

18, 18, 19, 19, 20, 22, 22, 23, 27, 28, 28, 31, 34, 34, 36.

The box and whisker plot for this data is shown below.

(a) Write down the values of A, B, C, D and E.

A = ... B = ... C= ..... D = ... E = ...

(b) Find the interquartile range.

(Total 6 marks)

13. There are 50 boxes in a factory. Their weights, w kg, are divided into 5 classes, as shown in the following table.

Class	Weight (kg)	Number of boxes
A	$9.5 \leq w < 18.5$	7
B	$18.5 \leq w < 27.5$	12
C	$27.5 \leq w < 36.5$	13
D	$36.5 \leq w < 45.5$	10
E	$45.5 \leq w < 54.5$	8

(a) Show that the estimated mean weight of the boxes is 32 kg.

(3)

(b) There are x boxes in the factory marked "Fragile". They are all in class E. The estimated mean weight of all the other boxes in the factory is 30 kg. Calculate the value of x.

(4)

(c) An additional y boxes, all with a weight in class D, are delivered to the factory. The total estimated mean weight of **all** of the boxes in the factory is less than 33 kg. Find the largest possible value of y.

(5)

(Total 12 marks)

14. Consider the four numbers a, b, c, d with $a \leq b \leq c \leq d$, where $a, b, c, d \in$ ×.
The mean of the four numbers is 4.
The mode is 3.
The median is 3.
The range is 6.

Find the value of a, of b, of c and of d.

(Total 6 marks)

15. The table below represents the weights, W, in grams, of 80 packets of roasted peanuts.

Weight (W)	$80 < W \leq 85$	$85 < W \leq 90$	$90 < W \leq 95$	$95 < W \leq 100$	$100 < W \leq 105$	$105 < W \leq 110$	$110 < W \leq 115$
Number of packets	5	10	15	26	13	7	4

(a) Use the midpoint of each interval to find an estimate for the standard deviation of the weights.

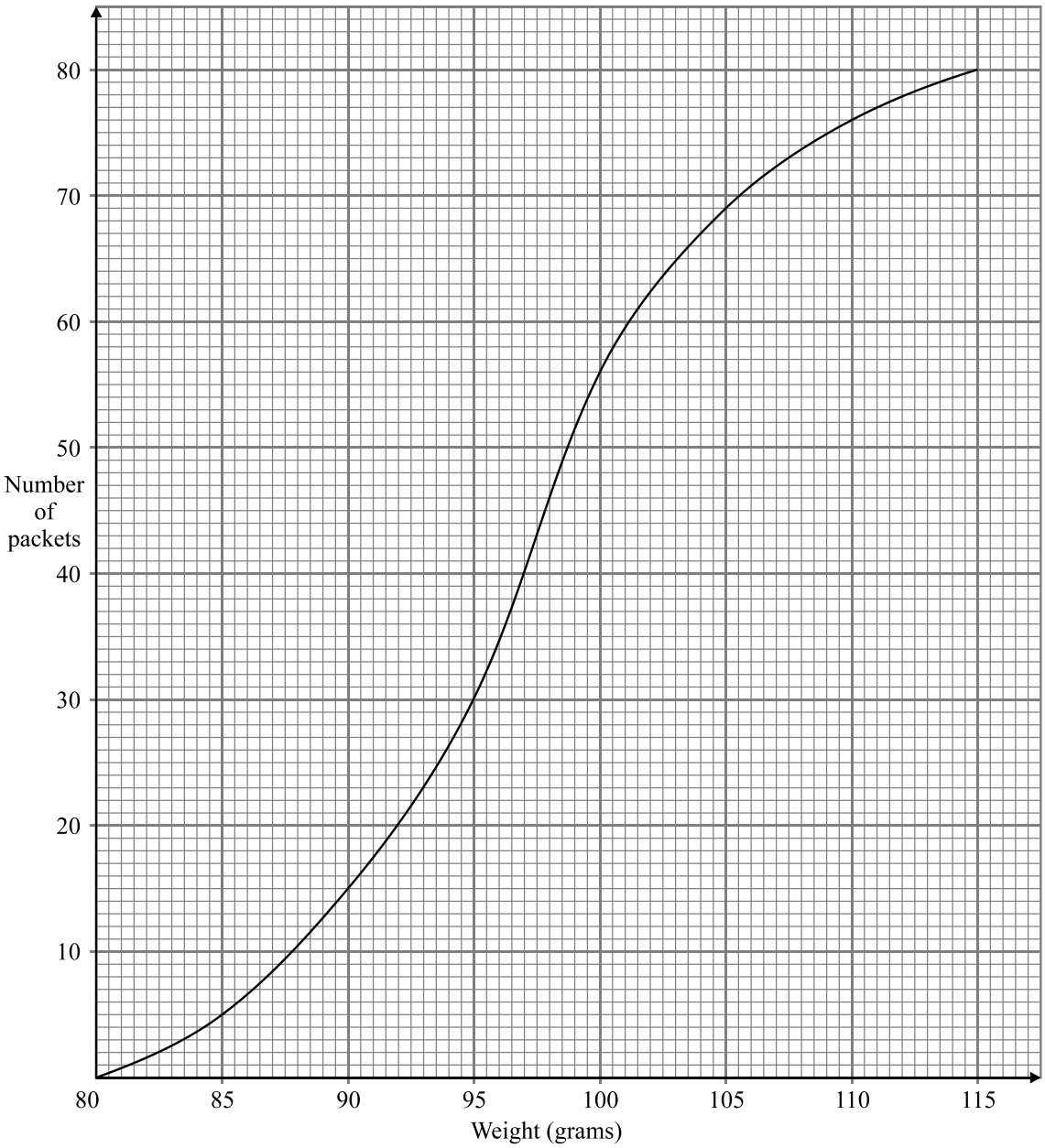
(3)

(b) Copy and complete the following cumulative frequency table for the above data.

Weight (W)	$W \leq 85$	$W \leq 90$	$W \leq 95$	$W \leq 100$	$W \leq 105$	$W \leq 110$	$W \leq 115$
Number of packets	5	15					80

(1)

(c) A cumulative frequency graph of the distribution is shown below, with a scale 2 cm for 10 packets on the vertical axis and 2 cm for 5 grams on the horizontal axis.



Use the graph to estimate

(i) the median;

(ii) the upper quartile (that is, the third quartile).

Give your answers to the nearest gram.

(4)

(d) Let W_1, W_2, ..., W_{80} be the individual weights of the packets, and let $\overline{W}$ be their mean. What is the value of the sum

$$(W_1 - \overline{W}) + (W_2 - \overline{W}) + (W_3 - \overline{W}) + \ldots + (W_{79} - \overline{W}) + (W_{80} - \overline{W})?$$

(2)

(e) One of the 80 packets is selected at random. Given that its weight satisfies $85 < W \leq 110$, find the probability that its weight is greater than 100 grams.

(4)

(Total 14 marks)

16. In a suburb of a large city, 100 houses were sold in a three-month period. The following **cumulative frequency table** shows the distribution of selling prices (in thousands of dollars).

Selling price P ($1000)	$P \leq 100$	$P \leq 200$	$P \leq 300$	$P \leq 400$	$P \leq 500$
Total number of houses	12	58	87	94	100

(a) Represent this information on a cumulative frequency **curve**, using a scale of 1 cm to represent $50000 on the horizontal axis and 1 cm to represent 5 houses on the vertical axis.

(4)

(b) Use your curve to find the interquartile range.

(3)

The information above is represented in the following frequency distribution.

Selling price P ($1000)	$0 < P \leq 100$	$100 < P \leq 200$	$200 < P \leq 300$	$300 < P \leq 400$	$400 < P \leq 500$
Number of houses	12	46	29	a	b

(c) Find the value of a and of b.

(2)

(d) Use mid-interval values to calculate an estimate for the mean selling price.

(2)

(e) Houses which sell for more than $350000 are described as *De Luxe*.

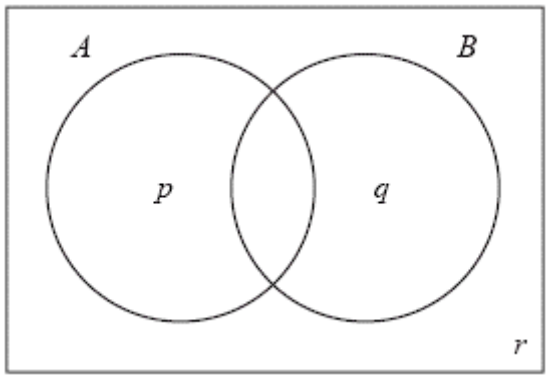
(i) Use your graph to estimate the number of *De Luxe* houses sold. Give your answer to the nearest integer.

(ii) Two *De Luxe* houses are selected at random. Find the probability that **both** have a selling price of more than $400000.

(4)
(Total 15 marks)

17. Consider the events A and B, where $P(A) = 0.5$, $P(B) = 0.7$ and $P(A \cap B) = 0.3$.

The Venn diagram below shows the events A and B, and the probabilities p, q and r.



(a) Write down the value of

(i) p;

(ii) q;

(iii) r.

(3)

(b) Find the value of $P(A \mid B')$.

(2)

(c) Hence, or otherwise, show that the events A and B are **not** independent.

(1)
(Total 6 marks)

18. A company uses two machines, A and B, to make boxes. Machine A makes 60 % of the boxes.

80 % of the boxes made by machine A pass inspection.
90 % of the boxes made by machine B pass inspection.

A box is selected at random.

(a) Find the probability that it passes inspection.

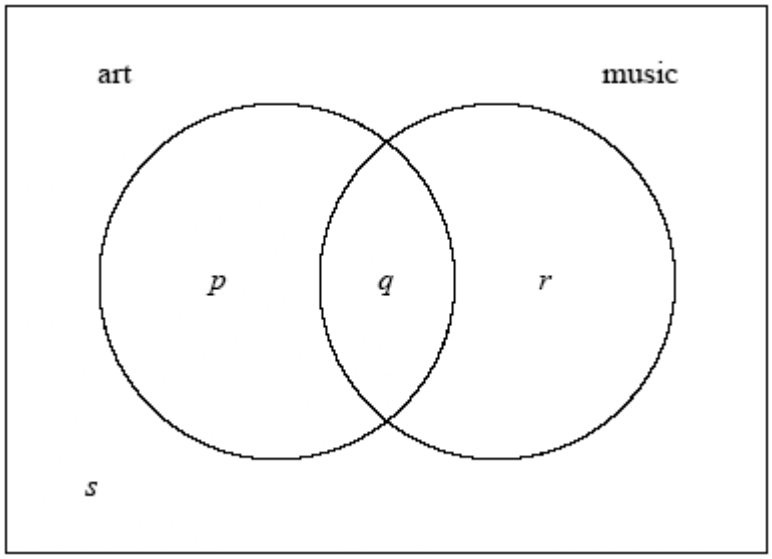
(3)

(b) The company would like the probability that a box passes inspection to be 0.87. Find the percentage of boxes that should be made by machine B to achieve this.

(4)

(Total 7 marks)

19. In a group of 16 students, 12 take art and 8 take music. One student takes neither art nor music. The Venn diagram below shows the events art and music. The values p, q, r and s represent numbers of students.



(a) (i) Write down the value of s.

(ii) Find the value of q.

(iii) Write down the value of p and of r.

(5)

(b) (i) A student is selected at random. Given that the student takes music, write down the probability the student takes art.

(ii) **Hence**, show that taking music and taking art are **not** independent events.

(4)

(c) Two students are selected at random, one after the other. Find the probability that the first student takes **only** music and the second student takes **only** art.

(4)

(Total 13 marks)