



Maths Questions By Topic:

Probability

A-Level Edexcel

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7. Alyona, Dawn and Sergei are sometimes late for school.

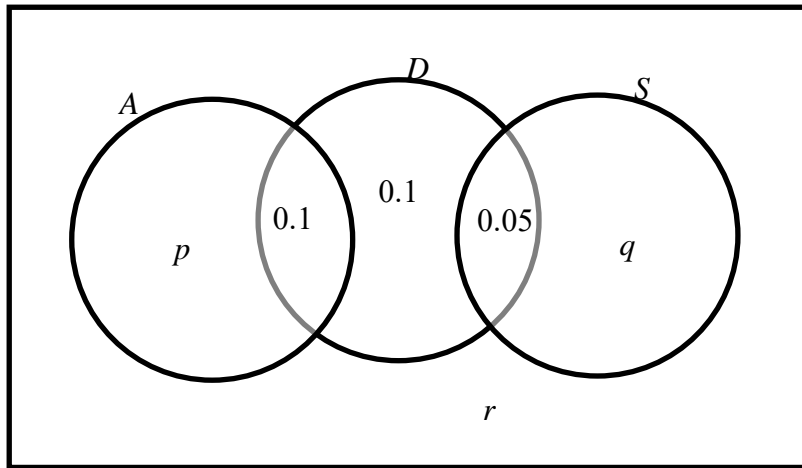
The events A , D and S are as follows:

A Alyona is late for school

D Dawn is late for school

S Sergei is late for school

The Venn diagram below shows the three events A , D and S and the probabilities associated with each region of D . The constants p , q and r each represent probabilities associated with the three separate regions outside D .



(a) Write down 2 of the events A , D and S that are mutually exclusive. Give a reason for your answer.

(1)

The probability that Sergei is late for school is 0.2 . The events A and D are independent.

(b) Find the value of r .

(4)

Dawn and Sergei's teacher believes that when Sergei is late for school, Dawn tends to be late for school.

(c) State whether or not D and S are independent, giving a reason for your answer.

(1)

(d) Comment on the teacher's belief in the light of your answer to part (c).

(1)

9. A company has 1825 employees.
The employees are classified as professional, skilled or elementary.

The following table shows

- the number of employees in each classification
- the two areas, A or B , where the employees live

| | A | B |
|--------------|-----|-----|
| Professional | 740 | 380 |
| Skilled | 275 | 90 |
| Elementary | 260 | 80 |

An employee is chosen at random.

Find the probability that this employee

- (a) is skilled, (1)

- (b) lives in area B and is not a professional. (1)

Some classifications of employees are more likely to work from home.

- 65% of professional employees in both area A and area B work from home
- 40% of skilled employees in both area A and area B work from home
- 5% of elementary employees in both area A and area B work from home
- Event F is that the employee is a professional
- Event H is that the employee works from home
- Event R is that the employee is from area A

- (c) Using this information, complete the Venn diagram on the opposite page. (4)

- (d) Find $P(R' \cap F)$ (1)

- (e) Find $P([H \cup R]')$ (1)

- (f) Find $P(F | H)$ (2)

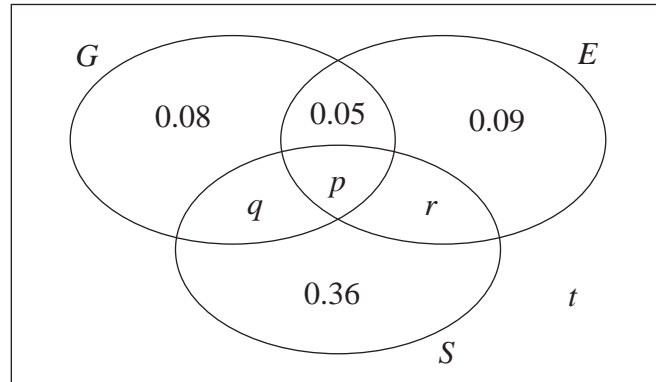
10. A large college produces three magazines. One magazine is about green issues, one is about equality and one is about sports. A student at the college is selected at random and the events G , E and S are defined as follows

G is the event that the student reads the magazine about green issues

E is the event that the student reads the magazine about equality

S is the event that the student reads the magazine about sports

The Venn diagram, where p , q , r and t are probabilities, gives the probability for each subset.



- (a) Find the proportion of students in the college who read exactly one of these magazines.

(1)

No students read all three magazines and $P(G) = 0.25$

- (b) Find

(i) the value of p

(ii) the value of q

(3)

Given that $P(S | E) = \frac{5}{12}$

- (c) find

(i) the value of r

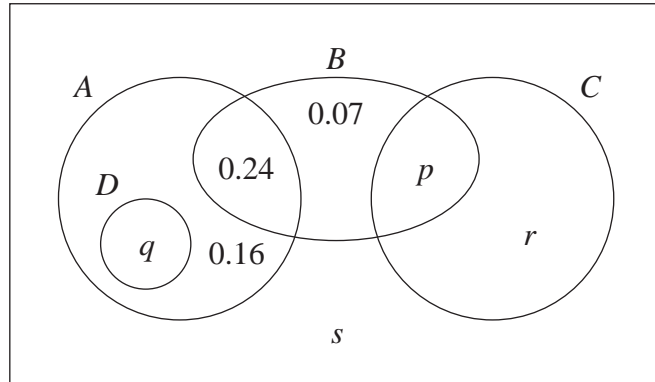
(ii) the value of t

(4)

- (d) Determine whether or not the events $(S \cap E')$ and G are independent. Show your working clearly.

(3)

11. The Venn diagram shows the probabilities associated with four events, A , B , C and D



(a) Write down any pair of mutually exclusive events from A , B , C and D (1)

Given that $P(B) = 0.4$

(b) find the value of p (1)

Given also that A and B are independent

(c) find the value of q (2)

Given further that $P(B'|C) = 0.64$

(d) find (4)

(i) the value of r

(ii) the value of s

17. A meteorologist believes that there is a relationship between the daily mean windspeed, w kn, and the daily mean temperature, t °C. A random sample of 9 consecutive days is taken from past records from a town in the UK in July and the relevant data is given in the table below.

| | | | | | | | | | |
|-----|------|------|------|------|------|------|------|------|------|
| t | 13.3 | 16.2 | 15.7 | 16.6 | 16.3 | 16.4 | 19.3 | 17.1 | 13.2 |
| w | 7 | 11 | 8 | 11 | 13 | 8 | 15 | 10 | 11 |

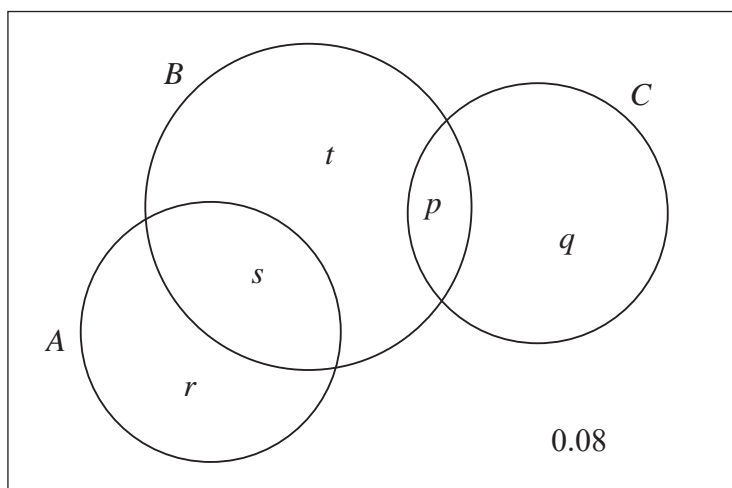
The meteorologist calculated the product moment correlation coefficient for the 9 days and obtained $r = 0.609$

Explain why a linear regression model based on these data is unreliable on a day when the mean temperature is 24 °C

(1)

(Total for Question 17 is 1 mark)

20. The Venn diagram shows three events A , B and C , where p , q , r , s and t are probabilities.



$P(A) = 0.5$, $P(B) = 0.6$ and $P(C) = 0.25$ and the events B and C are independent.

- (a) Find the value of p and the value of q . (2)
- (b) Find the value of r . (2)
- (c) Hence write down the value of s and the value of t . (2)
- (d) State, giving a reason, whether or not the events A and B are independent. (2)
- (e) Find $P(B | A \cup C)$. (3)

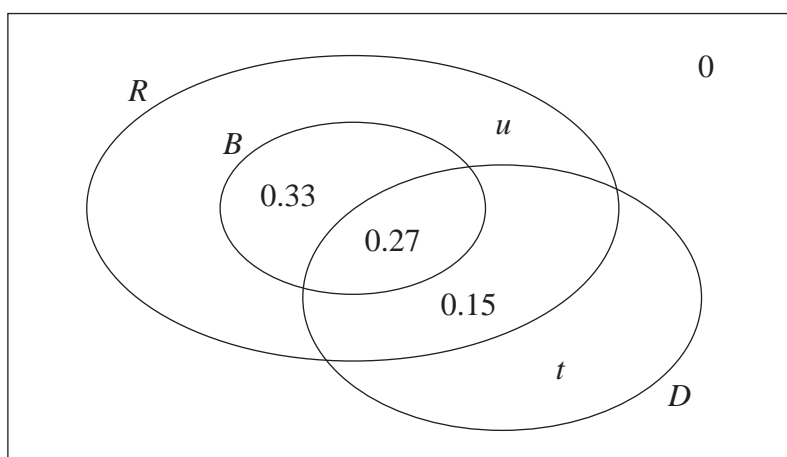
21. The Venn diagram shows the probabilities of customer bookings at Harry's hotel.

R is the event that a customer books a room

B is the event that a customer books breakfast

D is the event that a customer books dinner

u and t are probabilities.



(a) Write down the probability that a customer books breakfast but does not book a room. (1)

Given that the events B and D are independent

(b) find the value of t (4)

(c) hence find the value of u (2)

(d) Find

(i) $P(D|R \cap B)$

(ii) $P(D|R \cap B')$ (4)

A coach load of 77 customers arrive at Harry's hotel.

Of these 77 customers

40 have booked a room and breakfast

37 have booked a room without breakfast

(e) Estimate how many of these 77 customers will book dinner. (2)

22. A college has 80 students in Year 12.

- 20 students study Biology
- 28 students study Chemistry
- 30 students study Physics
- 7 students study both Biology and Chemistry
- 11 students study both Chemistry and Physics
- 5 students study both Physics and Biology
- 3 students study all 3 of these subjects

(a) Draw a Venn diagram to represent this information. (5)

A Year 12 student at the college is selected at random.

(b) Find the probability that the student studies Chemistry but not Biology or Physics. (1)

(c) Find the probability that the student studies Chemistry or Physics or both. (2)

Given that the student studies Chemistry or Physics or both,

(d) find the probability that the student does not study Biology. (2)

(e) Determine whether studying Biology and studying Chemistry are statistically independent. (3)

26. The discrete random variable X has probability distribution

$$P(X = x) = \frac{1}{10} \quad x = 1, 2, 3, \dots 10$$

(a) Write down the name given to this distribution. (1)

(b) Write down the value of

(i) $P(X = 10)$

(ii) $P(X < 10)$ (2)

(Total 3 marks)

30. A biased die with six faces is rolled. The discrete random variable X represents the score on the uppermost face. The probability distribution of X is shown in the table below.

| | | | | | | |
|------------|-----|-----|-----|-----|-----|-----|
| x | 1 | 2 | 3 | 4 | 5 | 6 |
| $P(X = x)$ | a | a | a | b | b | 0.3 |

- (a) Given that $E(X) = 4.2$ find the value of a and the value of b . (5)

A biased die with five faces is rolled. The discrete random variable Y represents the score which is uppermost. The cumulative distribution function of Y is shown in the table below.

| | | | | | |
|--------|----------------|----------------|------|------|------|
| y | 1 | 2 | 3 | 4 | 5 |
| $F(y)$ | $\frac{1}{10}$ | $\frac{2}{10}$ | $3k$ | $4k$ | $5k$ |

- (b) Find the value of k . (1)

- (c) Find the probability distribution of Y . (3)

Each die is rolled once. The scores on the two dice are independent.

- (d) Find the probability that the sum of the two scores equals 2 (2)

31.

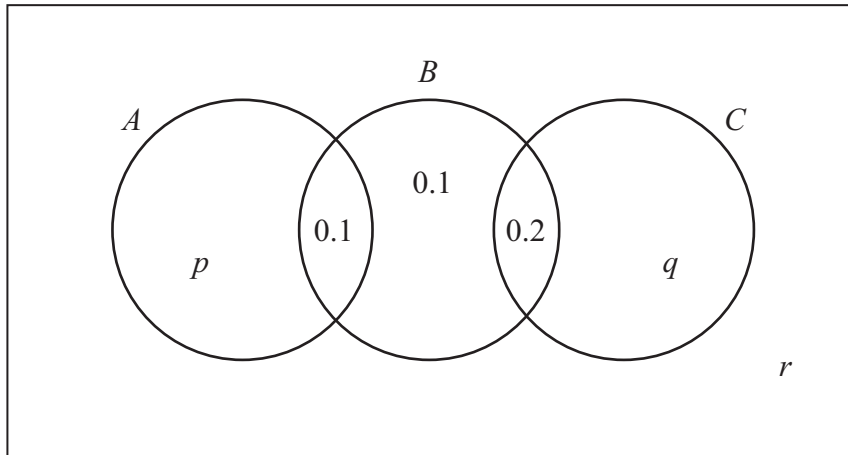


Figure 1

The Venn diagram in Figure 1 shows three events A , B and C and the probabilities associated with each region of B . The constants p , q and r each represent probabilities associated with the three separate regions outside B .

The events A and B are independent.

- (a) Find the value of p . (3)

Given that $P(B|C) = \frac{5}{11}$

- (b) find the value of q and the value of r . (4)

- (c) Find $P(A \cup C|B)$. (2)

36. Jake and Kamil are sometimes late for school.
The events J and K are defined as follows

J = the event that Jake is late for school
 K = the event that Kamil is late for school

$P(J) = 0.25$, $P(J \cap K) = 0.15$ and $P(J' \cap K') = 0.7$

On a randomly selected day, find the probability that

(a) at least one of Jake or Kamil are late for school, (1)

(b) Kamil is late for school. (2)

Given that Jake is late for school,

(c) find the probability that Kamil is late. (3)

The teacher suspects that Jake being late for school and Kamil being late for school are linked in some way.

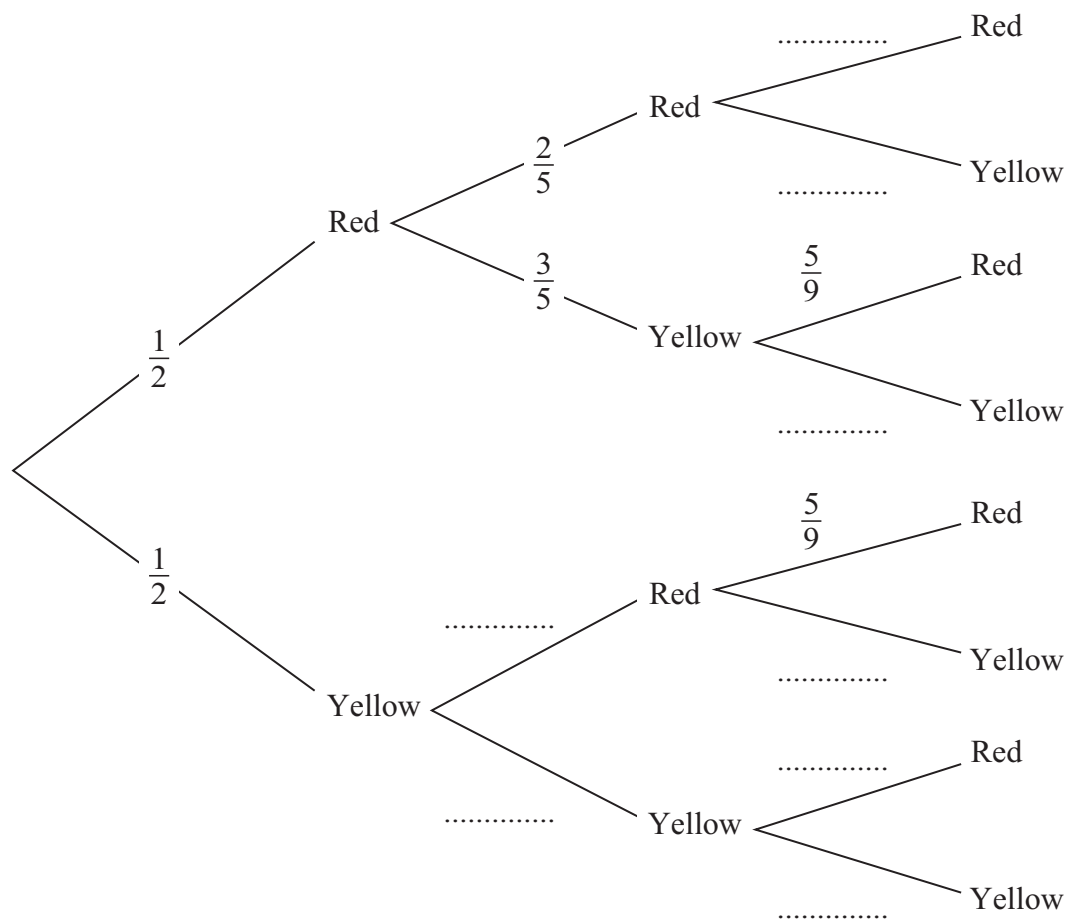
(d) Determine whether or not J and K are statistically independent. (2)

(e) Comment on the teacher's suspicion in the light of your calculation in (d). (1)

37. The bag P contains 6 balls of which 3 are red and 3 are yellow.
 The bag Q contains 7 balls of which 4 are red and 3 are yellow.
 A ball is drawn at random from bag P and placed in bag Q . A second ball is drawn at random from bag P and placed in bag Q .
 A third ball is then drawn at random from the 9 balls in bag Q .

The event A occurs when the 2 balls drawn from bag P are of the same colour.
 The event B occurs when the ball drawn from bag Q is red.

- (a) Complete the tree diagram shown below.



(4)

- (b) Find $P(A)$

(3)

- (c) Show that $P(B) = \frac{5}{9}$

(3)

- (d) Show that $P(A \cap B) = \frac{2}{9}$

(2)

- (e) Hence find $P(A \cup B)$

(2)

- (f) Given that all three balls drawn are the same colour, find the probability that they are all red.

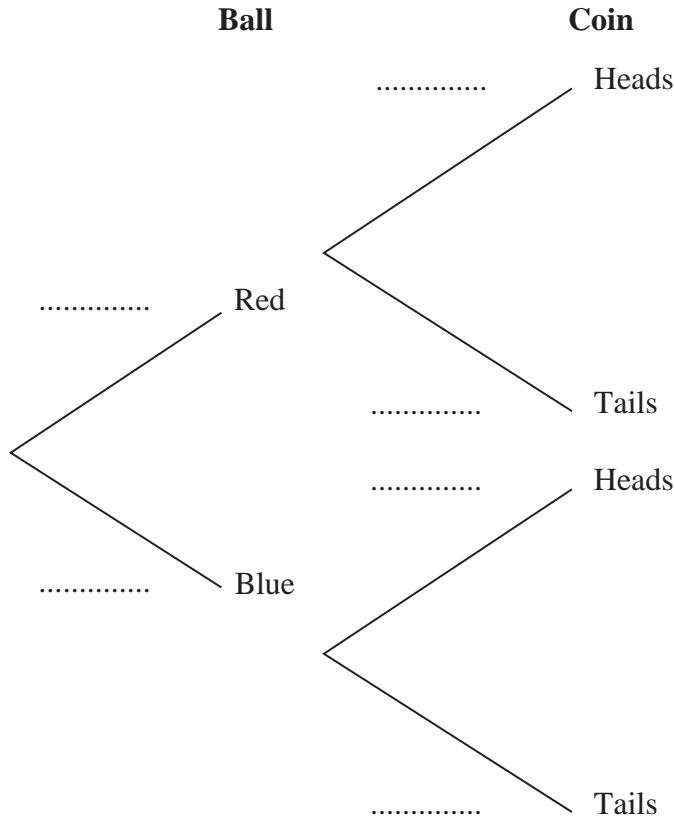
(3)

38. An experiment consists of selecting a ball from a bag and spinning a coin. The bag contains 5 red balls and 7 blue balls. A ball is selected at random from the bag, its colour is noted and then the ball is returned to the bag.

When a red ball is selected, a biased coin with probability $\frac{2}{3}$ of landing heads is spun.

When a blue ball is selected a fair coin is spun.

(a) Complete the tree diagram below to show the possible outcomes and associated probabilities.



(2)

Shivani selects a ball and spins the appropriate coin.

(b) Find the probability that she obtains a head.

(2)

Given that Tom selected a ball at random and obtained a head when he spun the appropriate coin,

(c) find the probability that Tom selected a red ball.

(3)

Shivani and Tom each repeat this experiment.

(d) Find the probability that the colour of the ball Shivani selects is the same as the colour of the ball Tom selects.

(3)

39. The Venn diagram in Figure 1 shows the number of students in a class who read any of 3 popular magazines *A*, *B* and *C*.

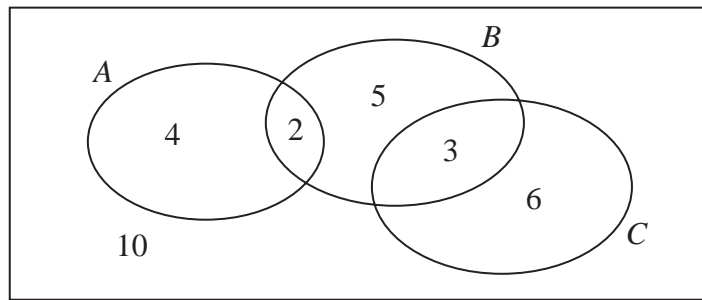


Figure 1

One of these students is selected at random.

- (a) Show that the probability that the student reads more than one magazine is $\frac{1}{6}$. (2)
- (b) Find the probability that the student reads *A* or *B* (or both). (2)
- (c) Write down the probability that the student reads both *A* and *C*. (1)

Given that the student reads at least one of the magazines,

- (d) find the probability that the student reads *C*. (2)
- (e) Determine whether or not reading magazine *B* and reading magazine *C* are statistically independent. (3)

45. A disease is known to be present in 2% of a population. A test is developed to help determine whether or not someone has the disease.

Given that a person has the disease, the test is positive with probability 0.95

Given that a person does not have the disease, the test is positive with probability 0.03

- (a) Draw a tree diagram to represent this information.

(3)

A person is selected at random from the population and tested for this disease.

- (b) Find the probability that the test is positive.

(3)

A doctor randomly selects a person from the population and tests him for the disease. Given that the test is positive,

- (c) find the probability that he does not have the disease.

(2)

- (d) Comment on the usefulness of this test.

(1)

46. A person's blood group is determined by whether or not it contains any of 3 substances A , B and C .

A doctor surveyed 300 patients' blood and produced the table below.

| Blood contains | No. of Patients |
|-------------------------|-----------------|
| only C | 100 |
| A and C but not B | 100 |
| only A | 30 |
| B and C but not A | 25 |
| only B | 12 |
| A , B and C | 10 |
| A and B but not C | 3 |

- (a) Draw a Venn diagram to represent this information.

(4)

47. The following shows the results of a wine tasting survey of 100 people.

- 96 like wine *A*,
- 93 like wine *B*,
- 96 like wine *C*,
- 92 like *A* and *B*,
- 91 like *B* and *C*,
- 93 like *A* and *C*,
- 90 like all three wines.

(a) Draw a Venn Diagram to represent these data. (6)

Find the probability that a randomly selected person from the survey likes

(b) none of the three wines, (1)

(c) wine *A* but not wine *B*, (2)

(d) any wine in the survey except wine *C*, (2)

(e) exactly two of the three kinds of wine. (2)

Given that a person from the survey likes wine *A*,

(f) find the probability that the person likes wine *C*. (3)

48. Tetrahedral dice have four faces. Two fair tetrahedral dice, one red and one blue, have faces numbered 0, 1, 2, and 3 respectively. The dice are rolled and the numbers face down on the two dice are recorded. The random variable R is the score on the red die and the random variable B is the score on the blue die.

(a) Find $P(R=3 \text{ and } B=0)$. (2)

The random variable T is R multiplied by B .

(b) Complete the diagram below to represent the sample space that shows all the possible values of T .

| | | | | | |
|----------|----------|----------|----------|----------|----------|
| 3 | | | | | |
| 2 | | 2 | | | |
| 1 | 0 | | | | |
| 0 | | | | | |
| <i>B</i> | <i>R</i> | 0 | 1 | 2 | 3 |

Sample space diagram of T (3)

(c) The table below represents the probability distribution of the random variable T .

| | | | | | | | |
|----------|----------|----------|-----|-----|----------|-----|----------|
| <i>t</i> | 0 | 1 | 2 | 3 | 4 | 6 | 9 |
| $P(T=t)$ | <i>a</i> | <i>b</i> | 1/8 | 1/8 | <i>c</i> | 1/8 | <i>d</i> |

Find the values of a , b , c and d . (3)
