A Level · Edexcel · Maths

3 hours 32 questions

3.1 Basic Probability

3.1.1 Calculating Probabilities & Events / 3.1.2 Venn Diagrams / 3.1.3 Tree Diagrams

Easy (8 questions)	/37
Medium (8 questions)	/40
Hard (8 questions)	/43
Very Hard (8 questions)	/48
Total Marks	**/168**

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Easy Questions

1 (a) The heights, in cm, of 100 rockhopper penguins are recorded in the following table:

Height, h (cm)	**Frequency**
40 ≤ h <45	12
45 ≤ h <50	36
50 ≤ h <55	42
55 ≤ h <60	10

Write down the number of penguins that are

(i) at least 50 cm tall

(ii) between 45 and 55 cm tall.

(2 marks)

(b) A rockhopper penguin is chosen at random.
Use your answers to part (a) to help determine the probability that the penguin is

(i) at least 50 cm tall

(ii) between 45 and 55 cm tall.

(2 marks)

2 (a) A and B are two events such that $P(A) = 0.3$, $P(B) = 0.8$, and $P(A \text{ and } B) = 0.24$.
Use the formula $P(A \text{ and } B) = P(A) \times P(B)$ to determine whether A and B are independent or not.

(2 marks)

(b) C and D are two events such that $P(C) = 0.42$, $P(D) = 0.51$, and $P(C \text{ or } D) = 0.91$.
Use the formula $P(C \text{ or } D) = P(C) + P(D)$ to determine whether C and D are mutually exclusive or not.

(2 marks)

3 (a) You may use the formula $P(A \text{ and } B) = P(A) \times P(B)$ in this question.

A fair spinner has five sections labelled 'dog', 'cat', 'dog', 'dog' and 'rabbit'.

The spinner is spun once.
Find the probability the spinner comes to rest on a section labelled

(i) 'dog'

(ii) 'rabbit'.

(2 marks)

(b) The spinner is spun twice.
Find the probability that

(i) the spinner comes to rest on the section labelled 'cat' on both spins

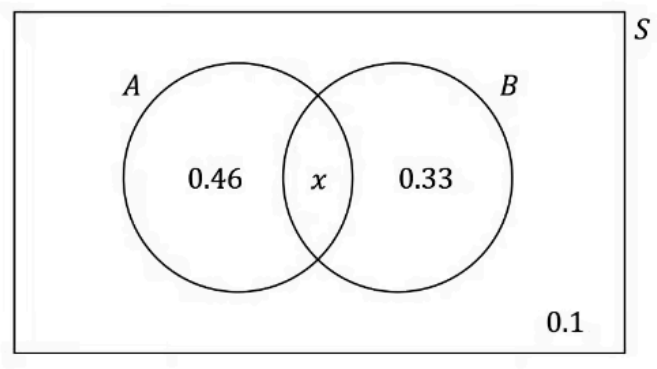
(ii) the spinner does **not** come to rest on a section labelled 'dog' on either spin.

(3 marks)

4 (a) The Venn diagram below shows the probabilities of members of a tennis club participating in two different formats of the sport.

A represents the event that the member participates in the singles competition.

B represents the event that the member participates in the doubles competition.



Use the fact that the sum of probabilities equals 1 to determine the value of x.

(2 marks)

(b) Write down what the probability 0.1 represents in the context of the question.

(1 mark)

5 (a) A box of equally sized toy bricks contains 3 blue bricks and 2 red bricks.

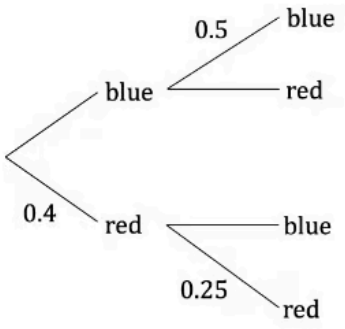
A random toy brick is removed from the box. Determine the probability that this brick is

(i) blue

(ii) red.

(2 marks)

(b) A second brick is taken from the box **without** the first one being replaced.
Copy and complete the tree diagram below that represents this situation.



(3 marks)

(c) Use your tree diagram from part (b) to determine the probability that both bricks taken from the box are blue.

(2 marks)

6 (a) A and B are two events such that $P(A) = 0.25$ and $P(B) = 0.7$.
Given that A and B are independent use the formula $P(A \text{ and } B) = P(A) \times P(B)$ to find $P(A \text{ and } B)$.

(2 marks)

(b) C and D are two events such that $P(C) = 0.4$ and $P(D) = 0.5$.
Given that C and D are mutually exclusive use the formula $P(C \text{ or } D) = P(C) + P(D)$ to find $P(C \text{ or } D)$.

(2 marks)

7 (a) Visitors to a nature museum were polled to see if they liked the museum's two main attractions – a dinosaur skeleton and a stuffed Peruvian bear. The probability that a visitor liked the dinosaur skeleton is 0.7. The probability that a visitor liked the stuffed Peruvian bear is 0.5. The probability a visitor liked both is 0.4.

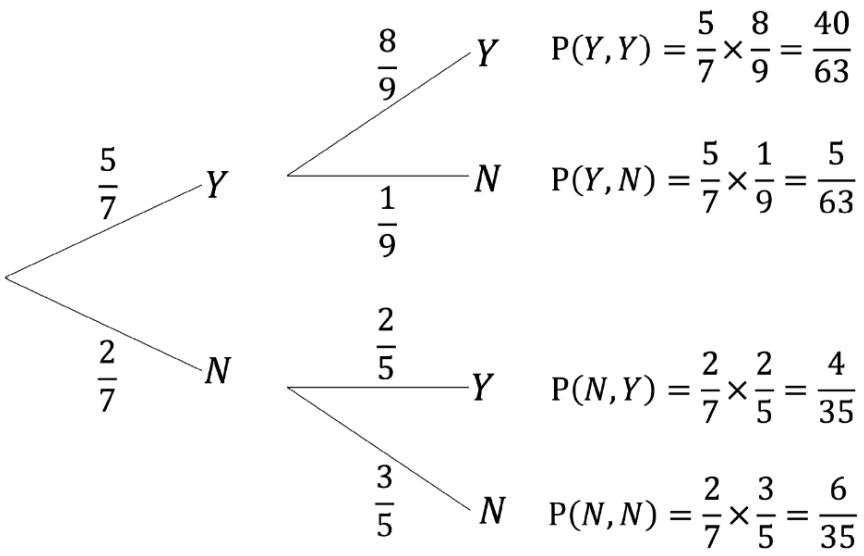
Draw a Venn diagram to represent this information.

(3 marks)

(b) Use your Venn diagram from part (a) to determine the probability of a visitor liking neither of the two main attractions.

(2 marks)

8 The tree diagram below shows the probabilities that a pool player will successfully complete two successive trick shots. Y indicates a successful trick shot, N indicates a failed trick shot.



Use the probabilities given to determine the probability that the pool player

(i) successfully completes both trick shots

(ii) successfully completes exactly one trick shot

(iii) successfully completes at least one trick shot.

(5 marks)

Medium Questions

1 The lengths, in cm, of 120 adult platypuses are recorded in the following table:

Length, l (cm)	**Frequency (female)**	**Frequency (male)**
$39 \leq l < 42$	14	0
$42 \leq l < 45$	29	0
$45 \leq l < 48$	12	7
$48 \leq l < 51$	6	21
$51 \leq l < 54$	3	19
$54 \leq l < 57$	1	5
$57 \leq l < 60$	0	2
$60 \leq l < 63$	0	1

One platypus is chosen at random. Find the probability that the platypus is:

(i) male

(ii) less than 51 cm long

(iii) a male less than 45 cm long

(iv) a female between 45 and 54 cm long.

(4 marks)

2 Two fair spinners each have three sectors numbered 1 to 3. The two spinners are spun together and then the product of the numbers indicated on each spinner is recorded.

Find the probability of the product indicated by the spinners being

(i) exactly 6

(ii) less than 4

(iii) an odd number.

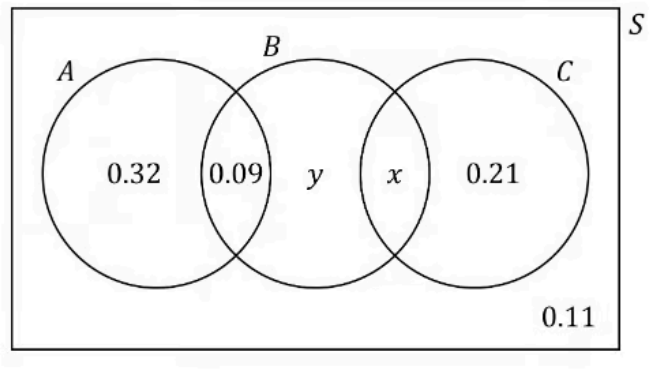
(4 marks)

3 (a) The Venn diagram below shows the probabilities of members of an exotic sports society participating in various activities.

A represents the event that the member participates in aerial yoga.

B represents the event that the member participates in bog snorkelling.

C represents the event that the member participates in cheese rolling.



Given that the probability of a member participating in cheese rolling is 0.44,

determine the values of

(i) x

(ii) y.

(3 marks)

(b) Determine the probability that a member of the society

(i) participates in at least one of the three activities

(ii) participates in exactly one of the three activities.

(2 marks)

4 On any given day the probability that Radigast has a lichen smoothie with his lunch is 0.4, and the probability that he has a wild mushroom wrap is 0.8. Given that the probability of him having both those items is 0.35, find the probability that Radigast has:

(i) a wild mushroom wrap but not a lichen smoothie

(ii) neither a wild mushroom wrap nor a lichen smoothie.

(4 marks)

5 (a) A and B are two events such that $P(A) = 0.35$, $P(B) = 0.25$ and $P(A \text{ or } B) = 0.6$. State, with a reason, whether A and B are mutually exclusive.

(2 marks)

(b) C and D are two events such that $P(C) = 0.2$, $P(D) = 0.4$ and $P(C \text{ and } D) = 0.18$. State, with a reason, whether C and D are independent.

(2 marks)

6 (a) The Idiosyncratic Delights ice cream company polls a group of students to find out whether they like the company's two signature ice cream flavours – asparagus and blue cheese. The probability that a student likes asparagus ice cream is 0.2. The probability that a student likes blue cheese ice cream is 0.15. The probability that a student likes neither flavour is 0.68.

Draw a Venn diagram to represent this information.

(3 marks)

(b) Determine whether the events 'likes asparagus ice cream' and 'likes blue cheese ice cream' are independent.

(2 marks)

7 (a) A bag contains 13 yellow tokens and 7 green tokens. Two tokens are drawn from the bag without replacement.

Draw a tree diagram to represent this experiment.

(3 marks)

(b) Find the probability that the two tokens drawn are the same colour.

(3 marks)

8 (a) In a game of Galactic Unicorns your Monocerian-class space frigate is attacking an evil Sargonian robot ship. Your attack will either hit or miss the robot ship, the probability of hitting the ship is 0.7. If you hit the robot ship then there is a probability of 0.8 that the ship will be destroyed, otherwise it will manage to escape. If you miss the robot ship then there is a probability of 0.2 that it will manage to escape, otherwise it will surrender because it has witnessed the immense power of your rainbow lasers.

Draw a tree diagram to represent this information.

(3 marks)

(b) Find the probability that the robot ship

(i) is destroyed

(ii) manages to escape

(iii) surrenders.

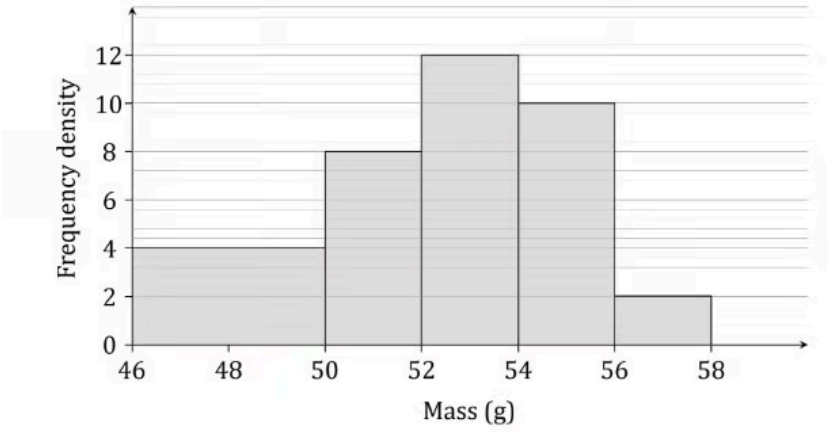
(3 marks)

(c) Show that the events 'you hit the robot ship' and 'the robot ship manages to escape' are independent.

(2 marks)

Hard Questions

1 (a) The histogram below shows the distribution of masses, in grams, of 80 newly hatched ducklings:



Find the probability that a duckling chosen at random has a mass less than 54 g.

(2 marks)

(b) Estimate the probability that a duckling chosen at random has a mass greater than 53 g.

(3 marks)

2 A game is played using a fair spinner with four sectors numbered 1 to 4, as well as a fair dice with its six sides numbered 1 to 6. The spinner is spun and the dice is rolled, and the score in the game is defined as the (positive) difference between the two results.

Find the probability of the score in the game being

(i) exactly 0

(ii) 3 or more

(iii) a prime number.

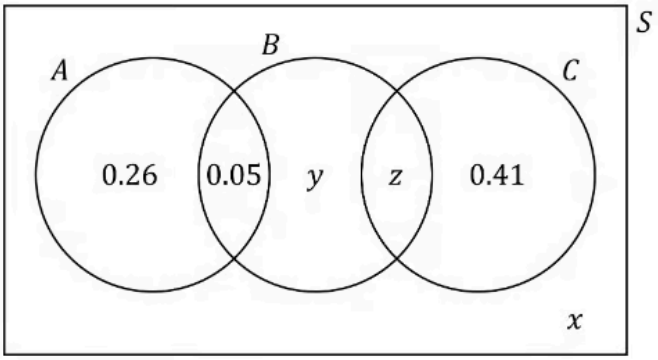
(4 marks)

3 (a) The Venn diagram below shows the probabilities of contributors to a wildlife charity sponsoring certain targeted campaigns run by the charity.

A represents the event that the member sponsors Aardvarks Aanonymous.

B represents the event that the member sponsors Bandicoots Unbanned.

C represents the event that the member sponsors Carry On Capybaras.



Given that the probability of a contributor sponsoring at least one of the three campaigns is 0.92, and the probability of a contributor sponsoring exactly one of the three campaigns is 0.7, determine the values of x, y and z.

(4 marks)

(b) Determine the probability that a contributor to the charity

(i) sponsors Bandicoots Unbanned

(ii) sponsors exactly two of the three campaigns.

(2 marks)

4 On any given day the probability that Tomás works on his poetry is 0.55, and the probability that he stops in at his local pub is 0.75. Given that he always does at least one of those two things, find the probability that on a given day Tomás:

(i) goes to the pub and works on his poetry

(ii) goes to the pub but doesn't work on his poetry.

(4 marks)

5 A, B, C and D are four events such that $P(A) = 0.28$, $P(B) = 0.33$, $P(C) = 0.43$ and $P(D) = 0.25$.

(i) Given that B and C are mutually exclusive, find $P(B \text{ or } C)$.

(ii) Given that A and D are independent, find $P(A \text{ and } D)$.

(4 marks)

6 (a) The Tell It Like It Is burger bar has been collecting data to find out whether customers like the restaurant's two signature menu items – the Absolutely Awesome A-list Burger and the Basic But It'll Do Bargain Burger. The probability that a customer likes both burgers is 0.12. The probability that a customer likes only one of the burgers is 0.71. The probability that a customer likes the Basic But It'll Do Bargain Burger but doesn't like the Absolutely Awesome A-list Burger is 0.03.

Draw a Venn diagram to represent this information.

(3 marks)

(b) Determine whether the events 'likes the Absolutely Awesome A-list Burger' and 'likes the Basic But It'll Do Bargain Burger' are independent.

(2 marks)

7 (a) A bag contains 12 red marbles, 7 green marbles and 1 black marble. Two marbles are drawn from the bag without replacement.

Draw a tree diagram to represent this experiment.

(4 marks)

(b) Find the probability that the two marbles drawn are not both the same colour.

(3 marks)

8 (a) In a game of Unicorns Versus Zombies your unicorn is attempting to use the magic of its horn to dispel a cloud of zombie apocalypse flies. On the first attempt, the probability of the magic working is 0.7. If the magic works, then there is a probability of 0.2 that the flies will be turned into glitter pixies and join your rainbow army, otherwise the flies will simply be dispelled. If the magic does not work the first time you may try again, although the probability of your magic working the second time is only 0.6. Similarly, if your magic does not work the second time you may try a third time, but on the third attempt the probability of your magic working is reduced to 0.5. If your magic works on the second or third attempts the probabilities of dispelling the flies or turning them into glitter pixies are the same as for the magic working on the first attempt. If your magic does not work on the third attempt, however, then your unicorn is turned into an evil zombiecorn and joins the zombie horde. In all cases, the game ends when either the flies are turned into glitter pixies, or the flies are dispelled, or your unicorn is turned into a zombiecorn.

Draw a tree diagram to represent this information.

(4 marks)

(b) Find the probability that

(i) the flies are turned into glitter pixies

(ii) the flies are dispelled

(iii) your unicorn is turned into a zombiecorn.

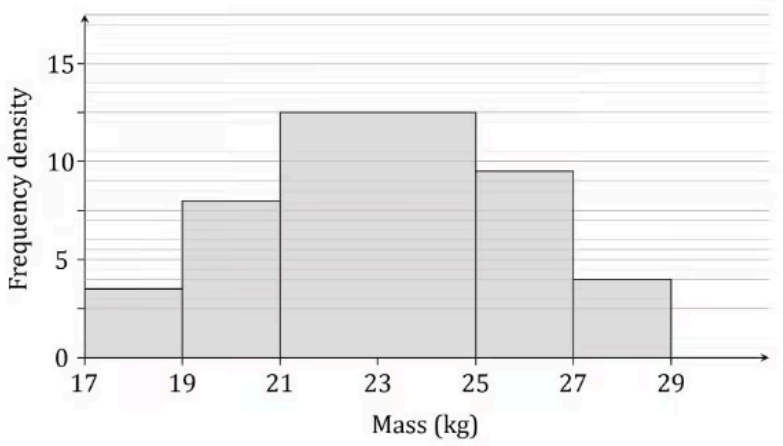
(3 marks)

(c) Give an example of two events in the game that are mutually exclusive.

(1 mark)

Very Hard Questions

1 (a) The histogram below shows the distribution of masses, in kg, of 100 newborn calves:



Find the probability that a calf chosen at random has a mass greater than 21 kg.

(2 marks)

(b) Estimate the probability that a calf chosen at random has a mass less than 23.5 kg.

(3 marks)

2 A game is played using a fair spinner with four sectors numbered 1 to 4, as well as a fair eight-sided dice with its sides numbered 1 to 8. The spinner is spun and the dice is rolled, and the score in the game is determined as follows:

if the number on the spinner is higher than the number on the dice, then the score is the sum of the two numbers;

if the number on the spinner is lower than the number on the dice, then the score is the (positive) difference of the two numbers;

if the numbers on the spinner and the dice are equal, then the score is the product of the two numbers.

Find the probability of the score in the game being

(i) exactly 7

(ii) 10 or more

(iii) a triangular number (1, 3, 6, 10, 15, 21, ...).

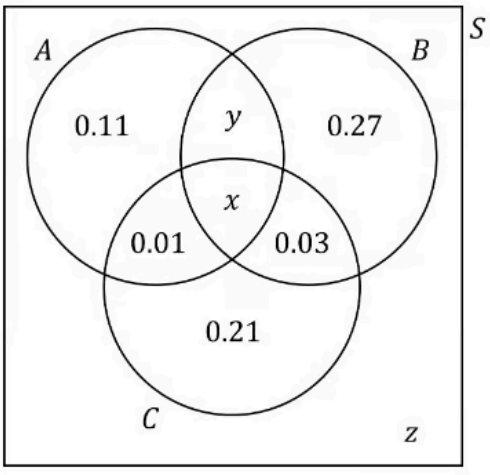
(4 marks)

3 (a) The Venn diagram below shows the probabilities of members of a horror film society having seen various films.

A represents the event that the member has seen Aaaaaaaaaaagh!.

B represents the event that the member has seen Beware the Gloaming.

C represents the event that the member has seen Cute Kittens of Doom.



Given that half the members of the society have seen Cute Kittens of Doom, and that 38% of members have seen at least two of the three films determine the values of x, y and z.

(4 marks)

(b) Determine the probability that a member of the society

(i) has seen exactly two of the three films

(ii) has seen at least one of three films but not all three of them.

(2 marks)

4 On any given day the probability that Björn has an avocado with his lunch is 0.39, while the probabilities of him having a bacon butty or a piece of carrot cake are 0.32 and 0.44 respectively. He never has all three items on the same day, but the probability that he doesn't have at least one of them is only 0.09. Given that the probability of him having exactly two of the three items is the same regardless of which two items those are, find the probability that on a given day Björn has:

(i) exactly one of the three items

(ii) a bacon butty but not a piece of carrot cake.

(5 marks)

5 A, B and C are three events such that $P(A) = 0.28$, $P(A \text{ or } C) = 0.4$ and $P(B \text{ and } C) = 0.02$.

Given that A and C are mutually exclusive, and that B and C are independent, find $P(B)$, $P(C)$ and $P(C \text{ but not } B)$.

(5 marks)

6 (a) The online streaming music service Smudgify has been collecting data about the types of music listened to by its users. The probability that a user listens to ambient grime is 0.25. The probability that a user listens to banjo & bass is 0.36. The probability that a user listens to coracle shanties is 0.56. Only 10% of users do not listen to at least one of the three types of music, although it is also known that no users listen to both ambient grime and coracle shanties. It is twice as likely that a randomly selected user would listen to both coracle shanties and banjo & bass, as it is that the user would listen to both ambient grime and banjo & bass.

Draw a Venn diagram to represent this information.

(4 marks)

(b) Determine whether any of the events 'listens to ambient grime', 'listens to banjo & bass' and 'listens to coracle shanties' are independent of one another.

(3 marks)

7 (a) A bag contains 10 black tokens and 6 white tokens. A token is drawn from the bag and its colour recorded, and then a fair coin is flipped. If the coin lands on heads then a second token is drawn from the bag without replacing the first token. If the coin lands on tails then the first token is replaced in the bag before a second token is drawn.

Draw a tree diagram to represent this experiment.

(4 marks)

(b) Find the probability that the second token drawn is white.

(3 marks)

8 (a) The game Undead Redemption is played using three fair dice – a four-sided dice with the sides numbered 1 to 4, a six-sided dice with the sides numbered 1 to 6, and an eight-sided dice with the sides numbered 1 to 8.

In the game your character is battling a zombie. The battle can last between one and three rounds, and it is resolved as follows:

- In the first round, you and the zombie each roll the four-sided dice. If your roll is greater than or equal to the zombie's roll then the zombie is destroyed and the battle is over. Otherwise your character is wounded and the battle goes on to the second round.
- In the second round, you roll the four-sided dice and the zombie rolls the six-sided dice. If your roll is greater than or equal to the zombie's roll then the zombie is destroyed and the battle is over. Otherwise your character is wounded again and the battle goes on to the third round.
- In the third round, you roll the four-sided dice and the zombie rolls the eight-sided dice. If your roll is greater than or equal to the zombie's roll then the zombie is destroyed and the battle is over. Otherwise your character is wounded for the third time and dies.

Draw a tree diagram to represent this information.

(6 marks)

(b) Find the probability that

(i) the zombie is destroyed

(ii) your character dies

(iii) your character is wounded one or more times but still manages to destroy the zombie

(3 marks)