5.23 Venn Diagrams: 1-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 In a group of 30 children, 10 eat cereal, 8 eat toast and 4 eat both cereal and toast. How many children eat neither cereal nor toast?

(Total for Question 1 is 2 marks)

2 On a two-set Venn diagram showing sets A and B inside E, describe in words the region that represents A and B'.

(Total for Question 2 is 1 mark)

3 A Venn diagram for three hobbies shows the following numbers: only A = 7, only B = 5, only C = 6, A and B only = 3, B and C only = 2, A and C only = 4, all three = 1. A teacher wants to divide pupils into teams of 6 so that each team has exactly one pupil who is in all three hobbies if possible. What is the maximum number of such teams the teacher can form? Show your working.

(Total for Question 3 is 3 marks)

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4 In a survey of 120 shoppers, 50 said they buy apples, 70 buy bananas and 40 buy cherries. 30 buy both apples and bananas, 20 buy both bananas and cherries, 15 buy both apples and cherries. Exactly 10 buy all three. Draw a three-set Venn and find the number of shoppers who buy none of these fruits.

(Total for Question 4 is 4 marks)

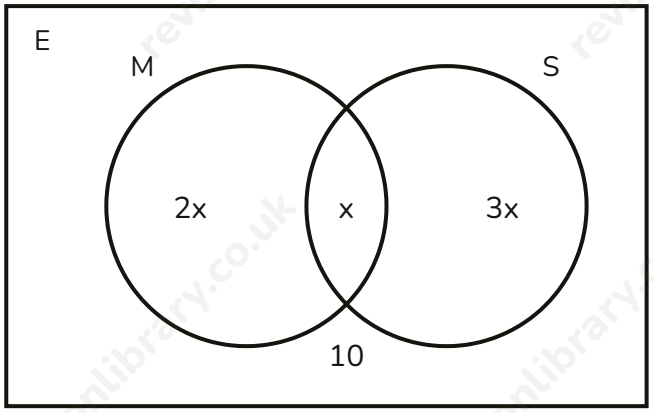
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5 In a town, 400 people were asked if they recycle paper (P) and plastic (L). 260 recycle paper, 180 recycle plastic and 120 recycle both. A person is chosen at random. Find the probability that the person recycles either paper or plastic but not both.

(Total for Question 5 is 3 marks)

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6 100 students were surveyed about whether they attend a Maths club (M) or a Science club (S). On a Venn diagram, the number in M only is 2x, the number in both is x, the number in S only is 3x, and the number in neither is 10.



(a) Write down an equation in x and show that it simplifies to 6x + 10 = 100. **(2)**

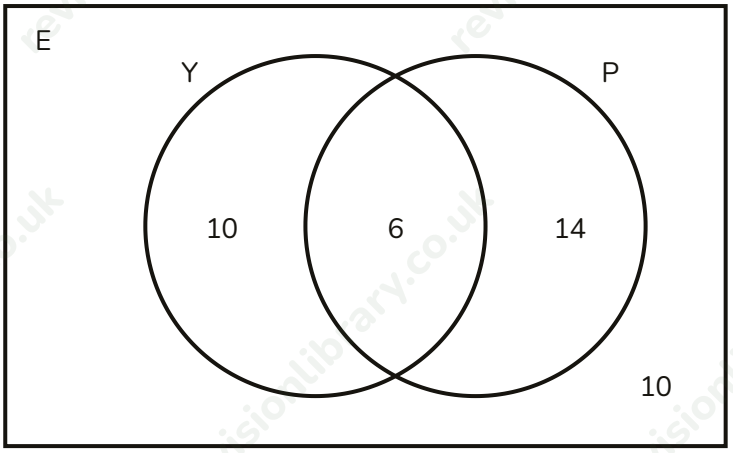
(b) Solve the equation to find the value of x. **(2)**

(c) Work out the number of students who attend the Science club. **(2)**

(Total for Question 6 is 6 marks)

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7 40 people at a gym were asked whether they do yoga (Y) or pilates (P). The Venn diagram shows: 10 people in Y only, 6 people in the overlap of Y and P, 14 people in P only, and 10 people outside both circles.



(a) Find P(Y). **(1)**

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(b) Given that a person does pilates, find the probability that they also do yoga. **(2)**

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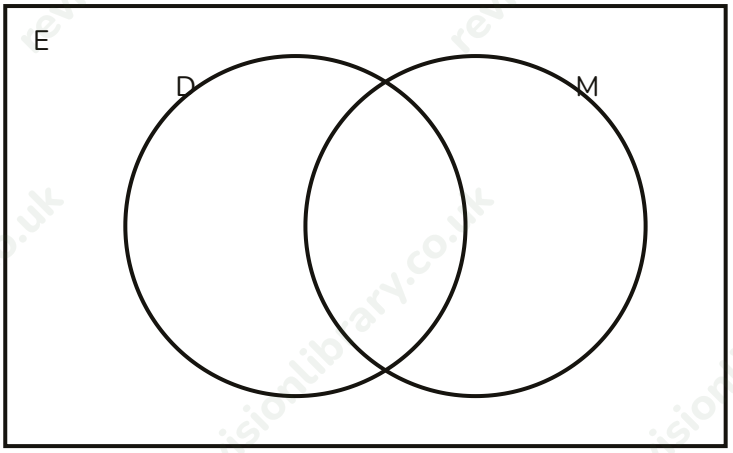
(c) Two people are chosen at random from all 40 people, without replacement. Find the probability that both people do neither yoga nor pilates. **(3)**

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(Total for Question 7 is 6 marks)

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8 A survey of 50 Year 11 students at a school in Leeds asked whether they study Drama (D) and/or Music (M). 28 students study Drama, 19 students study Music, and 8 students study neither.



(a) Find the number of students who study both Drama and Music. **(3)**

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(b) Find the probability that a randomly selected student studies Drama only. **(2)**

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(Total for Question 8 is 5 marks)

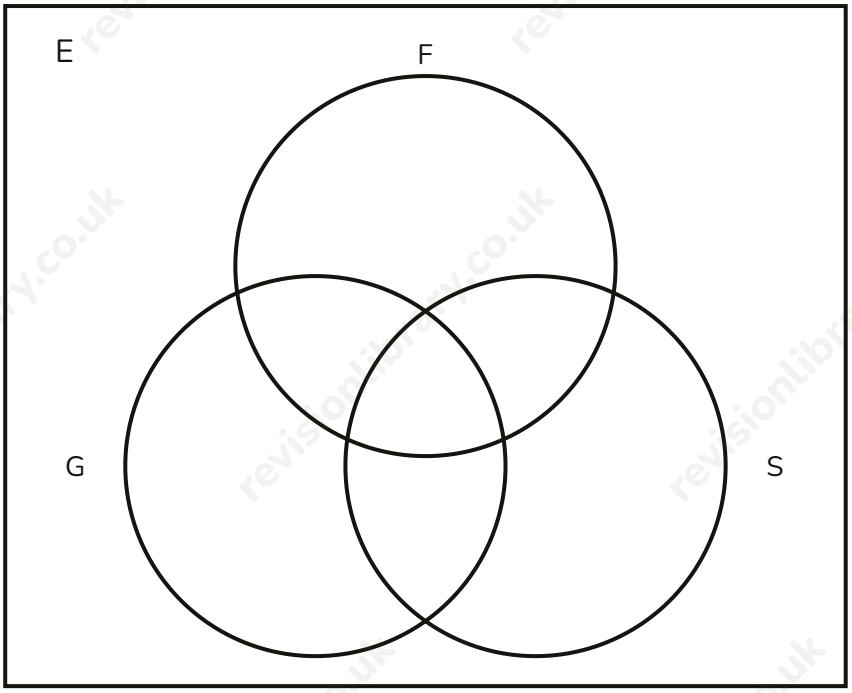
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9 Show that for any two finite sets A and B, n(A union B) = n(A) + n(B) - n(A intersect B) by considering the regions in a two-set Venn diagram. You do not need to give a diagram but give a concise explanation with arithmetic using variables.

(Total for Question 9 is 3 marks)

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10 50 students were asked which of French (F), German (G) and Spanish (S) they study. 28 study French, 20 study German, 22 study Spanish, 10 study French and German, 12 study French and Spanish, 8 study German and Spanish, and 5 study all three languages.



(a) Complete a three-set Venn diagram to show this information, and find the number of students who study none of the three languages. **(4)**

(b) Find the probability that a randomly selected student studies exactly two of the three languages. **(2)**

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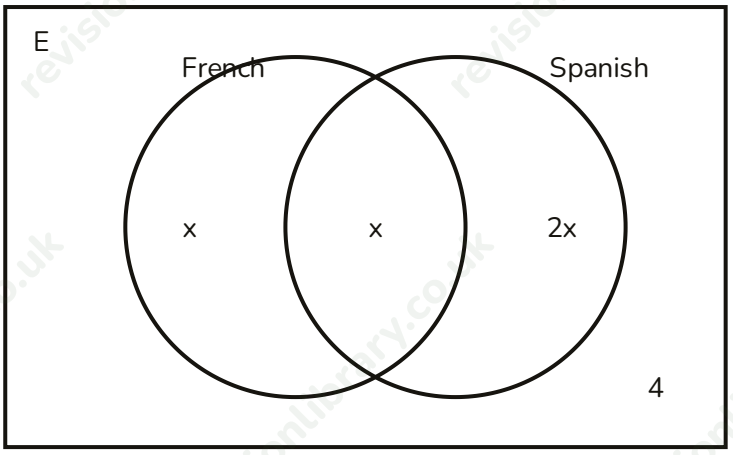
(c) A student is chosen at random from those who study French. Find the probability that they also study at least one other language. **(2)**

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(Total for Question 10 is 8 marks)

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11 In a class of 32 students, x study French only, 2x study Spanish only, x study both French and Spanish, and 4 students study neither.



(a) Form an equation in x and solve it to find the value of x. **(3)**

(b) Hence write down the number of students who study French. **(1)**

(Total for Question 11 is 4 marks)

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Mark scheme · 5.23 Venn Diagrams: 1-hour Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

correctly compute number who eat cereal or toast: 10 + 8 - 4 = 14	**M1**
16 cao (30 - 14 = 16)	**A1**

Answer: 16 children (30 - (10 + 8 - 4) = 16).

Question 2

correct description, e.g. the elements in A but not in B (the 'A only' region)	**B1**

Answer: The elements that are in A but not in B (the A only region).

Question 3

recognise that only 1 pupil is in all three hobbies, so at most 1 team can be formed	**M1**
show that a team can be completed: 7 + 5 + 6 + 3 + 2 + 4 = 27 other pupils, so at least 5 are available; or identify at least 5 pupils outside the all-three region	**M1**
1 team cao, supported by the limit and enough other pupils to complete the team	**A1**

Answer: 1 team (only 1 pupil is in all three, so at most one such team; 7 + 5 + 6 + 3 + 2 + 4 = 27 other pupils, so five can complete it).

Question 4

Place triple intersection = 10; compute pair-only regions: A and B only = 30 - 10 = 20, B and C only = 20 - 10 = 10, A and C only = 15 - 10 = 5	**M1**
Compute single-only counts, e.g. apples only = 50 - (20+5+10) = 15; bananas only = 70 - (20+10+10) = 30; cherries only = 40 - (10+10+5) = 15	**M1**
Add all regions to find number buying at least one: 15+30+15+20+10+5+10 = 105	**M1**
None = 120 - 105 = 15 cao	**A1**

Answer: 15 shoppers buy none.

Question 5

Compute exclusive counts: paper only = 260 - 120 = 140; plastic only = 180 - 120 = 60	**M1**
Number recycling exactly one = 140 + 60 = 200	**A1**
Probability = 200/400 = 1/2 cao	**A1**

Answer: 1/2

Question 6

(a) 2x + x + 3x + 10 = 100 seen	**M1**
(a) cso, correctly simplified to 6x + 10 = 100	**A1**

(a) Answer: 6x + 10 = 100

(b) 6x = 90	**M1**
(b) x = 15 cao	**A1**

(b) Answer: x = 15

(c) 3(15) + 15 oe, ft from their x	**M1**
(c) 60 cao	**A1**

(c) Answer: 60

Question 7

(a) 2/5 oe (16/40)	**B1**

(a) Answer: 2/5

(b) 6/(6 + 14) oe seen	**M1**
(b) 3/10 oe	**A1**

(b) Answer: 3/10

(c) 10/40 for the first person	**M1**
(c) 9/39 for the second person, dependent on the first method mark, and multiplied together	**dM1**
(c) 3/52 oe	**A1**

(c) Answer: 3/52

Question 8

(a) 50 - 8 (= 42) used for n(D or M)	**M1**
(a) 28 + 19 - 42 (oe) to find the overlap	**M1**
(a) 5 cao	**A1**

(a) Answer: 5

(b) 28 - 5 (= 23) oe, ft from part (a)	**M1**
(b) 23/50 cao	**A1**

(b) Answer: 23/50

Question 9

Let x = n(A only), y = n(B only), z = n(A intersect B); then n(A) = x+z and n(B)=y+z	**M1**
Add: n(A)+n(B) = x+z+y+z = x+y+2z	**M1**
Since n(A union B) = x+y+z, conclude n(A union B) = n(A)+n(B)-z = n(A)+n(B)-n(A intersect B) cao	**A1**

Answer: Proof: let A only = x, B only = y, A cap B = z. Then n(A)=x+z, n(B)=y+z so n(A)+n(B)=x+y+2z. The union has x+y+z, so n(A union B)=n(A)+n(B)-z = n(A)+n(B)-n(A intersect B).

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Question 10

(a) 5 placed correctly in the region where all three circles overlap	**M1**
(a) pairwise-only regions correct: F and G only = 5, F and S only = 7, G and S only = 3	**M1**
(a) single-subject-only regions correct: F only = 11, G only = 7, S only = 7	**M1**
(a) number studying none = 5, cao	**A1**

(a) Answer: 5 students study none of the three languages

(b) (5 + 7 + 3)/50 oe seen, ft from part (a)	**M1**
(b) 3/10 oe	**A1**

(b) Answer: 3/10

(c) (28 - 11)/28 oe, ft from part (a)	**M1**
(c) 17/28 oe	**A1**

(c) Answer: 17/28

Question 11

(a) x + 2x + x + 4 = 32 oe (correct equation formed)	**M1**
(a) 4x = 28 (oe, correct simplification)	**M1**
(a) x = 7 cao	**A1**

(a) Answer: x = 7

(b) 14 cao, ft from part (a)	**B1**

(b) Answer: 14

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