Statistics Year 1 exam questions (AS maths) - AQA

NOTE:
Please be aware that in the Year 12 collections, you will find questions from the Year 13 papers. However, these questions are intentionally included because they align with Year 12 content and topics.
Happy studying!

Ch 16 Probability

June 2022 Question 14 Paper 2

14 Yingtai visits her local gym regularly.

After each visit she chooses one item to eat from the gym's cafe.

This could be an apple, a banana or a piece of cake.

She chooses the item independently each time.

The probability that Yingtai chooses each of these items on any visit is given by:

$$P(\text{Apple}) = 0.2$$

$$P(\text{Banana}) = 0.35$$

$$P(\text{Cake}) = 0.45$$

For any **four** randomly selected visits to the gym, find the probability that Yingtai chose:

14 (a) at least one banana.

[2 marks]

14 (b) the same item each time.

[2 marks]

14 (c) apple twice and cake twice.

[3 marks]

ANSWER

Q	Marking instructions	AO	Marks	Typical solution
14(a)	Uses 1 – P(no bananas) (at least $1 - p^4$ for $0 < p < 1$ seen) or Uses P(1) + P(2) + P(3) + P(4) Or Uses $P(x \geq 1)$ using B(4, 0.35)	3.1b	M1	P(at least 1 banana) = 1 – P(no bananas) $= 1 - 0.65^4$
	Obtains correct probability AWFW 0.821 to 0.822 Accept 0.82	1.1b	A1	= 0.82149
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
14(b)	Calculates the correct three terms, not necessarily evaluated and not necessarily added	3.1b	M1	$0.2^4 + 0.35^4 + 0.45^4$
	Obtains correct answer (AWRT 0.058)	1.1b	A1	= 0.0576125
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
14(c)	Uses 0.2^2 or 0.45^2 anywhere or fraction equivalents	1.1b	B1	P(apple twice and cake twice)
	Uses $(k \times)\ 0.2^2 \times 0.45^2\ (\times 0.35^0)$ or fraction equivalents and no other terms PI by correct answer	3.1b	M1	$= 6 \times 0.2^2 \times 0.45^2$
	Obtains correct answer CAO	1.1b	A1	= 0.0486
	Subtotal		**3**	

June 2022 Question 15 Paper 2

15 The discrete random variable X is modelled by the probability distribution defined by:

$$P(X = x) = \begin{cases} cx & x = 1, 2 \\ kx^2 & x = 3, 4 \\ 0 & \text{otherwise} \end{cases}$$

where k and c are constants.

15 (a) State, in terms of k, the probability that $X = 3$

[1 mark]

15 (b) Given that $P(X \geq 3) = 3 \times P(X \leq 2)$

Find the exact value of k and the exact value of c.

[4 marks]

ANSWER

Q	Marking instructions	AO	Marks	Typical solution
15(a)	Obtains $9k$	1.1b	B1	$9k$
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
15(b)	Uses probabilities c, 2c, 9k, 16k	1.1b	B1	$c + 2c + 9k + 16k = 1$
	Uses $\Sigma p = 1$ to obtain an equation in k and c, at least one term in k or c correct or Uses ratio of 1:3(:4) to obtain an equation either in c related to 0.25 or in k related to 0.75. At least one term in k or c correct [$c + 2c = 0.25$; $9k + 16k = 0.75$]	3.1a	M1	$3c + 25k = 1$
	Uses ratio of 1:3 to find an equation in k and c, at least one term in k or c correct or Obtains a second equation in k or c using the ratio of 1:3(:4), at least one term in k or c correct	1.1a	M1	$9k + 16k = 3(c + 2c)$ $25k = 9c$
	Obtains correct exact values for k and c (ACF but must be exact)	1.1b	A1	$c = \frac{1}{12}$ $k = \frac{3}{100}$
	Subtotal		**4**	

June 2022 Question 16 Paper 2

16 It is believed that a coin is biased so that the probability of obtaining a head when the coin is tossed is 0.7

16 (a) Assume that the probability of obtaining a head when the coin is tossed is indeed 0.7

16 (a) (i) Find the probability of obtaining exactly 6 heads from 7 tosses of the coin.

[1 mark]

16 (a) (ii) Find the mean number of heads obtained from 7 tosses of the coin.

[1 mark]

16 (b) Harry believes that the probability of obtaining a head for this coin is actually greater than 0.7

To test this belief he tosses the coin 35 times and obtains 28 heads.

Carry out a hypothesis test at the 10% significance level to investigate Harry's belief.

[5 marks]

ANSWER

Q	Marking instructions	AO	Marks	Typical solution
16(a)(i)	Obtains correct answer from model AWRT 0.247 Accept 0.25 and %	3.4	B1	0.24706
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
16(a)(ii)	Obtains correct mean (CAO) Do not ISW	1.1b	B1	Mean = np $= 7 \times 0.7$ $= 4.9$
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
16(b)	States both hypotheses correctly for a one-tailed test. Accept population proportion for p. Accept 70%, but not $H_0 = 0.7$ or $x =$ or $\overline{x} =$ or $\mu =$	2.5	B1	Y is 'No of times the coin lands heads' H_0: p = 0.7 H_1: p > 0.7
	States model used (PI by AWRT 0.13, 0.068, 0.038, 0.065, 0.87 Or critical region >28)	3.3	M1	Under H_0: $Y \sim B(35\ ,\ 0.7)$
	Evaluates $P(Y \geq 28)$ using calculator = 0.13 (AWRT) OE	1.1b	A1	$P(Y \geq 28) = 1 - P(Y \leq 27)$ $= 1 - 0.86735\ \ldots$ $= 0.13265$ $= 0.133$
	Compares 0.13 to 0.1 Or 0.87 to 0.9 Or 28 to justified critical region of 29 or more **And** makes appropriate inference	2.2b	A1	As 0.133 > 0.1 Accept H_0
	Concludes correctly in context CSO 'insufficient evidence' OE required. Only award for full complete correct solution.	3.2a	R1	There is insufficient evidence to suggest that the probability of getting a head is more than 0.7.
	Subtotal		**5**	

November 2021 Question 17 Paper 2

17 The number of toilets in each of a random sample of 200 properties from a town was recorded.

Four types of properties were included: terraced, semi-detached, detached and apartment.

The data is summarised in the table below.

	Number of toilets		
	One	**Two**	**Three**
Terraced	20	10	4
Semi-Detached	18	50	16
Detached	12	10	8
Apartment	22	30	0

One of the properties is selected at random.

A is the event 'the property has exactly two toilets'.

B is the event 'the property is detached'.

17 (a) (i) Find P(A).

[1 mark]

17 (a) (ii) Find $\mathrm{P}(A' \cap B)$.

[1 mark]

17 (a) (iii) Find $\mathrm{P}(A \cup B)$.

[2 marks]

17 (a) (iii) Find $\mathrm{P}(A \cup B)$.

[2 marks]

17 (b) Determine whether events A and B are independent.

Fully justify your answer.

[2 marks]

17 (c) Using the table, write down two events, **other than event A and event B**, which are mutually exclusive.

[1 mark]

Event 1 ____

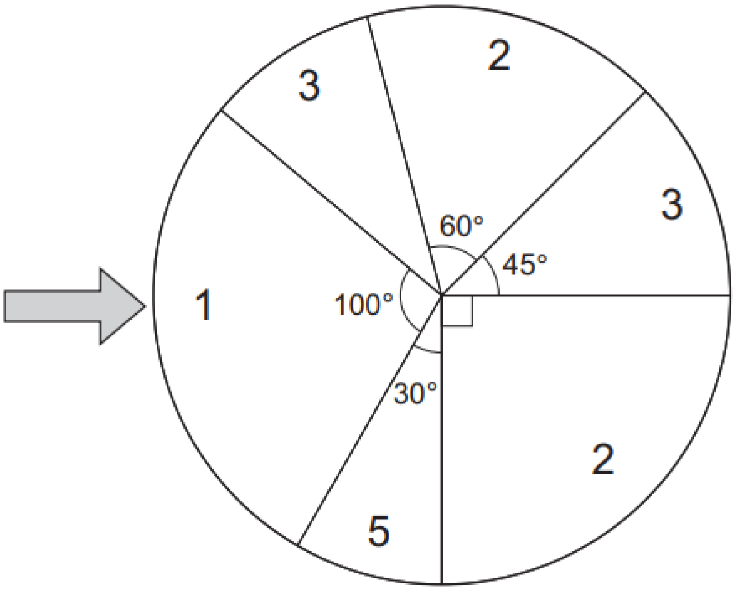
Event 2 ____

ANSWER

Q	Marking instructions	AO	Marks	Typical solution
17(a)(i)	States correct answer (ACF)	1.1b	B1	P(A) = $\frac{100}{200}$ = 0.5
	Subtotal		**1**	
17(a)(ii)	States correct answer (ACF)	1.1b	B1	Find P($A' \cap B$) = $\frac{20}{200}$ = 0.1
	Subtotal		**1**	
17(a)(iii)	Uses correct formula for P($A \cup B$) with 'their' P(A), P(B) and P($A \cap B$) ($\neq 0$) (PI by correct answer) Or Counting from the table $\frac{12+8+10+50+30+10}{200}$ Condone double-counting the 10 for A∩B for this mark.	3.1a	M1	P(B) = $\frac{30}{200}$ = 0.15 P($A \cap B$) = $\frac{10}{200}$ = 0.05 P($A \cup B$) = P(A) +P(B) – P($A \cap B$) P($A \cup B$) = 0.5 + 0.15 – 0.05 = 0.6
	Obtains correct answer. (ACF)	1.1b	A1	
	Subtotal		**2**	
17(b)	Calculates P(A) × P(B) for 'their' P(A) and P(B)	3.1a	M1	P(A) × P(B) = 0.5 × 0.15 = 0.075 0.075 ≠ 0.05
	Compares to 'their' P($A \cap B$) (providing P($A \cap B$) ≠ 0) and deduces that the events are not independent	2.2a	A1F	As P($A \cap B$) ≠ P(A) × P(B) Events A and B are not independent
	Subtotal		**2**	
17(c)	States any two events which are mutually exclusive, but must be different to events A and B 2 from terraced / semi – detached /apartment Or 1 toilet and 3 toilets Or apartment and 3 toilets	1.1b	B1	Event 1 is the event the property has 1 toilet Event 2 is the event the property has 3 toilets
	Subtotal		**1**	

November 2020 Question 17 Paper 2

17 A game consists of spinning a circular wheel divided into numbered sectors as shown below.



On each spin the score, X, is the value shown in the sector that the arrow points to when the spinner stops.

The probability of the arrow pointing at a sector is proportional to the angle subtended at the centre by that sector.

17 (a) Show that $P(X = 1) = \frac{5}{18}$

[1 mark]

17 (b) Complete the probability distribution for X in the table below.

x	1			
$P(X = x)$	$\frac{5}{18}$			

[2 marks]

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
17(a)	Shows clearly where $\frac{5}{18}$ comes from. Need to see $\frac{100}{360}$ and simplification.	3.1b	B1	$P(X = 1) = \frac{100}{360}$ $= \frac{5}{18}$
	Subtotal		**1**	
17(b)	States at least one pair of $(X, P(X = x))$ correctly	1.1a	M1	<table><tr><td>X</td><td>2</td><td>3</td><td>5</td></tr><tr><td>$P(X = x)$</td><td>$\frac{5}{12}$</td><td>$\frac{2}{9}$</td><td>$\frac{1}{12}$</td></tr></table>
	Completes table correctly ACF	1.1b	A1	
	Subtotal		**2**	
	Question Total		**3**	

November 2020 Question 18 Paper 2

18 (b) Bag A contains 7 blue discs, 4 red discs and 1 yellow disc.

Bag B contains 3 blue discs and 6 red discs.

A disc is drawn at random from Bag A and placed in Bag B.

A disc is then drawn at random from Bag B.

Find the probability that the disc drawn from Bag B is red.

[3 marks]

18 (a) Bag A contains 7 blue discs, 4 red discs and 1 yellow disc.

Two discs are drawn at random from bag A **without replacement**.

Find the probability that exactly **one** of the discs is blue.

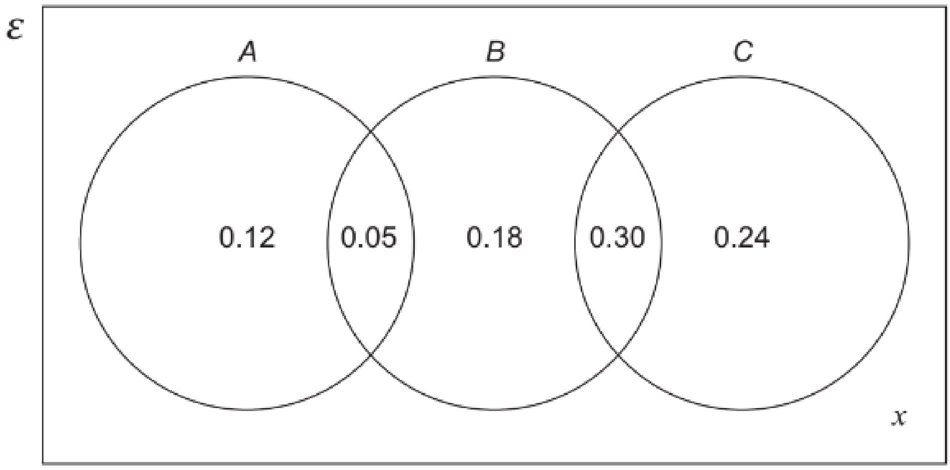
[2 marks]

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
18(a)	Finds the sum of two or more products each term in the products having denominators of 12 and 11	1.1a	M1	P(one blue) = $\frac{7}{12} \times \frac{5}{11} + \frac{5}{12} \times \frac{7}{11}$ $= \frac{35}{66}$
	Obtains $\frac{35}{66}$ OE (accept 0.53 or better)	1.1b	A1	
	Subtotal		**2**	
18(b)	Uses correct denominator (12 × 10) at least once	1.1b	B1	P(Red from Bag B) $= \frac{8}{12} \times \frac{6}{10} + \frac{4}{12} \times \frac{7}{10}$ $= \frac{19}{30}$
	Uses correct numerator in two or three termed expression (8×6)+(4×7) or (7×6)+(4×7)+(1×6) (OE)	1.1a	M1	
	Obtains $\frac{19}{30}$ OE (accept 0.63 or better)	1.1b	A1	
	Subtotal		**3**	
	Question Total		**5**	

June 2020 Question 10 Paper 3 (A-Level)

10 The probabilities of events A, B and C are related, as shown in the Venn diagram below.



Find the value of x.

Circle your answer.

[1 mark]

0.11 0.46 0.54 0.89

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
10	Circles correct answer	1.1b	B1	0.11
	Total		1	

June 2019 Question 14 Paper 2

14 A probability distribution is given by

$$P(X = x) = c(4 - x), \text{ for } x = 0, 1, 2, 3$$

where c is a constant.

14 (a) Show that $c = \dfrac{1}{10}$

[2 marks]

14 (b) Calculate $P(X \geq 1)$

[2 marks]

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
14(a)	Substitutes x values into formula at least 3 terms correct in terms of c ACF NB No need for addition of terms to be seen or Uses $c = \frac{1}{10}$ and shows the addition of the correct four probabilities summing to 1 **Max mark M1R0**	3.1a	M1	$4c + 3c + 2c + c = 1$ $10c = 1$ $c = \dfrac{1}{10}$
	Equates sum to 1 and shows convincingly that $c = \frac{1}{10}$	2.1	R1	
14(b)	Adds probabilities for x = 1, 2 and 3 NB Can be in terms of c or States $P(X = 0) = 4c$ OE **and** subtracts this from 1	1.1a	M1	$3c + 2c + c = 6c$ $P(X \geq 1) = 0.6$
	Obtains correct value for probability CAO ACF	1.1b	A1	
	Total		**4**	

June 2019 Question 15 Paper 2

15 Two independent events, A and B, are such that

$$P(A) = 0.2$$

$$P(A \cup B) = 0.8$$

15 (a) (i) Find $P(B)$

[4 marks]

15 (a) (ii) Find $P(A \cap B)$

[1 mark]

15 (b) State, with a reason, whether or not the events A and B are mutually exclusive.

[1 mark]

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
15 (a)(i)	Uses the formula $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ PI by $0.8 = 0.2 + P(B) -$ stated term/value or States $P(A' \cap B') = 0.2$ **and** $P(A') = 0.8$ OE	3.1a	M1	$0.8 = 0.2 + P(B) - P(A \cap B)$ $0.8 = 0.2 + P(B) - 0.2P(B)$ $0.6 = 0.8P(B)$ $P(B) = 0.75$
	Uses the formula $P(A \cap B) = P(A) \times P(B)$ or $P(A' \cap B') = P(A') \times P(B')$ OE	3.1a	M1	
	Obtains correct equation in $P(B)$ or $P(B')$ only PI	1.1a	A1	
	Finds correct value of $P(B)$	1.1b	A1	
15 (a)(ii)	Finds 'their' correct value of $P(A \cap B)$ **provided** P(B) lies between 0 and 0.8	1.1b	B1F	$P(A \cap B) = 0.15$
15(b)	Deduces not mutually exclusive and states a correct reason Other reasons: Not mutually exclusive, since $P(A \cap B) \neq 0$ or Shows $P(A \cup B) \neq P(A) + P(B)$ or Not mutually exclusive as they can both occur at the same time	2.2a	R1	A and B are not mutually exclusive since independent events cannot be mutually exclusive
	Total		**6**	

June 2018 Question 13 Paper 2

13 The table below shows the probability distribution for a discrete random variable X.

x	0	1	2	3	4 or more
P($X = x$)	0.35	0.25	k	0.14	0.1

Find the value of k.

Circle your answer.

[1 mark]

0.14 0.16 0.18 1

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
13	Circles correct answer	AO1.1b	B1	0.16
	Total		**1**	