

TOPICAL PAST PAPERS

AS & A Level Mathematics (9709) Paper 6

[Probability & Statistics 2]

Exam Series: February/March 2020 – October/November 2025

Format Type A:

Answers to all questions are provided as an appendix



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Introduction

Each Topical Past Paper Questions Compilation contains a comprehensive collection of hundreds of questions and corresponding answer schemes, presented in worksheet format. The questions are carefully arranged according to their respective chapters and topics, which align with the latest IGCSE or AS/A Level subject content. Here are the key features of these resources:

1. The workbook covers a wide range of topics, which are organized according to the latest syllabus content for Cambridge IGCSE or AS/A Level exams.
2. Each topic includes numerous questions, allowing students to practice and reinforce their understanding of key concepts and skills.
3. The questions are accompanied by detailed answer schemes, which provide clear explanations and guidance for students to improve their performance.
4. The workbook's format is user-friendly, with worksheets that are easy to read and navigate.
5. This workbook is an ideal resource for students who want to familiarize themselves with the types of questions that may appear in their exams and to develop their problem-solving and analytical skills.

Overall, Topical Past Paper Questions Workbooks are a valuable tool for students preparing for IGCSE or AS/A level exams, providing them with the opportunity to practice and refine their knowledge and skills in a structured and comprehensive manner. To provide a clearer description of this book's specifications, here are some key details:

- Title: Cambridge AS & A Level Mathematics (9709) Paper 6 Topical Past Papers
- Subtitle: Exam Practice Worksheets With Answer Scheme
- Examination board: Cambridge Assessment International Education (CAIE)
- Subject code: 9709
- Years covered: February/March 2020 – October/November 2025
- Paper: 6 (Probability & Statistics 2)
- Number of pages: 607
- Number of questions: 296

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Chapter 1

The Poisson distribution

4. 9709_w24_qp_61 Q: 6

The numbers of customers arriving at service desks A and B during a 10-minute period have the independent distributions $Po(1.8)$ and $Po(2.1)$ respectively.

- (a) Find the probability that during a randomly chosen 15-minute period more than 2 customers will arrive at desk A . [2]

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- (b) Find the probability that during a randomly chosen 5-minute period the total number of customers arriving at both desks is less than 4. [3]

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8. 9709_w23_qp_63 Q: 3

A website owner finds that, on average, his website receives 0.3 hits per minute. He believes that the number of hits per minute follows a Poisson distribution.

(a) Assume that the owner is correct.

(i) Find the probability that there will be at least 4 hits during a 10-minute period. [3]

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(ii) Use a suitable approximating distribution to find the probability that there will be fewer than 40 hits during a 3-hour period. [4]

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9. 9709_m22_qp_62 Q: 7

- (a) Two ponds, *A* and *B*, each contain a large number of fish. It is known that 2.4% of fish in pond *A* are carp and 1.8% of fish in pond *B* are carp. Random samples of 50 fish from pond *A* and 60 fish from pond *B* are selected.

Use appropriate Poisson approximations to find the following probabilities.

- (i) The samples contain at least 2 carp from pond *A* and at least 2 carp from pond *B*. [3]

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- (ii) The samples contain at least 4 carp altogether. [3]

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10. 9709_s22_qp_61 Q: 5

Cars arrive at a fuel station at random and at a constant average rate of 13.5 per hour.

- (a) Find the probability that more than 4 cars arrive during a 20-minute period. [3]

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- (b) Use an approximating distribution to find the probability that the number of cars that arrive during a 12-hour period is between 150 and 160 inclusive. [4]

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Appendix A

Answers

1. 9709_s25_ms_61 Q: 1

Question	Answer	Marks	Guidance
	$(\lambda) = 4$	B1	SOI.
	$e^{-4} \left(1 + 4 + \frac{4^2}{2!} + \frac{4^3}{3!} \right) = e^{-4} (1 + 4 + 8 + 10.6666)$ $= 0.018316 + 0.073263 + 0.146525 + 0.19537$	M1	Allow any λ , allow one end error.
	$= 0.433$	A1	SC ₁ Unsupported answer of 0.433 scores B1B1 . SC ₂ Use of Normal mean = 4 B1 . SC ₃ Use Binomial 0.432 or 0.433 scores B1 .
		3	

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2. 9709_w25_ms_62 Q: 4

Question	Answer	Marks	Guidance
(a)	Assume flaws in cups are independent OR prob of containing a flaw is the same for all cups	B1	OE in context (e.g. prob... is consistent) but $p = 0.18$ is B0 .
	$H_0: P(\text{contains flaw}) = 0.18$ $H_1: P(\text{contains flaw}) < 0.18$	B1	Both. Allow 'p'
	$[P(X \leq 3) =] 0.82^{40} + 40 \times 0.82^{39} \times 0.18 + 40C_2 \times 0.82^{38} \times 0.18^2 + 40C_3 \times 0.82^{37} \times 0.18^3$ $= 0.0003569 + 0.0031338 + 0.013414 + 0.037298$	M1	
	0.0542 (3 sf)	A1	Unsupported 0.0542 scores M0B1 .
	0.0542 > 0.05	M1	Valid comparison – must be a tail probability Or if CR found (≤ 2) then comparison with 3 M1 .
	[Accept H_0] Insufficient evidence to accept factory owners claim. [Insufficient evidence that percentage less than 18%]	A1FT	In context, not definite, no contradictions no use of 'p' unless defined. e.g. not '%age is not less than 0.18' or '%age is 18%' 2TT scores max B1B0M1A1M1 (with 0.025) is A0 .
			<u>Normal approx'n:</u> (First B1B1 * if earned) then: $CV = \frac{3.5 - 40 \times 0.18}{\sqrt{40 \times 0.18 \times 0.82}} = \pm 1.523$ SCB1 (need cc). $1.523 < 1.645$ or $0.0639 > 0.05$ No evidence less than 18% SCB1 . *hypotheses $\mu = 7.2$ and $\mu < 7.2$ can score if Normal approx. used.
		6	

Question	Answer	Marks	Guidance
(b)	$np = 7.2$ which is too large, or > 5 . Or $n = 40$ which is not greater than 50. Or $p = 0.18$ which is not small or > 0.1 .	B1	Context required (7.2 or 40 or 0.18). One correct condition required ISW.
		1	

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3. 9709_w25_ms_63 Q: 2

Question	Answer	Marks	Guidance
	est (μ) = 499.5 or 29970/60	B1	
	est (σ^2) = $\frac{60}{59} \left(\frac{14970300}{60} - 499.5^2 \right)$ or $1/59(14970300 - (29970)^2/60)$	M1	Biased var = 4.75 M0 .
	= 4.83 or 285/59	A1	
	H ₀ : Pop mean (or μ) = 500 H ₁ : Pop mean (or μ) \neq 500	B1	Both. Not just 'mean'.
	$\frac{499.5 - 500}{\frac{\sqrt{4.83}}{\sqrt{60}}}$	M1	For standardising with their values. Must have $\div \sqrt{60}$. Ignore cc s.
	= -1.762	A1	Allow -1.778 (from biased variance) accept 3 sf if nothing better.
	'1.762' < 1.96 or '-1.762' > -1.96 0.0390 > 0.025	M1	For valid comparison. Allow 1.778 < 1.96 0.0377 > 0.025.
	There is insufficient evidence that [mean] mass is not 500g	A1FT	In context. Not definite. No contradictions. FT from incorrect z. μ only accepted if defined. Accept CV method 499.5 > 499.44. Using biased var or using incorrect hypothesis can score a maximum of 6/8.
		8	

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4. 9709_w24_ms_61 Q: 6

Question	Answer	Marks	Guidance
(a)	$[\lambda = 2.7] 1 - e^{-2.7}(1 + 2.7 + \frac{2.7^2}{2})$ or $1 - e^{-2.7}(1 + 2.7 + 3.645)$ or $1 - (0.06721 + 0.1815 + 0.2450)$	M1	Any λ . Allow one end error. Must see expression.
	= 0.506 (3 sf)	A1	SC unsupported answer 0.506 scores B1 .
		2	

Question	Answer	Marks	Guidance
(b)	$\lambda = 1.95$	B1	
	$e^{-1.95}(1 + 1.95 + \frac{1.95^2}{2} + \frac{1.95^3}{3!})$ or $e^{-1.95}(1 + 1.95 + 1.90125 + 1.2358)$ or $0.1423 + 0.2774 + 0.2705 + 0.1758$	M1	Any λ . Allow one end error. Must see expression.
	$= 0.866$	A1	SC unsupported answer 0.866 scores B1B1 .
		3	
(c)	$1 - e^{-2.1x} \geq 0.90$ or $1 - e^{-\lambda} \geq 0.90$	M1	OE Condone use of '=' throughout.
	$[e^{-2.1x} \leq 0.1]$ or $e^{-\lambda} \leq 0.1$ $-2.1x \leq \ln 0.1$ or $-\lambda \leq \ln 0.1$ [$\lambda \geq 2.3026, 2.3026/2.1$]	M1	Rearrange and attempt take logs of relevant form.
	1.096 or 10.96 accept 1.097 or 10.97	*A1	Seen.
	She must wait for at least 11 minutes	A1 dep	
			SC Use of trial and improvement. Use of $1 - e^{-\lambda}$ any numerical λ (not 2.1) ie one trial M1 . Use of enough trials to give an answer of 0.90 (2sf) M1 . $\lambda = 2.30$ i.e. 3sf accuracy AND 1.09... or 10.9 ... A1 . Then 11 A1 dep .
	4		

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5. 9709_w24_ms_62 Q: 3

Question	Answer	Marks	Guidance
(a)	$H_0: p = 0.8$ $H_1: p > 0.8$	B1	
	[Assuming H_0 , $P(X \geq 23) = {}^{25}C_{23} \times 0.2^2 \times 0.8^{23} + {}^{25}C_{24} \times 0.2 \times 0.8^{24} + 0.8^{25}$ $= 0.070835 + 0.0236118 + 0.0037779$	M1	No end errors. Expression must be seen or supported by enough figures to be convinced B(25,0.8) used. Accept correct Σ notation.
	$= 0.0982$	A1	SC B1 for 0.0982 unsupported.
	$0.0982 < 0.1$	M1	Valid comparison their 0.0982 must be a tail probability.
	[There is evidence to reject H_0] There is sufficient evidence to suggest that p has increased	ftA1	No contradictions. In context, non-definite. Condone 'there is sufficient evidence that the 'claim' is correct' and condone 'there is sufficient evidence that the number of employees (using the canteen) has increased' Note: CR method will include $P(X \geq 23)$ so M1 A1 as above, and $P(X \geq 22) = 0.234 > 0.1$ with at least one probability comparison with 0.1 needed to find CR of 23,24,25 (so 23 in CR) M1 A1ft as above.
	5		
(b)	Not suitable as model does not allow for more than 25 employees to use the canteen/Not suitable as uses a sample instead of all employees/Not suitable doesn't include all employees /Not suitable as 30 is only just bigger than 25 should have used 30 OR Suitable as owner knows that not all employees use the canteen, or similar	B1	Need both (i.e. suitable or not suitable plus reason).
		1	

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6. 9709_s23_ms_61 Q: 6

Question	Answer	Marks	Guidance
	$\frac{5}{4} \left(\frac{1+2^2+6^2+1+a^2}{5} - \left(\frac{1+2+6+1+a}{5} \right)^2 \right) = \frac{11}{2}$ or $\frac{1}{4} \left((42+a^2) - \frac{(10+a^2)}{5} \right) = \frac{11}{2}$	M1*	OE attempted or e.g., $\frac{42+a^2}{5} - \left(\frac{10+a}{5}\right)^2 = \frac{22}{5}$. Allow use of biased i.e., without $\frac{5}{4}$.
	$4a^2 - 20a + 0 = 0$ or $a^2 - 5a + 0 = 0$	DM1	Two- or three-term quadratic equation in a , with at least two terms correct.
	$a = 5$	A1	Ignore $a = 0$, if seen.
		3	

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7. 9709_w23_ms_62 Q: 6

Question	Answer	Marks	Guidance
	Cost of dried yeast and flour: \$D and \$F $E(D) = 13.5 \times 0.7 = 9.45$ $E(F) = 0.9 \times 100 = 90$	B1	One of these soi – can be given at early stage.
	$\text{Var}(D) = 0.02^2 \times 13.50^2 = 0.0729$ $\text{Var}(F) = 3.0^2 \times 0.90^2 = 7.29$	B1	One of these soi – can be given at early stage.
	Total cost: $T \sim N(99.45, (0.02^2 \times 13.50^2 + 3.0^2 \times 0.90^2))$	M1	Attempt to combine their D and their F with or without 55 and 200 (but variance must not include 55 or 200). Or $N(99.45 + 55, (0.02^2 \times 13.50^2 + 3.0^2 \times 0.90^2))$. Or $N(200 - 55 - 99.45, (0.02^2 \times 13.50^2 + 3.0^2 \times 0.90^2))$. Or $N(99.45 + c, (0.02^2 \times 13.50^2 + 3.0^2 \times 0.90^2))$.
	$N(99.45, 7.3629)$ accept 99.4 or 99.5	A1	Or $N(154.45, 7.3629)$ or $N(45.55, 7.3629)$. Accept 3sf (accept 45.5 or 45.6).
	$[P(\text{profit} > \$40) = P(T < 105)]$ $\frac{105 - 99.45}{\sqrt{7.3629}} [= 2.045]$	M1	$160 - 154.45 / \sqrt{7.3629}$ or $40 - 45.55 / \sqrt{7.3629}$. No mixed methods.
	$[P(T < 105) = P(z < 2.045) =]$ $\Phi(2.045)$	M1	For area consistent with their working.
	$= 0.9795$ or 0.9796 or $0.98(0)$ or 0.979 (3 sf)	A1	
		7	

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8. 9709_w23_ms_63 Q: 3

Question	Answer	Marks	Guidance
(a)(i)	$\lambda = 3$	B1	For mean = 3.
	$1 - e^{-3}(1 + 3 + \frac{3^2}{2} + \frac{3^3}{3!})$ or $1 - e^{-3}(1 + 3 + 4.5 + 4.5)$ or $1 - (0.04979 + 0.14936 + 0.22404 + 0.22404)$	M1	Any λ . Allow one end error.
	= 0.353 (3 sf)	A1	No working scores B1.
		3	
(a)(ii)	$N(54, 54)$	M1	soi
	$\frac{39.5 - 54}{\sqrt{54}}$ (= -1.973)	M1	Allow with wrong or no continuity correction. For standardising with their mean and variance.
	$1 - \Phi(1.973)$	M1	For area consistent with their working.
	= 0.0242 (3 sf)	A1	Special case: if no working seen, 0.0242 scores SC B3 , 0.0284 scores SC B2 .
	4		
(b)(i)	'Mean not constant' or 'number of hits per minute not constant' or 'not a constant rate'	B1	
		1	
(b)(ii)	$2p + p = 2 \times 0.3 [\Rightarrow p = 0.2]$ [where p is the rate per minute for night time]	M1	May be implied by answer.
	[During day-time]: Po(0.4). [During night-time]: Po(0.2)	A1	Accept Po(24) [per daytime hour], Po(12) [per night time hour]. Accept Po(288) [per day time shift], Po(144) [per night time shift]. Note: Po(432), Po(216) scores M0A0.
		2	

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9. 9709_m22_ms_62 Q: 7

Question	Answer	Marks	Guidance
(a)(i)	$0.024 \times 50 [= 1.2]$ and $0.018 \times 60 [= 1.08]$	B1	
	$(1 - e^{-1.2}(1 + 1.2)) \times (1 - e^{-1.08}(1 + 1.08))$	M1	For $(1 - e^{-\lambda}(1+\lambda)) \times (1 - e^{-\mu}(1+\mu))$ any λ, μ ($\lambda \neq \mu$) Allow one end error on either or both terms
	$= 0.0991$ (3 sf)	A1	Unsupported answer scores maximum SC B1 B1 SC Use of binomial 0.0994 scores B1 only
		3	
(a)(ii)	$\lambda = 0.024 \times 50 + 0.018 \times 60$	M1	or <i>their</i> 1.2 + 1.08 (NB 0.024+0.018 is M0)
	$1 - e^{-2.28} \times \left(1 + 2.28 + \frac{2.28^2}{2!} + \frac{2.28^3}{3!}\right)$	M1	any λ and allow one end error
	$= 0.197$ (3 sf)	A1	Unsupported answer scores maximum SC B2
		3	
(b)	$e^{-\lambda} = [e^{-\mu}]^2 = e^{-2\mu}$	M1	
	$e^{-\lambda} \times \frac{\lambda^2}{2} = k[e^{-\mu} \times \mu]^2$	M1	
	$e^{-2\mu} \times 2\mu^2 = k \times e^{-2\mu} \times \mu^2$	M1	OE. Use of $\lambda = 2\mu$ to find equation in μ and k only (or λ and k only)
	$k = 2$	A1	
		4	

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10. 9709_s22_ms_61 Q: 5

Question	Answer	Marks	Guidance
(a)	$\lambda = 4.5$	B1	
	$1 - e^{-4.5} \left(1 + 4.5 + \frac{4.5^2}{2!} + \frac{4.5^3}{3!} + \frac{4.5^4}{4!}\right)$	M1	Allow one end error Allow any λ . Poisson expressions must be seen
	$= 0.468$ (3 sf)	A1	If M0 awarded allow SC B1 for 0.468
		3	
(b)	$\lambda = 162$ ($X \sim \text{Po}(162) \Rightarrow X \sim \text{N}(162, 162)$)	B1	
	$\frac{149.5 - \sqrt{162}}{\sqrt{162}}$ and $\frac{160.5 - \sqrt{162}}{\sqrt{162}}$ ($= -0.982$ and -0.118)	M1	One of these; allow with incorrect or no continuity correction
	$\Phi(0.982) - \Phi(0.118)$ oe	M1	Area consistent with <i>their</i> values (both standardisations must be seen)
	$= 0.290$ (3 sf)	A1	Allow 0.29
		4	
Question	Answer	Marks	Guidance
(c)	$\lambda = \frac{13.5}{6} + 3.6 \times \frac{2}{3}$ OE or 4.65	M1	Attempt to find λ
	$e^{-4.65} \left(\frac{4.65^4}{4!} + \frac{4.65^5}{5!} + \frac{4.65^6}{6!}\right)$	M1	Allow any λ Allow one end error Poisson terms not be seen
	0.494 (3 sf)	A1	If M0 allow SC B1 for 0.494
		3	

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11. 9709_s22_ms_62 Q: 3

Question	Answer	Marks	Guidance
(a)	Poisson	B1	SOI
	Mean = 3.6	B1	Can be awarded for N(3.6, ...)
	$e^{-3.6}(1 + 3.6 + \frac{3.6^2}{2})$	M1	Allow any λ Allow one end error Expression must be seen
	0.303 (3 s.f.)	A1	If M0 awarded allow SC B1 for 0.303 SC Use of binomial: B1 for answer 0.300 (3 sf)
		4	
(b)	[Binomial with] $200 > 50$	B1	
	$[200 \times 0.018 =] 3.6 < 5$ or $[p =] 0.018 < 0.1$	B1	If B0 B0 then SC n large, p small: B1 or n large $np < 5$: B1 or $n > 50$ and either $np < 5$ or $p < 0.1$: B1
		2	

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12. 9709_s22_ms_62 Q: 7

Question	Answer	Marks	Guidance
	$\bar{X} \sim N(2.9, \frac{2.9}{100})$ OR Totals method N(290, 290)	B1	B1 for N(2.9, ...) OR N(290, ...)
		B1	B1 for Var = $\frac{2.9}{100}$ OR for var = 290 SOI
	$\frac{2.88 - 2.90}{\sqrt{\frac{2.9}{100}}} [= -0.1174]$ OR $\frac{288 - 290}{\sqrt{290}}$	M1	Standardising with <i>their</i> values Allow without -ve sign AND/OR with incorrect continuity correction No mixed methods
	$1 - \Phi(0.1174)$	M1	For area consistent with <i>their</i> values
	0.453 (3 sf)	A1	As final answer
Alternative method for question 7			
	$\bar{X} \sim N(2.9, \frac{2.9}{100})$ OR Totals method N(290, 290)	B1	B1 for N(2.9, ...) OR N(290, ...)
		B1	B1 for Var = $\frac{2.9}{100}$ OR Var = 290 stated or implied
	$\frac{(2.88 - \frac{1}{200}) - 2.90}{\sqrt{\frac{2.9}{100}}} [= -0.1468]$ OR $(287.5 - 290)/\sqrt{290}$	M1	Standardising with <i>their</i> values Allow without -ve sign AND/OR with incorrect continuity correction No mixed methods
	$1 - \Phi(0.1468)$	M1	For area consistent with <i>their</i> values
	0.442 (3 sf)	A1	As final answer
		5	

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