GCE A Level Mathematics (9MA0) – Shadow Paper (Set 1)

9MA0-01 Pure Mathematics 1

June 2022 Shadow Paper mark scheme

Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide, indicating where marks are given for correct answers. As such, it may not show follow-through marks (marks that are awarded despite errors being made) or special cases.

It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme from the original paper.

This document is intended for guidance only and may differ significantly from the examiners' final mark scheme for the original paper, which was published in August 2022.

Guidance on the use of codes within this document
M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect. A1 – accuracy mark. This mark is generally given for a correct answer following correct working. B1 – working mark. This mark is usually given when working and the answer cannot easily be separated. Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer).

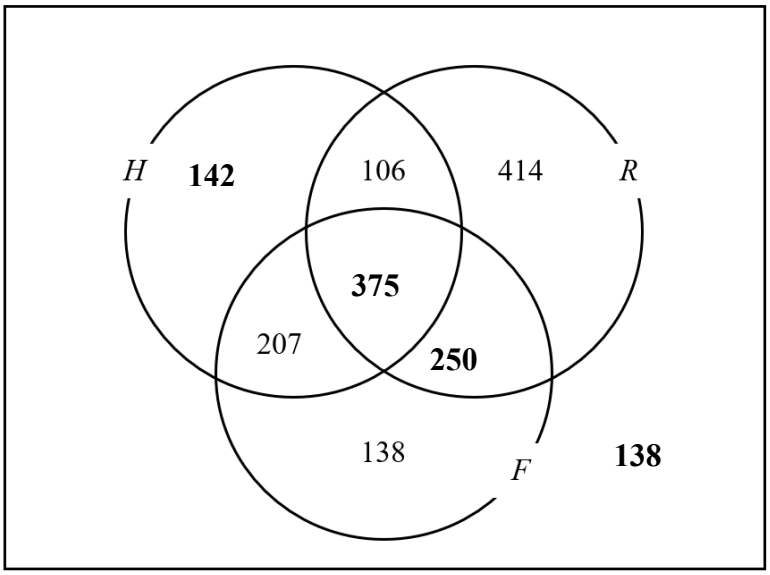
Question	Scheme	Marks	AOs
1(a)(i)	$X \sim \text{B}(25, 0.52)$	M1	3.3
	$P(X = 12) = 0.14595017\ldots$ awrt 0.146	A1	3.4
(ii)	$[P(X \geq 7) = 1 - P(X \leq 6)] = 0.99585103\ldots$ awrt 0.996	A1	1.1b
		(3)	
(b)	Y is the number of hits		
	$Y \sim \text{N}(182\ ,\ 87.4)$	B1	3.3
	$P(X > 210) \approx P(Y > 210.5)$ $\left[= P\left(Z > \frac{210.5 - "182"}{\sqrt{"87.4"}}\right)\right]$	M1	3.4
	$= 0.0011472\ldots$ awrt 0.00115	A1	1.1b
		(3)	
			(6 marks)

Qu	Scheme	Marks	AOs
2(a)	$\left[P\left(L < 8.877\right) = 0.05 \Rightarrow\right] \frac{8.877 - 9}{x} = -1.6449$	M1	3.4
	$(x =)\ 0.075$	A1cso*	1.1b
		(2)	
(b)	$P(8.92 \leq L \leq 9.07) = 0.68161486\ldots$ **awrt 0.682 or 0.683**	B1	1.1b
		(1)	
(c)	$[P(L < 8.92) =]\ 0.14306119\ldots$ (awrt 0.143) **or** $[P(L > 9.07) =]\ 0.1753239\ldots$	B1	1.1b
	$[P(L < 8.92) =]\ 0.14306119\ldots$ (awrt 0.143) **and** $[P(L > 9.07) =]\ 0.1753239\ldots$	B1	1.1b
	Expected income per 600 rods = ∑(income × probability × 600) (600 × "0.682" × 0.6) + (600 × "0.14306" × 0.06) + (600 × "0.17532394" × 0.48) + **or** Expected profit per rod = ∑(profit × probability) 0.30 × "0.682" + −0.24 × "0.14306" + 0.18 × "0.17532394"	M1	3.4
	Expected profit per 600 rods 600 × ∑(profit × probability) **or** ∑(income × probability × 600) − 600 × 0.3 = 600 × "0.20123…" **or** = "301.163" – 600 × 0.3	M1d	3.1b
	$= [£]121.163\ldots$ **awrt [£]121**	A1	1.1b
		(5)	
(d)	Let $X \sim \text{B}(150\ ,\ 0.02)$	M1	3.3
	$P(X \leq 5) =$ $P(X \geq 6) =$	M1	1.1b
	0.9181233… 0.08187668…	A1	1.1b
	Manufacturer is unlikely to achieve their aim since $\underline{0.91812 < 0.99}$ Manufacturer is unlikely to achieve their aim since $\underline{0.08188 > 0.01}$	A1ft	2.4
		(4)	

(12 marks)

Question	Scheme	Marks	AOs
3(a)	tr	B1	1.2
		(1)	
(b)(i)	$\mu = \frac{61.4}{31} = 1.9806...$ awrt 1.98	B1	1.1b
(ii)	$\sigma_r = \sqrt{\frac{463.88}{31} - \mu^2}$	M1	1.1b
	$= 3.32278\ldots$ awrt 3.32	A1	1.1b
		(3)	
(c)	Leuchars is in the North and Camborne is in the South	M1	2.4
	The mean is smaller in Camborne therefore there Dian's belief may be true	A1ft	2.2b
		(2)	
(d)	eg $p = 0.20$ is unlikely to be constant.	B1	2.4
		(1)	
			(7 marks)

Question	Scheme	Marks	AOs
4(a)	$H_{0:}\, p = 0.15 \quad H_{1:}\, p \neq 0.15$	B1	2.5
		(1)	
(b)	Use of $X \sim B(60, 0.15)$ implied by sight of one of awrt 0.04237 **or** awrt 0.9709 **or** awrt 0.02913	M1	3.4
	Critical regions $X \leq 4$ or $X \geq 15$	A1	1.1b
	$X \leq 4$ or $X \geq 15$ plus $P(X \leq 4)$ = awrt 0.4237 and $P(X \geq 15)$ = awrt 0.02913	A1	1.1b
	SC: Both CR correct with no probabilities and no distribution seen scores M0A1A0		
		(3)	
(c)	0.0715	B1ft	1.1b
		(1)	
(d)	14 is not in the critical region therefore there is insufficient evidence to support the **manager**'s belief	B1ft	2.2b
		(1)	
			(6 marks)

Question	Scheme	Marks	AOs
5(a)	$\frac{390}{1670}$ or 0.2335 oe awrt 0.233	B1	1.1b
		(1)	
(b)	$\frac{180}{1670}$ or $\frac{18}{167}$ or 0.1078 awrt 0.108	B1	1.1b
		(1)	
(c)	$0.3 \times 120 + 60 \times 0.1$ (= 42) **or** $0.7 \times 120 + 60 \times 0.9$ (= 138) **or** 0.4×625 (= 250) **or** 0.6×625 (= 375)  	M1 B1 B1 A1	3.1b 1.1b 1.1b 1.1b
		(4)	
(d)	$P(R' \cap F) = \frac{345}{1670}\left[= \frac{69}{334} = 0.2066...\right]$ oe awrt 0.207	B1	1.1b
		(1)	
(e)	$\frac{138 + "138"}{1670} = \frac{"138"}{835}$ awrt 0.165	B1ft	1.1b
		(1)	
(f)	$\frac{375 + 207}{42 + 106 + 375 + 207}$	M1	3.4
	$\frac{291}{365}$ awrt 0.797	A1	1.1b
		(2)	
			(10 marks)

Question	Scheme		Marks	AOs
6(a)	eg As the number of minutes exercise (m) increases the resting heart rate (h) decreases **or** the gradient of the curve is becoming flatter with increasing m: diminishing effect of each additional minute of exercise		B1	2.4
			(1)	
(b)	$H_0 : \rho = 0$ $H_1 : \rho < 0$		B1	2.5
	Critical value – 0.4329 (Allow $\pm$)		M1	1.1b
	There is evidence that the product moment **correlation** is **less than 0/ there is a negative correlation**		A1	2.2b
			(3)	
(c)	$\log_{10} h = -0.03 \log_{10} m + 1.95$	$h = am^k \rightarrow \log_{10} h = \log_{10} am^k$	M1	1.1b
	$\log_{10} h = -\log_{10} m^{0.03} + 1.95$ or $\log_{10} h = \log_{10} m^{-0.03} + 1.95$ or $h = 10^{(1.95 - 0.03 \log_{10} m)}$ oe	$\log_{10} h = \log_{10} a + \log_{10} m^k$ or $\log_{10} a = 1.95$	M1	2.1
	$\log_{10} hm^{0.03} = 1.95$ or $\log_{10}\left(\frac{h}{m^{-0.03}}\right) = 1.95$ or $h = 10^{1.95} \times 10^{-0.03 \log_{10} m}$ oe	$\log_{10} h = \log_{10} a + k \log_{10} m$	M1	1.1b
	$hm^{0.03} = 10^{1.95}$ or $\frac{h}{m^{-0.03}} = 10^{1.95}$ or $h = 10^{1.95} \times 10^{\left(\log_{10} m^{-0.03}\right)}$	$\log_{10} a = 1.95$ and $k = -0.03$	M1	1.1b
	$h = 10^{1.95} m^{-0.03}$ or $h = 89.125...m^{-0.03}$ or $a = 89.1$ **and** $k = -0.03$		A1	1.1b
			(5)	
				(9 marks)