

GCE AS Mathematics (8MA0) – Paper 2 Statistics & Mechanics

Summer 2019 student-friendly 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 to good practice, indicating where marks are given for correct answers. As such, it doesn't 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.

This document is intended for guidance only and may differ significantly from the final mark scheme published in July 2019.

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).

Paper 021 – Statistics

Question 1 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	Label Year 12s 1–84 and Year 13s 1–56	B1	This mark is given for a suitably labelled list for each year group
	Use random numbers to select a...	B1	This mark is given for the use of random numbers to select students
	... simple random sample of 24 Year 12s and 16 Year 13s	B1	This mark is given for 24 Year 12s and 16 Year 13s
(b)	$5.60 \times 0.5 = 2.8$ Increase by 2.8 marks	B1	This mark is given for the using the gradient of the regression equation
(c)	For example: The model suggests that the longer students sleep, the better they will perform in the test The best performance is predicted for the students who never wake up The model is only valid between 0 and 24 hours (the range of the data)	B1	This mark is given for a valid limitation of the model

Question 2 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Events B and c are mutually exclusive so $x = 0$	B1	This mark is given for deducing that $x = 0$
	$P(A) = 0.1 + z + y$ $P(C) = 0.93 + z [+ x]$ $P(A \text{ and } C) = z$	M1	This mark is given for identifying the probabilities required for independence
	$P(A \text{ and } C) = P(A) \times P(C)$ $(0.1 + z + y) \times (0.39 + z + 0) = z$	M1	This mark is given for using independence
	$\sum p = 1$ $0.06 + 0.3 + 0.39 + 0.1 + z + y + 0 = 1$	M1	This mark is given for using the fact that the sum of probabilities sum to 1
	$y + z = 0.15$ $z = (0.1 + 0.15) \times (0.39 + z)$ $z = 0.975 + 0.25z$ $0.75z = 0.0975$ $z = \frac{0.0975}{0.75} = 0.13$ $y = 0.15 - 0.13 = 0.02$	A1	This mark is given for finding the values of y and z

Question 3 (Total 6 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	Discrete uniform distribution	B1	This mark is given for the correct distribution
(b)(i)	$X \sim B(28, 0.2)$	B1	This mark is given for identifying the correct model
	$P(X \geq 7) = 1 - P(X \leq 6)$ $= 1 - 0.6784$	M1	This mark is given for a method to find the probability
	$= 0.322$	A1	This mark is given for finding the correct probability
(b)(ii)	$P(4 \leq X < 8) = P(X \leq 7) - P(X \leq 3)$ $= 0.818 - 0.160$	M1	This mark is given for a method to find the probability
	$= 0.658$	A1	This mark is given for finding the correct probability

Question 4 (Total 8 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	Trace data needs to be converted to numbers before the calculation can be carried out	B1	This mark is given for a valid explanation
(b)	$(1 +) \frac{138 - 131}{24} \times 4$	M1	This mark is given for a methods to find an estimate of the upper quartile
	= 2.17	A1	This mark is given for a correct estimate of the upper quartile
(c)	$\sigma = \sqrt{\frac{7704.1875}{184} - \left(\frac{539.75}{184}\right)^2}$	M1	This mark is given for using the formula for standard deviation to find an estimate for the standard deviation of the total daily rainfall
	= 5.77	A1	This mark is given for a correct estimate for the standard deviation of the total daily rainfall
(d)(i)	Using class midpoints to estimate the mean assumes that the values are uniformly distributed in each class	B1	This mark is given for an explanation that the data is assumed to be spread evenly across each class
(d)(ii)	The assumption does not hold since the majority of the data in the first class are 0	B1	This mark is given for a valid explanation by the assumption does not hold
(d)(iii)	The actual mean is likely to be smaller than the estimate; the first group has more values at 0 and close to 0	B1	This mark is given for a correct inference based on knowledge of the Large Data Set

Question 5 (Total 6 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$H_1: p \geq 0$ is incorrect; it should be $H_1: p > 0$	B1	This mark is given for identifying the error in the alternative hypothesis
	The calculation of the test statistic $P(X = 8)$ is incorrect; it should be $P(X \geq 8)$	B1	This mark is given for identifying the error in the test statistic
(b)	The errors will affect the conclusion as the null hypothesis should not be rejected since $P(X \geq 8) [= 0.0698]$ is greater than 0.05	B1	This mark is given for a correct explanation
(c)	$P(X \leq 8) = 0.9722 > 0.95$ or $P(X \geq 9) = 0.0278 < 0.05$	M1	This mark is given for the use of tables or calculator to find the probability associated with the critical value with $B(30, 0.15)$
	Critical region: $\{X \geq 9\}$	A1	This mark is given for finding the correct critical region
(d)	0.0278	B1	This mark is given for finding the correct level of significance of the test

Paper 022 – Mechanics

Question 1 (Total 10 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$V = 3 \text{ (s)} \times 10 \text{ (m s}^{-2}\text{)} = 30 \text{ (m s}^{-1}\text{)}$	B1	This mark is given for finding the speed of the parachutist
(b)		B1	This mark is given for the correct shape of the graph
		B1	This mark is given for the correct numbers on the graph
(c)	$s = \frac{1}{2}(u + v)t + s = \frac{1}{2}(u + v)t + vT$ $550 =$ $\frac{1}{2}(0 + 30) \times 3 + \frac{1}{2}(30 + 6) \times 2 + 6(T - 5)$	M1	This mark is given for a method to use the distance travelled to set up an equation in T only
		A1	These marks are given for a fully correct equation
		A1	
	$45 + 36 + 6T - 30 = 550$ $6T = 499$	M1	This mark is given for a method to solve the equation in T
	$T = 83$	A1	This mark is given for a correct value of T
(d)	The new value of T would be greater	B1	This mark is given for a correct conclusion
(e)	Allow for the effect of wind Allow for the dimensions of the parachutist and spin Use a more accurate version of g Allow that the parachutist doesn't fall vertically	B1	This mark is given for a valid refinement stated

Question 2 (Total 12 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$0.6g - T$	M1	This mark is given for a method to find an equation of motion for Q
	$0.6g - T = 0.6a$	A1	This mark is given for a correct equation of motion for Q
	$P = -T + 0.8a = 0$	M1	This mark is given for a correct equation of motion for P
	$T = 0.8a$	A1	This mark is given for finding a correct value for T
	$0.6g - 0.8a = 0.6a$ $a = \frac{0.6g}{1.4} = \frac{5.88}{1.4}$ $a = 4.2 \text{ (m s}^{-2}\text{)}$	A1	This mark is given for finding a correct value for the acceleration of Q
(b)	$0.4 = \frac{1}{2} \times 4.2 \times t_1^2$	M1	This mark is given using $s = \frac{1}{2}at^2$ to find the time for Q to hit the floor
	$t_1 = 0.436$	A1	This mark is given for solving to find t_1 correctly
	$v = 0 + 4.2 \times 0.436$ or $v = \sqrt{2 \times 4.2 \times 0.4}$	M1	This mark is given for using $v = u + at$ or $v^2 = 2as$ to find the speed of P
	$t_2 = \frac{1.5 - 0.4}{v}$	M1	This mark is given for a method to find the time for P to hit the pulley after Q hits the floor
	$t_1 + t_2 = 0.436 + \frac{1.5 - 0.4}{1.8312}$	M1	This mark is given for a method to find the time taken by summing t_1 and t_2
	1.04 s	A1	This mark is given for finding the time taken by P to hit the pulley
(c)	For example: The rope is light The rope is inextensible The pulley is smooth	B1	This mark is given for a valid limitation stated

Question 3 (Total 8 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$v = 12 + 4t - t^2 = 0$	M1	This mark is give for setting the equation for v equal to zero
	$v = (6 - t)(2 + t) = 0$ $t = 6$	A1	This mark is given for solving to find t
	$a = \frac{dv}{dt}$	M1	This mark is given for differentiating v with respect to t to find the acceleration
	$a = 4 - 2t$	A1	This mark is given for finding a correct expression for a
	When $t = 6$, $a = -8$ The magnitude of the acceleration is 8	A1	This mark is given for finding a correct value for the magnitude of the acceleration
(b)	$s = \int 12 + 4t - t^2 \, dt$	M1	This mark is given for integrating v with respect to t to find the distance
	$s = 12t + 2t^2 - \frac{1}{3}t^3 (+ c)$	A1	This mark is given for a correct integral for v
	$\left[12t + 2t^2 - \frac{1}{3}t^3 \right]_0^3 = 45 \text{ (m)}$	A1	This mark is given for a correct evaluation from 0 to 3 to find the distance travelled