AS Mathematics Unit 2: Applied Mathematics A
General instructions for marking GCE Mathematics

1. The mark scheme should be applied precisely and no departure made from it. Marks should be awarded directly as indicated and no further subdivision made.

2. Marking Abbreviations
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
MR = misread
PA = premature approximation
bod = benefit of doubt
oe = or equivalent
si = seen or implied
ISW = ignore subsequent working

F.T. = follow through ($\surd$ indicates correct working following an error and $\not\surd$ indicates a further error has been made)

Anything given in brackets in the marking scheme is expected but, not required, to gain credit.

3. Premature Approximation
A candidate who approximates prematurely and then proceeds correctly to a final answer loses 1 mark as directed by the Principal Examiner.

4. Misreads
When the data of a question is misread in such a way as not to alter the aim or difficulty of a question, follow through the working and allot marks for the candidates' answers as on the scheme using the new data.
This is only applicable if a wrong value, is used consistently throughout a solution; if the correct value appears anywhere, the solution is not classed as MR (but may, of course, still earn other marks).

5. Marking codes

- 'M' marks are awarded for any correct method applied to appropriate working, even though a numerical error may be involved. Once earned they cannot be lost.
- 'm' marks are dependant method marks. They are only given if the relevant previous 'M' mark has been earned.
- 'A' marks are given for a numerically correct stage, for a correct result or for an answer lying within a specified range. They are only given if the relevant M/m mark has been earned either explicitly or by inference from the correct answer.
- 'B' marks are independent of method and are usually awarded for an accurate result or statement.
- 'S' marks are awarded for strategy
- 'E' marks are awarded for explanation
- 'U' marks are awarded for units
- 'P' marks are awarded for plotting points
- 'C' marks are awarded for drawing curves

AS Mathematics Unit 2: Applied Mathematics A

Solutions and Mark Scheme

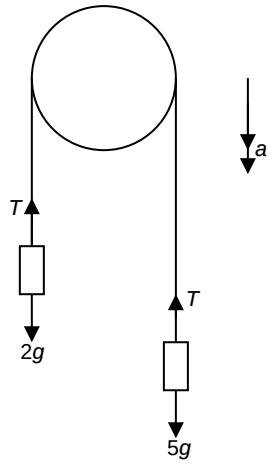
SECTION A – Statistics

Qu. No.	Solution	Mark	AO	Notes
1(a)	$P(A\cup B) = P(A) + P(B)$ $= 0.2 + 0.3 = 0.5$	M1 A1	AO1 AO1	
(b)	$P(A\cup B) = P(A) + P(B) - P(A\cap B)$ $= P(A) + P(B) - P(A)P(B)$ $= 0.2 + 0.3 - 0.06 = 0.44$	M1 A1 A1	AO1 AO1 AO1	
(c)	$P(A\cup B) = P(B) = 0.3$	B1 **[6]**	AO2	
2(a)	$H_0 : p = 0.45 : H_1 : p < 0.45$	B1	AO3	
(b)(i)	Under H_0, X is B(60,0.45). Sig level = $P(X \leq 20)$ $= 0.0446$	B1 M1 A1	AO3 AO2 AO1	
(ii)	Type II error prob = $P(X \geq 21 \mid X$ is B(60,0.35)) $= 0.548$	 M1 A1	 AO2 AO1	
(iii)	A Type II error here is accepting that support for Dewi is 45% when it is actually 35%.	E1	AO3	
(iv)	It is a large value for an error probability. It could be reduced by taking a larger sample.	E1 E1 **[9]**	AO3 AO3	
3(a)	The Poisson distribution can be used when arrivals can be assumed to be independent at a constant mean rate.	E1	AO2	Accept any correct equivalent statement
(b)	The number of arrivals X is Poi(5) $P(X = 6) = \frac{e^{-5} \times 5^6}{6!}$ $= 0.146(22280\ldots)$	B1 M1 A1	AO3 AO1 AO1	 Or from the calculator
(c)	Use Poisson tables to find $P(X > 10) = 1 - 0.7060 = 0.2940\ (\approx 0.3)$ Obtain mean = 9 Therefore time at bridge = 36 minutes	M1 A1 A1 **[7]**	AO3 AO3 AO1	

Qu. No.	Solution	Mark	AO	Notes
4(a)	Allocate each fruit a number 01 to 90 (or 00 to 89)	E1	AO2	
	Generate a random number on a calculator using the random number function.	E1	AO2	
	Match this to the number allocated to the fruits and this is the first member of the sample Repeat this until 14 different fruits are in the sample	E1	AO2	
b)(i)	The correlation is strong and positive.	E1	AO3	
(ii)	More carbohydrates in a fruit suggests more calories.	E1	AO3	
(c)(i)	Each additional gram of carbohydrate corresponds to an increase in the number of calories by 2.9 on average.	E1	AO2	Accept – Each additional gram of carbohydrate corresponds to an increase in the number of calories by 3 on average.
(ii)	If there is no carbohydrate in the fruit there still may be calories present (eg from fat)	E1	AO3	
		[7]		

Qu. No.	Solution	Mark	AO	Notes
5(a)	We cannot be sure that the sample is representative without knowing how the UK Official Singles Chart is constructed.	B1	AO2	Or other valid reason
(b)	Close the gaps between the bars as length of single is a continuous variable	B1	AO3	B0 add gridlines or for any formatting suggestions
	Correct the width of column 3.0–4.0	B1	AO3	
(c)(i)	Mean will decrease	B1	AO2	
(ii)	Standard deviation will decrease	B1	AO2	
(d)(i)	1.5 x (3.89 – 3.26) + 3.89 = 4.84(minutes) Since 4.38(minutes)< 4.84(minutes) not an outlier	M1 A1 B1	AO1 AO1 AO2	
(ii)	Claim is not supported. Median=3.6 > 3 so at least half of singles are longer than 3 mins.	E1	AO3	
(e)	Gareth's singles are shorter than chart singles on average. Gareth's singles are less variable in length than chart singles. Chart singles have a roughly symmetrical distribution of lengths, whereas more than half of Gareth's singles are shorter than the mean length.	E1 E1 E1 **[12]**	AO2 AO2 AO2	E0 Gareth's singles are shorter Or smaller spread Or positively skewed

SECTION B – Mechanics

Question Number	Solution	Mark	AO	Notes
6. (a)	$v^2 = u^2 + 2as$, u=0, a=9.8, s=160 $v^2 = 2 \times 9.8 \times 160$ $v = 56$ (ms^{-1})	M1 A1 A1	AO3 AO1 AO1	
(b)	$s = ut + 0.5at^2$, u=0, a=9.8, s=160 $160 = 0.5 \times 9.8 \times t^2$ $t = \frac{40}{7}$ (s)	M1 A1 A1	AO3 AO1 AO1	
(c)	Object modelled as particle. Air resistance/external forces apart from gravity all ignored.	B1 **[7]**	AO3	
7. (a)				
	Apply N2L to one particle $5g - T = 5a$ Apply N2L to other particle $T - 2g = 2a$ $3g = 7a$ $a = 4.2$ (ms^{-1}) $T = 28$ (N)	M1 A1 A1 m1 A1 A1	AO3 AO2 AO2 AO1 AO1 AO1	
(b)	Light string enables me to assume tension is constant throughout the string.	E1 **[7]**	AO3	

Question Number	Solution	Mark	AO	Notes
8. (a)	$x = \int (12t - 3t^2)\mathrm{d}t$	M1	AO2	
	$x = 6t^2 - t^3 + C$	A1	AO2	correct integration
	When $t = 1$, $x = 0$ $C = -5$			
	$x = 6t^2 - t^3 - 5$	A1	AO2	
(b)	$a = \dfrac{\mathrm{d}v}{\mathrm{d}t}$	M1	AO2	
	$a = 12 - 6t$	A1	AO1	
		[5]		
9. (a)	Apply N2L to truck $T = 180 \times 0.8 = 144$ (N)	B1	AO3	
	Apply N2L to load	M1	AO3	Dimensionally correct eqn T and Mg opposing
	$Mg - T = M \times 0.8$	A1	AO2	
	$M(9.8 - 0.8) = 144$	M1	AO1	substitute value of T
	$M = 16$	A1	AO1	
(b)	No resistance to motion due to external forces, eg air resistance. Truck/load modelled as particle.	B1	AO2	one sensible assumption
	As the truck/load is required to move with acceleration 0.8 ms^{-2}, the value of T would depend on any other external forces. If the resultant external force aids motion, T will be less, but if the external resultant force resists motion, T will be greater.	B1	AO2	any correct statement about T
	The N2L equation will have an extra term opposing motion so M will have to increase.	B1	AO2	any correct statement about M
		[8]		

Question Number	Solution	Mark	AO	Notes
10.	Resultant force vector = $\mathbf{F} + \mathbf{G}$ $= (\mathbf{i} - 8\mathbf{j}) + (3\mathbf{i} + 11\mathbf{j})$ $= 4\mathbf{i} + 3\mathbf{j}$	B1	AO1	
	Magnitude of force = $\sqrt{4^2 + 3^2}$ = 5 (N)	M1 A1	AO1 AO1	
	Use $F = ma$ mag. of acceleration = $\frac{5}{3}(\text{ms}^{-2})$	M1 A1	AO3 AO1	
	Let θ be angle direction of motion makes with the vector **i**. $\tan\theta = \frac{3}{4}$ $\theta = 36.87°$	M1 A1	AO2 AO1	
	<u>Alternative solution</u> Resultant force vector = $\mathbf{F} + \mathbf{G}$ $= (\mathbf{i} - 8\mathbf{j}) + (3\mathbf{i} + 11\mathbf{j})$ $= 4\mathbf{i} + 3\mathbf{j}$	**(**B1)	(AO1)	
	Use $\mathbf{F} = m\mathbf{a}$ $4\mathbf{i} + 3\mathbf{j} = 3\mathbf{a}$ $\mathbf{a} = \frac{4}{3}\mathbf{i} + \mathbf{j}$	(M1) (A1)	(AO3) (AO1)	
	mag $\mathbf{a} = \sqrt{\left(\frac{4}{3}\right)^2 + 1}$ mag $\mathbf{a} = \frac{5}{3}(\text{ms}^{-2})$	(M1) (A1)	(AO1) (AO1)	
	Direction = $\tan^{-1}\left(\frac{3}{4}\right)$ $= 36.87°$	(M1) (A1) **[7]**	(AO2) (AO1)	