Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2024

Mathematics

Assessment Unit AS 2

assessing

Applied Mathematics

[SMT21]

TUESDAY 28 MAY, AFTERNOON

MARK SCHEME

General Marking Instructions

GCE Advanced/Advanced Subsidiary (AS) Mathematics

Introduction

The mark scheme normally provides the most popular solution to each question. Other solutions given by candidates are evaluated and credit given as appropriate; these alternative methods are not usually illustrated in the published mark scheme.

The marks awarded for each question are shown in the right-hand column and they are prefixed by the letters **M**, **W** and **MW** as appropriate. The key to the mark scheme is given below:

M indicates marks for correct method.

W indicates marks for working.

MW indicates marks for combined method and working.

The solution to a question gains marks for correct method and marks for accurate working based on this method. Where the method is not correct no marks can be given.

A later part of a question may require a candidate to use an answer obtained from an earlier part of the same question. A candidate who gets the wrong answer to the earlier part and goes on to the later part is naturally unaware that the wrong data is being used and is actually undertaking the solution of a parallel problem from the point at which the error occurred. If such a candidate continues to apply correct method, then the candidate's individual working must be followed through from the error. If no further errors are made, then the candidate is penalised only for the initial error. Solutions containing two or more working or transcription errors are treated in the same way. This process is usually referred to as "follow-through marking" and allows a candidate to gain credit for that part of a solution which follows a working or transcription error.

Positive marking

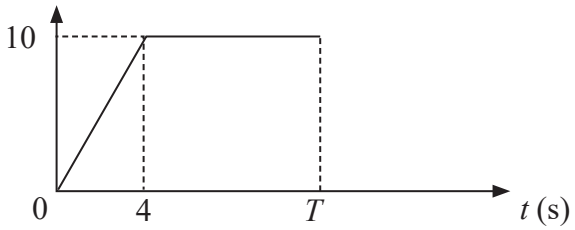
It is our intention to reward candidates for any demonstration of relevant knowledge, skills or understanding. For this reason we adopt a policy of following through their answers, that is, having penalised a candidate for an error, we mark the succeeding parts of the question using the candidate's value or answers and award marks accordingly.

Some common examples of this occur in the following cases:

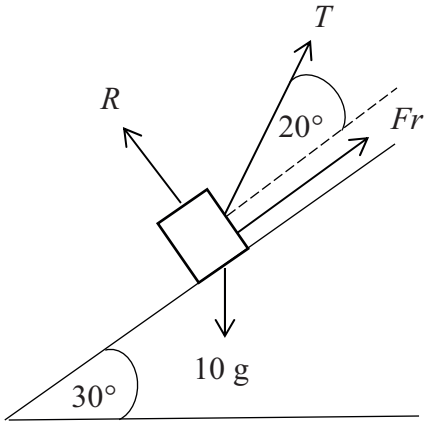
(a) a numerical error in one entry in a table of values might lead to several answers being incorrect, but these might not be essentially separate errors;

(b) readings taken from a candidate's inaccurate graphs may not agree with the answers expected but might be consistent with the graphs drawn.

When the candidate misreads a question in such a way as to make the question easier only a proportion of the marks will be available (based on the professional judgement of the examining team).

			AVAILABLE MARKS
1	**(i)** $\mathbf{v} = \mathbf{u} + \mathbf{a}t$		
	$14\mathbf{i} - 21\mathbf{j} = 6\mathbf{i} - 5\mathbf{j} + 8\mathbf{a}$	M1	
	$\mathbf{a} = (\mathbf{i} - 2\mathbf{j})\ \text{m s}^{-2}$	W1	
	(ii) $\mathbf{F} = m\mathbf{a}$		
	$= 6(\mathbf{i} - 2\mathbf{j})$	M1 W1	
	$= 6\mathbf{i} - 12\mathbf{j}$		
	Magnitude of $\mathbf{F} = \sqrt{(6)^2 + (-12)^2}$		
	$= 13.4$ newtons	MW1	
	Direction of $\mathbf{F} = \tan^{-1}\left(\frac{12}{6}\right)$		
	$= 63.4°$ below the horizontal	MW1	6
2	**(i)** For Adam		
	$v\ (\text{m s}^{-1})$		
			
		MW1	
	(ii) Total distance travelled = area under the graph		
	$100 = \frac{1}{2}(4)(10) + 10(T - 4)$	M1 MW1	
	$100 = 20 + 10T - 40$		
	$120 = 10T$		
	$T = 12$ seconds	W1	
	For Ben		
	$s = ut + \frac{1}{2}at^2$		
	$100 = 0 + \frac{1}{2}(2)t^2$	M1	
	$100 = t^2$		
	$t = 10$ seconds	W1	
	Ben wins the race because he took less time.	MW1	7

3 (i)



MW2

(ii) Resolve forces perpendicular to the plane:

$R + T\sin 20° = 10\,g\cos 30°$ M1 MW1

$R = 49\sqrt{3} - T\sin 20°$

Resolve forces parallel to the plane:

$10\,g\sin 30° = T\cos 20° + Fr$ M1 MW1

$Fr = \mu R$

$49 = T\cos 20° + 0.4\,(49\sqrt{3} - T\sin 20°)$ M1 MW1

$49 = T\cos 20° + \dfrac{98\sqrt{3}}{5} - 0.4\,T\sin 20°$

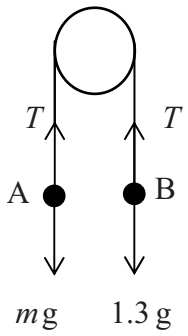
$T = 18.7$ N W1 9

AVAILABLE MARKS

4 **(i)** $v^2 = u^2 + 2as$

		AVAILABLE MARKS
$16 = 0 + 2(a)(2.5)$	M1	
$a = 3.2\ \text{m s}^{-2}$	W1	

(ii)



MW2

(iii) For B

$F = ma$

$1.3\,\text{g} - T = 1.3(3.2)$	M1 W1	
$T = 8.58\ \text{N}$	W1	

For A

$8.58 - m\,\text{g} = m(3.2)$	MW1	
$m = 0.66$	W1	

(iv) $v^2 = u^2 + 2as$

$0^2 = 4^2 - 2\,\text{g}s$	M1	
$s = \dfrac{16}{2\,\text{g}} = 0.816$	W1	
$0.816 < d - 2.5$	MW1	
$d > 3.316...$ Minimum value of d is 3.32m	W1	13

AVAILABLE MARKS

5 **(i)**

Age, a	Frequency, f
7.5	10
22.5	30
37.5	44
52.5	26
67.5	8
82.5	2

MW2

$\sum f = 120, \sum fa = 4470$

$$\bar{a} = \frac{\sum fa}{\sum f}$$

$$= \frac{4470}{120} \quad \text{M1}$$

$$= 37.25 \text{ years} \quad \text{W1}$$

(ii) $\sum fa^2 = 199\,350$ MW1

$$\sigma^2 = \frac{\sum fa^2}{\sum f} - \left(\frac{\sum fa}{\sum f}\right)^2$$

$$= \frac{199\,350}{120} - (37.25)^2 \quad \text{M1}$$

$$= 274 \text{ years}^2 \quad \text{W1}$$

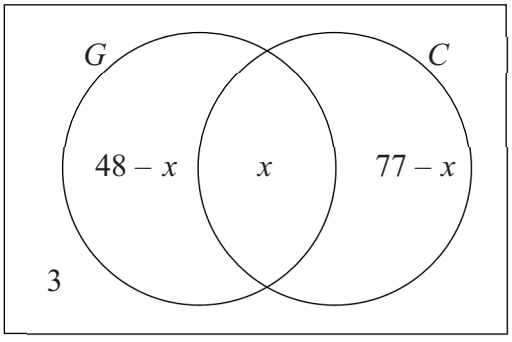
(iii) $Q_1 = 26, \quad Q_3 = 48$ MW1

$$26 - 1.5(48 - 26) \leqslant A \leqslant 48 + 1.5(48 - 26)$$

$$-7 \leqslant A \leqslant 81 \quad \text{MW1}$$

There are no lower outliers since $A > 0$ MW1

If neither of the two runners in the 75 to 90 age range is older than 81, then there are no upper outliers either. MW1 11

				AVAILABLE MARKS
6	**(i)**	$s_{xy} = \Sigma xy - \frac{\Sigma x \Sigma y}{n} = 4939 - \frac{220 \times 1099}{48} = -98.08\dot{3}$	MW1	
		$s_{xx} = \Sigma x^2 - \frac{(\Sigma x)^2}{n} = 1314 - \frac{220^2}{48} = 305.\dot{6}$	MW1	
		$s_{yy} = \Sigma y^2 - \frac{(\Sigma y)^2}{n} = 33145 - \frac{1099^2}{48} = 7982.4791\ldots$	MW1	
		$r = \frac{s_{xy}}{\sqrt{s_{xx} s_{yy}}}$		
		$= \frac{-98.08\dot{3}}{\sqrt{305.\dot{6} \times 7982.4791\ldots}}$	M1	
		$= -0.0628$	W1	
	(ii)	The value of r is very close to zero so this suggests that there is no correlation between job satisfaction and number of days absent from work.	MW2	
	(iii)	The gradient of the line is positive whereas the value of the correlation coefficient is negative.	MW1	
	(iv)	The value of the correlation coefficient is close to zero which indicates that the pairs of data do not lie close to a straight line.	MW1	9
7	**(i)**	G = customer gets their candles gift wrapped		
		C = customer pays by card		
			MW2	
		$115 = 48 - x + x + 77 - x + 3$	M1	
		$x = 13$	W1	
		$\mathrm{P}(G \cap C) = \frac{13}{115}$	MW1	
	(ii)	Amy's claim is based on the observation that $\frac{77}{115} = 67.0\%$ which is about two-thirds. However, her claim may not be accurate as the figures are based on one Saturday's trading and it is not known whether this sample is representative of the behaviour of all of Amy's customers.	MW2	7

8 $9[4p^3(1-p)] = 4[4p(1-p)^3]$ M2 W3

As $p \neq 0, p \neq 1$ $9p^2 = 4(1-p)^2$

$$\frac{p^2}{(1-p)^2} = \frac{4}{9}$$ MW1

$$\frac{p}{1-p} = \pm\frac{2}{3}$$ M1

$$p = \frac{2}{5}, -2$$

$$p = \frac{2}{5}$$ W1

Total

AVAILABLE MARKS
8
70