



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2022**

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**Mathematics**

**Assessment Unit AS 2**

*assessing*

**Applied Mathematics**

**[SMT21]**

**THURSDAY 9 JUNE, MORNING**

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**MARK  
SCHEME**

# 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 an 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 candidates' 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).

## COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

Section A: Mechanics

AVAILABLE  
MARKS

1  $\mathbf{F} = (3\mathbf{i} - 2\mathbf{j}) + (7\mathbf{i} + 8\mathbf{j}) + (-15\mathbf{i} + 9\mathbf{j})$   
 $\mathbf{F} = -5\mathbf{i} + 15\mathbf{j}$   
 Use  $\mathbf{F} = m\mathbf{a}$   
 $-5\mathbf{i} + 15\mathbf{j} = 5\mathbf{a}$   
 $\mathbf{a} = -\mathbf{i} + 3\mathbf{j}$   
 $|\mathbf{a}| = \sqrt{1^2 + 3^2}$   
 $= \sqrt{10}$   
 $= 3.16 \text{ m s}^{-2}$

M1  
W1  
  
M1  
W1  
M1  
  
W1

6

2  $1800 - 400 - 200 = 2500a$   
 $1200 = 2500a$   
 $a = 0.48 \text{ m s}^{-2}$

M1 W2  
  
W1

$1800 - 400 - T = 2000(0.48)$   
 $1400 - T = 960$   
 $T = 440 \text{ N}$

M1 W1  
  
W1

**Alternative solution:**

Car  $1800 - 400 - T = 2000a$   
 $1400 - T = 2000a$

M1  
W1

Trailer  $T - 200 = 500a$

MW1

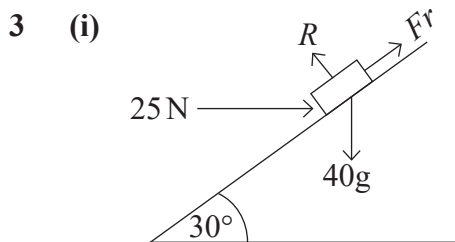
$1400 - (500a + 200) = 2000a$   
 $1200 = 2500a$   
 $a = 0.48 \text{ m s}^{-2}$

M1  
  
W1

$T = 500(0.48) + 200$   
 $T = 440 \text{ N}$

M1  
W1

7



MW2

(ii) Resolve perpendicular to plane  
 $R = 40g \cos 30^\circ + 25 \sin 30^\circ$   
 $R = 351.98\dots$

M1 W2

Resolve parallel to plane  
 $Fr + 25 \cos 30^\circ = 40g \sin 30^\circ$   
 $\mu R + 25 \cos 30^\circ = 20g$   
 $\mu(351.98\dots) + 25 \cos 30^\circ = 20g$   
 $\mu(351.98\dots) = 20g - 25 \cos 30^\circ$   
 $\mu = 0.495$

M1 W2  
  
M1  
  
W1

10

4 (a) (i) 1<sup>st</sup> ball:  
 $u = 20 \text{ ms}^{-1}$  M1  
 $a = -9.8 \text{ ms}^{-2}$   
 $t = T$   
 $s = S$

$S = 20T - 4.9T^2$  W1

2<sup>nd</sup> ball:  
 $u = 22 \text{ ms}^{-1}$   
 $a = -9.8 \text{ ms}^{-2}$   
 $t = T - 3$   
 $s = S$

$S = 22(T - 3) - 4.9(T - 3)^2$  M1 MW1 W1

$20T - 4.9T^2 = 22(T - 3) - 4.9(T - 3)^2$  M1

$20T - 4.9T^2 = 22T - 66 - 4.9T^2 + 29.4T - 44.1$

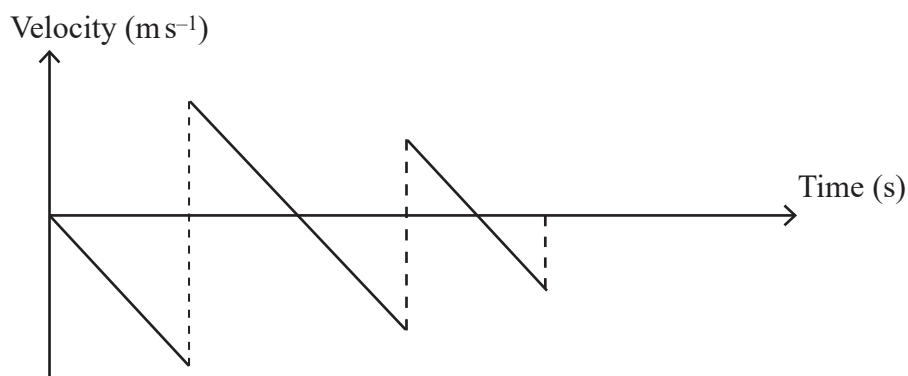
$110.1 = 31.4T$

$T = 3.51 \text{ s}$  W1

(ii)  $v = u + at$   
 $v = 20 - 9.8(3.5063)$   
 $v = -14.4 \text{ ms}^{-1}$  MW1

Ball is moving downwards MW1

(b)



MW3

12

**Section B: Statistics**

			AVAILABLE MARKS
<b>5</b>	<b>(i)</b> The mean temperature in cell A9 is missing.	MW1	6
	The sunshine in cell D6 is 92 which must be incorrect.	MW1	
	The relative humidity in row F3 is recorded as AB which is unclear.	MW1	
<b>(ii)</b>	$Q_3 + 1.5(Q_3 - Q_1) = 5.2 + 1.5(5.2 - 2.5)$	M1	
	$= 9.25$	W1	
	Since $8.3 < 9.25$ it is not an outlier so Kevin's claim is not correct.	MW1	
<b>6</b>	<b>(i)</b> $\bar{x} = \frac{\sum x}{n}$		
	$= \frac{2214.44}{220}$	MW1	
	$= 10.1 \text{ kg}$	W1	
	$\sigma^2 = \frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2$	M1	
	$= \frac{31454.76}{220} - \left(\frac{2214.44}{220}\right)^2$	MW1	
	$= 41.7 \text{ kg}^2$	W1	
	<b>(ii)</b> $r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$		
	$= \frac{196.205}{\sqrt{9165.012 \times 2804.465}}$	MW1	
	$= 0.0387$	W1	
	<b>(iii)</b> The value of $r$ is close to zero which indicates no correlation between the masses of hold luggage and hand luggage for each passenger.	MW2	9

7 (i)  $\frac{5}{6}$

MW1

(ii)  $X =$  no. of seeds that will germinate so  $X \sim \text{Bin}(12, \frac{5}{6})$

M1

$$P(X=9) = \binom{12}{9} \left(\frac{5}{6}\right)^9 \left(\frac{1}{6}\right)^3$$

$$= 0.197$$

MW1

W1

(iii)  $P(X \leq 10) = 1 - [P(X=11) + P(X=12)]$

M1

$$= 1 - \left[ \binom{12}{11} \left(\frac{5}{6}\right)^{11} \left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^{12} \right]$$

MW2

$$= 0.619$$

W1

(iv) Extract from the probability distribution of  $X$ :

$X$	12	11	10	9
$P(X=x)$	0.112	0.269	0.296	0.197

M1

MW1

Mode of  $X = 10$

W1

11

8 (i)  $x + \frac{1}{2} + y + \frac{1}{12} = 1$

$$x + y = \frac{5}{12}$$

MW1

(ii)  $\left(x + \frac{1}{2}\right)\left(y + \frac{1}{2}\right) = \frac{1}{2}$

M1

MW1

$$xy + \frac{1}{2}(x+y) - \frac{1}{4} = 0$$

$$x\left(\frac{5}{12} - x\right) + \frac{1}{2}\left(\frac{5}{12}\right) - \frac{1}{4} = 0$$

M1

$$\frac{5}{12}x - x^2 - \frac{1}{24} = 0$$

$$24x^2 - 10x + 1 = 0$$

W1

$$(6x - 1)(4x - 1) = 0$$

M1

$$x = \frac{1}{6} \text{ or } \frac{1}{4}, y = \frac{1}{4} \text{ or } \frac{1}{6}$$

MW2

$$x = \frac{1}{4}, y = \frac{1}{6}$$

W1

9

**Total**

**70**