



# **MARKSCHEME**

**November 2004**

**MATHEMATICAL STUDIES**

**Standard Level**

**Paper 1**

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## Paper 1 Markscheme

### Instructions to Examiners

**Note:** The number of marks for each question has been increased to 8. Where there are 2 marks (e.g. M2, A2) for an answer do NOT split the marks unless otherwise instructed.

#### 1 Method of Marking

- (a) All marking must be done using a **red** pen.
- (b) In this paper, the maximum mark is awarded for a **correct answer**, irrespective of the method used. Thus, if the correct answer appears in the answer box, award the maximum mark and move onto the next question; in this case there is no need to check the method.
- (c) If an **answer is wrong**, then marks should be awarded for the method according to the markscheme. (A correct answer incorrectly transferred to the answer box is awarded the maximum mark.)

#### 2 Abbreviations

The markscheme may make use of the following abbreviations:

- M** Marks awarded for **Method**
- A** Marks awarded for an **Answer** or for **Accuracy**
- G** Marks awarded for correct solutions, generally obtained from a **Graphic Display Calculator**, irrespective of working shown
- C** Marks awarded for **Correct** answers (irrespective of working shown)
- R** Marks awarded for clear **Reasoning**

#### 3 Follow Through (ft) Marks

Errors made at any step of a solution can affect all working that follows. To limit the severity of the penalty, **follow through (ft)** marks should be awarded. The procedures for awarding these marks require that all examiners:

- (i) penalize the error when it **first occurs**;
- (ii) **accept the incorrect answer** as the appropriate value or quantity to be used in all subsequent working;
- (iii) award **M** marks for a correct method and **A(ft)** marks if the subsequent working contains no further errors.

**Follow through** procedures may be applied repeatedly throughout the same problem.

The following illustrates a use of the **follow through** procedure.

Markscheme		Candidate’s Script	Marking
\$ 600 × 1.02	<i>MI</i>	Amount earned = \$ 600 × 1.02	✓ <i>MI</i>
= \$ 612	<i>AI</i>	= \$ 602	× <i>A0</i>
\$ (306 × 1.02) + (306 × 1.04)	<i>MI</i>	Amount = 301 × 1.02 + 301 × 1.04	✓ <i>MI</i>
= \$ 630.36	<i>AI</i>	= \$ 620.06	✓ <i>AI(ft)</i>

**Note that** the candidate made an arithmetical error at line 2; the candidate used a correct method at lines 3, 4; the candidate’s working at lines 3, 4 is correct.

However, if a question is transformed by an error into a **different, much simpler question** then:

- (i) **fewer** marks should be awarded at the discretion of the Examiner;
- (ii) marks awarded should be followed by “(d)” (to indicate that these marks have been awarded at the **discretion** of the Examiner);
- (iii) a brief **note** should be written on the script explaining **how** these marks have been awarded.

#### 4 Using the Markscheme

- (a) This markscheme presents a particular way in which each question may be worked and how it should be marked. **Alternative methods** have not always been included. Thus, if an answer is wrong then the working must be carefully analysed in order that marks are awarded for a different method in a manner which is consistent with the markscheme.

In this case:

- (i) a mark should be awarded followed by “(d)” (to indicate that the marks have been awarded at the **discretion** of the Examiner);
- (ii) a brief **note** should be written on the script explaining **how** these marks have been awarded.

Where alternative methods for complete questions are included, they are indicated by **METHOD 1, METHOD 2, etc.** Other alternative solutions, including graphic display calculator alternative solutions are indicated by **OR**. For example:

$$\begin{aligned} \text{Mean} &= 7906/134 && \text{(M1)} \\ &= 59 && \text{(A1)} \end{aligned}$$

**OR**

$$\text{Mean} = 59 \qquad \qquad \qquad \text{(G2)}$$

- (b) Unless the question specifies otherwise, accept **equivalent forms**. For example:  $\frac{\sin \theta}{\cos \theta}$  for  $\tan \theta$ .

On the markscheme, these equivalent numerical or algebraic forms will be written in brackets after the required answer. Paper setters will indicate the required answer, by allocating full marks at that point. Further working should be ignored, even if it is incorrect. For example: if candidates are asked to factorize a quadratic expression, and they do so correctly, they are awarded full marks. If they then continue and find the roots of the corresponding equation, do not penalize, even if those roots are incorrect *i.e.*, once the correct answer is seen, ignore further working.

- (c) As this is an international examination, all **alternative forms of notation** should be accepted. For example: 1.7, 1·7, 1,7 ; different forms of vector notation such as  $\vec{u}$  ,  $\overline{u}$  ,  $\underline{u}$  ;  $\tan^{-1} x$  for  $\arctan x$ .

## 5 Accuracy of Answers

If the level of accuracy is specified in the question, a mark will be allocated for giving the answer to the required accuracy.

There are two types of accuracy error. Candidates should be penalized once only **IN THE PAPER** for an accuracy error (**AP**). Award the marks as usual then write  $-1(\mathbf{AP})$  against the answer and also on the **front** cover.

**Rounding errors:** only applies to final answers not to intermediate steps.

**Level of accuracy:** when this is not specified in the question the general rule *unless otherwise stated in the question all numerical answers must be given exactly or to three significant figures* applies.

- If a final correct answer is incorrectly rounded, apply the **AP**
- **OR**
- If the level of accuracy is not specified in the question, apply the **AP** for answers not given to 3 significant figures. (Please note that this has changed from May 2003).

Incorrect answers are wrong, and the accuracy penalty should not be applied to incorrect answers.

## 6 Graphic Display Calculators

Many candidates will be obtaining solutions directly from their calculators, often without showing any working. They have been advised that they must use mathematical notation, not calculator commands when explaining what they are doing. Incorrect answers without working will receive no marks. However, if there is written evidence of using a graphic display calculator correctly, method marks may be awarded. Where possible, examples will be provided to guide examiners in awarding these method marks

**QUESTION 1**

- (a)  $\frac{4.24}{256} = 0.0165625$  (M2)(A2) (C4)
- (b) 0.0166 (A2) (C2)
- (c)  $1.66 \times 10^{-2}$  (A1)(A1) (C2)

**Note:** Award (A1) for 1.66, (A1) for  $-2$ .

**QUESTION 2**

- (a) 0.40 (A2) (C2)
- (b)  $0.55 + 0.50 = 1.05$  (A1)(A1)(A1) (C3)

**Note:** Award (A1) for 0.55, (A1) for 0.50, (A1) for correct total of amounts given.

- (c)  $0.80 + 1.40 = 2.20$  (A1)(A1)(A1) (C3)

**Note:** Award (A1) for 0.80, (A1) for 1.40, (A1) for correct total of amounts given.

**QUESTION 3**

- (a) 6 hours (accept (5.5 – 6.5)) (A2) (C2)
- (b)  $\frac{(4 \times 4 + 5 \times 5 + 6 \times 9 + 7 \times 8 + 8 \times 4)}{30}$  (M1)(A2)(A1)
- $= \frac{183}{30}$
- $= 6.1$  (A2) (C6)

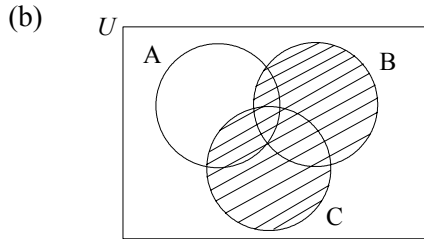
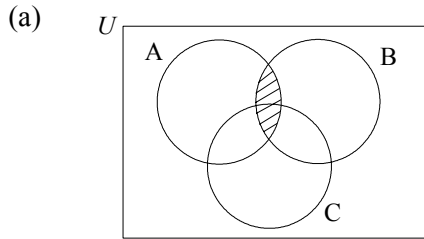
**Note:** Award (M1) for method, (A2) for all 5 terms in numerator correct. ((A1) for 3 or 4 terms in the numerator correct), (A1) for denominator.

**QUESTION 4**

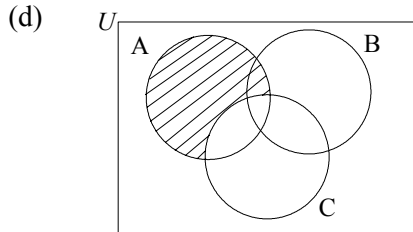
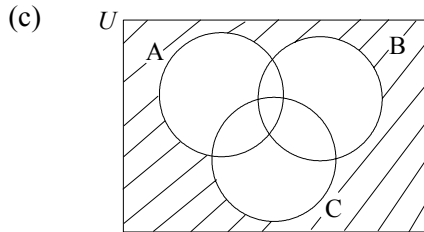
- (a)  $\mathbf{u} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$   $\mathbf{v} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$  (A1)(A1) (C2)
- (b)  $\mathbf{w} = \begin{pmatrix} 3 \\ 2 \end{pmatrix} - \begin{pmatrix} -1 \\ 3 \end{pmatrix} = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$  (M1)(A1)(A1) (C3)
- (c) vector on grid (A1)(A1)(A1) (C3)

**Note:** Award (A1) for correct line, (A1) for arrow in correct direction, (A1) for labelling vector  $\mathbf{w}$ . ( $\mathbf{w}$  can be anywhere on the grid)

**QUESTION 5**



(A2)(A2)



(A2)(A2)

**Note:** Award (A0), (A0), (A2)ft, (A2)ft if  $\cup$  and  $\cap$  are consistently reversed.

**QUESTION 6**

(a) If the train arrives on time then I am not late for school. (A2) (C2)

**Note:** Award (A1) for “If...then” in correct order and (A1) for “not”.

(b)  $\neg p \wedge \neg q$  (A2) (C2)

**Note:** Award (A1) for both  $\neg$  symbols and (A1) for  $\wedge$ .

(c) missing elements are 

	<b>F</b>
<b>T</b>	<b>F</b>

 (A3) (C3)

(d) The implications are **not** logically equivalent. (A1) (C1)

**QUESTION 7**

(a)  $1200 \times 1.03^2 = 1273$  (M1)(A1)(A2) (C4)

**Note:** Award (M1) for using correct formula, (A1) for substituting correct numbers, (A2) for answer ((A1) of which is for answer to the nearest pound).  
Award (M1)(A0)(A2)ft if the candidate has put 3 for the power.  
Award (M1)(A0)(A1)ft if the candidate has put 1 for the power.

**OR**

3 % of 1200 = 36 (M1)  
After 1 year fees = 1236 (A1)  
3 % of 1236 = 37.08 (M1)  
fees after 2 years = 1236 + 37.08 = 1273.08 (A1)  
= 1273

**Note:** Award (M1)(A1)(M1)(A0) if candidate has repeated the process another time.

(b)  $\frac{1200(1.03^5 - 1)}{(1.03 - 1)}$  (M1)(A1)  
= 6370.96 (6370 to 3 s.f.) (A2) (C4)

**Note:** Award (M1) for using correct formula, (A1) for substituting correct numbers, (A2) for answer. Candidates can also write out each term and add them up.  
Award (M1)(A1) for terms and (A2) for the correct answer.  
Award only (A1) if answer is incorrect due to premature rounding.

**QUESTION 8**

(a) Domain  $x < 3$  (accept  $-4 \leq x < 3$ ) Range  $y \leq 2$  (accept  $-2 \leq y \leq 2$ ) (A2)(A2) (C4)

**Note:** Award (A1) for  $x \leq 3$  and (A1) for  $y < 2$ . If the domain and range are reversed award [0 marks] in this part of the question. Allow for other notation such as  $[-\infty, 3[$  or  $[\infty, 3)$  for domain and  $[-\infty, 2]$  for range.

(b) Domain  $\{-3, -2, -1, 0, 1, 2, 3\}$  Range  $\{1, 2, 3, 4\}$  (A2)(A2) (C4)

**Note:** Award (A2)ft, (A2)ft if domain and range are reversed.  
Award (A1) if 1 number is omitted from the domain and (A1) if 1 number is omitted from the range.  
Award (A0) if more than 1 number is omitted from the domain and (A0) if more than 1 number is omitted from the range.  
Award (A0) for  $-3 \leq x \leq 3$  and  $1 \leq y \leq 4$ .



**QUESTION 9**

- (a)  $XM = 2$  (A1) (C1)
- (b)  $DM = \sqrt{(9+4)} = \sqrt{13} (= 3.61)$  (M1)(A2) (C3)
- (c)  $\tan DMX = \frac{3}{2}$  (M1)(A1)

**Note:** Award (M1) for the correct angle, (A1) for the correct ratio.

angle  $DMX = 56.3^\circ$  (A2) (C4)

**OR**

$\sin DMX = \frac{3}{3.61}$  (M1)(A1)

angle  $DMX = 56.2^\circ$  (A2)

**OR**

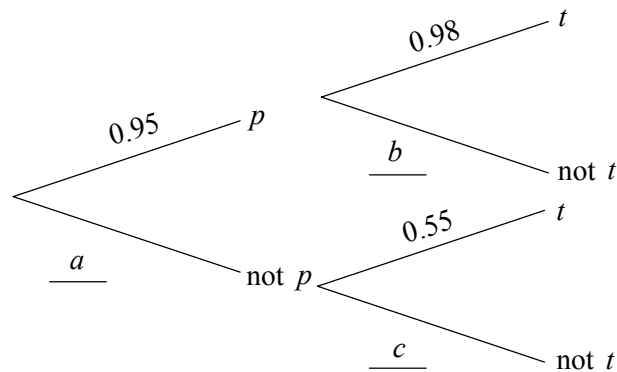
$\cos DMX = \frac{2}{3.61}$  (M1)(A1)

angle  $DMX = 56.4^\circ$  (A2)

**Note:** Accept correct answer given in radians, or degrees, minutes and seconds.

**QUESTION 10**

(a)



- $a = 0.05$  (A1)
- $b = 0.02$  (A1)
- $c = 0.45$  (A1) (C3)

(b)  $0.95 \times 0.98 = 0.931$  (M1)(A1) (C2)

(c)  $0.95 \times 0.02 + 0.05 \times 0.45 = 0.0415$  (M1)(M1) (A1) (C3)

**QUESTION 11**

- (a) (i)  $500 \times 0.983 = 491.50$  Euros (492 Euros) (M1)(A1)
- (ii)  $491.50 - 328 = 163.50$  Euros (A1)
- $\frac{163.50}{1.59} = 102.83$  GBP (103 GBP) (M1)(A1) (C5)
- (b)  $\frac{102.83 \times 0.5 \times 6}{100}$  (M1)(A1)
- $= \text{£ } 3.08$  (A1) (C3)

**QUESTION 12**

- (a)  $u_6 = u_1 + 5d = 24$
- $u_1 + 5 \times 8 = 24$  (M1)(A1)
- $u_1 = 24 - 40$
- $= -16$  (A1) (C3)
- (b)  $S_n = \frac{n}{2}(2 \times -16 + (n-1)8)$  (M1)(A1)
- $600 = \frac{n}{2}(-32 + 8n - 8)$  (A1)
- $1200 = -40n + 8n^2$
- $150 = -5n + n^2$  (A1)
- $(n-15)(n+10) = 0$
- $n = 15$  or  ~~$n = -10$~~  (A1) (C5)

**Note:** Not all the steps of working out need to be shown.

**QUESTION 13**

- (a)  $(x-3)(x+1)$  (A1)(A1) (C2)

**Note:** Award (A0)(A1) if the signs are reversed.

- (b) A(-1, 0), B(3, 0) (A1)(A1) (C2)

- (c)  $x = 1$  or  $x = \frac{(-1+3)}{2} = 1$  or  $x = \frac{-(-2)}{2(1)} = 1$  (A1)(A1) (C2)

**Note:** Award (A1) for  $x =$  and (A1) for 1.

- (d) C(1, -4) (A1)(A1) (C2)

**QUESTION 14**

- (a) (i)  $120^\circ$  (A2) (C2)
- (ii) 1 (A2) (C2)
- (iii) 1 (A2) (C2)
- (b)  $\frac{360}{a} = 120 \Rightarrow a = 3$  (A2) (C2)

**QUESTION 15**

- (a)  $85 \pm 1$  (M1)(A1) (C2)
- (b)  $21.5 \pm 0.5$  (M1)(A1) (C2)
- (c)  $y = 100 \times (5^{-0.02 \times 80})$   
 $= 7.61$  (M1)(A1) (C2)
- (d)  $y = 0$  (A1)(A1) (C2)

<b>Note:</b> Award (A1) for $y =$ and (A1) for 0.
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