

OCR

Oxford Cambridge and RSA

Friday 22 June 2018 – Morning

A2 GCE MATHEMATICS (MEI)

4754/01A Applications of Advanced Mathematics (C4) Paper A

QUESTION PAPER

Candidates answer on the Printed Answer Book.

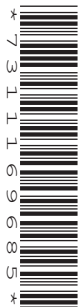
OCR supplied materials:

- Printed Answer Book 4754/01A
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator

Duration: 1 hour 30 minutes



INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the barcodes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets [] at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **16** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.
- This paper will be followed by **Paper B: Comprehension**.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Section A (36 marks)

- 1 Express $\sin \theta - 2.4 \cos \theta$ in the form $R \sin(\theta - \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$.
Hence write down the maximum value of the function $f(\theta) = 1 - \sin \theta + 2.4 \cos \theta$, where $0 \leq \theta \leq 2\pi$. [5]
- 2 The finite region bounded by the curve $y = \ln x$, the x -axis, the y -axis and the line $y = 1$ is rotated through 360° about the y -axis. Find the exact volume of the solid of revolution generated. [4]
- 3 Find the first three terms of the binomial expansion of $\frac{1+2x}{(2-x)^3}$ in ascending powers of x .
State the set of values of x for which the expansion is valid. [7]
- 4 A curve has parametric equations $x = \sin 2\theta$, $y = 1 + 2 \cos \theta - \cos 2\theta$, where $0 < \theta < \pi$.
(i) Find $\frac{dy}{dx}$ in terms of θ . [3]
(ii) Find the exact coordinates of the point on the curve where the gradient is zero. [4]
- 5 Fig. 5 shows the curve with equation $y = \sqrt{1+x^3}$.

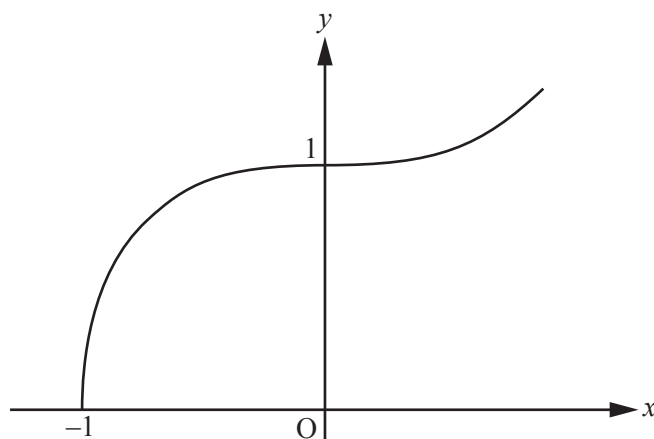


Fig. 5

- (i) Use the trapezium rule with 4 strips to estimate the finite area enclosed by the curve and the x - and y -axes, giving your answer correct to 3 significant figures. [3]
- (ii) Use a quarter circle of radius 1 to estimate this area, giving your answer correct to 3 significant figures. [1]
- (iii) State, with a reason, which of these estimates is closer to the true area. [1]

- 6 In Fig. 6, triangle ADC is right-angled at C, with $CD = h$. The point B on AC is such that $AB = x$, angle $ADB = \alpha$ and angle $BDC = \beta$.

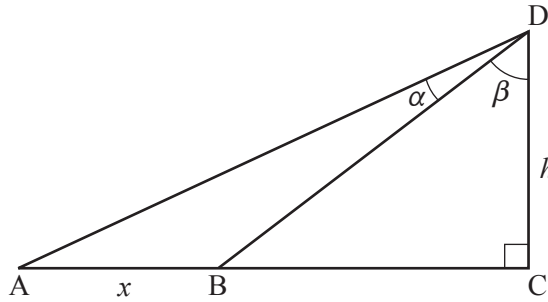


Fig. 6

- (i) Find BC and AC in terms of h , α and β .

Hence show that $x = \frac{h \tan \alpha \sec^2 \beta}{1 - \tan \alpha \tan \beta}$. [5]

- (ii) Given that $x = h$ and $\beta = 30^\circ$, find α , giving your answer correct to 1 decimal place. [3]

Section B (36 marks)

- 7 Three points A, B and C have coordinates A (2, 1, 1), B (1, -3, -1) and C (-4, -1, 0).

- (i) Find the lengths AB and AC, and use a scalar product to calculate the angle BAC.

Hence find the area of triangle ABC. [7]

The lines with vector equations

$$\mathbf{r} = 2\mathbf{i} + \mathbf{j} + \mathbf{k} + \lambda(2\mathbf{i} + \mathbf{j} - \mathbf{k}), \quad \mathbf{r} = \mathbf{i} - 3\mathbf{j} - \mathbf{k} + \mu(-\mathbf{i} + 3\mathbf{j} + 3\mathbf{k}) \quad \text{and} \quad \mathbf{r} = -4\mathbf{i} - \mathbf{j} + \nu(4\mathbf{i} + \mathbf{j} + 2\mathbf{k})$$

pass through the points A, B and C respectively.

- (ii) Show that these three lines meet at a point D. [6]

You are given that the plane ABC has equation $\mathbf{r} \cdot (\mathbf{j} - 2\mathbf{k}) = -1$. The normal through D to the plane ABC meets the plane at E.

- (iii) Find the coordinates of E. [3]

The volume of a tetrahedron is $\frac{1}{3} \times \text{area of base} \times \text{height}$.

- (iv) Find the volume of the tetrahedron ABCD. [3]

- 8 The speed $v \text{ m s}^{-1}$ of an object at time t seconds is modelled by the differential equation

$$\frac{dv}{dt} = -kv(4 + v^2),$$

where k is a positive constant. Initially, $v = 4$.

(i) Find constants A , B and C such that $\frac{1}{v(4 + v^2)} = \frac{A}{v} + \frac{Bv + C}{4 + v^2}$. [5]

(ii) Hence show by integration that $v = \frac{4}{\sqrt{5e^{8kt} - 4}}$. [9]

(iii) After 1 second the speed of the object is 2 m s^{-1} . Find the value of k . [3]

END OF QUESTION PAPER

OCR
Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

Friday 22 June 2018 – Morning

A2 GCE MATHEMATICS (MEI)

4754/01B Applications of Advanced Mathematics (C4) Paper B: Comprehension

QUESTION PAPER

Candidates answer on the Question Paper.

OCR supplied materials:

- Insert (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator

Duration: Up to 1 hour



Candidate forename		Candidate surname	
-----------------------	--	----------------------	--

Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

INSTRUCTIONS TO CANDIDATES

- The Insert will be found inside this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.
- The Insert contains the text for use with the questions.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- You may find it helpful to make notes and do some calculations as you read the passage.
- You are **not** required to hand in these notes with your question paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **18**.
- This document consists of **8** pages. Any blank pages are indicated.

- 1 In a 40-over match, Team 1 scored 183/8 in their 40 overs. Team 2, in the first 23 overs of their innings, reached 102/4 when rain caused a delay. This delay meant that only 5 more overs were available to Team 2. Using the ARR method, calculate how many runs Team 2 had to score in these 5 overs in order to win the match. [3]

1	

PLEASE DO NOT WRITE IN THIS SPACE

- 2 In line 94 the article says that the D/L method can set a higher target for Team 2 than the ARR method would have set.

In a 50-over match Team 1 scores 239 runs. Team 2 only have 40 overs available. Calculate how many more runs Team 2 need to score to win the match if the D/L method, rather than the ARR method, is used. [3]

2	

PLEASE DO NOT WRITE IN THIS SPACE

3 Rewrite equation (4) in line 101 to make the b the subject.

[2]

3	

PLEASE DO NOT WRITE IN THIS SPACE

- 4 The article, in line 147, says that the D/L method can be used to deal with a match in which there are multiple interruptions in either team's innings.

In 2003, a 50-over match between two teams took place and before play began the match was reduced to 46 overs each.

Rain stopped play when Team 1 reached 123/2 from 25 overs. At the restart both innings were reduced to 43 overs.

Rain stopped play again when Team 1 had reached 150/3 from 33 overs, and at the restart both innings were reduced further to 38 overs.

Team 1 finished on 185/3 from their 38 overs.

- (i) Complete the final column of the table below. [4]
- (ii) Calculate the target score to win for Team 2 given that in 2003 the value of G50 was 235. [2]

4(i)		Overs left and wickets remaining	Resource as a percentage
	Total resource available to Team 1 at the start	46 overs left, 10 wickets remaining	
	Total resource remaining to Team 1 at the first interruption	21 overs left, 8 wickets remaining	
	Total resource remaining to Team 1 at the restart	18 overs left, 8 wickets remaining	
	Total resource lost by first interruption		
	Total resource remaining to Team 1 at the second interruption	10 overs left, 7 wickets remaining	
	Total resource remaining to Team 1 at the second restart	5 overs left, 7 wickets remaining	
	Total resource lost by second interruption		
	Total resource available to Team 1		
	Total resource available to Team 2	38 overs left, 10 wickets remaining	86.7
4(ii)			

5 In lines 148 and 149 the article says

‘There are also cases where the D/L method sets a target that requires Team 2 to score *fewer* runs than Team 1 in the same number of overs.’

By calculating the target score required by Team 2 to win, show that the above statement is true in the following scenario.

50 overs per innings
Team 1 scores 110/8 in 35 overs
Rain causes Team 1’s innings to be terminated and Team 2 have 35 overs for their innings

[4]

5	

END OF QUESTION PAPER

OCR

Oxford Cambridge and RSA

Friday 22 June 2018 – Morning

A2 GCE MATHEMATICS (MEI)

4754/01B Applications of Advanced Mathematics (C4) Paper B: Comprehension

INSERT

Duration: Up to 1 hour



INFORMATION FOR CANDIDATES

- This Insert contains the text for use with the questions.
- This document consists of **8** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

- Do not send this Insert for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Rain Stopped Play

Introduction

This article concerns the use of mathematical procedures to try to ensure a fair outcome in cricket matches where bad weather has reduced the time available for the match to be completed.

Cricket is a bat-and-ball game involving two teams, referred to here as Team 1 and Team 2, who take it in turn to try to score the most ‘runs’. Runs in cricket correspond to points or goals in other games. 5

In the first part of a match, Team 1 is the ‘batting’ team trying to score runs while Team 2 is the ‘fielding’ team trying to prevent runs being scored. In the second part, the teams exchange roles so that Team 2 becomes the batting team and Team 1 becomes the fielding team. Each part of the game is called an ‘innings’, so that the first part of a game is Team 1’s innings and the second part is Team 2’s innings. 10

During an innings, a player from the fielding team (the ‘bowler’) bowls the ball to a player from the batting team (the ‘batsman’). Each time the ball is bowled, the batsman has the opportunity of hitting the ball in such a way as to be able to score runs, while the bowler has a chance of dismissing the batsman. A batsman who is dismissed can take no further part in the team’s innings, and the batting team is said to have ‘lost a wicket’. At each loss of a wicket the dismissed batsman is replaced by another member of the batting team, until the team’s 10th wicket is lost. At this point no more replacement batsmen are allowed, and the innings of the batting team is complete. 15

Limited Overs Cricket

In the form of cricket discussed in this article, the length of a team’s innings is also limited by the number of times that the fielding team is allowed to bowl the ball. This is expressed as a number of ‘overs’, where an over refers to a particular bowler bowling the ball six times in succession. (This is usually referred to as the bowler ‘bowling six balls’, although the same actual cricket ball is in fact used each time.) So in a ‘50-over’ match, for example, each team’s innings can have at most $50 \times 6 = 300$ balls bowled. An innings will be shorter if a team loses all its 10 wickets before the maximum number of allowed overs have been bowled. 20 25

Matches in limited overs cricket have at most 50 overs per innings, but some matches are shorter, for example 45 or 40 overs per innings.

When bad weather interrupts the innings of either team it may be necessary to reduce the total number of overs that are available in the match, and so a revised target for the number of runs that Team 2 needs to score in order to win may be required. The number of runs that a team has scored and the number of wickets that it has lost when interruptions occur are both factors that need to be taken into account when the match resumes. These two factors are presented in a standard notation so that $127/4$, for example, indicates that a team has scored 127 runs for the loss of 4 wickets. 30

Various different methods have been used to tackle this issue of setting a revised target when bad weather interrupts a match. One of these methods is the Average Run-Rate method. 35

Average Run-Rate (ARR) method

The Average Run-Rate (ARR) method was used at the start of limited overs cricket in the 1960s to set a target number of runs for Team 2 if bad weather reduced the time available for a game.

For example, if Team 1 scores 247 runs in 50 overs, then this gives an ARR of

$$\frac{247}{50} = 4.94 \text{ runs per over.} \quad 40$$

If Team 2's innings is reduced to 33 overs, the target score for Team 2 would be $4.94 \times 33 = 163.02$.

As this is a non-integer value Team 2 would require 164 runs to win. If the target score had been an integer n then Team 2 would have required $n + 1$ runs to win.

It was generally felt that this method was not completely fair, as achieving a given average run rate for a smaller number of overs, without regard to the number of wickets that could be lost, was an easier task for Team 2. However, the method's simplicity, and a lack of any viable alternative, meant that the ARR method was used until the early 1990s. 45

One method that was tried as an alternative to the ARR method was the Most Productive Overs (MPO) method. In this method, Team 2 has a harder task as their target is equivalent to the total scored by Team 1 in its n highest scoring overs, where n is the number of overs available to Team 2. 50

The deficiency of this method was highlighted in a match between England and South Africa in 1992. In the closing stages of the match South Africa required 22 runs to win with 13 balls remaining. Rain stopped play for 12 minutes which meant that only 1 further ball could be bowled. The revised target under the MPO method, was 21 runs from 1 ball, which was an impossible target given that the maximum score from one ball is generally 6 runs. 55

After this match the International Cricket Council (ICC) appealed to mathematicians to come up with something better. Two British mathematicians, Frank Duckworth and Tony Lewis, took up this challenge and their method, known as the Duckworth-Lewis (D/L) method, was first used in 1997.

Duckworth-Lewis (D/L) method

The D/L method is based on the idea that, in building up its score of runs, a team has two ‘resources’ available: the number of wickets remaining and the number of overs to be bowled. A team’s available resources decrease as its innings progresses as there are progressively fewer overs left to be bowled and wickets will usually be lost also. 60

Let R_1 be the total resources used by Team 1 in their innings and let R_2 be the total resources available to Team 2 in their innings. R_1 and R_2 take values between 0 and 100 and are the percentages of the total resources available to a team at the start of a 50-over match. 65

If S_1 is the number of runs scored by Team 1, then the D/L method sets the target number of runs required by Team 2 to be S_2 , where

$$S_2 = S_1 \times \frac{R_2}{R_1} \text{ when } R_2 < R_1, \quad (1)$$

$$S_2 = S_1 \text{ when } R_2 = R_1, \quad (2) \quad 70$$

$$S_2 = S_1 + \left(\frac{R_2 - R_1}{100} \right) \times G50 \text{ when } R_2 > R_1, \text{ where } G50 \text{ is a constant.} \quad (3)$$

Equation (1) deals with the case when Team 2’s resources are less than Team 1’s and the target for Team 2 is reduced in proportion to the resources.

Equation (2) indicates that no change in target is required when resources are equal.

Equation (3) applies when Team 2 has more resources available than Team 1, and their target score is increased by an amount proportional to the extra resources. The constant $G50$ in this equation is the average number of runs scored in a full 50-over innings at the appropriate level of the game, so that the increase in the target for Team 2 is the number of runs that an average team could expect to score with that amount of resources. As of 2014, the value of $G50$ in international matches is 245, and unless otherwise stated this value will be used in calculations in this article. 75 80

As before, if the target score for Team 2 is a non-integer, then Team 2’s target to win is rounded up to the next integer. If the target score for Team 2 is an integer n , then Team 2 needs to score $n + 1$ runs to win.

For example, if Team 2 has only 70% of the resources that were available to Team 1, and Team 1 scored 273 then

$$S_2 = 273 \times 0.7 = 191.1, \quad 85$$

so Team 2’s target to win is 192.

A single table gives the resources remaining at any stage of an innings for any combination of overs remaining and wickets lost. The resources are expressed as percentages of the resources available at the start of a full 50-over innings. An abbreviated version of the D/L resource table is shown in Table 1.

Overs left	Wickets lost									
	0	1	2	3	4	5	6	7	8	9
50	100	93.4	85.1	74.9	62.7	49.0	34.9	22.0	11.9	4.7
49	99.1	92.6	84.5	74.4	62.5	48.9	34.9	22.0	11.9	4.7
48	98.1	91.7	83.8	74.0	62.2	48.8	34.9	22.0	11.9	4.7
47	97.1	90.9	83.2	73.5	61.9	48.6	34.9	22.0	11.9	4.7
46	96.1	90.0	82.5	73.0	61.6	48.5	34.8	22.0	11.9	4.7
45	95.0	89.1	81.8	72.5	61.3	48.4	34.8	22.0	11.9	4.7
44	93.9	88.2	81.0	72.0	61.0	48.3	34.8	22.0	11.9	4.7
43	92.8	87.3	80.3	71.4	60.7	48.1	34.7	22.0	11.9	4.7
42	91.7	86.3	79.5	70.9	60.3	47.9	34.7	22.0	11.9	4.7
41	90.5	85.3	78.7	70.3	59.9	47.8	34.6	22.0	11.9	4.7
40	89.3	84.2	77.8	69.6	59.5	47.6	34.6	22.0	11.9	4.7
35	82.7	78.5	73.0	66.0	57.2	46.4	34.2	21.9	11.9	4.7
30	75.1	71.8	67.3	61.6	54.1	44.7	33.6	21.8	11.9	4.7
25	66.5	63.9	60.5	56.0	50.0	42.2	32.6	21.6	11.9	4.7
24	64.6	62.2	59.0	54.7	49.0	41.6	32.3	21.6	11.9	4.7
23	62.7	60.4	57.4	53.4	48.0	40.9	32.0	21.5	11.9	4.7
22	60.7	58.6	55.8	52.0	47.0	40.2	31.6	21.4	11.9	4.7
21	58.7	56.7	54.1	50.6	45.8	39.4	31.2	21.3	11.9	4.7
20	56.6	54.8	52.4	49.1	44.6	38.6	30.8	21.2	11.9	4.7
19	54.4	52.8	50.5	47.5	43.4	37.7	30.3	21.1	11.9	4.7
18	52.2	50.7	48.6	45.9	42.0	36.8	29.8	20.9	11.9	4.7
17	49.9	48.5	46.7	44.1	40.6	35.8	29.2	20.7	11.9	4.7
16	47.6	46.3	44.7	42.3	39.1	34.7	28.5	20.5	11.8	4.7
15	45.2	44.1	42.6	40.5	37.6	33.5	27.8	20.2	11.8	4.7
10	32.1	31.6	30.8	29.8	28.3	26.1	22.8	17.9	11.4	4.7
5	17.2	17.0	16.8	16.5	16.1	15.4	14.3	12.5	9.4	4.6

Table 1

As can be seen from the table, the resources available when overs are lost for a team batting second are not simply proportional to the number of overs lost. For example, in a 50-over match where Team 2 loses 10 overs at the start of their innings, the table gives 89.3 as the (percentage) resources for a team with 40 overs remaining and no wickets yet lost. This is significantly greater than the 80% that would correspond to the ARR method. So the D/L method can set a higher target for Team 2 than the ARR method, thus attempting to remove the unfairness shown by ARR to Team 1.

90

95

Table 1 is used for all matches, not only full 50-over ones. In a 40-over match, for example, Team 1 starts its innings with a resource value of 89.3, just as though 10 overs had been lost at the start of a full-length match.

The values in Table 1 were calculated from a mathematical formula giving the average number of runs, z , obtainable when a team has w wickets remaining with u overs left. The original formula developed was 100

$$z = z_0(1 - e^{-bu}), \quad (4)$$

though there have been some subsequent modifications. In equation (4), both b and z_0 are functions of w , though the actual definitions of these functions have never been revealed, due to commercial confidentiality.

Details of the how the D/L method works are shown in the following examples, which illustrate some of the ways in which interruptions can occur. 105

Team 1's innings complete; Team 2's innings cut short

45 overs per innings
 Team 1 score 298 in their innings
 Rain reduces Team 2's innings to 35 overs

110

In this scenario Team 1 started their innings with 45 overs and no wickets lost so according to Table 1, Team 1 began with 95.0% of the resources they would have had in a 50-over innings. Team 1 lost no resources due to the interruption so $R1 = 95.0$. The value of $S1$ is 298.

Team 2 start their innings with 35 overs and no wickets lost and so according to Table 1, $R2 = 82.7$.

$R2 < R1$, so using equation (1)

115

$$S2 = 298 \times \frac{82.7}{95.0} = 259.416\dots$$

and Team 2 are therefore set a target of 260 runs to win.

Team 1's innings cut short; Team 2's innings complete

50 overs per innings
 Team 1 score 165/4 in 35 overs
 It rains, leaving only enough time for a further 35 overs in the match
 Team 2 must be set a target for their 35 overs

120

In this scenario Team 1 started their innings with 100% of their resources. When the rain came Team 1 had 15 overs remaining and had lost four wickets. According to Table 1 they had 37.6% resources available at that point, so they had only used up 62.4% of the original amount in scoring their 165 runs. The values for Team 1 are therefore $R1 = 62.4$ and $S1 = 165$. 125

Team 2 started their innings with only 35 overs and no wickets lost and so according to Table 1 they had 82.7% of the resources they would have had if they had their full complement of 50 overs so $R2 = 82.7$. In this case $R2 > R1$ and so equation (3) is used to set the target for Team 2. Using $G50 = 245$ gives

$$S2 = 165 + 245 \left(\frac{82.7 - 62.4}{100} \right) = 214.735. \quad 130$$

So Team 2 are set a target of 215 runs to win.

Team 1's innings interrupted; Team 2's innings completed**45 overs per innings**

Team 1 scores 172/5 in 30 overs and then rain causes the match to be reduced to 40 overs per team

Team 1 scores 220/7 in 40 overs

Team 2 must be set a target for their 40 overs

135

In this scenario Team 1 started their innings with 95.0% of their resources. When the rain came Team 1 had 15 overs left and had lost 5 wickets. Therefore Team 1 had 33.5% resources available at that point. When play resumed Team 1 had only 10 overs left, still with 5 wickets lost, and so they now only had 26.1% resources available. So the rain delay resulted in a loss of resources of $33.5 - 26.1 = 7.4\%$. Therefore the value of R_1 , the resources used by Team 1, is $95.0 - 7.4 = 87.6$.

140

Team 2 started their innings with 40 overs and no wickets lost and so $R_2 = 89.3$. In this case $R_2 > R_1$ and so the score, S_2 , required by Team 2 as given by equation (3) is

$$S_2 = 220 + 245 \left(\frac{89.3 - 87.6}{100} \right) = 224.165.$$

So Team 2 are set a target of 225 runs to win.

145

Along with the cases illustrated above, the D/L method can be used in a range of other scenarios. For example, matches being prematurely abandoned and multiple interruptions in either team's innings can be dealt with. There are also cases where the D/L method sets a target that requires Team 2 to score *fewer* runs than Team 1 in the same number of overs. This seems surprising at first sight, but is in fact an indication that Team 1 performed rather poorly in their innings.

150

In Conclusion

The version of the D/L method seen in this article is relatively transparent and easy to implement and was used widely in all forms of the game until 2003 but it unfortunately had a flaw when handling very high first innings scores. Over the last decade or so the D/L method has evolved so that it requires a computer to perform the calculations required to deal with this flaw but the version seen in this article is still used in most school and club games where computers are not widely available.

155

**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.