Guidelines for marking the MCAT 2022

As you begin to assess your candidates' answers you may find it helpful to check the FAQ page link https://bit.ly/2022_MCAT_FAQ. This will be updated regularly.
The title of the standard requires candidates to use algebraic procedures in solving problems. To fulfil the requirements of explanatory note 2, all questions require the candidates to choose the procedures from explanatory note 4 (EN4) which will lead them towards a solution, and apply these correctly. Evidence of algebraic working must be shown.

In order to provide evidence towards any grade, the candidate must demonstrate a level of algebraic thinking consistent with level six of the curriculum and be consistent with the spirit of the New Zealand Curriculum.

If a candidate requires a further u, r, or t grade in this paper (ie **is a borderline candidate for any** overall grade), the assessor may award **one** "**s" (soft)** grade anywhere in the paper where there is evidence of:
a correct answer only, **or** a correct guess and check response (for achievement level only),
or at any level where there is a minor algebraic error in a response, which the marker feels that penalising the candidate for this prevents them from gaining a grade that is generally indicated they deserve holistically.
An "s" grade may only be awarded once in a paper.
These papers should not be sent for verification.

Implications
All working must be checked in order to identify evidence of the application of a listed procedure. This may involve a consistent application of an appropriate procedure applied to an incorrect algebraic expression on the condition that the expression does not significantly simplify the application.

Grading in general

1. In grading a candidate's work, the focus is on evidence required within the achievement standard demonstrating knowledge and use of specific algebraic methods at level 6 of the curriculum .
2. Where there is evidence of correct algebraic processing and the answer is incorrect due to a numerical error, the candidate should not be penalised **except** in questions **1a, 2a and 3a on both days.** If it cannot be determined if it is a numerical or an algebraic error, the grade should not be awarded. e.g. factorising of a quadratic expression.
3. Units are not required anywhere in the paper.
4. The grade for evidence towards the awarding of **achievement** is coded as **"u" or "us"**.
   For **merit**, the demonstrating of relational thinking is coded as **"r" or "rs"**,
   and for **excellence**, the demonstrating of abstract thinking is coded as **"t" or "ts"**.
5. Once a student has made an error, for any consistent working to provide evidence towards a grade, the procedure must be performed at curriculum level 6 appropriate to the problem.

Grading parts of questions

1. Check each part of each question to ensure they have been allocated a grade.
2. Only the highest grade is to be recorded for each part of a question ie u, r, or s.

Question grade
Each question gains the overall grade indicated below and this is recorded in the box at the end of each question.

No **u** or **us** gains **N**	1**u** gains **1A** 2**u** or more gains **2A**	1**r** gains **1M** 2**r** or more gains **2M**	1**t** gains **1E** 2**t** or more gains **2E**
Note: Only one us, rs or ts grade may be awarded across the paper.			

Minimum requirements of sufficiency across the paper
1. For a Not Achieved grade (N)
2A or lower
1r and 1u overall gains N

2. For the award of an Achievement grade (A)

3A or higher from either:

- 1A or higher in each question
- 1A in one question and 2A in another
- 1A in one question and 1E in another (because the award of a t grade will involve more than one of the procedures)

OR a total of

- 1 r and 2 u across at least two questions

3. For the award of a Merit grade (M)

3M or higher from either:

- 1M in each question
- 1M in one question and 2M in another
- 2E in one question and 1A in another
- 1E, 1M and a total of 2u or more from any questions

OR a total of

- 2 r and 2 u across at least two questions.

4. For the award of an Excellence grade (E)

A total of

- At least 2 t grades and at least 2 r grades across at least two questions.

Results

1. When loading school data, ensure you follow the instructions given on the NZQA schools' secure web site. (In high security features, Provisional and Final Results Entry, L1 MCAT Instructions – School's PN has access to this).
2. **Please ensure that <u>all</u> registered candidates have a grade recorded on the website before submitting your school's papers to NZQA for verification otherwise your submission cannot be verified.**
   <u>Do not share results with your candidates prior to them being released in January by NZQA.</u>
3. Verification reports will not be included in the envelope returned to the school. These can be accessed on the NZQA secure web site. You may receive your scripts back to the school before your report is available online. You must still check the verification report and not assume that the grades you allocated were correct. This is because the report is not visible to the provider for a week after the final report is loaded to allow for any checking by the National Verifier.

Verifying

A reminder that candidates' work submitted for verification **should not be scripts where assessors have allocated final grades by professional judgement or on a holistic basis (ie. a us, ms or ts grade) or scripts that have been discussed on the help line.** The purpose of verification is to check the school's ability to correctly apply the schedule.

A holistic decision is when a candidate's work provides significant evidence towards the award of a higher grade across the paper and the assessor believes it would be appropriate to award such a grade. The assessor should review the entire script and determine if it is a minor error or omission that is preventing the award of the higher grade. The question then needs to be asked "Is this minor error preventing demonstration of the requirements of the standard?" The final grade should then be determined on the basis of the response to this question.

For assistance with marking please use:
Email: mcat.help@xtra.co.nz
You may wish to include a contact phone number as in some cases it can be easier to discuss the response.

The completed verification report will be posted on the NZQA schools' secure site.

Assessment Schedule – 2022

Mathematics and Statistics: Apply algebraic procedures in solving problems (91027A)

Day 1

Candidates must show algebraic working.
Solutions in a multi-part question may be found in **any** part and awarded credit.
Equivalent methods of solving problems are accepted on condition that the candidate is demonstrating algebraic solutions at curriculum level 6, which may include algebraic thinking at curriculum level 6.
Once a student has made an error, for any consistent working to provide evidence towards a grade, the procedure must be performed at curriculum level 6.

Q	Expected Coverage	Grade (generated by correctly demonstrating the procedures listed in EN4) Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent.
ONE (a)(i)	Perimeter $= x-3+2x-5+3x^2+5x+y$ $= 3x^2+8x+y-8$ No alternatives accepted. Allow C.A.O.	For award of u: • correct simplified expression for the perimeter.
(ii)	$\frac{1}{2}(2x-5)(x-3)=3$ $(2x-5)(x-3)=6$ $2x^2-11x+9=0$ #1 $(2x-9)(x-1)=0$ Either $2x-9=0$ $x=\frac{9}{2}=4.5$ Or $x-1=0$ $x=1$ (not valid) Accept alternative formats of the answer. Do not penalise if both solutions accepted as valid.	For award of u: ONE of: • forming the quadratic equation # 1 • consistent factorising of their quadratic expression. For award of r: • both values for x found.
(b)	$3^2\times 3^{p+q}=\left(3^3\right)^{2q}$ $3^{2+p+q}=3^{6q}$ $2+p+q=6q$ $p=5q-2$	For award of u: ONE of: • simplification of the powers of 3 on both sides • consistently forming a linear equation from a base of 3. For award of r: ONE of : • forming the linear equation • consistently forming an equation for p, in terms of q. For award of t: • forming an equation for p, in terms of q.

(c)	$580 = 2a + 140b$ $640 = 2a + 200b$ Subtracting gives $60 = 60b$ $b = 1$ Then $580 = 2a + 140$ $2a = 440$ $a = 220$ i.e. $P = 440 + n$ $P = 440 + 300$ $P = \$740$ Allow alternative algebraic methods. Units not required.	For award of u: ONE of: • forms both equations • consistent combining of their equations in one variable • consistent solution for one variable. For award of r: • correct value for the cost of 300 ducks.
(d)	$(2n)^2 + (2n+2)^2 + (2n+4)^2 - 2$ $= 4n^2 + (2n+2)(2n+2) + (2n+4)(2n+4) - 2$ $= 4n^2 + 4n^2 + 4n + 4n + 4 + 4n^2 + 8n + 8n + 16 - 2$ $= 4n^2 + 4n^2 + 8n + 4 + 4n^2 + 16n + 16 - 2$ #1 $= 12n^2 + 24n + 18$ $= 2(6n^2 + 12n + 9)$ As this expression has a factor of 2, it is a multiple of 2. As required. Allow alternative algebraic methods.	For award of u: ONE of: • correct expression for the sum of three consecutive even numbers • consistently expanding and simplifying of a pair of brackets forming a quadratic expression. For award of r: ONE of : • simplifying to a quadratic expression (equivalent to stage # 1) • consistently using algebraic reasoning and explanation to justify clearly that the result is a multiple of 2. For award of t: • algebraic reasoning and explanation to justify clearly that the result is a multiple of 2.

Q	Expected Coverage	Grade (generated by correctly demonstrating the procedures listed in EN4) Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent.
TWO (a)	$4+2\left(5\times(-2)^2\times 2-10\right)$ $=4+2\left(5\times 4\times 2-10\right)$ $=4+2\left(40-10\right)$ $=4+2\times 30$ $=4+60$ $=64$	For award of u: • correct solution. (Numerical errors not allowed.)
(b)	$2^{4x-5}=8$ $2^{4x-5}=2^3$ #1 $4x-5=3$ $4x=8$ $x=2$	For award of u: ONE of: • simplification of the powers of 2 on the RHS # 1 • consistently forming a linear equation from a base 2. For award of r: • forming a linear equation and solving for x.
(c)	$(3x+2y)(3x+2y)-(3x-2y)(3x-2y)$ $=\left(9x^2+6xy+6xy+4y^2\right)-\left(9x^2-6xy-6xy+4y^2\right)$ $=9x^2+12xy+4y^2-9x^2+12xy-4y^2$ $=24xy$	For award of u: ONE of: • forms correct expression for the required value of the area difference • expansion and simplification of either $(3x+2y)^2$ or $(3x-2y)^2$ • consistent simplification for both expansions. For award of r: • correctly simplifies the expression.
(d)	$3x+x\left(16-2x\right)+5x^2=14$ $3x+16x-2x^2+5x^2-14=0$ $3x^2+19x-14=0$ $(3x-2)(x+7)=0$ Either $3x-2=0$ $x=\frac{2}{3}=0.667$ Or $x+7=0$ $x=-7$ (Not valid as not a positive solution.) Allow alternative algebraic methods.	For award of u: ONE of: • forming correct expression for the total area • consistent simplification to a quadratic equation equal to 0. For award of r: ONE of : • simplification to a quadratic equation equal to 0 • consistent solving of their quadratic equation. For award of t: • correct positive solution found for the question, with evidence of negative value disregarded.

(e)	$\left[(2n+3)^2-2\right]-\left[(2n+1)^2-2\right]$ $=\left[(2n+3)(2n+3)-2\right]-\left[(2n+1)(2n+1)-2\right]$ $=\left[4n^2+12n+9-2\right]-\left[4n^2+4n+1-2\right]$ $=\left[4n^2+12n+7\right]-\left[4n^2+4n-1\right]$ $=4n^2+12n+7-4n^2-4n+1$ #1 $=8n+8$ $=4\left[2n+2\right]$ As this expression has a factor of 4, it is divisible by 4. As required. Accept any order of the differences considered. Allow alternative algebraic methods.	For award of u: ONE of: • correct expression for the difference between two successive odd numbered shapes • correct expansion and simplification of a pair of brackets forming a quadratic expression • consistently simplifies to an expression without any brackets (equivalent to stage #1). For award of r: ONE of: • correctly simplifies to an expression without any brackets #1 • consistently fully simplifies and uses algebraic reasoning and explanation to justify clearly that the result is divisible by 4. For award of t: • fully simplifies and uses algebraic reasoning and explanation to justify clearly that the result is divisible by 4.

Q	Expected Coverage	Grade (generated by correctly demonstrating the procedures listed in EN4) Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent.
THREE (a)	$2(2x-5)+2(3x+2)=24$ $4x-10+6x+4=24$ $10x-6=24$ $10x=30$ $x=3$ Alternative method: $2x-5+3x+2=12$ $5x-3=12$ $5x=15$ $x=3$	For award of u: • form and solve the linear equation.
(b)	$=\frac{(3x+2)(3x-2)}{(3x-2)(5x-1)}$ $=\frac{(3x+2)}{(5x-1)}$ $(5x-1\neq 0$ not required$)$	For award of u: ONE of: • numerator or denominator fully factorised • consistent simplification from their factorisation. For award of r: • simplification of the expression.
(c)	$\frac{(x+5)(x-2)}{(x+5)(x+3)}=\frac{3x}{2}$ $\frac{x-2}{x+3}=\frac{3x}{2}$ $2(x-2)=3x(x+3)$ $2x-4=3x^2+9x$ $0=3x^2+7x+4$ $0=(3x+4)(x+1)$ Either $3x+4=0$ $x=-\frac{4}{3}$ Or $x+1=0$ $x=-1$ Both solutions required.	For award of u: ONE of: • factorisation and simplification of both numerator and denominator of the LHS • consistently rearranges equation to a quadratic equation equal to 0 • rearranges equation to cubic equation equal to 0. For award of r: ONE of: • correctly rearranges equation to a quadratic equation equal to 0 • consistent solutions from their quadratic equation. For award of t: • equation solved for both values.

<table>
<tr>
<td>(d)</td>
<td>$x+2x+x+17=93$
$4x=93-17$
$4x=76$
$x=19$
i.e. Wednesday points total
= 19 + 17 = 36 points</td>
<td>For award of u:
ONE of:
• forming correct equation in order to solve the problem
• consistent solving of their equation and evaluation of points for Wednesday.

For award of r:
• correct solving of equation and evaluation of points for Wednesday.</td>
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<tr>
<td>(e)</td>
<td>$33\pi=2\pi r(r+9.5)$
$33=2r^2+19r$ #1
$0=2r^2+19r-33$ #2
$0=(2r-3)(r+11)$ #3
Either $2r-3=0$
$r=\frac{3}{2}$
Or $r+11=0$
$r=-11$
(Not valid as not a positive solution.)

Units not required.</td>
<td>For award of u:
ONE of:
• simplifying equation to a quadratic equation #1
• consistent simplifying to a quadratic equation equal to 0 #2
• consistent factorising of their quadratic equation.

For award of r:
ONE of:
• simplification to a factorised quadratic equation equal to 0 #3
• consistent solving of their quadratic equation and recognition of only positive value required.

For award of t:
• correct positive solution found for the question, with evidence of negative value disregarded.</td>
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Assessment Schedule – 2022

Mathematics and Statistics: Apply algebraic procedures in solving problems (91027B) Day 2

Candidates must show algebraic working.
Solutions in a multi-part question may be found in **any** part and awarded credit.
Equivalent methods of solving problems are accepted on condition that the candidate is demonstrating algebraic solutions at curriculum level 6, which may include algebraic thinking at curriculum level 6.
Once a student has made an error, for any consistent working to provide evidence towards a grade, the procedure must be performed at curriculum level 6.

Q	Expected Coverage	Grade (generated by correctly demonstrating the procedures listed in EN4) Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent.
ONE (a)	$2(5x+3)+2(3x-5)=28$ $10x+6+6x-10=28$ $16x-4=28$ $16x=32$ $x=2$ Alternative method: $5x+3+3x-5=14$ $8x-2=14$ $8x=16$ $x=2$	For award of u: • form and solve the linear equation.
(b)	$=\frac{(2x-5)(2x+5)}{(4x-1)(2x-5)}$ $=\frac{(2x+5)}{(4x-1)}$ $(4x-1\neq 0$ not required$)$	For award of u: ONE of: • numerator or denominator fully factorised • consistent simplification from their factorisation. For award of r: • simplification of the expression.
(c)	$\frac{(x+2)(x-3)}{(x+7)(x+2)}=\frac{3x}{2}$ $\frac{x-3}{x+7}=\frac{3x}{2}$ $2(x-3)=3x(x+7)$ $2x-6=3x^2+21x$ $0=3x^2+19x+6$ $0=(3x+1)(x+6)$ Either $3x+1=0$ $x=-\frac{1}{3}$ Or $x+6=0$ $x=-6$ Both solutions required.	For award of u: ONE of: • factorisation and simplification of both numerator and denominator of the LHS • consistently rearranges equation to a quadratic equation equal to 0 • rearranges equation to a cubic equation equal to 0. For award of r: ONE of: • correctly rearranges equation to a quadratic equation equal to 0 • consistent solutions from their quadratic equation. For award of t: • equation solved for both values.

<table>
<tr>
<td>(d)</td>
<td>$x+3x+x+16=111$
$5x+16=111$
$5x=111-16$
$5x=95$
$x=19$
i.e. Wednesday goals total
= 19 + 16 = 35 goals</td>
<td>For award of u:
ONE of:
• forming correct equation in order to solve the problem
• consistent solving of their equation and evaluation of goals for Wednesday.

For award of r:
• correct solving of equation and evaluation of goals for Wednesday.</td>
</tr>
<tr>
<td>(e)</td>
<td>$27\pi=2\pi r(r+7.5)$
$27=2r^2+15r$ #1
$0=2r^2+15r-27$ #2
$0=(2r-3)(r+9)$ #3
Either $2r-3=0$
$r=\frac{3}{2}$
Or $r+9=0$
$r=-9$
(Not valid as not a positive solution.)

Units not required.</td>
<td>For award of u:
ONE of:
• simplifying equation to a quadratic equation #1
• consistent simplifying to a quadratic equation equal to 0 #2
• consistent factorising of their quadratic equation.

For award of r:
ONE of:
• simplification to a factorised quadratic equation equal to 0 #3
• consistent solving of their quadratic equation and recognition of only positive value required.

For award of t:
• correct positive solution found for the question, with evidence of negative value disregarded.</td>
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Q	Expected Coverage	Grade (generated by correctly demonstrating the procedures listed in EN4) Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent.
TWO (a)(i)	Perimeter $= x-3+3x+2+4x^2+7x+y$ $= 4x^2+11x+y-1$ No alternatives accepted. Allow C.A.O.	For award of u: • correct simplified expression for the perimeter.
(ii)	$\frac{1}{2}(3x+2)(x-3)=7$ $(3x+2)(x-3)=14$ $3x^2-7x-6=14$ $3x^2-7x-20=0$ #1 $(3x+5)(x-4)=0$ Either $3x+5=0$ $x=-\frac{5}{3}$ (not valid) Or $x-4=0$ $x=4$ Accept alternative formats of the answer. Do not penalise if both solutions accepted as valid.	For award of u: ONE of: • forming the quadratic equation # 1 • consistent factorising of their quadratic expression. For award of r: • both values for x found.
(b)	$3^3\times 3^{p+2q}=\left(3^2\right)^{3q}$ $3^{3+p+2q}=3^{6q}$ $3+p+2q=6q$ $p=4q-3$	For award of u: ONE of: • simplification of the powers of 3 on both sides • consistently forming a linear equation from a base of 3. For award of r: ONE of : • forming the linear equation • consistently forming an equation for p, in terms of q. For award of t: • forming an equation for p, in terms of q.

(c)	$740 = 2a + 60b$ $840 = 2a + 160b$ Subtracting gives $100 = 100b$ $b = 1$ Then $740 = 2a + 60$ $2a = 680$ $a = 340$ i.e. $P = 680 + n$ $P = 680 + 300$ $P = \$980$ Allow alternative algebraic methods. Units not required.	For award of u: ONE of: • forms both equations • consistent combining of their equations in one variable • consistent solution for one variable. For award of r: • correct value for the cost of 300 calculators.
(d)	$(2n)^2 + (2n+2)^2 + (2n+4)^2 + 4$ $= 4n^2 + (2n+2)(2n+2) + (2n+4)(2n+4) + 4$ $= 4n^2 + 4n^2 + 4n + 4n + 4 + 4n^2 + 8n + 8n + 16 + 4$ $= 4n^2 + 4n^2 + 8n + 4 + 4n^2 + 16n + 16 + 4$ #1 $= 12n^2 + 24n + 24$ $= 3(4n^2 + 8n + 8)$ As this expression has a factor of 3, it is a multiple of 3. As required. Allow alternative algebraic methods.	For award of u: ONE of: • correct expression for the sum of three consecutive even numbers • consistently expanding and simplifying of a pair of brackets forming a quadratic expression. For award of r: ONE of : • simplifying to a quadratic expression (equivalent to stage # 1) • consistently using algebraic reasoning and explanation to justify clearly that the result is a multiple of 3. For award of t: • algebraic reasoning and explanation to justify clearly that the result is a multiple of 3.

Q	Expected Coverage	Grade (generated by correctly demonstrating the procedures listed in EN4) Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent.
THREE (a)	$5+2\left(4\times2\times(-2)^2-12\right)$ $=5+2\left(4\times2\times4-12\right)$ $=5+2\left(32-12\right)$ $=5+2\times20$ $=5+40$ $=45$	For award of u: • correct solution (Numerical errors not allowed.)
(b)	$2^{5x-12}=8$ $2^{5x-12}=2^3$ #1 $5x-12=3$ $5x=15$ $x=3$	For award of u: ONE of: • simplification of the powers of 2 on the RHS # 1 • consistently forming a linear equation from a base 2. For award of r: • forming a linear equation and solving for x.
(c)	$\left(2x+4y\right)\left(2x+4y\right)-\left(2x-4y\right)\left(2x-4y\right)$ $=\left(4x^2+8xy+8xy+16y^2\right)-\left(4x^2-8xy-8xy+16y^2\right)$ $=4x^2+16xy+16y^2-4x^2+16xy-16y^2$ $=32xy$ Allow alternative algebraic methods.	For award of u: ONE of: • forms correct expression for the required value of the area difference • expansion and simplification of either $\left(2x+4y\right)^2$ or $\left(2x-4y\right)^2$ • consistent simplification for both expansions. For award of r: • correctly simplifies the expression.

<table>
<tr>
<td>(d)</td>
<td>$2x + x(15 - 2x) + 4x^2 = 9$
$2x + 15x - 2x^2 + 4x^2 - 9 = 0$
$2x^2 + 17x - 9 = 0$
$(2x - 1)(x + 9) = 0$
Either $2x - 1 = 0$
$x = \frac{1}{2} = 0.5$
Or $x + 9 = 0$
$x = -9$
(Not valid as not a positive solution.)
Allow alternative algebraic methods.</td>
<td>For award of u:
ONE of:
• forming correct expression for the total area
• consistent simplification to a quadratic equation equal to 0.

For award of r:
ONE of :
• simplification to a quadratic equation equal to 0
• consistent solving of their quadratic equation.

For award of t:
• correct positive solution found for the question, with evidence of negative value disregarded.</td>
</tr>
<tr>
<td>(e)</td>
<td>$\left[(2n+3)^2 - 3\right] - \left[(2n+1)^2 - 3\right]$
$= \left[(2n+3)(2n+3) - 3\right] - \left[(2n+1)(2n+1) - 3\right]$
$= \left[4n^2 + 12n + 9 - 3\right] - \left[4n^2 + 4n + 1 - 3\right]$
$= \left[4n^2 + 12n + 6\right] - \left[4n^2 + 4n - 2\right]$
$= 4n^2 + 12n + 6 - 4n^2 - 4n + 2$ #1
$= 8n + 8$
$= 2\left[4n + 4\right]$
As this expression has a factor of 2, it is divisible by 2.
As required.
Accept any order of the differences considered.
Allow alternative algebraic methods.</td>
<td>For award of u:
ONE of:
• correct expression for the difference between two successive odd numbered shapes
• correct expansion and simplification of a pair of brackets forming a quadratic expression
• consistently simplifies to an expression without any brackets (equivalent to stage #1).

For award of r:
ONE of:
• correctly simplifies to an expression without any brackets #1
• consistently fully simplifies and uses algebraic reasoning and explanation to justify clearly that the result is divisible by 4.

For award of t:
• fully simplifies and uses algebraic reasoning and explanation to justify clearly that the result is divisible by 2.</td>
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