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23 March 2020

Blaize McCabe
fyi-request-12416-73ebc226@requests.fyi.org.nz

Dear Blaize McCabe

Official Information Act Request

Thank you for your request of 09 March 2020, under the Official Information Act 1982, for the following information:

> *Requesting information about 2019 NCEA Level 2 Maths exams on the changes made to marking schedules after the exam date for AS91261, AS91262, and AS91267.*

I attach copies of the changes to the assessment marking schedules AS91262, AS91262, and AS91267. The attachments show the changes that were made to the draft assessment schedules at benchmarking and, in the case of AS91261 and AS91262, any further changes made in finalising the assessment schedules for publication. In the case of AS91267, the changes made at benchmarking were final.

These changes generally provide greater detail to assist in training markers and to ensure they all mark consistently to the same standard. The additional notes are relevant to markers in the context of assessing student work from the national cohort. They may be removed prior to publication, as the Panel Leader may consider them unhelpful for classroom teachers and others viewing the published schedules.

As part of the commitment to open and transparent government, NZQA is proactively releasing responses to Official Information Act requests which are of public interest. NZQA intends to publish its response to this request on its website in June 2020. Your name and contact details will be removed before publication.

If you require further assistance or believe we have misinterpreted your request, please contact Elizabeth Templeton in the Office of the Chief Executive, email elizabeth.templeton@nzqa.govt.nz or telephone (04) 463 3339.

If you are dissatisfied with our response, you have the right, under section 28(3) of the Official Information Act 1982, to lodge a complaint with the Office of the Ombudsman at www.ombudsman.parliament.nz. You can also telephone 0800 802 502 or write to the Ombudsman at PO Box 10152, Wellington, 6143.

Yours sincerely

Karen Poutasi (Dr)
Chief Executive

Achievement standard 91261

Question 1

No changes were made during marking to the assessment schedule for questions (a) (i) and (a) (ii)

	Draft	Changes made at Benchmarking	Final
(b)	For Achievement Quadratic set equal to 0.	No change	For Achievement Quadratic equation set equal to 0.
(c)	For Achievement with Merit Correct solution	For Achievement with Merit Sets up quadratic equation equal to 0	No further change
(d)	For Achievement with Merit Find the difference between correct roots.	For Achievement with Merit The correct roots are found	No further change
		Added for Achievement with Excellence Finds the difference between correct roots.	No further change
(e)		Added for Achievement Function is set up so that discriminant can be found.	No further change
	For Achievement with Merit Finds discriminant in factored form OR gives clear graphical argument.	For Achievement with Merit Finds discriminant in factored form	No further change
	For Achievement with Excellence Explains why the discriminant is greater than 0 and makes correct conclusion.	For Achievement with Excellence Explains why the discriminant is greater than 0 and makes correct conclusion OR graphical argument is fully described	No further change

Question 2

No changes were made during marking to the assessment schedule for questions (a) (i), (a) (ii), (c), (d) and (e)

	Draft	Changes made at Benchmarking	Final
(b)	For Achievement Factorisations and denominator correct.	For Achievement Cross-arrangement to a single fraction	No further change

Question 3

No changes were made during marking to the assessment schedule for questions (a), (b), and (d) (i)

	Draft	Changes made at Benchmarking	Final
(c)	For Achievement CAO	For Achievement Correct answer only	No further change
(d)(ii)		Added for Achievement with Merit Finds 1 + r/100	
(e)	For Achievement with Merit Finds k	Added for Achievement with Merit OR finds two consistent solutions from calculated k	No further change
	Expected coverage $k = \frac{227-67}{(640)^2} = 0.000390625$ $h = 0.000390625\ (x - 640)^2 + 67 = 100$ $0.000390625x^2 - 0.5x + 127 = 0$ $x = 349.3$ m	Expected coverage $k = \frac{227-67}{(640)^2} = 0.000390625$ $h = 0.000390625\ (x - 640)^2 + 67 = 100$ $0.000390625x^2 - 0.5x + 127 = 0$ $x = 349.3$ m	Expected coverage $k = \frac{227-67}{(640)^2} = 0.000390625$ $h = 0.000390625\ (x - 640)^2 + 67 = 100$ $0.000390625x^2 - 0.5x + 127 = 0$ $x = 349.3, 930.7$ m Required distance = 349.3 m

Achievement standard 91262

Question 1

No changes were made to question (a)

	Draft	Changes made at Benchmarking	Final
(b)	For Achievement with Merit Both points found	For Achievement with Merit Only one co-ordinate point found.	For Achievement with Merit Only one co-ordinate point found.
		For Achievement with Excellence Both points found	No further changes
(c)	For Achievement Derivative found and made equal to 25π.	For Achievement Derivative found and made equal to 25π. [Note: If $\frac{dV}{dr}$ is correctly found and set $\frac{dV}{dr} = 25$, so $r = 1.4105$ $(4\ dp)$ →u.]	For Achievement Derivative found and made equal to 25π.
(d)		Added for Achievement General form of quadratic, with derivative found	No further changes
	For Achievement with Merit General form of quadratic, with derivative found and made equal to 7 when $x = 0$, and made equal to 0 when $x = 1$.	For Achievement with Merit Made $\frac{dy}{dx} = 7$, when x = 0 **AND** made $\frac{dy}{dx} = 0$, when $x = 1$	For Achievement with Merit General form of quadratic, with derivative found and made equal to 7 when $x = 0$, and made equal to 0 when $x = 1$.

(e)		Added for Achievement Both derivatives of both g and h found.	For Achievement Finds either $g'(x)$ **AND** $g'(-1)$ **OR** $h'(x)$ **AND** $h'(-1)$
	For Achievement with Merit Derivatives of both g and h found, recognising that they must be equal when $x = -1$ AND recognising that $g(-1) = h(-1)$.	For Achievement with Merit Recognising that $g'(-1) = h'(-1)$ **AND** recognising that $g(-1) = h(-1)$.	For Achievement with Merit Derivatives of both g and h found, recognising that they must be equal when $x = -1$ AND recognising that $g(-1) = h(-1)$.
	For Achievement with Excellence Simultaneous equations set up to find a and b AND point of contact found.	For Achievement with Excellence Simultaneous equations set up to find a and b **AND** Co-ordinates of contact point is found.	For Achievement with Excellence Simultaneous equations are set up to find a and b AND Co-ordinates of point of contact found.

Question 2

	Draft	Changes made at Benchmarking	Final
(a)	For Achievement Upright parabola with x intercepts lined up with turning points of original graph between – 3 and – 2 and 4 and 5 OR turning point midway between these or lined up with steepest gradient of original (x = 1).	For Achievement • Upright parabola • x-intercepts lined up with turning points of original graph between – 3 and – 2 and 4 and 5 Symmetry/turning point midway between these or lined up with steepest gradient of original (x = 1) Accept [0.5,1.5].	For Achievement Upright parabola with x intercepts lined up with turning points of original graph between – 3 and – 2 and 4 and 5 OR turning point midway between these or lined up with steepest gradient of original (x = 1).
	For Achievement with Merit Upright parabola with x intercepts lined up with turning points of original graph between – 3 and – 2 and 4 and 5 AND turning point midway between these or lined up with steepest gradient of original (x = 1).	For Achievement with Merit Need ~~ALL~~ 3 aspects	For Achievement with Merit Upright parabola with x intercepts lined up with turning points of original graph between – 3 and – 2 and 4 and 5 AND turning point midway between these or lined up with steepest gradient of original (x = 1).
(b)	For Achievement Correct polynomial in any form.	For Achievement Correct polynomial in any form. [Note: minor error ignored if c ≠ -3, **MUST** show a substitution of x = 2, e.g. –25 = 10 – 32 + c or similar.]	For Achievement Correct polynomial in any form.
(c)	For Achievement Derivative found and made greater than 0.	For Achievement Derivative found **AND** made either: $f'(x) > 0$ OR $f'(x) = 0$.	For Achievement Derivative found and made greater than 0.

	For Achievement with Excellence Correct range and justification for the choice of that range of values for k.	For Achievement with Excellence Correct interval **AND** justification for the choice of that range of values for k.	For Achievement with Excellence Correct range and justification for the choice of that range of values for k.
(d)	For Achievement Inverted parabola either going through (0,0) OR with turning point lined up with x intercept.	For Achievement Need 2 aspects of: • Inverted parabola • Going through (0,0) • Turning point is lined up with the intercept $x = 2$.	For Achievement Inverted parabola either going through (0,0) and (4,0) OR with turning point lined up with x intercept.
	For Achievement with Merit Inverted parabola going through (0,0) with turning point lined up with x-intercept.	For Achievement with Merit Need ALL three aspects	For Achievement with Merit Inverted parabola going through (0,0) and (4,0) AND with turning point lined up with x-intercept.

(e)	Expected coverage $a = -4$ $v = -4t + c$ When $t = 0$, $v = 28$ So $v = -4t + 28$ $s = 28t - \frac{4t^2}{2} + c$ $= 28t - 2t^2 + c$ $28 - 4t = 10$ means $t = 4.5$, so it takes 4.5 seconds for the car to reach the corner. When $t = 4.5$, $s = 0$ Here s is the distance from the corner. So $0 = 28 \times 4.5 - 2 \times (4.5)^2 + c$ $c = -85.5$ so $s = 28t - \frac{4t^2}{2} - 85.5$ i.e. the car was 85.5 metres away from the corner when the brakes were first applied.	Expected coverage $a = -4$ $v = -4t + c$ When $t = 0$, $v = 28$ So $v = -4t + 28$ $28 - 4t = 10$ means $t = 4.5$, so it takes 4.5 seconds for the car to reach the corner. When $t = 4.5$ seconds. $s = 28t - \frac{4t^2}{2} + c$ $= 28t - 2t^2 + c$ Here s is the distance from the corner. So, $0 = 28 \times 4.5 - 2 \times (4.5)^2 + c$ $c = -85.5$ so $s = 28t - \frac{4t^2}{2} - 85.5$ i.e. the car was 85.5 metres away from the corner when the brakes were first applied.	Expected coverage $a = -4$ $v = -4t + c$ When $t = 0$, $v = 28$ So $v = -4t + 28$ $s = 28t - \frac{4t^2}{2} + c$ $= 28t - 2t^2 + c$ $28 - 4t = 10$ means $t = 4.5$, so it takes 4.5 seconds for the car to reach the corner. When $t = 4.5$, $s = 0$ Here s is the distance from the corner. So $0 = 28 \times 4.5 - 2 \times (4.5)^2 + c$ $c = -85.5$ so $s = 28t - \frac{4t^2}{2} - 85.5$ i.e. the car was 85.5 metres away from the corner when the brakes were first applied
	For Achievement with Merit Finds general expression for s and solves to find how long it takes the car to reach the corner.	For Achievement with Merit Solves to find how long it takes the car to reach the corner.	For Achievement with Merit Finds general expression for s and solves to find the time it takes the car to reach the corner.

	For Achievement with Excellence Finds value of c and correctly finds distance car was from corner.	For Achievement with Excellence Finds general expression for *s* **AND** Finds value of c and correctly finds the distance car was from corner.	For Achievement with Excellence Finds value of c and correctly finds distance car was from corner.

Question 3

No changes were made during marking to the assessment schedule for question (a) (i)

	Draft	Changes made at Benchmarking	Final
(a) (ii)		Added for Achievement Finds the value of t when v = 0.	For Achievement Finds the value of t **OR** v = 0 is identified.
	For Achievement with Merit Change of direction justified: either velocity found before and after t = 3, or maximum given when $v = 0$ at turning point.	For Achievement with Merit Change of direction is justified, either by: Finding velocity before and after t = 3, eg. when t = 2.9 and 3.1 **OR** states when $v = 0$ at a turning point.	For Achievement with Merit Change of direction justified: either velocity found before and after t = 3, or maximum given when $v = 0$ at turning point.
(a)(iii)	Expected coverage It reaches P when $s = 0$ $t(6 - t) = 0$ means $t = 0$ or $t = 6$. When $t = 6$, $v = 6 - 12 = -6$ m s^{-1}	Expected coverage It reaches P when $s = 0$ $t(6 - t) = 0$ means $t = 0$ or $t = 6$. When $t = 6$, $v = 6 - 12 = -6$ m s^{-1} Speed = 6 m s^{-1}	Expected coverage It reaches P when $s = 0$ $t(6 - t) = 0$ means $t = 0$ or $t = 6$. When $t = 6$, $v = 6 - 12 = -6$ m s^{-1}
		Added for Achievement Finds $t = 6$ when reaches P for second time and finds speed. Note: NO calculus is required for this question part.	For Achievement Finds $t = 6$ when it reaches P for the second time and finds the speed.
	For Achievement with Merit Finds $t = 6$ when reaches P for second time and finds speed.	For Achievement with Merit Interprets that the speed is 6 m s^{-1} in the opposite direction	For Achievement with Merit Interprets that the speed is 6 m s^{-1} in the opposite direction.

(b)	Expected coverage Let l be length of rectangular side, and x be length of one of the square sides. $l + 4x = 100$ $l = 100 - 4x$ $V = lx^2$ $= (100 - 4x)x^2$ $= 100x^2 - 4x^3$ $\frac{dV}{dx} = 200x - 12x^2$ $= x(200 - 12x)$ $x = 0$ means $V = 0$, so for max volume, $12x = 200$ $x = 16.666$ cm Maximum possible volume is 9259 cm^3. Accept any clear justification of the fact that this is the maximal volume. Methods include noting that the other turning point leads to zero volume, second derivative test, testing gradients in the neighbourhood, referring to shape of curve.	Expected coverage Let l be length of rectangular side, and x be length of one of the square sides. $l + 4x = 100$ $l = 100 - 4x$ $V = lx^2$ $= (100 - 4x)x^2$ $= 100x^2 - 4x^3$ $\frac{dV}{dx} = 200x - 12x^2$ $= x(200 - 12x)$ $x = 0$ means $V = 0$, so for max volume, $12x = 200$ $x = 16\frac{2}{3}$ (16.666) cm Maximum possible volume is 9259 cm^3 (4sf). Accept any clear justification of the fact that this is the maximal volume. Methods include : • noting that the other turning point leads to zero volume • second derivative test • testing gradients in the neighbourhood of $x = 16\frac{2}{3}$ referring to shape of curve.	Expected coverage Let l be length of rectangular side, and x be length of one of the square sides. $l + 4x = 100$ $l = 100 - 4x$ $V = lx^2$ $= (100 - 4x)x^2$ $= 100x^2 - 4x^3$ $\frac{dV}{dx} = 200x - 12x^2$ $= x(200 - 12x)$ $x = 0$ means $V = 0$, so for max volume, $12x = 200$ $x = 16.666$ cm Maximum possible volume is 9259 cm^3. Accept any clear justification of the fact that this is the maximal volume. Methods include noting that the other turning point leads to zero volume, second derivative test, testing gradients in the neighbourhood, referring to shape of curve.
		Added for Achievement Sets up equation for volume in terms of one variable and differentiates.	For Achievement Sets up equation for volume in terms of one variable and differentiates.

	For Achievement with Merit Sets up equation for volume in terms of one variable and differentiates.	For Achievement with Merit Makes derivative equal 0, solves the quadratic derivative, with two solutions, for x. [Note: Common error is setting up the equation: $8l + 4x = 100$, if consistent to solving to get $V = x^2(25-2x)$ $\frac{dV}{dx} = 50x - 6x^2$ $x = 0$ *or* $\frac{25}{3}$ $V = 578.7$ cm^3 and with justification → r.]	For Achievement with Merit Makes derivative equal 0, solves the quadratic derivative with two solutions, for x.
	For Achievement with Excellence Makes derivative equal to 0, solves for x and finds correct maximum volume with justification.	For Achievement with Excellence Finds correct maximum volume **AND** with justification.	For Achievement with Excellence Finds correct maximum volume with justification.
(c)	For Achievement Derivative of f found and makes some valid progress.	For Achievement Derivative of $f(x)$ found and makes some valid progress. e.g. $f'(0) = -4$	For Achievement Finds derivative of f and makes some valid progress.
	For Achievement with Merit Equation set up and finds values for x	For Achievement with Merit One point and the equations of the tangent is found e.g. (0,0) and $y = -4x$ **OR** (1.5, – 9.375) and $y = – 6.25x$	For Achievement with Merit Finds one point and the equation of the tangent.

	For Achievement with Excellence Finds both points and equations of tangents.	For Achievement with Excellence Finds both points and equations of tangents.	For Achievement with Excellence Finds both points and equations of tangents.

Achievement standard 91267

For this standard the post benchmarking assessment schedule became the final schedule. No changes were made after benchmarking

Question 1

No changes were made during marking to the assessment schedule for questions (a) (i) and (a) (ii)

	Draft	Post Benchmarking
(b)	Expected coverage The relative risk that a male in this sample has a bag which is heavy: $\frac{141}{558}$ over $\frac{98}{413}$ = 1.0649 This means that males are very slightly (6%) more likely to have a heavy bag in this sample. However, (1) this RR is only very slightly over 1 so it means that the difference is small using the means, there is very little difference between bag weights for males and females. This shows the difference is small.	Expected coverage The relative risk that a female in this sample has a bag which is heavy = $^{141}/_{558}\ over\ ^{98}/_{413} = 1.0649$ Accept as Minor Error Ignored: $^{208}/_{558}\ over\ ^{144}/_{413} = 1.0691$ Explanation: This **means** that females are (6%) more likely to have a heavy bag. Qualification: this R R is only very slightly over 1 so it means that the difference may not actually be statistically significant (in essence) NB: Reciprocal RR for male/female is 0.94
	For Achievement with Merit Relative risk correctly calculated OR consistent comment on the claim is made in line with those given.	For Achievement with Merit **Correct** relative risk OR valid qualification on the claim is made

	For Achievement with Excellence Relative risk correctly calculated AND a clear comment made which qualifies the claim's validity.	For Achievement with Excellence T1: Correct or reciprocal relative risk and explanation T2: Correct or reciprocal relative risk and explanation AND a clear comment made which qualifies the claim's validity
(c) (i)	For Achievement Describes the lack of symmetry compared to a normal distribution.	For Achievement Describes the lack of symmetry.
(c) (ii)	For Achievement Clear consideration of the context including either light or heavy bags.	For Achievement Question deemed at merit level so A criteria removed
	For Achievement with Merit Clear consideration of the context including either light or heavy bags and a comparison with features of a normal distribution.	For Achievement with Merit Clear consideration of symmetry with one reason given to support the statement OR 2 reasons given clearly
	For Achievement with Excellence Clear consideration of the context including both light and heavy bags and a comparison with features of a normal distribution.	For Achievement with Excellence Clear consideration of symmetry with two reasons given to support the statement.

Question 2

No changes were made during marking to the assessment schedule for questions (a) (i), (a) (ii), (b), (c) (ii) and (d) (i)

	Draft	Post Benchmarking
(c) (i)		Added for Achievement Unclear or contradictory comments with some validity.
(d) (ii)	Expected coverage Eddy's plates might have: (1) a higher mean than usual, since if the mean was the same the chance of 2 over 520 g is very low. For example, if the mean was 550 g, there is a 0.25 probability of producing 2 such plates, which is much more likely. (2) a significantly increased variation in the weights of plates that he makes but kept the mean the same. For example, if the sd = 135, this probability rises to 0.23 … (3) both a higher mean and increased variation (example calculations above) (4) a distribution that may not even be normal, in which case it will be difficult to find probabilities.	Expected coverage The probability from d(i) is very small, suggesting that Eddy's plates might have: (1) a higher mean than usual, since if the mean was the same the chance of 2 over 520 g is very low. (2) a significantly increased variation in the weights of plates that he makes but kept the same mean. (3) both a higher mean and increased variation (4) a distribution that may not even be normal, in which case it will be difficult to find probabilities. (5) Other valid reasoning
	For Achievement Correct response shows correct logic but does not include relevant probability calculations.	For Achievement Question deemed at the Merit level so Achievement requirements not needed
	For Achievement with Merit Correct response shows correct logic but does not include relevant probability calculations but a comparison with part (i) is made.	For Achievement with Merit One of the reasons is clearly stated
	For Achievement with Excellence Correct response includes relevant probability calculations with an example of a new mean or standard deviation and a comparison with part (i).	For Achievement with Excellence Student cites low value of P(2 plates>520g) **AND** one of the reasons is clearly stated

Question 3

No changes were made during marking to the assessment schedule for questions (a) (i) and (a) (ii)

	Draft	Post Benchmarking
(a)(iii)	Expected coverage (1) If you play 100 times, you would expect to win \$2 ~ 36 times, win \$1 ~ 48 times, giving you total winnings of \$120. (2) But it would have cost you \$50 to play 100 games, so you would profit by about \$70. (3) Ju-Eun cannot say that Kim will profit by exactly any amount as there is always random variation in games of chance so if you repeated the 100 games many times you would get a variety of profit figures. (4) The experimental probability would usually differ from the theoretical probability in any game of chance, so if Ju-Eun makes a claim like this based on calculations she is not likely to be correct in practice.	Expected coverage (1) If you play 100 times, you would expect to win \$2 ~ 36 times, win \$1 ~ 48 times, giving you total winnings of \$120 (or consistent with 24% in (ii), ie \$96). (2) But it would have cost you \$50 to play 100 games, **so** you would profit by about \$60 (using the \$110). (3) Ju-Eun cannot say that Kim will profit by exactly any amount as there is always random variation in games of chance so if you repeated the 100 games many times you would get a variety of profit figures. (4) The experimental probability would usually differ from the theoretical probability in any game of chance, so if Ju-Eun makes a claim like this based on calculations she may not be correct in practice. (5) Other valid reasoning
	For Achievement ONE of points (1), (3), or (4).	For Achievement ONE of points (1) to (4).
	For Achievement with Merit TWO of points (1) to (4).	For Achievement with Merit At least TWO of points (1) to (4).
	For Achievement with Excellence THREE of points (1) to (4), connected in a clear, reasoned manner.	For Achievement with Excellence This question was not deemed to be at an E level so criteria was removed

(b)	For Achievement One correct, identifiable probability calculated.	For Achievement One correct, identifiable probability calculated for at least 3 games Or CAO
	For Achievement with Merit 5 out of the 6 probabilities correctly calculated and summed.	For Achievement with Merit At least 4 out of the 6 probabilities correctly calculated and summed.
(c)	For Achievement Probability tree set up correctly with x, $2x$ and $\frac{x}{2}$	For Achievement Probability tree set up correctly with x, $2x$ and $\frac{x}{2}$ OR CAO
	For Achievement with Merit Forms equation consistent with tree OR Obtains p(win first game) = 0.3536.	For Achievement with Merit Obtains p(win first game) = 0.3536.