NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1, 2004

Mathematics

Use straightforward algebraic methods to solve equations (90147)

Sketch and interpret graphs (90148)

Solve straightforward number problems in context (90151)

Solve right-angled triangle problems (90152)

Use geometric reasoning to solve problems (90153)

Determine probabilities (90194)

National Statistics

Assessment Report

Assessment Schedule

Mathematics, Level 1, 2004

General Comments

Every candidate for a NCEA Mathematics paper is expected to:

- read the questions carefully and do what the questions ask, without making assumptions from any diagrams
- show working where this is requested
- bring a calculator
- reset their graphics calculator to factory settings before entering the examination
- allow adequate time to complete answers
- check their work to ensure accuracy
- use appropriate mathematical terms
- write clearly
- use pen if work is to be eligible for reconsideration.

Mathematics: Use straightforward algebraic methods to solve equations (90147)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
39,476	36.2%	36.5%	25.9%	1.4%

Assessment Report

Candidates gaining Achievement were able to use *straightforward algebraic methods* and s*olve equations.* They understood key words in the questions such as *factorise, expand,* and *solve* and used appropriate methods for solving the problem.

Candidates gaining Achievement used a variety of appropriate methods to solve equations. Mathematical ideas were, in general, communicated clearly and concisely.

Candidates often provided evidence of their ability to use *straightforward algebraic methods* and s*olve equations* in Questions 7 and 8. It is important that candidates realise that evidence for Achievement may be found anywhere in the paper and thus should attempt all questions.

Candidates gaining Achievement with Merit or Achievement with Excellence were able to form equations, solve them, and relate the solution to the problem given.

Mathematics: Sketch and interpret graphs (90148)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
38,231	49.3%	43.0%	4.7%	3.0%

Assessment Report

Candidates gaining Achievement were able to **both** *sketch* and *interpret* graphs.

Candidates gaining Achievement were also able to:

- recognise the type of graph (linear or quadratic) from the form of the equation
- accurately calculate the coordinates required
- draw the required graph accurately (in Question 1, *draw the graph* often prompted the use of a table of values)
- draw neat graphs with relevant features shown, using rulers for straight lines
- draw graphs of parabolas that were smooth, especially around the turning point, with correct intercepts and symmetry.

Candidates would be better able to demonstrate their ability to draw parabolas if they calculated and marked all the intercepts and the turning point.

Candidates gaining Achievement were able to use key words in the question like *charge per kilometre*, *fixed fee, length of trip,* and *charge the same,* and were able to recognise and select the correct feature in Question 2.

Candidates gaining Achievement with Merit were able to:

- manipulate equations in order to draw more complex graphs
- interpret the features of a parabola
- find the equations of linear graphs.

For Achievement with Excellence, candidates were able to determine the equation for the situation being modelled and apply it to the question asked.

Mathematics: Solve straightforward number problems in context (90151)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
40,810	22.3%	38.1%	37.5%	2.1%

Assessment Report

Candidates gaining Achievement were able to solve a range of *straightforward number problems in context*. Keywords such as *ratio, what fraction, how many,* and *what percentage* generally triggered a correct method for solving the problem. These candidates were able to round appropriately in the given context.

Candidates gaining Achievement demonstrated:

- correct selection of skills to apply to the problem
- competent calculation skills to produce correct results
- the ability to write clear statements showing an understanding of what was being calculated.

Candidates gaining Achievement with Merit were able to:

- select the correct method for more complex number problems
- use reverse processes to find the original quantity before a percentage increase
- demonstrate confidence in working with numbers in standard form
- solve multi-step problems where a systematic approach was required.

For Achievement with Excellence candidates demonstrated:

- an understanding of the sequence of steps needed to reach the answer
- clear communication of these steps
- the ability to give well-structured answers with consistent calculations
- the ability to maintain accuracy during calculations
- evidence of checking their answers.

Mathematics: Solve right-angled triangle problems (90152)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
40,414	38.3%	44.0%	16.1%	1.6%

Assessment Report

Candidates gaining Achievement were able to use **both** Pythagoras' Theorem and trigonometric ratios to *solve right-angled triangle problems*. Students were able to use the key words *distance, height,* and *angle* in the question to choose the appropriate method for solving the problem.

Candidates gaining Achievement were able to choose the correct method to solve the problem by using:

- a trigonometric ratio to find a side
- a trigonometric ratio to find an angle
- Pythagoras’ Theorem to find a side
- Pythagoras’ Theorem to find the hypotenuse.

Candidates gaining Achievement with Merit or Achievement with Excellence were familiar with grid references (or had good comprehension skills).

In Question 4 the candidates gaining Achievement with Excellence:

- did not assume the triangle was right angled, without proving this first
- had the ability to draw a clear accurate diagram
- maintained a high degree of accuracy
- rounded sensibly
- used units correctly
- used correct mathematical statements.

Candidates need to be aware that setting calculators back to the factory defaults leaves the calculator in radian mode.

Mathematics: Use geometric reasoning to solve problems (90153)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
35,187	19.1%	56.9%	21.9%	1.9%

Assessment Report

Candidates gaining Achievement were able to *use geometric reasoning to solve problems*. They were able to use the appropriate methods from the range of angle facts and apply them to the problem presented. They were also able to calculate the angle, and many gave geometric reasons as well.

Candidates gaining Achievement with Merit were able to:

- calculate the required angle correctly
- use correct mathematical reasons
- match the intermediate calculations with corresponding geometric reasons
- provide a logical chain of reasoning in the correct order.

Candidates gaining Achievement with Excellence were able to:

- use correct mathematical reasons
- prove any assumptions made from the diagram
- match the intermediate steps with corresponding geometric reasons
- provide a logical chain of reasoning to link the two angles.

Mathematics: Determine probabilities (90194)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
37,943	44.1%	31.7%	20.8%	3.4%

Assessment Report

Candidates gaining Achievement were able to d*etermine probabilities* in both *calculating probabilities in problems* involving *multivariate statistical data* and problems involving *theoretical methods.* They understood that the key words of the questions, such as *what is the probability* and *randomly chosen,* were indicators to candidates that they had to determine probabilities.

Candidates gaining Achievement:

- gave numerical answers to the questions
- used appropriate methods to solve the problems
- recognised probability situations that produced outcomes that were not equally likely
- could accurately convert a fraction into a decimal or percentage.

Candidates who gained Achievement with Merit were able to:

- use tree diagrams appropriately
- calculate probabilities involving combinations of events
- understand the concept of conditional probability from keywords such as *if*
- either avoid rounding intermediate results, or round them appropriately.

Candidates who gained Achievement with Excellence were able to:

- devise an appropriate method to solve this theoretical probability problem
- calculate accurately.

Assessment Schedule

Mathematics: Use straightforward algebraic methods to solve equations (90147)

AT THE POOL

	Achievement criteria	No.	Evidence	Code	Judgement	Sufficiency
Achievement	Solve equations.	1(a)	$x = \frac{1}{3}$ or $x = -2$ 0.33 or 0.3 … or 0.3 (1 dp)	A1	Both solutions needed.	**ACHIEVEMENT**
		1(b)	$x = 2.75$ or $2\frac{3}{4}$ or $\frac{11}{4}$ or 2.8 (1 dp)	A1	Or equivalent.	2 of code A1 **and**
		1(c)	$x = \frac{8}{5}$ or 1.6 or $1\frac{3}{5}$	A1		
		2	$6x^2 + 13x - 5$	A2	Or equivalent.	3 of code A2.
		3	$(x - 6)(x - 1)$	A2	Or equivalent.	
		4	$3x^4$ or $x^4 3$	A2	No other alternative.	**Replacement evidence:** 7, 8, 9 for either A1 or A2 and 6 for A2.
	Use straightforward algebraic methods.	5	51.75	A2	Accept 51.7 or 51.8	

	Achievement criteria	No.	Evidence	Code	Judgement	Suffiency
Achievement with Merit	Use algebraic methods and solve equations in context.	6	$\frac{a-5b}{2a}$	A2/M	Or equivalent.	**MERIT:** ACHIEVEMENT PLUS 2 of code M **OR** 3 of code M. **Replacement evidence:** 9 for 6, 7 or 8.
		7	$85T \le 900$ or $85T = 900$ $T \le 10.58$ …	M	Must give an equation (or inequation), and the correct number of tickets.	
			No. tickets = 10	A1	Correct number of tickets.	
				A2	Algebraic manipulation of equation formed must be seen.	
		8	No. (swimming) tickets = 6	A1/M	No alternative.	
			$d = 9$, $w = 6$	A2	Algebraic manipulation must be seen eg elimination or substitution to next step.	
Achievement with Excellence	Use algebraic strategies to investigate and solve problems.	9	$10\,500 = (x + 10) \times 3.5 \times 5x$ $0 = x^2 + 10x - 600$ $(x + 30)(x - 20) = 0$ $x = 20, -30$ Number of sports = 20	M/E	Must have an equation. Must have solution interpreted in context.	**EXCELLENCE:** MERIT PLUS code E.
				A1	Solution found to the equation formed.	Replacement evidence for Merit if linear equation formed and solved correctly.
				A2	Algebraic manipulation must be seen given to the equation formed.	

It is not permissible to use one piece of evidence for more than one level of attainment, except that three of code M is sufficient for Achievement with Merit.

Judgement Statement

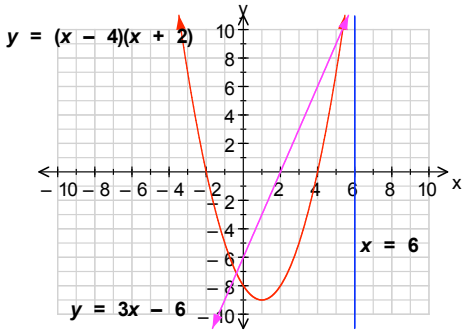
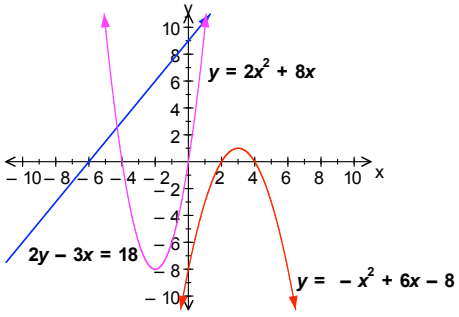
Achievement	Achievement with Merit	Achievement with Excellence
Two of code **A1 and** three of code **A2**	Achieve plus two of code **M** or **three of code M**	Merit plus one of code **E**

Note: Insufficient evidence to support a judgement above **(X)**
A1 Solve equations
A2 Algebraic methods

Assessment Schedule

Mathematics: Sketch and interpret graphs (90148)

TOUCH FOOTBALL

	Achievement Criteria	No.	Code	Evidence	Judgement	Sufficiency
Achievement	Sketch, and interpret features of, graphs.	1(a) 1(b) 1(c)	AG AG AG		(a) Vertical line *x* intercept (6,0) (b) Parabola must be a smooth curve. Intercepts within ±0.2. Turning point to the right of the *y*-axis. (c) Straight line through (0,–6) and (2,0).	**Two** of code AG **plus** **two** of code AI.
		2(a)	AI	$1.40		
		2(b)	AI	$30		
		2(c)	AI	50 km	Units not required.	
Achievement with Merit	Sketch, and interpret features of, graphs.	2(d)	MQ	$y = 0.8x + 30$	Or equivalent use of other letters allowable.	**Achievement** **plus** **two** code EQ **plus** **two** code MG **plus** **two** code MI **OR** **three** code EQ **plus** **three** code MG **plus** **three** code MI. Q4 can be used as replacement evidence for AG.
		3(a)	MQ	$y = -\frac{2}{5}x + 2$	Or equivalent.	
		3(b)	MQ	$y = \frac{1}{2}x - 8$	Or equivalent.	
	Write equations for linear graphs.	4(a) 4(b) 4(c)	MG MG MG		(a) Straight line through (–6.0) and (0,9). Parabolas must be smooth curves. (b) *y* intercept (0,–8), *x* intercepts (2,0) and (4,0). Intercepts within ± 0.2. Turning point at (1,1). (c) *x* intercepts (–4,0) and (0,0). Intercepts within ± 0.2. Turning point at (–2,–8).	
		5(a)	AI/MI	16 m		Q5 can be used as replacement evidence for AI.
		5(b)	AI/MI	3.2 m		
		5(c)	AI/MI	3 m	Units not required.	

Achievement with Excellence	Determine and apply an appropriate model for a situation involving graphs.	6	E	$h = -\frac{1}{36}d^2 + 4$ $h = -\frac{1}{36}(d+12)(d-12)$ $h = \frac{1}{36}(d+12)(12-d)$ Solve $\frac{-d^2}{36} + 4 = 2.2$ $d = 8.05$, so Jim cannot reach the ball as he is too close to Lea **Or** Substitute $d = 7$ into $h = \frac{-d^2}{36} + 4$ and get 2.64, so not able to reach.	Must have equation. Must have a value. Must have an interpretation. Use of other letters acceptable.	**Merit** plus code E. Q6 can be used as replacement evidence for MQ or MI.

Note: it is not permissible to use any piece of evidence for more than one level of attainment, except that all questions correct for Merit is sufficient for the award of a Merit grade.

Assessment Schedule

Mathematics: Solve straightforward number problems in context (90151)

OLYMPIC GAMES

	Achievement Criteria	No.	Code	Evidence	Judgement	Sufficiency
Achievement	Solve straightforward number problems in context.	1	A	525.4 g	Units not required throughout the assessment.	**Three** Code A.
		2	A	1335.71429% 1335 and 1336 okay	Accept any correct rounding/truncating.	Further evidence can be found in Q 4, 5, 6 & 7.
		3(a)	A	$\frac{1}{10}$ or 0.1 or 10%	Or any equivalent fraction.	
		3(b)	A	419 (419.328)	Must be a whole number.	
Achievement with Merit	Solve number problems in context involving manipulation, several steps or reversing processes.	4	A/M	24.5927%	Accept any correct rounding/truncating to 3 sf.	**Achievement plus two** Code M **OR three** of code **M.**
		5	A/M	37 000	Must be a whole number.	Further evidence can be found in Q7.
		6	A/M	$168.75	Accept any correct rounding/truncating to a money value.	
Achievement with Excellence	Devise a strategy and solve a number problem.	7	E	See table below. So Daisy will have saved enough.	Must have logical communication. A single minor omission is acceptable. $ sign used at least once.	**Merit** plus E.
			A	(for increasing by a percentage – only 8.5%)	The majority of mathematical statements must be correct. Decision made.	

Answers starting with $0 in the account and starting with $40 in the account. Both are acceptable.

Year	Start ($)	End ($)	Average ($)	Interest ($)	Total ($)
2005	0	2080	1040.00	0.085 × 1040 = 88.40	2168.40
2006	2168.40	2168.40 + 2080 = 4248.40	3208.40	0.085 × 3208.40 = 272.71	4521.11
2007	4521.11	4521.11 + 2080 = 6601.11	5561.11	0.085 × 5561.11 = 472.69	7073.80

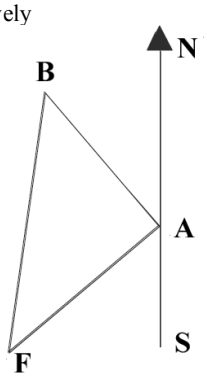
Year	Start ($)	End ($)	Average ($)	Interest ($)	Total ($)
2005	40	2080	1060.00	0.085 × 1060 = 90.10	2170.10
2006	2170.10	2170.10 + 2080 = 4250.10	3210.10	0.085 × 3210.10 = 272.86	4522.96
2007	4522.96	4522.96 + 2080 = 6602.96	5562.96	0.085 × 5562.96 =472.85	7075.81

It is not permissible to use one piece of evidence for more than one level of attainment, except that three of code M is sufficient for Achievement with Merit.

Assessment Schedule

Mathematics: Solve right-angled triangle problems (90152)

THE ADVENTURE PLAYGROUND

	Achievement Criteria	No.	Code	Evidence	Judgement	Sufficiency
Achievement	Solve right-angled triangle problems.	1 2(a) 2(b) 2(c)	AP AP AT AT	25.2 m 2.06 m 47.3^{o} 3.79 m	Any correct rounding/truncating. Any correct rounding/truncating. Any correct rounding/truncating. Any correct rounding/truncating.	**Three** Code A (at least one of AP and one of AT). Further evidence can be found in Q2(d), 3, 4.
Achievement with Merit	Solve problems in practical situations involving right-angled triangles.	2(d) 3(a) 3(b)	AT/M AP/M AT/M	11.5 m 848 m 237	Any correct rounding/truncating. Any correct rounding/truncating. Any correct rounding/truncating.	**Achievement plus two code** M **OR three code M.** Further evidence can be found in Q4.
Achievement with Excellence	Solve problems in word or 3D situations.	4	AT AT M AP AT AP E (entire question)	Northing from Turn 1 to Turn 2 is 250 cos 51° = 157 m. Westing from Turn 1 to Turn 2 is 250 sin 51° = 194 m. So grid reference of Turn 2 is 437763. Length of Leg 3 = 648 m. Total distance is 1498 m, which is very close to 1500 m. Alternatively  $\angle SAF = \tan^{-1}\left(\frac{380}{444}\right) = 39.3^{\circ}$ $\angle NAB = 51^{\circ}$ $\angle FAB = 89.7 \approx 90^{\circ}$ $BF = 650$ m Total course is approx. 1500 m since BAF is not exactly a right angle.	Majority of mathematical statements correct. Rounding/truncating should be correct and sensible in the majority of cases. Units should be given at least once. Candidates are not required to give the Turn 2 grid reference. Other methods are acceptable. A decision must be given together with evidence of working. It cannot be assumed that the angle at Turn 2 is a right angle. This must be proved.	**Merit** plus E.

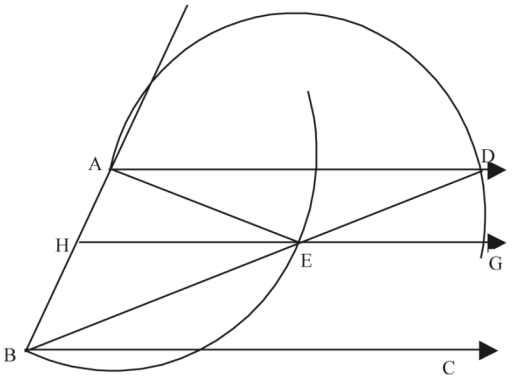
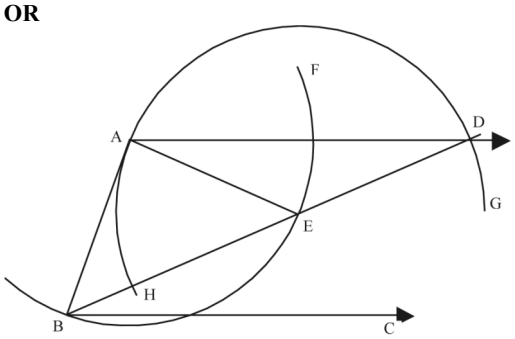
Note: It is not permissible to use any piece of evidence for more than one level of attainment, except that three of code M is sufficient for Achievement with Merit.

Assessment Schedule

Mathematics: Use geometric reasoning to solve problems (90153)

PLAYGROUND MATHEMATICS

	Achievement Criteria	No.	Code	Evidence	Judgement	Sufficiency
Achievement	Use geometric reasoning to solve problems.	1 2 3	A A A	∠BCD = 55° ∠AED = 160° ∠BAC = 75°	A correct value together with a correct chain of reasoning may be used as replacement evidence for Q4 only.	**Two of Code A.** Further evidence for **Achievement** can be obtained from Questions 4, 5, 6.
Achievement with Merit	Use, and state, geometric reasons in solving problems.	4	A/M	∠ABC = 108° Interior angle of a regular pentagon. ∠GBF = 108° Vertically opposite angle. **OR** ∠GBC = 72° Exterior angle of a regular pentagon. ∠GBF = 108° Adjacent angles on a line are supplementary. [Or Adjacent angles.]	**Throughout merit:** • allow other valid chains of reasoning. • reasons may be combined into one statement, eg base angles and angle sum of the isosceles triangle. • A is for the correct angle without the chain of reasoning.	**Achievement plus two** of code M **OR** **three** of code M. Further evidence for **Merit** can be gained from Q6.
		5(a)	A/M	∠ABD = 90° Angle in a semicircle. ∠DFA = 130° Exterior ∠ of Δ = sum of interior opposites. Δ AFD is isosceles – [symmetry of diagram.] ∠CAD = 25° [Base angles isosceles triangle.] {Isosceles needs to be mentioned in this part.}		
		5(b)	A/M	∠JIK = 58° Base angles isosceles Δ. ∠IKJ = 64° Angle sum of Δ. ∠HKG = 64° Symmetry. ∠HKI = 52° Angles on a line. **OR** ∠JIK = 58° Base angles isosceles Δ. ∠HIJ = 132° Co-interior angles. ∠IHK = ∠HIK = 64° Base angles isosceles triangle. ∠HKI = 52° Angle sum of triangle.		

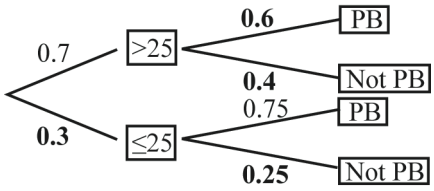
Achievement with Excellence	Solve an extended geometrical problem.	6	A/M/E	Let ∠EBC = α ∠ADE = α Alternate angles, parallel lines. ∠DAE = α Base angles isosceles triangle. ∠AEB = 2α Exterior angle of triangle = sum of interior opposites. ∠ABE = 2α Base angles isosceles triangle. Therefore ∠ABE = 2 × ∠CBE. **OR**  Draw a line HE through E // BC. Let ∠EBC = α ∠HEB = α Alternate angles // lines. ∠ADE = α Alternate angles // lines. ∠EAD = α Base angles isosceles triangle. ∠AEH = α Alternate angles // lines. ∠ABE = ∠AEB = 2α Base angles isosceles triangle. So ∠ABE is twice ∠CBE. **OR**  Let the circle centre E cut BE at H. Let ∠CBE = α. ∠ADE = α Alternate angles // lines. Then ∠AEH = 2α Angle at the centre is twice the angle at the circumference. ∠ABE = 2α Base angles isosceles triangle. So ∠ABE is twice ∠CBE.	Allow other valid proofs. Allow definition on diagram. A is for a complete chain of angles that uses numeric values. M is for a chain of reasoning that uses numeric values with at most one reason missing.	**Merit** plus Code E.

It is not permissible to use one piece of evidence for more than one level of attainment, except that three of code M is sufficient for Achievement with Merit.

Assessment Schedule

Mathematics: Determine probabilities (90194)

GO FOR GOLD

	Criteria	Question	Code	Evidence	Judgement	Sufficiency
Achievement	Determine probabilities	1(a) 1(b) 2(a) 2(b)	A A A A	$\frac{30}{71} = 0.422535$ (6 sf) $\frac{17}{30} = 0.566667$ (6 sf) $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4} = 0.25$ $\frac{1}{16} + \frac{1}{16} + \frac{1}{4} = \frac{3}{8} = 0.375$	Allow equivalent fractions, decimals, or percentages with any rounding or truncation. Accept CAO. Accept ratio if correct 30:41, 17:13, 1:3, 3:5 or equivalent.	**Achievement:** **Three** of Code A *Replacement evidence can be found in questions 3 or 4.*
Achievement with Merit	Solve probability problems using theoretical methods.	3 3(a) 3(b) 3(c)	 A/M A/M A/M	 $0.7 \times 0.6 = 0.42$ $0.3 \times 0.75 + 0.7 \times 0.6 = 0.645$ $0.75 \times \frac{1}{3} = \frac{1}{4}$	Allow equivalent fractions, decimals, or percentages with any rounding or truncation. Accept CAO but 3(b) must have at least 2 significant figures.	**Merit:** Achievement **plus** **two** of Code M, **OR** **three** of code M. *Replacement evidence can be found in Question 4.*
Achievement with Excellence	Explore probability situations to solve problems.	4	 A/M E	A → In Backstroke final. R → In Breaststroke final. U → In Butterfly final. P(A) = 0.18. P(R) = 0.1. P(U) = 0.28. Require P(ARU) + P(ARU′) + P(AR′U) + P(A′RU) = 0.00504 + 0.01296 + 0.04536 + 0.02296 = 0.08632.	Decision supported by diagram, explanation or calculations of the probabilities involved. Allow 1 minor error in solving the problem. The A /M is for any one of the 4 elements in the problem, provided that a calculation is completed. It may only be credited once.	**Excellence:** Merit **plus** **Code E.**

It is not permissible to use one piece of evidence for more than one level of attainment, except that three of code M is sufficient for Achievement with Merit.