NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2, 2003

Physics: Demonstrate understanding of mechanics (90255)

National Statistics

Assessment Report

Assessment Schedule

Physics: Demonstrate understanding of mechanics (90255)

National Statistics

Number of Results	Percentage achieved			
	Not Achieved	Achieved	Merit	Excellence
9,114	13.7%	68.3%	14.1%	3.9%

Assessment Report

General Comments

Every candidate for a National Certificate of Educational Achievement examination paper is expected to:

- read the question and do what the question asks
- allow adequate time to complete answers
- be accurate: check and/or proofread
- use appropriate technical terms
- bring the correct equipment
- write and/or draw clearly
- use pen if work is to be eligible for reconsideration.

Candidates were generally able to *identify or describe aspects of phenomena, concepts or principles* related to sufficient areas of mechanics and thus were able to achieve the standard.

Candidates were generally able to *solve straightforward problems* and to *solve problems* related to mechanics.

Candidates who understood the Physics concept in depth were able to write concise explanations and solve complex problems.

Moderately successful candidates showed that they had a clear understanding of the *difference* between concepts such as force, energy, momentum and power.

Merit requires candidates to *be aware of the appropriate use of significant figures*. Preparation for Level 2 Physics should reflect this.

Merit and Excellence require candidates to write explanations: credit at these levels is not gained by repeating the question nor by merely quoting the name of a law or a principle.

Excellence requires candidates to combine two different concepts to solve a complex problem.

Assessment Schedule

Physics: Demonstrate understanding of mechanics (90255)

Evidence Statement

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct provided there is sufficient evidence that the mistake is not due to a lack of understanding of the concepts in Physics.
Such evidence could include the following:

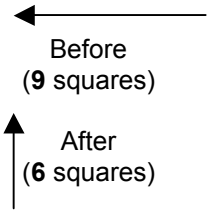
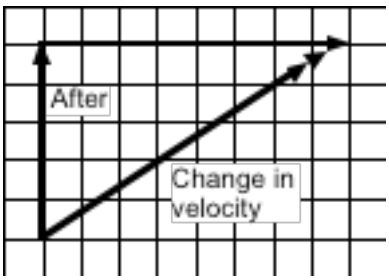
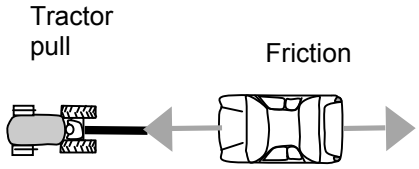
- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct
- numerical data wrongly transferred

Correct units and significant figures are required only in the questions that specifically ask for them {1(e) & 3(d)}.

Italics indicate replacement evidence.

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
Q1				
(a)	$v_{AVG} = \frac{d}{t} = \frac{790}{25}$ $v = 31.6$ $v_{AVG} = 32\ ms^{-1}$	[2] Correct working and answer		
(b)	$E_K = \frac{1}{2}mv^2$ $E_K = \frac{1}{2}1200 \times (26)^2$ $E_K = 405600\ J$ $= 4.1 \times 10^5$ J	[2] Correct working and answer (Standard form not obligatory)		
(c)	$v_f = vi + at$ $v_f = 26 + 1.2 \times 7.2$ $v_f = 34.64$ $v_f = 35\ m\ s^{-1}$	[2] *v_i is taken as zero or 32 [from (a)]*	[2] Correct working and answer	
(d)	$d = v_i t + \frac{1}{2}at^2$ $d = 26 \times 7.2 + \frac{1}{2}1.2 \times 7.2^2$ $d = 187.2 + 31.1$ $d = 218.3$ $d = 220$ m	[2] *Correct substitution but wrong answer* OR *v_i is taken as zero or 32*	[2] Correct working and answer	
(e)	$P = \frac{w}{t}$ and W = F × d $P = \frac{F \times d}{t}$ $P = \frac{400 \times 12.0}{1}\ OR = \frac{400 \times 12 \times 8.0}{8.0}$ $P = 4800\ W$	[2] *Calculation of d = 96 m*	[2] Calculation of work as 400 × 12 × 8 = 38400 J	[2] Correct working and answer for power [Some students learned $P = Fv$ that gives the answer in one step]
unit	watt	[1] watt (accept J s^{-1} or N m s^{-1})		
(f)	The energy is converted to heat because of friction	[1] Mention of heat energy or friction force.	[1] Correct answer, *or* other example of energy conversion if scenario given, eg car goes uphill and gains gravitational potential energy (GPE).	

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
Q2				
(a)	$v = \frac{\pi r}{t}$ $v = \pi \frac{56}{6.77}$		[2] Correct working	
(b)	$F_C = \frac{mv^2}{R} = \frac{1200 \times (26)^2}{56}$ F_C = 14486 $F_C = 1.4 \times 10^4$ N	[2] Correct substitution and correct answer (Standard form not obligatory)		
(c)		[1] Correct direction, pointing towards centre of the semicircle		
(d)	A car in circular motion is always changing direction. In order to change direction, a force perpendicular to the direction of motion is needed (otherwise the car will leave the circular path and travel in a straight line).	*[1] A force is needed to change the direction of the car* *OR* *Without a force the car would travel in a straight line*	[1] Achieved plus reference to centripetal / centrally directed force	[1] Merit plus the direction of the force is perpendicular to the direction of motion resulting in constant speed.
(e)	The car will travel in a straight line (at a tangent) at a constant speed.	[1] Travel along a straight line, or travel at constant speed	[1] Correct answer	
(f)	The car will travel at a tangent (in a straight line) due to lack of a centripetal force, in this case the lack of friction force between the tyre and the road fails to provide the centripetal force. The car will travel at constant speed because there is no resultant force.	*[1] Mention of absence (reduction) of friction* OR *The absence (reduction) of the centripetal force*	[1] The absence of friction or centripetal force is linked to the car travelling in a straight line OR The zero net force is linked to the car travelling at constant speed	[1] The absence of friction causing both the lack of a centripetal force and causing the zero net force are explained.

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
Q3				
(a)		[1] Both vectors are correct, including arrows.		
(b)	 $V_{RtA} = \sqrt{18^2 + 12^2}$ $V_{RtA} = 21.63$ $\theta = \tan^{-1}\left(\frac{18}{12}\right)$ Change in velocity is 22 ms^{-1} at an angle of 56°. Graphical solution acceptable.	[2] *Correct answer of 22 ms^{-1} only* OR *correct diagram* OR *correct angle*	2 *Correct answers of 22 ms^{-1} and 56°, but the direction of the final vector is wrong.*	[2] Correct answers of 22 ms^{-1} and 56°, and the vector showing the change in velocity is in the correct direction.
(c)		[1] Both arrows in correct direction and both labelled appropriately.		
(d)	F = kx = 29500 × 0.085 = 2507.5 = 2510 N	[2] Correct working and answer		
sf	2.5×10^3 N (accept 2500 N)		[1] Two significant figures	

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
(e)	F_{net} = ma = 1 200 × 1.1 = 1 320 N $F_{friction} = F_{pull} - F_{net}$ $F_{friction}$ = 1 650 – 1 320 = 330 N W = F × d = 330 × 36 = 11 880 = 12 000 J OR using the idea of energy Total work W_T = Fd = 1 650 × 36 = 59 400 J Work needed to accelerate W_{acc} = m × a × d = 1 200 × 1.1 × 36 = 47 520 J $W_{friction} = W_T - W_{acc}$ = 11 800 J =12 000 J	[2]*Correct working and answer for unbalanced force* OR [2]*Correct working for total work* OR [2]*Correct working for W_{acc} only*	[2]*Correct working and answer for friction force* OR [2]*Correct working and answer for total work and W_{acc}.*	[2] Merit plus correct working and answer work done OR Logical working and answer

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
Q4				
(a)	P = mv = 1200 × 28	[2] Correct working		
(b)	$p_T = p_A + p_B$ p_T = 1 400 × 21 + 33 600 p_T = 29 400 + 33 600 p_T = 63 000 kg ms^{-1}	[2]P_A calculated correctly but not added to p_B	[2] Correct working and answer	
(c)	$v = \frac{p}{m} = \frac{26\,000}{1200} = 21.67$ = 22 ms^{-1}.	[2] Correct working and answer		
(d)	Momentum lost by car B is gained by car A because there is no external force acting on the cars. Both cars experience an equal, but opposite, force for the same length of time.	[1]*momentum lost = momentum gained* or *there is no external force acting*	[1] Clear statements of momentum lost and gained, and lack of external force is mentioned	[1]Merit plus equal and opposite internal forces

(e)	$\Delta p = p_f - p_i = 26\,000 - 33\,600$ $\Delta p = -7\,600$ kg m s^{-1} Direction is to the right (accept opposite direction or east)	[2] *An answer of 7 600 kg m s^{-1} from 33 600 – 26 000*	[2] Correct working of 26 000 – 33 600 = –7 600 but no statement of direction	[2] Merit plus correct statement for direction
	$\Delta p = F\Delta t$			
	Total opportunities:	Criterion 1: 6 Criterion 2: 7	Criterion 1: 6 Criterion 2: 7	Criterion 1: 3 Criterion 2: 4

Judgement Statement

Judgement statements (formerly referred to as sufficiency statements) help candidates understand how their overall results for each standard were arrived at.

The grade awarded is the highest one that has been demonstrated in all achievement criteria up to and including that grade.

The following is a guide to the standard required for each grade in the two criteria.

Criterion 1

- Achievement is demonstrated if 3 different aspects of phenomena, concepts or principles are identified or described.
- Achievement with Merit is demonstrated if descriptions or explanations show understanding of 5 different phenomena, concepts or principles, including 3 at Merit level or above.
- Achievement with Excellence is demonstrated if Merit has been gained and explanations show clear understanding of 1 phenomenon, concept, principle or relationship at Excellence level.

Criterion 2

- Achievement is demonstrated if 4 different relationships, concepts or principles are used to solve problems.
- Achievement with Merit is demonstrated if 7 different relationships, concepts or principles are used to solve problems in areas that are not straightforward, including 4 at Merit level or above.
- Achievement with Excellence is demonstrated if Merit has been gained and 2 integrations of relationships, concepts or principles lead to the solution of a problem at Excellence level.