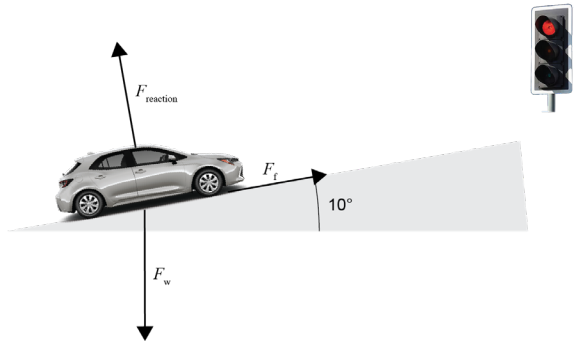
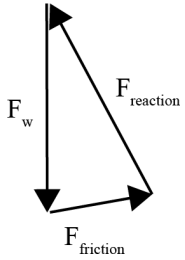
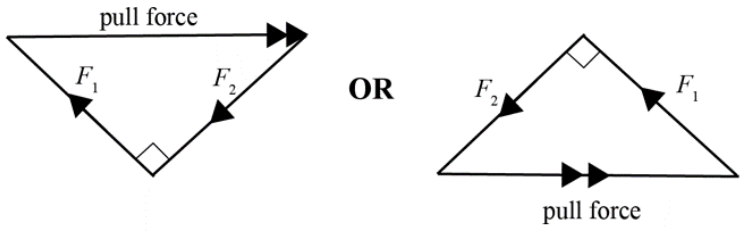
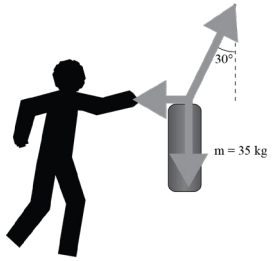
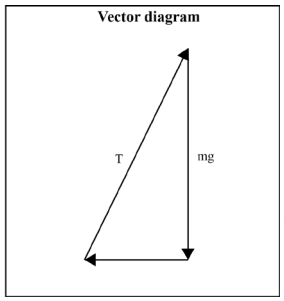
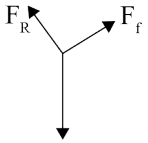
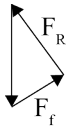
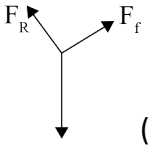
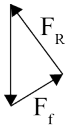
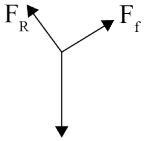
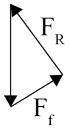
Level 2 Physics: Mechanics – Vectors Answers

Question	Evidence	Achievement	Merit	Excellence
2020(1) (b)(i) (ii)	 	Correct labelled force diagram.	Correct labelled vector diagram with obvious rightangle.	
(c)	$F_w = 1600 \times 9.8 = 15\,680$ N $F_{friction} = F_w \sin 10° = 2722 = 2700$ N	Correct *F*w.	Correct working.	

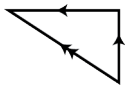
2018 (1) (c)	 **OR** F_1 = 57 N ± 2 N. *Labels on vectors not required. Correct arrows are required*	Diagram drawn correctly OR 57 N ± 2 N.	Correct diagram and to correct scale (F_1 being 57 N and 5.7 cm).	
2014 (1) (c)	v_v = 0 because downward acceleration / force of gravity has slowed the ball to a stop v_H = 12 m s^{-1} (V_H is constant) because there is no horizontal force / gravity does not affect horizontal motion	EITHER BOTH component values correct. OR ONE component value and ONE explanation correct.	BOTH component values and BOTH explanations correct	

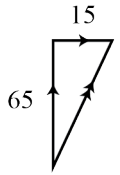
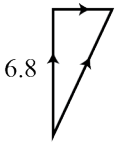
2014(2) (c)	  $\cos 30 = \frac{mg}{T}$ $T = \frac{35 \times 9.8}{\cos 30}$ $T = 396\ \text{N}$	Correct forces – may gain credit from either diagram. (Note that the question does not require labels.) OR Correct mathematical solution.	Correct forces on either diagram AND correct mathematical solution.	

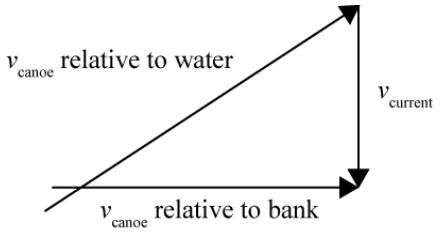
Question	Achievement	Merit	Excellence
2013(1) (d)	ONE OF: Net force = 0. Reaction force acts at 90° to surface. Friction acts upwards along surface.  Closed triangle to show balanced forces with correct labels  	TWO OF: Net force = 0. Reaction force acts at 90° to surface AND Friction acts upwards along surface.  (** No contradictory vectors) Closed triangle to show balanced forces with correct labels  	ALL OF: Net force = 0. Reaction force acts at 90° to surface AND Friction acts upwards along surface.  Closed triangle to show balanced forces with correct labels. Or shows that sum of horizontal and vertical components add to zero. 
2012(4) (a)	$\cos 30° = \frac{F_H}{55}$ $F_H = 55\cos 30$ $F_H = 47.6 = 48 \text{ N}$		

(b)(i)	If the trolley is in equilibrium the net force is zero. OR Forces are balanced. OR Net torque is zero. OR Velocity is constant.	If the trolley is in equilibrium the net force is zero OR Forces are balanced. AND Net torque is zero.	If the trolley is in equilibrium the net force is zero OR Forces are balanced. AND Net torque is zero. AND This means that velocity is constant, or acceleration is zero (NOT v =0).
b(ii)	Force to the right labelled Friction or traction OR Grip OR Thrust. OR Force to the left labelled push force OR similar.	Force to the right labelled Friction or traction OR Grip OR Thrust. AND Force to the left labelled push force OR similar.	

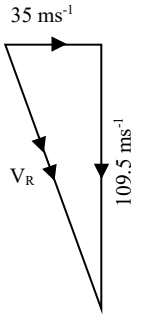
(c)	By decreasing the angle between the handle and the floor.	By decreasing the angle between the handle and the floor. AND This increases the horizontal force.	By decreasing the angle between the handle and the floor. AND This increases the horizontal force causing the horizontal force to become unbalanced. AND This will result in acceleration. ($a = \frac{F}{m}$) and *m* is constant.

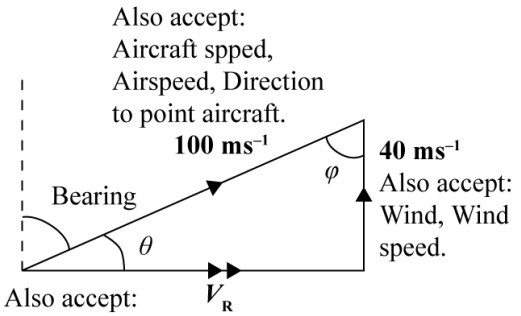
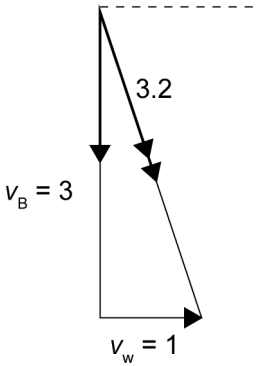
Question	Evidence	Achievement	Merit	Excellence
2011(1) (b)	 ** triangle must have arrows $\Delta v = \sqrt{16.8^2 + 16.8^2}$ $\Delta v = 23.76 \text{ m s}^{-1}$ $\theta = 45^\circ$	[2]Correct diagram. OR Correct answer to change in velocity without direction.	[2]Correct diagram. AND Correct answer to change in velocity without direction/wrong direction. OR incorrect diagram AND correct Δv with wrong direction (consequential to wrong diagram).	[2]Correct diagram. AND Correct answer to change in velocity including direction.

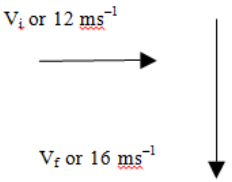
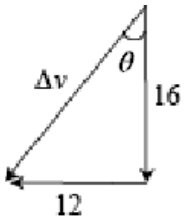
(c)	$t = \frac{d}{v} = \frac{65}{6.8} = 9.6\ \text{s}$ $v_{\text{river}} = \frac{d}{t} = \frac{15}{9.6} = 1.56\ \text{ms}^{-1}$ $v_{\text{boat rel bank}} = \sqrt{6.8^2 + 1.56^2} = 7.0\ \text{ms}^{-1}$  $\theta = \tan^{-1}\ \frac{15}{65}\ = 13°$  $v = \frac{6.8}{\cos 13}$ $v = 7.0\ \text{m s}^{-1}$ (either method acceptable)	[2]Correct labelled diagram. OR Correct time (9.6 s)	[2]Correct answer to direction (13° or 77°). OR Correct answer to speed of river = 1.56 ms^{-1}	[2]Correct answer to relative speed.
2011(3) (a)	Since the force is at an angle and the lawn mower is moving horizontally, only the horizontal component of the force will act to move the lawn mower forward. The vertical component of the force will act into the ground, pushing the lawn mower down.	[1]One point made about either the vertical or horizontal components.	[1]Both points made and explained.	

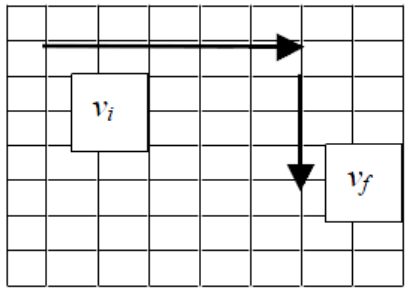
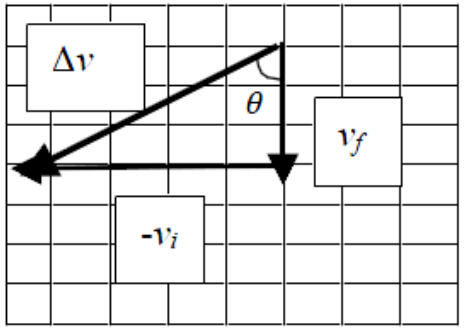
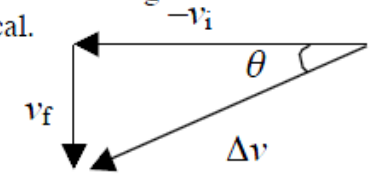
2009(2) (a)		[1]Correct answer.		
(b)	Resultant velocity = $\sqrt{1.39^2 - 0.67^2} = 1.217 ms^{-1}$ $t = \frac{d}{v} = \frac{45}{1.217} = 36.976s$ $= 37s$	[2]Correct resultant velocity. *Consequential marking if they have got the answer to (a) incorrect but have related the use of $t = d / v$ correctly.	[2]Correct answer for time.	
2008(2) (k)	F_h = 95cos45° F_h =67.18 F_{net}= 67.18-35 = 32.18 N $a = \frac{F}{m} = \frac{32.18}{76} = 0.42 \text{ m s}^{-2}$	[2]Calculates the horizontal force component due to rope. OR Incorrectly determines the net force, then goes on to find a = 0.79 m s^{-2}	[2]Correct working and determines the net force.	[2]Correct working and answer.

2007(1) (a)	A projectile has only the force of gravity acting on. An aircraft is powered as it has its own motor and hence is acted on by more than one force. The path of a projectile is a parabola – that of an aircraft need not be so.	[1]Describe the motion of the aircraft or the projectile IN TERMS OF: Force(s) (gravity, thrust, engine force, drag, air resistance, lift, etc) OR Parabolic path shape.	[1]Compares motion of aircraft to motion of projectile with reference to gravity and other force(s) AND Parabolic path.	
(b)	By Principal of Conservation of Energy Total $E_{KV \text{ at bottom}} = E_{P \text{ at top}} + E_{K \text{ horizontal}}$ $½ mv^2_{Total} = mgh + ½ mv_H^2$ $v_{Total} = √ (2gh + v_H^2)$ $v_{Total} = 115 \text{ m s}^{-1}$ OR By Principal of Conservation of Energy VERTICALLY E_{KV} at bottom = E_P at top $v = √2gh = √2 \times 10 \times 600 = 109.54 \text{ ms}^{-1}$ OR VERTICAL velocity when it reaches the ground	[2]Calculated vertical velocity correctly. OR Appropriate vector diagram, with arrows and labels.	[2]Calculated vertical velocity correctly. AND Appropriate vector diagram drawn with arrows and labels. OR Calculates the final speed.	[2]Calculated vertical velocity correctly. AND Appropriate vector diagram drawn with arrows and labels. AND Calculates the final speed.

	$v_f^2 = v_i^2 + 2ad$ $v_f^2 = 0 + 2 \times 10 \times 600$ v_f = 109.54 m s^{-1} vert. down OR VERTICAL velocity when it reaches the ground $d = v_i t + ½ at^2$ hence $t = \sqrt{2 \times 600/10} = 10.954$ s $v_f = v_i + at$ $v_f = 0 - 10 \times 10.95$ v_f = 109.54 m s^{-1} vert. down THEN Horizontal velocity = 35 m s^{-1} Final velocity on reaching the ground = $\sqrt{109.5^2 + 35^2}$ = 114.99 m s^{-1}  			

(c)	 $\theta = \sin^{-1}\left(\frac{40}{100}\right) = 23.58°$ Bearing = 90 – 24 = 66° OR $\varphi = \cos^{-1}\left(\frac{40}{100}\right) = 66.42°$ Bearing = 66°	[1]Vector diagram, with arrows and labels, but misunderstanding of air/ground speed on horizontal.	[1]Appropriate vector diagram drawn with arrows and all correct labels.	
		[2]Any identified angle calculated correctly.	[2]Achieved plus… Bearing correctly shown on diagram or clear from calculation. Doesn't need to be given to 3 figures.	
2006(1) (g)	$\tan \vartheta = \frac{3}{1}$ $\vartheta = 72°$ $v = \sqrt{3.0^2 + 1.0^2}$ $v = 3.2$ m s^{-1} 	[2]Correct diagram must have arrows and labels. OR Speed correctly determined. OR Angle correctly determined	[2]Correct diagram must have arrows and labels. AND Speed AND Angle.	

2005(1) (f)(i)	Two vectors drawn to scale in correct directions.  Horizontal arrow 6 cm (squares) long and vertical arrow 8 cm (squares). Whether they touch or not is irrelevant.	[1]Vectors correctly drawn & labelled with arrows and names or values. (Accept if student has rotated grid through 90˚ ONLY if labelled with correct directions or with a new compass rose).		
(f)(ii)	Vectors drawn thus.  	[2]Correct fully labeled diagram. OR Correct change in velocity. OR Correct angle shown on diagram or given as a bearing or compass direction.	[2]Any TWO correct of velocity, angle or diagram.	[2]Diagram and answers all correct.
(f)(iii)	$\Delta v = \sqrt{16^2 + 12^2} = 20 \text{ m s}^{-1}$			
(f)(iv)	$\tan\theta = \frac{12}{16} = 0.75$ Hence $\theta = 37^\circ$ W of S (bearing 217°)			

2004(4) (a)		[1]Both vectors are the correct length, have arrows in the correct direction and are appropriately labelled.		
(b)		[2]Correct value of 12 m s^{-1} only.	[2]Any two correct of speed, angle and direction.	[2]Diagram and answers all correct.
(i)	$\Delta v = \sqrt{6^2 + 10^2} = 11.66 \text{ m s}^{-1}$ $\theta = \tan^{-1}(\frac{10}{6}) = 59°$ or $31°$	*OR* correct angle (must be shown on diagram unless given as a bearing)		
(ii)	Change in velocity of arrow is 12 m s^{-1} at an angle of 59° from the vertical. 	*OR* correct diagram.		

The Mess that is NCEA Assessment Schedules….

Level 2 Physics: AS 91171 replaced AS 90255.

In 90255, from 2003 to 2011, there was an Evidence column with the correct answer and Achieved, Merit and Excellence columns explaining the required level of performance to get that grade. Each part of the question (row in the Assessment Schedule) contributed a single grade in either Criteria 1 (Explain stuff) or Criteria 2 (Solve stuff). From 2003 to 2008, sometimes the NCEA shaded columns that were not relevant to that question.

In 91171, from 2012 onwards, the answers/required level of performance are now within the Achieved, Merit and Excellence columns. Each part of a question contributes to the overall Grade Score Marking of the question and there are no longer separate criteria. There is no shading anymore. The inconsistency remains. At least their equation editor has stopped displaying random characters over the units.

And in 2013, with 91171, we still have no Evidence column with the correct answer and Achieved, Merit and Excellence columns explaining the required level of performance to get that part – even though the other two Level 2 Physics external examinations do!!.

And now in 2014 and 2015, we have the Evidence column back……