Question Number	Answer		Mark
1(a)(i)	Use of $v^2 = u^2 + 2as$ a = 2.9 (m s^{-2}) Example of calculation $a = \frac{(15\ \text{m s}^{-1})^2 - (0\ \text{m s}^{-1})^2}{2 \times 39\ \text{m}}$ a = 2.88 m s^{-2}	(1) (1)	**2**
1(a)(ii)	Use of $F = ma$ to find a or F Maximum a = 3.2 m s^{-2} **Or** Force in (a)(i) F = 580 N(or 600 N) (3.2 m s^{-2} is the maximum acceleration because) the box must have the same acceleration as the lorry Example of calculation a = 630N/200 kg a = 3.15 m s^{-2}	(1) (1) (1)	**3**
1(b)(i)	$W_{\text{parallel}} = W\sin\theta$ $W_{\text{perpendicular}} = W\cos\theta$ (Accept mg, 200g or 1962 for W)	(1) (1)	**2**
1(b)(ii)	$F = W\sin\theta$ **Or** $F = W_{\text{parallel}}$ **Or** $R = W\cos\theta$ **Or** $R = W_{\text{perpendicular}}$ Substitute $F = 0.32R$ into candidate's equation for F or R Use of $\sin\theta/\cos\theta = \tan\theta$ θ = 18°	(1) (1) (1) (1)	**4**
	Total for question		**11**

Question Number	Answer	Mark
2(a)(i)	State or show $E_p \rightarrow E_k$ (1) $mgh = ½ mv^2$ Or $gh = ½ v^2$ (1) Use of $mgh = ½ mv^2$ Or $gh = ½ v^2$ (1) $v = 3.4$ (m s^{-1}) [no ue] (1) Calculation using $v^2 = u^2 + 2as$ scores 0 marks Use of $g = 10$ N kg^{-1} gives 3.46 m s^{-1}, 3.5 m s^{-1}, max 3 marks Do not credit bald answer (Candidates may calculate in steps using $m = 40$ kg, mark 2 becomes use of $E_p = mgh$ and mark 3 becomes use of $E_k = ½ mv^2$) <u>Example of calculation</u> $E_p = E_k$ $mgh = 1/2\ mv^2$ $gh = 1/2\ v^2$ 9.81 N kg^{-1} x 0.6 m = $1/2\ v^2$ $v = 3.4$ m s^{-1}	**4**
2(a)(ii)	All $E_p \rightarrow E_k$ / no friction/air resistance **/** no stretch of cable / $u = 0$ / no push at start / no energy transferred to other forms (1) (No energy lost is not sufficient.)	**1**
2(b)(i)	Label 2 x tension (T) parallel to cable and **away** from P only (1) Label weight / pull of child / W / mg vertically downward (1) One correct and one incorrect scores 1 mark. Two correct and one incorrect scores 1 mark. Two incorrect scores 0. Ignore unlabelled arrows.	**2**
2(b)(ii)	Use of $W = mg$ (1) Use of correct trigonometrical function (T sin 2 = W/2)(accept with missing factor 2, i.e. T sin 2º = W)(do not accept tan) (accept cos 88)(1) Force = 5600 (N) [no ue] (1) Accept calculation of 11 200 N divided by 2 at the end for full marks only if accompanied by an explanation, such as 'there are two cables' <u>Example of calculation</u> $W = mg$ W = 40 kg x 9.81 N kg^{-1} = 392 N T sin 2º = $W/2$ T = 392 N / 2 x sin 2º T = 5621 N	**3**
	Total for question	**10**

Question Number	Answer	Mark
3(a)	Free body force diagram, arrows must begin at the point shown – including: weight vertical, (W, mg, gravitational force – not 'gravity') friction and/or air resistance parallel to slope upwards, (D, V, F) normal contact force perpendicular to slope upwards. (ncf, N, R) 3 correct forces = 2 marks, 1 or 2 correct forces = 1 mark, Ignore arrows not coming from point Each incorrect force (e.g. pull down slope) decreases the maximum possible number of creditable forces by one Ignore upthrust.	**2**
3(b)(i)	Use of equations of motion sufficient to lead to answer (1) $a = 0.9$ (m s^{-2}) (1) Example of calculation $s = ut + ½ at^2$ 11 m = ½ a x $(4.9s)^2$ $a = 0.92$ m s^{-2}	**2**
3(b) ii)	Use of $F = ma$ (1) F = 36 to 40 N (1) Example of calculation $F = ma$ F = 40 kg x 0.92 m s^{-2} F = 37 N	**2**
3(c)(i)	Use of trigonometrical relationship (200 cos 20º) to resolve force (1) F = 152 N (1) Example of calculation Horizontal component of force = 200 N x cos 20º = 188 N 37 N = 188 N – resistive force resistive force = 151 N	**2**
3(c)(ii)	Use of work = force x distance (1) Use of work / time (1) Power = 420 W (1) For $P = Fv$, Find (or use) ave velocity (1), use of $P = Fv$ (1), correct answer (1) Example of calculation Work = force x distance = 188 N x 11 m = 2070 J Power = work / time = 2070 J / 4.9 s = 422 W	**3**
	Total for question	**11**

Question Number	Answer	Mark
4(a)	What is meant by Newton's first law. reference to constant velocity OR rest and uniform motion in a straight line (1) reference to zero resultant force / unbalanced force (1) (examples: $\Delta v = 0$ if $\Sigma F = 0$; $\Delta v = 0$ unless $\Sigma F \neq 0$)	**2**
4(b) (i)	State 2 ways in which the forces in the pair are identical. 2 of magnitude, type of force, line of action, time of action (1) (1)	**2**
4(b) (ii)	State 2 ways in which the forces in the pair differ. Opposite direction, act on different bodies (1) (1)	**2**
4(b) (iii)	Describe the force that Newton's third law identifies as the pair of this force. car exerts upward/opposite force on Earth (the different points) (1) gravitational and 12 000 N/equal (the identical points) (1) [no ue]	**2**
	Total for question	**8**