Question Number	Answer		Mark
19(a)	Use of $\Delta W = F\,\Delta x$ [allow any dimensionally correct variation, *e.g.* involving trig] $\Delta W = 3.2 \times 10^4$ (J) [do not allow if cos 4° used in MP1, gives 3.217].] Example of calculation $\Delta W = 150\text{ N} \times 215\text{ m} = 3.23 \times 10^4\text{ J}$	**(1)** **(1)**	**2**
19(b)(i)	Use of correct trigonometry to calculate Δh **Or** Use of correct trigonometry to calculate component of g along slope, [61.6 (N)] Use of $\Delta E_{grav} = m\,g\,\Delta h$ [$\Delta E_{grav} = 90\text{ kg} \times 9.81 \times 215\text{ m} \times \sin 4.0°$ scores MP1&2] Total work done = work done against gravity + work done against air resistance Work against air resistance = 2.0×10^4 J (allow ecf from (a)) ["show that" value gives 1.68×10^4 J] Example of calculation $\Delta h = 215\text{ m} \times \sin 4.0° = 15.0\text{ m}$ $\Delta E_{grav} = 90\text{ kg} \times 9.81 \times 15.0 = 1.32 \times 10^4\text{ J}$ $W = 3.20 \times 10^4\text{ J} - 1.32 \times 10^4\text{ J} = 1.88 \times 10^4\text{ J}$	**(1)** **(1)** **(1)** **(1)**	**4**
19(b)(ii)	Force of gravity and air resistance are the only significant forces acting (to oppose the motion of the bicycle) **Or** Frictional forces (in the bearings of the bicycle) are negligible [accept zero, do not accept friction between bicycle and slope/ground] **Or** Work done against frictional forces (in the bearings of the bicycle) is negligible [accept zero]	**(1)**	**1**
19(c)	No work done against (force of) gravity **Or** All work done against air resistance **Or** No backward force due to gravity so resultant force acts Speed increases [MP2 dependent on MP1]	**(1)** **(1)**	**2**
	Total for question 19		**9**