Forces and Motion

1	**(a)**	scalar has magnitude/ size/ value	B1
		vector has direction and magnitude/ size/ value	B1
		(vector has direction and scalar does not: scores ½)	
	(b)	velocity	B1
		momentum	B1
		acceleration	B1
		(-1 for each error and extra quantity given)	
	(c)(i)	6 cos30 = 5.2 (N)	B1
	(ii)	6 sin30 = 3(.0) (N) possible ECF	B1
		(if answers are left not calculated then –1 if answers reversed then –1)	
	(d)(i)	12 N down requires 12 N up / net force vertically is zero / 6 sin30	C1
		(3 N from right string hence) 9 N needed from T	A1
	(ii)	T cos30 = 9 / T = 12 cos30 / or correct triangle of forces used (possible ECF)	C1
		T = 10.4 (N) (Allow ± 0.2N if scale diagram used)	A1
			[11]
2	**(a)**	change of velocity/ change in velocity	M1
		OR equation	M1
		And labels	A1
	(b)(i)	1. Acceleration = 0 – 25 / 60	C1
		= - 0.42 (m s^{-2}) (one mark for correct sign)	A2
		(Do not allow 0.4 or 0.41 (ms^{-2})	
		2. distance is area under graph / = 25 x 60 / 2	C1
		= 750 (m)	A1
	(ii)	distance is area under graph / = 25 x 40 / 2	C1
		= 500 (m)	A1
	(iii)	time taken stopping at station = 60 + 90 + 40	
		= 190 (s)	C1
		distance travelled 1250 (m)	C1
		time taken by non stopping train 1250/25 = 50 (s)	C1
		time lost = 190 – 50	
		= 140 (s)	A1
		alternatives	
		time taken 230/ 240/ 280	C1
		distance travelled 2250/ 2500/ 3500	C1
		time take 90/ 100/ 140	C1
			[13]

3 (a)	density = mass / volume		B1
(b)(i)	density = 45 / 50 x 600 x 600 (x 10^{-9})		C1
	= 2500 and	kgm^{-3}	A1
	(or equivalent answer in kg mm^{-3} or kg cm^{-3})		
(ii)	pressure = force / area		C1
	weight = 45 x 9.8		C1
	area = 600 x 50 (x 10^{-6})		C1
	= 14700 / 15000 (Pa)		A1
	(Bold 15000 (Pa) scores ¾ / Bold 14700 (Pa) scores 4/4)		
(iii)	same area on the ground		B1
	same total weight		B1
	same pressure (therefore same damage/or other suitable comment)		B1
			[10]
4 (a)(i)	speed = 1800 / 65		C1
	= 27.7 ($m\ s^{-1}$) / 28 ($m\ s^{-1}$)		A1
(ii)	loss in potential energy = m x g x h		C1
	= 495000 (J)		A1
(b)(i)	work done = 250 x 1800		C1
	= 450000 (J)		A1
(ii)	**1.** Kinetic energy gained = 495000 – 450000		
	= 45000 (J)		B1
	2. k.e. = ½ mv^2 (allow one mark if seen in 1 or 2) Possible ECF.		C1
	v^2 = 45000 x 9.8 x 2 / 900 (allow g = 10NKg^{-1} here)		C1
	v = 31.3 ($m\ s^{-1}$)		A1
(iii)	greater final speed		M1
	as the skier will also do some work (pushing with poles)		A1
			[12]
5 (a)	point where (all) the weight / mass of the body		M1
	seems appears to act		A1
(b)	force x perpendicular distance		M1
	from the pivot (to the line of action of the force)		A1
	(special case –1 if perpendicular is omitted)		
(c)(i)	two forces correct		B1
	two further forces correct		B1
	(Label can be value or name, position judged by eye.)		

(c)(ii)	moments about P / statement of principle of moments	C1
	50g x 0.2	C1
	8g x 0.5 + 5g x d (ignore g value used or if g is omitted)	C1
	d = 1.2	C1
	hence weight is 0.3 m from B OR: Allow equivalent working backwards	A0
(iii)	move the pivot towards the student or A move the student to the right move the mass to the right increase the value of the mass used increase the weight of the plank increase the strength of the plank increase the length of the plank (any two suitable answers)	M1, M1
	hence a greater moment can be obtained	A1
		[13]
6 (a)(i)	stress = force / (cross sectional) area	B1
(ii)	strain = extension / (original) length	B1
(b) (i)	elastic returns to its original length/shape when the force/load is removed	B1
	plastic does not regain its original length/size when the load is removed (allow ½ if removal of load is not specified but remainder is clear)	B1
(ii)	force/stress/strain/extension beyond which the material does not return to its original length (when the load is removed) (point beyond....scores one only)	B1 B1
(c)(i)	unit: Pa / N m^{-2}	B1
(ii)	Any <u>seven</u> from:	
	• Appropriate arrangement drawn	B1
	• Measure length	B1
	• Apply force and measure the extension	B1
	• Take a series of readings	B1
	• Measure the diameter	B1
	• Graph of stress against strain / force-extension graph	B1
	• Gradient for E / E = stress/strain / Gradient = $EA/_L$	B1
	• Point of detail e.g. second wire, micrometer used for diameter, Vernier for extension, very long wire	B1
		[14]

7 **(a)(i)** thinking distance is distance travelled while the driver is reacting B1

braking distance is the distance the car travels while the brakes are applied B1

(ii) thinking distance: factors which affect the reaction time
e.g. speed of the car, tiredness of driver, alcohol in blood

(do not allow distractions to the driver)

braking distance: factors which affect the braking distance
e.g. road surface, efficiency of the brakes, tyre conditions, speed of car, mass of car

4 points	B4			
Discussion	B2	or	3 points	B3
			Discussion	B3

(b) (i)

- increases time
- decreases deceleration
- reduces force on driver
- increases area
- reduces pressure
- prevents collision with steering wheel/ windscreen

any three points B3

(ii) e.g. crumple zone B1
reduces the force / increasing the impact time / absorbs the energy B1
or seat belt
restraining force/ reduces force / prevents collision with windscreen / increases time for (decleration)
or rigid cage/ structure
does not crumple [13]

QWC 4