Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit ____ = (underlining) key words which **must** be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument	
Question	**Expected Answers**	**Marks**
1 (a)	**Arrows of the correct length ± 2 mm**	**B1**
(b) (i)	**At B: zero / less than / smaller**	**B1**
(ii)	**At C: smaller and opposite / negative direction**	**B1**
(iii)	**At D: same size / no change and no change for all three horizontal components**	**B1**
(c)	**No change in horizontal component since no air resistance / no components of forces in this direction**	**B1**
	At B maximum height (therefore no vertical component)	**B1**
	At C direction of motion has changed / falling back down / vertical component increases as acceleration is vertically down	**B1**
	At D(velocity is same magnitude but opposite direction to starting velocity) ball has accelerated (due to gravity) down to original speed / idea of time or distance down being the same as that going up	**B1**
		Total: 8

Question	Expected Answers	Marks
2 (a) (i)	Braking force is the frictional force applied by the road on the tyre (in the opposite direction to the motion of the vehicle that brings the vehicle to rest)	B1
(ii)	Braking distance is the distance travelled from the time the brakes are applied to when the vehicle <u>stops</u>	B1
(b) (i)	Kinetic energy = ½ m v^2	C1
	= ½ 1380 x $(31.1)^2$	C1
	= 667375 (J) (667 kJ) 6.7 x 10^5 (J)	A1
(ii)	$v^2 = u^2 + 2as$	C1
	$0 = (31.1)^2 + 2 \times a \times 48.2$	A1
	a = 10 .0(3) (m s^{-2})	C1
(iii)	F = ma or work = force x distance = 1380 x 10.03 F = 667375 / 48.2 = 13800 (13846) (N) = 13800 (13846) (N)	A1
		Total: 9

Question	Expected Answers	Marks
3 (a) (i)	Work = force x distance moved / displacement in the direction of the force	B1
(ii)	Power = rate of doing work / work done per unit time	B1
(b)	Watt is the power used when one joule of work is done per second (allow joule / second)	B1
(c) (i)	Tension = Weight / mg	C1
	= 1.5 x 10^3 x 9.8 using g =10 -1	
	= 14700 (N)	A1
(ii)	time = 25 / 1.6 = 15.6 (s)	A1
(iii)	PE = mgh	C1
	PE / t = (14700 x 25) / 15.6 or 14700 x 1.6	C1
	= 24000 (23520) (J s^{-1})	A1
	or power = F x v	C1
	= 14700 x 1.6	C1
	= 24000 (23520) (J s^{-1})	A1
(iv)	(gain in PE per second = output power used to lift weight)	
	power = 24000 (23520) (W) / allow those answers that suggest greater due to friction in lifting mechanism	B1
		Total: 10

Question	Expected Answers	Marks
4 (a) (i)	Moment is the force x the perpendicular distance from (the line of action of) the force to the pivot/ point (missing perpendicular –1, missing from the force to the pivot / point –1)	B2
(ii)	Torque of a couple: one of the forces x perpendicular distance between (the lines of action of) the forces	B1
(b) (i) 1	3600 x 1.0 = X x 2.5 one mark for one correct moment, one mark for the second correct moment and equated to first moment	C2 A0
2	X = 1440 (N) Y = 3600 - 1440 or 3600 x 1.5 = Y x 2.5	C1 A1
(ii)	= 2160 (N)	B1
	Not a couple as forces are not equal and not in opposite directions / the forces are in the same direction	B1 C1
(iii)	P = F / A = 1440 / 2.3 x 10^{-2} = 62609 (6.3 x 10^{4}) unit Pa or N m^{-2}	B1 B1 Total: 12

Question	Expected Answers	Marks
5 (a) (i)	Stress = force / cross-sectional area	B1
(ii)	Strain = extension / original length	B1
(b) (i) 1	Elastic as returns to original length (when load is removed)	B1
2	Hooke's law is obeyed as force is proportional to the extension	B1
	Example of values given in support from table	B1
(ii)	Measure (original) length with a (metre) rule / tape	B1
	Suitable method for measuring the extension eg levelling micrometer and comparison wire or fixed scale plus vernier or travelling microscope and marker / pointer	B1
(iii)	E = stress / strain	C1
	= (25 x 1.72) / (1.8 x 10^{-7} x 1.20 x 10^{-3})	C1
	= 1.99 x 10^{11} (Pa)	A1
		Total: 10

Question	Expected Answers	Marks
6 (a)	At t = 0 / at start velocity is zero as gradient is zero	B1
	The velocity then increases	B1
	As gradient increases	B1
	The velocity is then constant	B1
	As the gradient is constant	B1
	Velocity decreases	B1
	As gradient decreases	B1
	Then velocity is zero	B1
	As gradient is zero	B1
	Increasing velocity / in opposite/ negative direction	B1
	As gradient is negative (and increasing)	B1
	Velocity decreasing	B1
	As gradient is decreasing	B1
	It comes to rest as gradient is zero	B1
		Max 5
(b)	Acceleration is change in velocity divided by time taken	B1
	The velocity can be determined by the gradient of (tangent to curve) graph	B1
	[max of two for explanations]	
	(Gradient is increasing) car is accelerating	B1
	(Then no change in gradient) no acceleration	B1
	Then (velocity decrease) deceleration occurs	B1
	Then (velocity increases) acceleration in opposite direction or deceleration continues	B1
	Then deceleration in original direction (as velocity decreases)	B1
		Max 4
	[max of three for statements]	
	SPAG	B1
	ORGANISATION	B1
		Total: 11