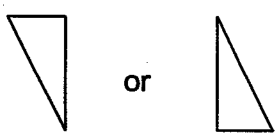
1. (a)(i)		speed is distance per unit time / distance / time	B1
(ii)		velocity is the displacement per unit time / displacement / time	B1
(iii)		speed is a scalar, velocity is a vector	B1
		velocity has a direction	B1
		(speed has magnitude, velocity had magnitude and direction scores 2)	
(b)(i)	1	speed = (40 x π) / (105 x 2)	C1
		= 0.60 (m s^{-1}) allow 1 s.f.	A1
	2	velocity = 40 / 105	C1
		= 0.38 (m s^{-1})	A1
(ii)	1	0.60 (m s^{-1}) allow ecf ((b)(i))	A1
	2	0	A1
		suitable comment for 2 e.g. there is no displacement	B1
(c)		different magnitudes	B1
		different directions	B1
		directions:	
		the average velocity is along the diameter / upwards	B1
		the instantaneous velocity is tangent to the circle / to the left	B1
		magnitudes:	
		instantaneous velocity equals average speed	B1
		average velocity is less as displacement is less	B1
			MAX 3
			TOTAL [14]

2. (a)(i)		vector triangle drawn (with arrows) showing the correct directions	B1
		suitable scale / correct working	B1
		velocity 256 (kmh^{-1}) / 71.1 m s^{-1}	A1
		direction 21° (west of north) (20.5) / 339	A1
		if scale diagram used:	
		(allow velocity of 240 to 270 and angle of 19 to 22)	



(ii)	1	40 (km)	A1
	2	15 (km)	A1
			TOTAL [6]

3. (a)	rate of change of velocity / change in velocity per unit time		A1
(b)(i)	correct velocity read from graph (18)		C1
	acceleration = (18 – 0) / 10 = 1.8 (m s^{-2})		A1
(ii)	force	= ma	
		= 105000 x 1.8	C1
		= 189000 N	A1
(iii)	area under the graph (maybe implied from calculations)		C1
	(treated as two triangles and a rectangle) areas = 90 + 2160 + 180		C1
	distance = 2430 m		A1
(c)	P = Fv F = 225 x 10^3 / 18		C1
		12500 (N)	A1
(d)	frictional force increase with speed		B1
	resultant force is zero / acceleration is zero		B1
	OR friction forces oppose / act against the driving force		B1
	these forces are equal		B1
			MAX 2
			TOTAL [12]

4. (a)	density = mass / volume		B1
(b)(i)	(volume = 80 x 1.2)		
	mass	= 80 x 1.2 x 1000	C1
	weight	= 80 x 1.2 x 1000 x 9.8	C1
		= 9.4 x 10^5 (N)	A0
(ii)	P = W / 80 or 9.4 x 10^5 / 80 or P = F / A		C1
	P = 1.18 x 10^4 unit: Pa or Nm^{-2}		A1
(c)	same pressure / or correct calculation of the pressure		B1
	as the water is the same depth / pressure does not depend on area (or the correct calculation of the pressure)		B1
			TOTAL [8]

5. (a)(i)	horizontal distance = (4.0 x 20)		
	= 80 (m)		A1
(ii)	vertical fall: $s = ut + ½ at^2$		C1
	$= 0 + 0.5 \times 9.8\ (4.0)^2$		C1
	= 78 (m)		A1
(iii)	horizontal component = 20 (m s^{-1})		A1
(iv)	vertical component: $v = u + at$		
	$= 0 + 9.8 \times 4$		C1
	= 39 (m s^1)		A1
(b)(i)	friction/air resistance		
	lift		
	weight / force due to gravity	**any 2**	B2
(ii)	(gravitational) potential		B1
	converted to kinetic energy		B1
	and thermal energy / heat / work done against friction		B1
	two methods and two explanations		
	or four methods		
	e.g. increase speed down runway		
	larger surface area of skis		
	point skis upwards		
	lie as flat as possible / streamlining		B4
			TOTAL [16]
6. (a)(i)	force x perpendicular distance from the force to the pivot / point		B2
	force x distance from pivot / point scores one		
(ii)	(one) force x (perpendicular) distance between the forces		B1
(b)(i)	couple = 25 x 0.3		
	= 7.5		B1
	unit: Nm (consistent with working)		B1
(ii)	(resultant force is zero) resultant turning effect is not zero / there is a clockwise movement		B1
	not in equilibrium		B1
			TOTAL [7]

7. (a)	stress/ strain	M1
	with qualification e.g. elastic limit, within limit of proportionality tensile stress, tensile strain, Hooke's law obeyed	A1
(b)(i)	$e/l = 0.55 \times 10^{-3} / 1.8$	C1
	$= 3.1 \times 10^{-4}$ (3.056)	
(ii)	$E = F \times l / A \times e$	
	$F = 2 \times 10^{11} \times 3.1 \times 10^{-4} \times 1.2 \times 10^{-7}$	C1
	$F = 7.33$ (N)	A1
(c)(i)	E is half therefore e will be twice	C1
	e = 1.1 (mm)	A1
	(or suitable calculation)	
(ii)	limit of proportionality not exceeded / elastic limit is not exceeded / temperature of wires the same / Hooke's law applies	B1
8. (a)(i)	thinking distance = 25 x 0.65 = 16(.25)	C1
	stopping distance = 40 + 16.25 = 56(.25) (m)	A1
(ii)	$Ke = ½ \times 800 (25)^2$	C1
	$= 250 \times 10^3$ (J)	A1
(iii)	work done (by braking force) = loss in Ke / $(25)^2 = 0 + 2a \times 40$	C1
	F x 40 = 250000 / a = 7.81	C1
	F = 6250 (N)	A1
(b)(i)	less friction force	B1
	hence less deceleration / greater stopping distance	B1
(ii)	reduced tread gives less friction due to water layer	
	OR tread required to remove layer of water	M1
	consistent effect on stopping distance or acceleration	A1
(iii)	gravitational potential energy converts to Ke	B1
	total Ke is greater	B1
	(for same braking force) distance will increase	B1
	OR terms of forces:	
	Force acts down slope / component of weight acts down slope	B1
	less opposing force / resultant force / less deceleration	B1
	distance increases	B1

TOTAL [14]

QWC 4

TOTAL [90]