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Question	**Expected Answers**			**Marks**
1 (a)(i)	**energy, power and speed underlined** **any error loses this mark**			**B1**
(ii)	**vector has magnitude / size** **vector has a direction**			**B1** **B1**
(b)	**Scale diagram:** **correct triangle / parallelogram drawn on Fig. 1.1** **scale stated and correct resultant arrow** **resultant force 25 to 26 (N)** **resultant force 24 to 27 (N)** **Value calculated:** **correct triangle drawn** **correct triangle labelled (arrows and labels which includes the resultant with an arrow in the correct direction)** **valid method of calculation: (e.g. cosine rule) / resolve into horizontal (12 + 16cos50) and vertical (16sin50) components and use of Pythagoras** **25.(4) (N)**			**M1** **A1** **B2** **B1** **M1** **A1** **C1** **A1** **Total: 7**

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Question	**Expected Answers**			**Marks**
2 (a)(i)	**$v^2 = 0 + 2 \times 9.8(1) \times 30$**			**C1**
	$v = 24.\ (3)$ $(m\ s^{-1})$ **(-1 if g = 10 is used ,once only on the paper)** **(zero scored if s = 36 m is used)**			**A1**
(ii)	**$s = ut + ½\ at^2$ or $v = u + at$ or $s = (u+v)t / 2$**			
	$30 = 0 + ½ \times 9.8(1) \times t^2$ $t = 24.3 / 9.8$ $t = 2 \times 30/24.3$			**C1**
	$t = 2.5$ (s)			**A1**
(b)	**In the air: weight / force due to gravity** **(allow air resistance if included as well)**			**B1**
	(Hence) constant acceleration / acceleration at 9.8 $m\ s^{-2}$ **(allow reduced acceleration / terminal velocity if air resistance included)**			**B1**
	In water: weight and (large) fluid resistance / upthrust / buoyancy			**B1**
	Hence deceleration / slows down			**B1**
				Total: 8

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Question	**Expected Answers**			**Marks**
3 (a)(i)	**V_h = 10 cos 53**			**B1**
	= 6.0(18) m s^{-1})			**A0**
(ii)	**speed = distance / time**			**C1**
	time = 4.9 / 6.0			
	= 0.8(2) (s)			**A1**
(iii)	**gain in potential energy = mgh**			**C1**
	= 50 x 10^{-3} x 9.8(1) x 3.3			**C1**
	= 1.6(2) (J)			**A1**
(b)(i)	**change in velocity = (-) 10 (m s^{-1})**			**B1**
	acceleration = (v – u) / t / 10 / 0.16			
	= 62.5			**A1**
	unit: m s^{-2}			**B1**
(ii)	**F = ma**			**C1**
	= 50 x 10^{-3} x 62.5			
	= 3.1(3) (N)			**A1**
	direction: left			**B1**
(iii)	**kinetic energy = ½ m v^2**			**C1**
	loss in kinetic energy = ½ x 50 x 10^{-3} (4^2 – 6^2)			**C1**
	= 0.5(0) (J)			**A1**
				Total: 15

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Question	**Expected Answers**			**Marks**
4 (a) (i)	**(one of the) force x perpendicular distance between the forces**			**B1**
(ii)	**torque = 1200 x 0.4**			**C1**
	= 480 Nm **[allow one mark for 1200 x 0.2 = 240 (N m)]**			**A1**
(b)(i)	**work = force x distance (moved)**			**B1**
	= 2 x 1200 x 2 x π x 0.2			**B1**
	= 3016 (J)			**A0**
(ii)	**power = work done / time**			**C1**
	= 3000 / (1/40)			
	= 1.2 x 10^5 (W)			**A1**
				Total: 7

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Question	**Expected Answers**			**Marks**
5 (a)	**One reading from the graph e.g. 1.0 N causes 7 mm**			**C1**
	Hence 5.0 (N) causes 35 ± 0.5 (mm) **(allow one mark for 35 ± 1 (mm)**			**A1**
(b) (i)	**Force on each spring is 2.5 (N)**			**C1**
	extension = 17.5 (mm) allow 18 (mm) or reading from graph **[allow ecf from (a)]**			**A1**
(ii)	**strain energy = area under graph / ½ F x e**			**C1**
	= 2 x 0.5 x 2.5 x 17.5 x 10^{-3}			
	= 0.044 (J) **[allow ecf from (b)(i)]**			**A1**
(c)	**E = stress / strain**			**C1**
	Stress = force / area and strain = extension / length			**C1**
	extension = (F x L) / (A x E)			
	= (5 x 0.4) / (2 x 10^{-7} x 2 x 10^{11})			
	= 5.(0) x 10^{-5} (m)			**A1**
(d)	**strain <u>energy</u> is larger in the spring**			**B1**
	extension is (very much larger) (for the same force) for the spring			**B1**
				Total: 11

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Question	**Expected Answers**			**Marks**
6 (a)	**Tyre exerts downward force on the road which is balanced by an upward force from the road** **Engine / car generates a torque on the wheels / or axle / force turns the wheels** **Tyre pushes back on the road** **Road pushes tyre forwards / in opposite direction (by Newton's third law)** **Brakes generate a torque on the wheels** **Tyres exert a force on the road in the same direction as the motion** **Push from road on tyres is in the opposite direction to the motion** **[Max of three marks for either engine or brakes explanation and one mark for indicating the other is then the reverse argument]** **Motive / braking force between the tyre and the road is friction** **The greater the friction the greater the acceleration / deceleration** **The greater the engine motive force / torque supplied the greater the acceleration or the greater the braking force greater the deceleration**			**Max 5**

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Question	**Expected Answers**			**Marks**
6 (b)	**Definition of braking distance [the distance a car travels after the brakes are applied until it comes to rest]** **Greater the speed the greater the b. d. plus explanation** **Poor brake pads / discs greater the b. d. plus explanation** **Road conditions given to suggest reduced / greater friction plus explanation e.g. ice / wet and the appropriate effect on b. d.** **tyre tread example and effect on b. d.** **plus explanation e.g. tyre tread and the effect on channelling water away.** **Greater mass plus explanation and effect on b.d.** **Gradient of road plus explanation and effect on b.d.** **2/3 factors unexplained can score 1**			
QWC	**≥4 factors unexplained can score 2**			**Max 5**
	SPAG **TECHNICAL**			**B1** **B1**
				Total: 12