

- 1 (a) (The point in the body) where (all) the mass / weight / gravity acts / appears to act (owtte) B1
- (b) h is the height through which the centre of mass/rises
OR centre of mass/rises (much) less than 2.0 m
- OR centre of mass/of athlete is above the ground level
OR centre of mass/gravity passes under bar B1
- Allow centre of gravity in place of centre of mass
- (c) Standing: has chemical energy B1
Run-up: kinetic energy gained B1
Pole bent: has strain / elastic energy B1
Rise: potential energy gained B1
Fall: kinetic energy gained B1
On mat: has thermal / heat / sound / strain / elastic energy B1 [8]
- 2 (a) 54 N *Unit penalty applies B1
- (b) (i) (the point where) proportionality between force/weight and extension/Hooke's Law stops B1
- (ii) 35 – 20 or 15 (cm) or 25 – 20 or 5 (cm) C1
(F =) kx or $54/15 \times 5$ or $54/15$ or $5/15$ from 2(a) C1
18 N *Unit penalty applies ecf from 2(a) A1
54 – 18 or 36 or 5.4 – 1.8 ecf from 2(b)(ii)1. C1
3.6 kg *Unit penalty applies ecf from 2(b)(ii)1. A1
- (iii) $(\rho =)m/V$ or $3.6/0.0045$ ecf from 2(b)(ii)2. C1
 800 kg/m^3 *Unit penalty applies ecf from 2(b)(ii)2. A1
- (c) air molecules further apart or oil molecules closer together B1 [10]
- *Apply unit penalty once onl

- 3 (a) $\frac{mg}{650\text{N}}$ in any form C1
A1
- (b) gravitational / attractive and the Earth B1
- (c) **c)** 65 kg B1
- (ii) 104 OR 100 N ecf **(i)** B1 [5]
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- 4 **(a)** racing car + 1 correct reason M1
2nd correct reason A1
correct reasons:
 - wider (car)
 - lower (centre of mass/gravity) NOT wider tyre/surfaces o.w.t.t.e.
- (b)** larger/wider tyres/area (of contact) ignore base area B1
- (c)** F/A OR $9600/0.012$ OR $9600/0.048$ OR $9600/(4 \times 0.012)$
OR 800,000 C1
 2×10^5 Pa OR 200 000 Pa (accept N/m^2) c.a.o. A1

[Total: 5]

5	(a)	force of gravity on a mass or mg mass/volume	B1 B1	[2]
	(b) (i)	hang object from spring balance, reading in N taken divide reading in N by 10 or g	B1 B1	
	(iii)	volume of water in cylinder or fill overflow can to top add object find increase in volume or measure overflow volume {no credit for mass unless not scored in (i) and no credit for density = mass/ volume unless not scored in a) }	B1 B1	[4]
	(c)	2N left	B1 B1	
	(ii)	$F = ma$ or $2 = 0.5 a$ $a = 4.0 \text{ m/s}^2$	C1 A1	[4]
				Total [10]

6	(a)	750 N	A1	
	(b)	p.e. lost / converted = mgh or weight x height 750×15 or $75 \times 10 \times 15 = 11250 \text{ (J)}$ p.e. lost = k.e. gained = 11250 (C1 C1 A1	3
	(c)	Any 3 of: heat in water / rock (kinetic) energy of (moved) water / to make water move/ make waves some k.e. still in (sinking) rock sound energy on impact / of splash	B3	3
		(just heat and sound C1)		[7]