Moments 2 - Answers

1.

(a)		the point (in a body) ✓ where the weight (or gravity) of the object appears to act [or resultant torque zero] ✓	**2**
(b)	(i)	$P \times 0.90 = 160 \times 0.50$ ✓ $P = 89\,\text{N}$ ✓ (88.9 N)	**3**
	(ii)	$Q = (160 - 89) = 71\,\text{N}$ ✓ (allow C.E. for value of P from (i))	
(c)		(minimum) force $\times$ 0.10 = 160 $\times$ 0.40 ✓ force = 640 N ✓	**2**
(d)		force is less ✓ because distance to pivot is larger ✓ smaller force gives large enough moment ✓	**3**

2.

(a)	(i)	force × perpendicular distance ✓ between line of action of force and the point ✓	**2**
(a)	(ii)	rear ✓ at rear + idea that centre of mass is closer to the rear wheel (than to the front wheel) ✓	**2**
(a)	(iii)	14000 × 1.4 = F × 2.5 ✓ F = 7840 (N) ✓ divides their final answer by 2 ✓ = 3900 (N) ✓ (3922)	**4**
(b)		$(F = k\Delta l)\frac{F}{k}$ or $(\Delta l =)$ $\frac{\text{a(iii)}}{100000}$ ✓ = 0.039 (m) ✓ ecf	**2**
(c)		F = (100000 × 0.065 =) 6500 (N) ✓ F = (2 × 6500) = 13000 (N) ✓	**2**

3.

(a)	(sum of) clockwise moments (about a point) =(sum of) anticlockwise moments ✓ (for a system) in equilibrium ✓ accept *balanced* not *stationary*	**2**
(b)	(780 × 0.35 =) 270 (Nm) ✓ (273) **Nm** ✓ or newton metre(s) accept Newton metre(s) (not J, nm or nM, Nms, etc)	**2**
(c)	1 (b) + (1100 x 0.60) ✓ (=) F_A × 1.3 ✓ (F_A = 660 + 273/1.3 gets both marks) (= 933/1.3) = 720 (N) ✓ (717.7 or 715 for use of 930) ecf 1 (b) **2 sf only** ✓ independent mark	**4**
(d)	(780 +1100 – (1(c)) = 1200 ✓ (1162 N) ecf 1 (c)	**1**
(e)	$\left(F = \frac{P}{v}\right) = \frac{7.5\,(\times 10^3)}{26}$ ✓ must be arranged in this form = 290 (N) ✓ (288.46)	**2**

4.

(a)(i)	moment: force x perpendicular distance to the pivot / axis / point	B1
(ii)	for equilibrium / balanced the sum of the clockwise moments about a pivot is equal to the sum of anticlockwise moments (about the same pivot/axis/point) (clockwise moments equal the anticlockwise moments scores one only)	B2
(b)(i)	total mass = (1000 + 250) / 9.81 = (127.42) or (127.55 if 9.8 used) (allow one mark for the individual masses being calculated)	C1
	volume = 2 x 3.5 x 10^{-2} = (7.0 x 10^{-2})	C1
	density = mass / volume = 127.42 / (7.0 x 10^{-2})	M1
	hence density = 1820 (kgm^{-3}) (1822 using 9.8)	A0
(c)(i)	moments about P (or other named and suitable point)	B1
	1000 x 0.2 = 200 or equivalent moment	C1
	equals 250 x 0.8 = 200 or equivalent moment	C1
	hence P is 0.4 + 0.8 = 1.2 m from B	A0
(ii)	P is the centre of gravity / mass (of the whole pillar) (Allow the point where the total weight acts)	B1

5.

(a)(i)	point where the weight (allow mass) (appears to) acts	B1
(ii)	force x perpendicular distance from (line of action to) point/pivot any missing points in the definitions –1	B2
(b)(i)	force up at A at pivot point force due to the weight of man down near centre of body support from scale up within pad ignore labels for reaction forces at A and B (arrows only needed), weight of man needs a label to distinguish from W weight of plank	B3
(ii)	anticlockwise moments = clockwise moments seen or implied	C1
	$5g \times 1 + 75g \times d = 44g \times 2$	C1
	$d = (88g - 5g) / 75g$	C1
	$= 1.1$ (m)	A1
	(if weight of plank ignored then max score of 2)	

6.

(a)	**1.** sum of the moments (about any point) is zero / no resultant torque	**B1**
	2. sum of all the forces acting is zero / no resultant force	**B1**
(b)(i)	$F_B \times 1.7 = (80 \times 0.85) + (650 \times 1.3)$ One moment correct allow 1 Analysis leading to 537 N i.e. $F_B = 913 / 1.7$	**B2** **B1**
	$F = 540$ (537) (N)	**A0**
(ii)	$F_A = 650 + 80 - 540$ or $F \times 1.7 = 650 \times 0.4 + 80 \times 0.85$	**C1**
	$= 190$ (N) (193 N)	**A1**
(iii)	F_A goes up F_B goes down To obtain the same moment a smaller force is required if the distance from the pivot increases / $(F_A + F_B)$ is a constant / weight (of painter) transfers from support B to support A	**B1** **B1** **B1**

7.

(a)(i)	pressure = force / area	B1
(ii)	moment = force multiplied by the perpendicular distance (from the line of action of the force) to the pivot	B1
(b)(i)	force drawn vertically upwards at plunger	B1
	force drawn vertically at H	B1
(ii)	20 x 500 / force on Plunger x 120 (one correct moment stated)	B1
	Plunger force x 120 = (20 x 500)	B1
	Plunger force = 83(.3) (N)	A0
(c)(i)	pressure = force / area	
	= 83 / 4 x 10^{-3}	C1
	= 20800 (Pa)	A1
(ii)	decrease area of plunger / decrease distance H to plunger / increase F / increase length of arm	B2 MAX 2