4. Forces, Density and Pressure

4.3 Density and pressure

Paper 2

Marking Scheme

Q1.

(a)	mass per unit volume	**B1**
(b)(i)	density = 0.243 / (0.0541 × 0.1109 × 0.0162)	**C1**
	= 2500 kg m^{-3}	**A1**

Q2.

(b)(iii)	U = 830 × 9.81 × 4.6 × (10^{-2})^3 (= 0.037 N)	**C1**
	W = 0.037 + 0.32 = 0.36 N	**A1**

Q3.

(a)	$\rho = m / V$ **or** $\rho = m / Ah$	**B1**
	$p = F / A$ **or** $p = W / A$	**B1**
	appropriate algebra leading to $p = \rho gh$ e.g. $p = \rho Ahg / A$ **or** $\rho Vg / A$ **or** $\rho Vg / (V/h)$ **and** (so) $p = \rho gh$	**B1**
(b)	there is atmospheric / air pressure	**B1**
(c)	$\Delta p = \rho g \Delta h$ e.g. (9.66 – 9.60) × 10^4 / 8.0 × 10^{-2} = ρ × 9.81	**C1**
	ρ = 760 – 770 kg m^{-3}	**A1**
(d)	$F = \rho gV$ = 760 × 9.81 × 3.7 × 10^{-4} × 4.0 × 10^{-2} (= 0.11 N)	**C1**
	tension = 0.53 – 0.11 = 0.42 N	**A1**
	or	
	F = (Δ)p × A = (9.63 – 9.60) × 10^4 × 3.7 × 10^{-4} (= 0.11 N)	**(C1)**
	tension = 0.53 – 0.11 = 0.42 N	**(A1)**

Q4.

(a)(i)	force / area (normal to the force)	**B1**

Q5.

(a)(i)	arrow upwards (↑) **and** labelled upthrust / U arrow downwards (↓) **and** labelled weight / W / mg arrow downwards (↓) **and** labelled tension / T *1 mark: One or two correctly labelled arrows* *2 marks: Three correctly labelled arrows*	**B2**
(a)(ii)	$U = T + W$ **or** upthrust = tension + weight	**C1**
	$\rho Vg = T + W$ V = [(4.00 × 10^2) + (3.39 × 10^4)] / (1.23 × 9.81)	**C1**
	V = 2.84 × 10^3 m^3	**A1**

Q6.

(a)	$65 = \rho g V$ **or** $65 = mg$ **and** $m = \rho V$	**C1**
	$\rho = 65 / (9.81 \times 7.5)$ $= 0.88\ \text{kg m}^{-3}$	**A1**

Q7.

(c)(i)	$(F = \rho g V)$ $V = 2.5 / (1100 \times 9.81)\ (= 2.32 \times 10^{-4})$	**C1**
	$V = (4 / 3)\pi r^3$	**C1**
	$r = [(3 \times 2.32 \times 10^{-4}) / 4\pi]^{1/3}$ $r = 0.038$ m	**A1**

Q8.

(b)(i)	$F = \rho g V$ $V = 280 / (1.0 \times 10^3 \times 9.81)$ $= 0.029\ \text{m}^3$	**A1**
(b)(ii)	$\rho = (32 / 9.81) / 0.029$	**C1**
	$= 110\ \text{kg m}^{-3}$	**A1**

Q9.

(b)(i)	$\rho = m / V$	**C1**
	$V = \frac{4}{3}\pi r^3$	**C1**
	$\rho = 0.017 / [\frac{4}{3}\pi \times (0.016 / 2)^3]$ $= 7900\ \text{kg m}^{-3}$	**A1**

Q10.

(a)	$F = \rho g V$ $0.071 = 1.2 \times 9.81 \times V$	**C1**
	$(V = 6.03 \times 10^{-3}\ \text{m}^3)$ $4/3 \times \pi \times r^3 = 6.03 \times 10^{-3}$ $r = 0.11$ m	**A1**

Q11.

(a)	mass / volume	**B1**
(c)	$p = F / A$ **or** $p = W / A$	**C1**
	$p = (19.5 \times 10^{-3} \times 9.81) / (4.0 \times 10^{-2})^2$	**C1**
	$= 120\ \text{Pa}$	**A1**

Q12.

(c)(i)	upthrust = $\rho g(\Delta)h \times A$	**C1**
	$= (1.00 \times 10^3 \times 9.81 \times 0.190) \times 0.0230$ $= 42.9$ N	**A1**

Q13.

(a)	mass / volume	**B1**

Q14.

(b)	$W = \rho Vg$ **or** $W = \rho ALg$	**C1**
	$A = 5.2 / (790 \times 2.4 \times 9.81)$ $(= 2.8 \times 10^{-4}\ (m^2))$	**C1**
	$= 2.8 \times 10^2$ mm^2	**A1**

Q15.

(a)(i)	$(\Delta)p = \rho g(\Delta)h$ $520 = 1000 \times 9.81 \times h$	**C1**
	$h = 0.053$ m	**A1**
(a)(ii)	(upthrust =) $(\Delta)p \times$ A	**C1**
	$= (\Delta)p \times \pi(d / 2)^2$ **or** $(\Delta)p \times \pi r^2$	
	$= 520 \times \pi(0.031 / 2)^2 = 0.39$ (N)	**A1**

Q16.

(a)(i)	$m = \rho \times V$	**C1**
	$= (4 / 3) \times \pi \times (1.2 \times 10^{-6})^3 \times 940 = 6.8 \times 10^{-15}$ (kg)	**A1**
(d)(i)	upthrust (force)	**B1**

Q17.

(b)(i)	$p = (4 \times 0.38) / (\pi \times 0.0125^2)$ $= 3100$ N m^{-2}	**A1**

Q18.

(a)	$\rho = m / V$	**C1**
	$V = \pi \times (0.16 / 2)^2 \times 7.6 \times 3.0$ $(= 0.458$ m$^3)$	**C1**
	$m = \pi \times (0.16 / 2)^2 \times 7.6 \times 3.0 \times 1.2 = 0.55$ kg	**A1**
(e)	the density of air is less at high altitude	**B1**

Q19.

(a)	$\rho = m/V$	**C1**
	$= (560/9.81)/(1.2 \times 0.018)$ $= 2600\,\text{kg}\,\text{m}^{-3}$	**A1**
(b)	$(\Delta)p = 940 \times 9.81 \times 1.2$	**C1**
	(upthrust =) $940 \times 9.81 \times 1.2 \times 0.018 = 200\,\text{N}$	**A1**

Q20.

(b)(i)	$m = \rho V$	**C1**
	$= 1.3 \times \pi \times 0.045^2 \times 1.8 \times 2.0 = 0.030\,(\text{kg})$	**A1**