Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	(mass = 1900 × 0.05) = 95 kg (2) OR ALLOW (*m* =) *ρV* in any form OR 1900 × 0.05 (1)	**2**			
1(b)	(= 95 × 1500) = 140 000 J / °C or 1.4×10^5 J / °C (2) Or ALLOW (*C* =) *m* × *c* (1)	**2**			
2(a)	(A = 44 × 20 =) 880 (m^2) (1) V = A × depth in any form **OR** (d =) V / A (1) (d = 264 / 880 =) 0.30 m (1)	**3**			
2(b)	ρ = m / V in any form **OR** (ρ =) m / V (1) (ρ = 2.7×10^5 / 264 =) 1020 kg / m^3 (1)	**2**			
2(c)	p = ρgh in any form **OR** (p =) ρgh (1) (p = 1020 × 10 × 0.3 =) 3 100 Pa (1)	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
3(a)	d = m / V in any form, symbols or words **OR** 24 000 × 1.3 (1) 31 000 kg (1)	**2**			
3(b)	KE = ½ mv^2 **OR** ½ × 31 200 × 16^2 (1) 4.0×10^6 J (1)	**2**			
4	(volume =) $\pi r^2 h$ **OR** π (0.035^2) × 0.12 **OR** 4.62×10^{-4} (m^3) (1) $\rho = m / V$ in any form **OR** (m =) ρV (1) (mass = $900 \times 4.62 \times 10^{-4}$ =) 0.41 (kg) (1) 0.66 kg **OR** 250 g **OR** 0.25 kg correctly added to previous result (1)	**4**			
5	(m =) ρV **OR** $\rho \pi r^2 l$ **OR** $\rho \pi d^2 l / 4$ **OR** in numbers (1) (W =) $\rho V g$ **OR** $\rho \pi r^2 l g$ **OR**	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
	$\rho \pi d^2 l g / 4$ **OR** in numbers (1) 84 N (1)				
6	(rises because) density of gas is less than density of **OR** resultant upward force on bubble (1) (as bubble rises) pressure (of gas in bubble) decreases (1) (volume of bubble increases because) $p \times V$ = constant **OR** $V \propto 1 \div p$ (1)	**3**			
7(a)	average/overall/combined density (of the metal and air contained) less (than density of sea water)	**1**			
7(b)	(P =) $h \times \rho \times g$ **OR** (V=) $A \times l$ in any form (1) (P= 1.2 × 1020 × 10 =) 12 000 (Pa) **OR** (V= 0.8 × 1.2 =) 0.96 (m^3) (1) $P = F \div A$ **OR** (F =) $P \times A$ **OR** (W =) $V \times \rho \times g$ (1) (F = 12240 × 0.80 =) 9800 N **OR** (F = W =) 9800 N (1)	**4**			

Question	Answer	Marks	AO Element	Notes	Guidance
7(c)	same numerical answer as **(b)** (1) resultant/net (vertical) force = 0 **OR** downward force = upward force **OR** forces are balanced (1)	**2**			
8(a)	(measure of) quantity / amount of matter **OR** (property) that resists change in motion / speed / momentum **OR** measure of a body's inertia	**1**			
8(b)(i)	$d = m / V$ **OR** in words **OR** $0.44 / 0.080^3$ **OR** $0.44 / 5.12 \times 10^{-4}$ **OR** $440 / 8^3$ **OR** 440 / 512 **OR** $0.44 / 8^3$ **OR** 0.44 / 512 $0.86\ g / cm^3$ **OR** $860\ kg / m^3$ **OR** $8.6 \times 10^{-4}\ kg / cm^3$	**2**			
8(b)(ii)	sinks **OR** does not float AND (cube) denser (than oil)	**1**			

Question	Answer	Marks	AO Element	Notes	Guidance
8(c)(i)	$W = mg$ **OR** (g =) W / m **OR** 0.70 / 0.44 1.6 N / kg	**2**			
8(c)(ii)	(P =) hdg **OR** 0.030 × 850 × 1.6 41 Pa	**2**			
9(a)	$p = h \rho g$ in any form **OR** (p =) 560 / (0.027 × 10) (p =) 2.1 × 10^3 kg / m^3	**2**			
9(b)	explains why there is a resultant downward force	**1**			
10(a)	(if no diagram, max. mark is 3) measuring / graduated cylinder	**B1**			
	water **AND** initial reading **OR** known volume alternative method: water **AND** filled eureka can	**B1**			owtte

Question	Answer	Marks	AO Element	Notes	Guidance
	immerse stone **AND** final reading alternative method: immerse stone **AND** catch overflow	**B1**			
	final reading – initial reading alternative method: reading on measuring cylinder	**B1**			
10(b)	attach weight to wood **OR** different liquid **OR** push down with stick	**M1**			
	accuracy mark must match method subtract volume of weight from total volume **OR** new liquid less dense than wood **OR** no part of stick in water / thin stick	**A1**			
11	$M = \rho V$ in any form or ρV in words, symbols or numbers	**C1**			

Question	Answer	Marks	AO Element	Notes	Guidance
	(mass = 1.2 × 76.4 =) 92 kg	**A1**			
12	any **three** from: measure mass of (empty) measuring cylinder on balance add liquid to measuring cylinder AND read volume measure mass of measuring cylinder AND liquid on balance find difference in the 2 mass readings	**3**			
13(a)	11 (g / cm^3) (2) OR (density =) 86 ÷ 8.0 (1)	**2**			
13(b)	any value greater than **(b)(i)** (g / cm^3)	**1**			
14	(density =) mass ÷ volume (1) (density =) 98.4 ÷ 41.0 (1) 2.4(0) (g / cm^3) (1)	**3**		(density =) 98.4 ÷ 41.0 gains 2 marks 2.4(0) (g / cm3) gains 3 marks	

Question	Answer	Marks	AO Element	Notes	Guidance
15	1 (volume of block) increases (1) 2 (mass) remains constant owtte (1) 3 (density) decreases (1)	**3**			
16	V (= 0.3 × 0.3 × 0.4) = 0.036 (m^3) (1) ρ = m / V in any form **OR** (m =) ρV **OR** 1020 × 0.036 (1) (m =) 37 kg (1)	**3**			
17	ρ = m / V in any form **OR** (V =) m / ρ **OR** (V =) 7.5 / 1.3 (1) (V = 7.5 / 1.3 =) 5.8 m^3 (1)	**2**			
18	density = mass / volume (1) 146 / 20 (1) 7.3 (1) g/cm^3 (1)	**4**			

Question	Answer	Marks	AO Element	Notes	Guidance
19(a)	density = mass ÷ volume in any form **OR** (mass =) density × volume (1) mass = 1000 × 0.05 (1) 50 (kg) (1)	**3**			
19(b)	*statement:* (floats /does not sink) *explanation:* density of full barrel / its density / density of plastic / density of barrel / density of (pure) water is less than sea water (1) density of plastic / barrel **AND** (pure) water is less than sea water (1)	**2**		no marks for the statement alone	
20	any **four** from: pour some water into measuring cylinder record volume / reading of water (in measuring cylinder) place metal in water (in cylinder and completely submerge) record volume of water and metal (in cylinder) subtract starting volume from final volume (to give volume of metal)	**4**			

Question	Answer	Marks	AO Element	Notes	Guidance
21	density = mass ÷ volume in any form (V =) M/d (1) 200 ÷ 8.4 (1) 24 (cm^3) (1)	**3**			
22(a)	(678 – 318 =) 360 (g)	**1**			
22(b)(i)	160 (cm^3)	**1**			
22(b)(ii)	400 (cm^3)	**1**			
22(b)(iii)	D = m / v in any form (1) 360 ÷ 400 (1) 0.9 (g / cm^3) (1)	**3**			
23(a)	density = mass ÷ volume in any form (1) 1260 ÷ 150 (1) 8.4 (1) g / cm^3 (1)	**4**			
23(b)	1.26 (kg)	**1**			

Question	Answer	Marks	AO Element	Notes	Guidance
24	add water to measuring cylinder/note the volume of water added (1) lower/immerse metal object into water (1) note new volume of water owtte (1) subtract new volume from initial volume/determine difference in volumes (1)	**4**			
25(a)	determine / read volume of water in measuring cylinder (1) (submerge / sink) metal in water / measuring cylinder (1) determine / read new volume of water (and metal) (1) find difference between final and initial volumes (1)	**4**			
25(b)	wood floats **OR** does not sink	**1**			
26	D = M / V **OR** 405 ÷ 150 (1) 2.7 (1) g/cm^3 (1)	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
27	mass = 0.25 (kg) **OR** $\rho = m / V$ (1) volume =($\pi \times 0.03^2 \times 0.1$ = 2.8×10^{-4} (m^3)) (1) density = ($0.25 / 2.8 \times 10^{-4}$) = 890 kg / m^3 (1) **OR** mass = 250 (g) **OR** $\rho = m / V$ (1) volume = ($\pi \times 3^2 \times 10$ =) 280 cm^3 (1) density = (250 / 280 =) 0.89 g / cm^3 (1) **OR** $\rho = F / A = h\rho g$ (1) $\rho = F / Ahg$ **OR** $2.5 / \pi \times 0.03^2 \times 0.1 \times 10$ (1) = 890 kg / m^3 (1)	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
28(a)	measure mass of empty measuring cylinder/beaker (1) add measured/fixed volume of liquid (1) measure mass of measuring cylinder/beaker and liquid (1) determine mass of liquid (by subtracting mass empty from mass when full) (1) use of D = M/V (1)	**5**			
28(b)	g/cm^3 **OR** kg/m^3	**1**			
29(a)	(volume of log =) 3 × 0.04 = 0.12 (m^3) (1) D = M / V **OR** (D=) M / V (1) 550 (kg/m^3) (1)	**3**			
29(b)	the density of the log is less than the density of water owtte	**1**			
30(a)	30 × 20 × 5 or length × width × height or cross-sectional area × length	**1**			

Question	Answer	Marks	AO Element	Notes	Guidance
30(b)	D = M / V in any acceptable form (1) 2400 ÷ 3000 (1) 0.80 (g / cm^3) or 0.8 (g / cm^3) (1)	**3**			
31	any **five** from: measure mass (on top pan balance) part fill measuring cylinder with water (and note volume submerge link in measuring cylinder determine increase in volume increase in volume = volume of link use density = mass ÷ volume	**5**		only award full marks for a viable method	

Question	Answer	Marks	AO Element	Notes	Guidance
32(a)	measuring cylinder (partially filled) with water / displacement can filled with water object (submerged) into water owtte new volume noted / displaced water collected in measuring cylinder (volume of object =) difference in volumes / volume of water collected	**4**			
32(b)	density = mass ÷ volume written in any recognised form 347 ÷ 18 19.28 **OR** 19.3 (g/cm^3)	**3**			
33(a)(i)	$D = M/V$ 450 ÷ 145 3.1 (g/cm^3)	**3**			
33(a)(ii)	$W = m \times g$ in any form 0.45 x 10 4.5 (N)	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
34(a)	$\rho = m / V$ in any form **OR** (m =) ρV **OR** (m =) $9000 \times 7.5 \times 10^{-5}$ 0.68 kg	**2**		allow 680 g	
34(b)(i)	$W = mg$ in any form **OR** (W =) mg **OR** (W =) 0.68×10 (W =) 6.8 N	**2**			
34(b)(ii)	any **one** of: weight has direction / mass does not weight is a vector / mass is not weight varies / mass does not mass is amount of matter weight is a force / mass is not	**1**			
35	C - 15 cm^3	**1**			
36	C - 4.5 g / cm^3	**1**			
37(a)(i)	6500 (g)	**1**			
37(a)(ii)	density = mass ÷ volume in any form 1.3 g / cm^3	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
37(b)	density (of brush) is less (than) density of paint	**1**			
38(a)(i)	(weight is) force/pull of gravity (acting on an object)	**1**			
38(a)(ii)	mass x acceleration due to gravity **OR** *mg* **OR** 350 × 7.5 2600 N	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
38(b)	(ρ =) m / V in any form 0.27 (kg / m^3) **OR** (g / m^3) balloon moves/floats up (floats when) density of balloon less than density of atmosphere **OR** (sinks when) density of balloon greater than atmosphere **OR** (ρ =) m / V in any form 110 g balloon rises (floats when) mass/weight of balloon less than mass/weight of atmosphere (of same volume as balloon) **OR** (sinks when) mass/weight of balloon greater than mass/weight of atmosphere (of same volume as balloon)	**4**			
39(a)	(ρ =) $\frac{m}{V}$ **OR** 180 ÷ 210 **OR** 0.18 ÷ 210 0.86 g / cm^3	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
39(b)	floats **OR** words to the same effect density of wood is less than density of liquid	**2**			
40	Honey has a larger density than water.	**B1**			
	Kerosene has a smaller density than water.	**B1**			
					[Total: 167]