Question	Answer	Marks
1 (a)	The newton is the force that will produce an acceleration of 1 m s^{-2} when acting on an object of mass 1 kg. ($F = m a$) The base unit of force = base unit of mass (kg) × base unit of acceleration (m s^{-2}) Therefore, base unit of force is kg m s^{-2}.	1 1 1
1 (b) (i)	weight = $m g$ = 3.0 × 10^6 × 9.81 net force = 34 × 10^6 – (3.0 × 10^6 × 9.81) = 4.57 × 10^6 N $a = \frac{4.57 \times 10^6}{3.0 \times 10^6}$ = 1.52 m s^{-2}	1 1 1
1 (b) (ii)	The mass of the rocket decreases as its fuel is used. The acceleration is inversely proportional to the mass, hence acceleration increases.	1 1
2 (a)	(net vertical force =) 120 – 90 $F^2 = 30^2 + 18^2$ net force = 35 N $\tan\theta = \frac{30}{18}$ angle = 59°	1 1 1 1
2 (b)	Any <u>two</u> from: • speed of balloon • (frontal) area • texture of balloon • temperature of air / density of air / viscosity (of air)	2
3 (a)	The resultant force on the lamp in any direction is zero. Vertically, the resultant of the upward forces T and F must equal to the downward force of weight, 24 N.	1 1
3 (b)	$\sin 35° = \frac{T}{24}$ T = 24 sin 35° = 13.8 N $\sin 55° = \frac{F}{24}$ F = 24 sin 55° = 19.7 N	1 1 1 1
3 (c)	The vertical component of T must remain the same for the lamp to be in equilibrium, therefore $T \sin\theta$ = constant. As θ is decreased the tension T will increase (T is inversely proportional to sin θ).	1 1
4 (a)	density = $\frac{\text{mass}}{\text{volume}}$ or 'density is mass <u>per</u> (unit) volume'	1
4 (b) (i)	Dramatic change(s) in density (at 3.0 Mm and 5.1 Mm)	1
4 (b) (ii)	mass = 0.18 × 6.0 × 10^{24} (= 1.08 × 10^{24} kg) or radius = 1.3 × 10^6 m volume = $\frac{4}{3}\pi \times (1.3 \times 10^6)^3$ density = $\frac{1.08 \times 10^{24}}{9.20 \times 10^{18}}$ density = 1.2 × 10^5 kg m^{-3}	 1 1 1
5 (a)	A straight line graph with a positive gradient. The line starts at a finite value of pressure when d = 0 (because of the Earth's atmospheric pressure).	1 1

Question	Answer	Marks
5 (b) (i)	The object experiences a greater pressure at its bottom surface compared with its upper surface. This difference in pressure produces an upward force (upthrust). The upthrust is equal to the weight of the water displaced – Archimedes' principle.	1 1 1
5 (b) (ii)	weight of object = $mg = (400 \times 6.0 \times 10^{-6}) \times 9.81$ upthrust = weight of water displaced = $(1000 \times 6.0 \times 10^{-6}) \times 9.81$ net upward force = $(6.0 \times 10^{-6} \times 9.81) \times (1000 - 400) = 3.53 \times 10^{-2}$ N $a = \frac{3.53 \times 10^{-2}}{400 \times 6.0 \times 10^{-6}}$ $a =$ 14.7 m s^{-2}	1 1 1 1 1
6 (a)	The point where the entire weight of the object appears to act.	1
6 (b)	moment of a force = force × perpendicular distance of the line of action from a point	1
6 (c) (i)	The resultant force is zero. The sum of the clockwise moments about any point is equal to the sum of the anticlockwise moments about the same point.	1 1
6 (c) (ii)	One of the moments shown: $0.12\,x$ or $0.35\,(0.50 - x)$ sum of clockwise moments about A = sum of anticlockwise moments about A $0.12\,x = 0.35\,(0.50 - x)$ $x = 0.37$ m	1 1 1
6 (c) (iii)	force = 0.35 + 0.12 = 0.47 N	1