Revision Sheet

A-Level Physics · Unit 4 Forces, density and pressure

10 vocabulary items · 28 marks of exam questions (11 questions)

Part 1 · Vocabulary review answer key. Section A wants the exact English spelling.

Question	Answer	Marks
1	centre of gravity	1
2	centre of mass	1
3	moment	1
4	pivot	1
5	couple	1
6	torque	1
7	equilibrium	1
8	principle of moments	1
9	vector triangle	1
10	Archimedes' principle	1

Question 11 (Answer: **C**)

- "Just fully submerged" puts the top of the sphere level with the liquid surface.
- Its lowest point is therefore a depth $2r$ below the surface.
- $p = P_A + \rho g(2r)$ – the air pressure plus the weight of the liquid column above.

Question 12 (Answer: **C**)

- Each force acts a distance d from the pivot, so each gives a moment Fd.
- Both turn the tap the same way, so the torque is $Fd + Fd = 2Fd$.
- Equivalently, one force times the $2d$ separation between them.

Question 13 (Answer: **D**)

- Fully submerged, the block feels an upthrust ρgV upwards.
- The string holds it down, so the three forces balance: $\rho gV = mg + T$.
- $T = \rho gV - mg$, which is positive precisely because the block would otherwise float.

Question 14 (Answer: **A**)

- Fully submerged, the upthrust is $\rho_{\text{liquid}} gV$ and the weight is $\rho_{\text{object}} gV$ – the same V.
- The ratio is therefore just $\rho_{\text{liquid}}/\rho_{\text{object}}$; the volume cancels entirely.
- Doubling the liquid's density doubles it, while B changes nothing and C halves it.

Question 15 (Answer: **D**)

(Explanation not available.)

Question 16 (Answer: **D**)

- The weight is the same whichever face is down, so the pressure is largest on the smallest face, 10.0 cm by 12.0 cm.
- For a uniform block $p = W/A = \rho gh$, where h is the height above that face: $1.13 \times 10^4 \times 9.81 \times 0.150 = 1.66 \times 10^4$ Pa $= 16.6$ kPa.
- C is the smallest pressure, with the 10.0 cm side upright; A and B leave out g.

Question 17 (Answer: **A**)

- Upthrust is the weight of water displaced, $\rho_{\text{water}} gV$: it depends on the water and on the volume under water, not on what the cuboid is made of.
- The four cuboids have the same volume and are all fully under water, so the upthrust on each is the same.
- The material's density changes only the weight, and so the force the rod must supply; Y still has an upthrust, exactly equal to its weight.

Question 18 (Answer: **A**)

- Pressure is force per unit area: $p = 290/0.036 = 8.06 \times 10^3$ Pa on the plate.
- This pressure is ρgh, so $h = 8.06 \times 10^3/(930 \times 9.81) = 0.88$ m.
- D leaves out g, and B turns the fraction upside down.

Multiple Choice Answers

Q19: D

20(a)	force × perpendicular distance (of line of action of force to / from the point)
20(b)(i)	150 × 9.81 × 4.5 **or** 90 × 9.81 × 4.5 **or** 3.0 × 9.81 × *m*
	(150 × 9.81 × 4.5) = (90 × 9.81 × 4.5) + (3.0 × 9.81 × *m*)
	m = 90 kg
20(b)(ii)	Young modulus = σ / ε **or** $F / A\varepsilon$ **or** FL / Ax
	Area of wire = $\pi \times (1.8 \times 10^{-3} / 2)^2$ $= 2.5 \times 10^{-6}$
	So Young modulus = $((90 \times 9.81) / \pi \times (9.0 \times 10^{-4})^2) / 1.2 \times 10^{-3}$ $= 2.9 \times 10^{11}$ Pa
20(b)(iii)	Moment provided by B will decrease / moment due to wire will increase
	So force acting on wire will increase (Young's modulus and area remain constant) and the strain will increase

21(f)	there is a resultant force (acting on sphere) **or** there is a resultant moment (about P acting on pendulum) (so) not in equilibrium