A-Level Physics: **w25 11**

Question 14 (Answer: **C**)

- Each force produces a moment Fd about P, and both turn the rod the same way.
- So they add rather than cancel: torque $= Fd + Fd = 2Fd$.
- Equivalently, it is one force times the $2d$ separation between their lines of action.

A-Level Physics: **w25 12**

Question 13 (Answer: **A**)

- A couple needs two forces equal in magnitude, opposite in direction, and on different lines of action.
- Equal and opposite gives zero resultant force; separate lines of action give a turning effect.
- Two opposite forces along the *same* line would simply cancel with no rotation.

A-Level Physics: **w25 14**

Question 14 (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.

A-Level Physics: **w25 24**

2(a)	product of force and distance
	perpendicular distance between the (line of action of the two) forces
2(b)	straight vertical line drawn from centre to bottom corner
2(c)(i)	centre of gravity is to the right of the rod so torque is anticlockwise **or** moment of weight of sheet about rod is clockwise so torque is anticlockwise
2(c)(ii)	(horizontal displacement) = $3.3 / (2.8 \times 9.81) = 0.12$ (m)
2(d)	$\rho = m / V$
	$V = 4.0 \times 10^{-3} \times$ (side length)^2
	side length = $\sqrt{\left[2.8 / (3000 \times 0.0040)\right]} = 0.48\,\text{m}$
2(e)	point lies on a straight line at 45° to the horizontal from the bottom-right corner to the edge of the rod
	point lies on a vertical line half-way between rod and right-hand edge

A-Level Physics: **s25 11**

Question 13 (Answer: **B**)

- A couple is two forces equal in magnitude, opposite in direction, and not along the same line.
- Equal and opposite means the resultant force is zero, so there is no acceleration.
- Because they are not in line, they still produce a turning effect.

Question 15 (Answer: **A**)

- The sign is uniform, so its weight acts at the centre, $0.86/2 = 0.43$ m from the hinge.
- A moment needs the *horizontal* offset of that point: $0.43 \sin 15° = 0.111$ m.
- $M = (2.4 \times 9.81) \times 0.111 = 2.6$ N m; C uses the whole side and D uses cos.

Question 17 (Answer: **B**)

- The torque of a couple is one force multiplied by the perpendicular distance between them.
- Each force contributes $F \times d/2$ about the centre, and the two add to Fd.
- So there is no extra factor of 2 (D) and no halving (A).

Question 12 (Answer: **D**)

- Take moments about P, the end still touching the ground.
- $360 \times 0.50 = 200 \times d + 400 \times 0.25$, so $180 = 200d + 100$.
- $d = 80/200 = 0.40$ m from P.

Question 10 (Answer: **B**)

- The two forces of a couple are equal and opposite, so the resultant force is zero.
- With no resultant force the centre of mass does not accelerate – there is no translation.
- They act along different lines, so they do turn the object: rotation only.

2(a)	force × <u>perpendicular</u> distance (of line of action of force to / from the point)
2(b)(i)	(moment due to weight =) 1.2 × 270 × 9.81
	(moment due to post =) 1800 × (1.6 / cosθ)
	1.2 × 270 × 9.81 = 1800 × (1.6 / cosθ) so θ = 25(°) or 1.2 × 270 × 9.81 – 1800 × (1.6 / cosθ) = 0 so θ = 25(°)
2(b)(ii)	A closed tip-to-tail vector triangle
	vector labelled *F* at an angle of 25° ± 3° anticlockwise from vertical **and** vector labelled *R* at an angle of 37° ± 3° clockwise from vertical
2(b)(iii)	$A = F / p$ $= 1800 / (150 \times 10^3)$
	$= 0.012\ m^2$

2(a)	force × <u>perpendicular</u> distance (of line of action of force to / from the point)
2(b)(i)	$150 \times 9.81 \times 4.5$ **or** $90 \times 9.81 \times 4.5$ **or** $3.0 \times 9.81 \times m$
	$(150 \times 9.81 \times 4.5) = (90 \times 9.81 \times 4.5) + (3.0 \times 9.81 \times m)$
	$m = 90$ kg
2(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
2(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