A-Level Physics: **w25 11**

Question 13 (Answer: **B**)

- F is drawn perpendicular to the rod, so its moment arm about X is the full length L.
- The weight is vertical and acts at the midpoint, so its arm is the *horizontal* distance $\frac{L}{2}\cos 40°$.
- $FL = 28 \times \frac{L}{2}\cos 40°$, giving $F = 14\cos 40° = 11$ N.

A-Level Physics: **w25 12**

Question 14 (Answer: **C**)

- The bar is uniform, so its weight acts at $L/2$ from end X.
- That point is $(L/2 - x)$ from the pivot, and the object at distance y balances it on the other side.
- $M(L/2 - x) = my$, so $y = M(L - 2x)/2m$.

A-Level Physics: **w25 14**

Question 13 (Answer: **D**)

- Taking moments about the hinge, the wire's vertical pull carries half the rod's weight.
- So the hinge must supply the other half upwards, plus an outward push to balance the wire pulling the rod towards the wall.
- The hinge force therefore points upwards and away from the wall, not along the rod.

Question 15 (Answer: **C**)

- Take moments about Y, at the far end of the 20.0 m beam.
- The man is 14.0 m from Y, and the beam's own weight acts at its centre, 10.0 m from Y.
- $R_X \times 20.0 = 700 \times 14.0 + 200 \times 10.0 = 11800$, so $R_X = 590$ N.

A-Level Physics: **w25 22**

3(a)	an arrow horizontally on the page to the left labelled *F*
	two arrows horizontally on the page to the right each labelled *T*
3(b)(i)	$T = 110 / 2$ $= 55$ N
3(b)(ii)	$x = F / k$
	$= 110 / 250$ $= 0.44$ m
3(c)(i)	extension = 55 / 250 **or** 110 / (2 × 250)
	extension = 0.22 m
3(c)(ii)	$E = \frac{1}{2}Fx$ **or** $E = \frac{1}{2}kx^2$ **or** $E = \frac{1}{2}F^2/k$
	$E_1 / E_2 = (\frac{1}{2} \times 110 \times 0.44) / (2 \times (\frac{1}{2} \times 55 \times 10.22))$ **or** $E_1 / E_2 = (\frac{1}{2}k \times 0.44^2) / (2 \times (\frac{1}{2}k \times 0.22^2))$ **or** $E_1 / E_2 = (\frac{1}{2} \times 110^2 / k) / (2 \times (\frac{1}{2} \times 55^2 / k))$ $E_1 / E_2 = 2.0$ (no ECF from **3(b)(ii)** and **3(c)(i)**)

Question 15 (Answer: **B**)

- The ruler's own weight acts at the 15 cm mark, which is the fulcrum, so it has no moment.
- Clockwise: $50 \times 8 = 400$ g cm; the 20 g mass gives $20 \times 4 = 80$ g cm anticlockwise.
- The new mass sits 8 cm from the fulcrum, so $8m = 400 - 80$ and $m = 40$ g.

A-Level Physics: **s25 13**

Question 10 (Answer: **B**)

- The four forces balance in pairs, so the resultant force on the object is zero.
- Zero resultant means zero acceleration, so the velocity cannot change.
- The object therefore keeps moving in a straight line at constant speed (or stays at rest).

Question 14 (Answer: **C**)

- Three forces act: the weight vertically down, the normal force perpendicular to the slope, and friction along it.
- In equilibrium they must form a closed triangle when drawn nose to tail.
- So look for the triangle whose sides are vertical, perpendicular to the slope, and parallel to the slope.

A-Level Physics: **s25 14**

Question 11 (Answer: **D**)

- Three forces act on the frame: its weight straight down and a tension along each half of the string.
- In equilibrium they form a closed triangle drawn nose to tail.
- The weight side is vertical and the two tension sides slope symmetrically, since the pin is central.

A-Level Physics: **m25 12**

Question 9 (Answer: **A**)

- The plank is uniform, so its weight acts at its centre of gravity – the midpoint.
- The pivot is at that same midpoint, so the weight's moment arm is zero.
- It therefore produces no moment at all, neither clockwise nor anticlockwise.

Question 11 (Answer: **C**)

- The sign's 75 N hangs at Y, held up by the tension along YZ at 30° to the horizontal.
- Vertically, $T \sin 30° = 75$, so $T = 150$ N.
- Horizontally the hinge must balance $T \cos 30° = 150 \times 0.866 = 130$ N.

A-Level Physics: **m25 22**

2(a)	in (rotational) equilibrium
	<u>sum / total</u> of CW moments about a point = <u>sum / total</u> of ACW moments about the (same) point.
2(b)(i)	The magnitudes of the moments about A are: (1700 × 3.0) (660 *x*) (1300 × 5) Correct magnitude of any one moment about A.
	Correct magnitudes of a second moment about A.
	(1700 × 3.0) + (660 *x*) = (1300 × 5) *x* = 2.1 m

2(b)(ii)	(Upthrust =) $11 \times 9.81 + 1300 = 1400$ (N)
2(b)(iii)	y = Upthrust / $\rho g A$ $= 1400 / (990 \times 9.81 \times \pi \times (0.78 / 2)^2)$
	$= 0.30$ m
	OR [$P = F / A = 1400 / \pi \times (0.78 / 2)^2 = 2930$] $y = P / \rho g$ $= 2930 / (990 \times 9.81)$
	$= 0.30$ m
2(b)(iv)	line with a non-zero value of depth at distance = 0
	A line from distance = 0 to distance = 6.0 m with a gradient that is always positive