

- 1 (a) 2 vectors correct direction AND relative length by eye B1
 correct triangle OR rectangle with resultant on correct diagonal B1
 7.2 kN tolerance 7.0 – 7.4 kN B1
- (b) (i) (moment =) force \times distance C1
 (moment = 11 000 \times 1.8 =) 20 kNm A1
- (ii) (moment of weight = 19 000 \times 1.25 =) 24 (kNm) B1
 correct statement based on two moments seen B1

[Total: 7]

- 2 (a) Note: answers in either order
 Resultant/net/total force B1
 Resultant/net/ total turning effect/moment/torque/couple B1
- (b) (i) 1. (240 \times 1.2 =) 290 (Nm)
 2. $F \times 3.2$ B1
- (ii) $F \times 3.2 = 288$ C1
 90 N A1
- (iii) To balance the weight B1
 OR to make resultant (vertical) force zero
 OR to make resultant moment zero
 OR to keep the ladder in (vertical) equilibrium
 OR because there is a downward force
 OR because the ladder is pressing on the ground
 OR otherwise the ladder would fall / sink (into the ground)

[Total: 7]

- 3 (a) no resultant/net force (acting) B1
- no resultant/net moment (acting)
OR clockwise moment = anticlockwise moment B1
- (b) (i) $W = P + Q$ in any form B1
OR (total) upward force = (total) downward force B1
- $P = W - Q$ so P must be less than W
OR P is not the only upward force B1
- (ii) $P \times$ its distance (from C) = $W \times$ its distance (from C)
OR P and W have equal moments (about C)
OR clockwise moment = anticlockwise moment B1
- P is farther from C/pivot (than W so P must be less than W) B1
- (c) clockwise moment = 75×0.24 C1
anticlockwise moment = $F \times 0.75$ C1
(moments equated gives $F =$) 24 N A1

[Total: 9]

- 4 (a) (i) 180 N B1
- (ii) $(P =) F \div A$ **OR** $180 \div (0.30 \times 0.04)$ C1
15000 Pa A1
- (b) (i) arrow (labelled W) from/to correct centre of mass B1
- (ii) 1. force \times (perpendicular) distance **OR** 40×0.60 **OR** 180×0.15 in 2. C1
24 N m A1
2. 27 N m e.c.f. from (a)(i) A1
- (iii) slab topples/rotates (about point D) **OR** corner C lifts from ground
OR falls over B1
- moment of force at B becomes bigger than moment of weight / W
OR anticlockwise moment becomes bigger than clockwise moment
OR weight/centre of mass outside base B1

[Total: 9]

- 5 (a) (immediately below/above the/at) 50 cm mark **OR** at pivot B1
- (b) (i) anticlockwise moment = clockwise moment **OR** $45 \times 0.40 = 25 \times W$ C1
0.72 N A1
- (ii) 0.072 kg **OR** 72 g e.c.f from (b)(i) B1
- (c) (i) no net moment **OR** two moments cancel C1
moment due to weight of rule cancels moment due to weight of apple A1
- (ii) weight of the rule / it is bigger B1

[Total: 7]

- 6 (a) 85 000 N (accept 83 300 N)
- (b) ((P =)F/A OR 85 000/3.4 OR 85 000/3.4 × 2 OR 85 000/6.8 (e.c.f. from (a)(i)) C1
1.2/1.25/1.3 × 10⁴ Pa (e.c.f. from (a)(i)) A
- (ii) larger area M1
smaller pressure A1
- (c) (i) (measure of) turning effect OR $F \times x$ B1
- (ii) no resultant/net force B1
no resultant/net turning effect/moment B1 [8]

- 7 (a) (i) 3 appropriate examples: e.g. spanner, scissors, tap etc. –1e.e.o.o. B2
- (ii) there is a resultant force OR more force down than up B1
 there is a resultant moment OR clockwise moment is not equal to
 anticlockwise moment B1
- (b) (i) $F \times 0.5 = 12 \times 0.3$ C1
 7.2N A1
- (ii) weight has no moment about centre of rod/has no perpendicular distance
 from centre of rod
 OR weight acts at centre of rod/pivot/centre of mass B1

[Total: 7]