

- 1 (a) Size / magnitude (NOT distance) and direction B1
- (b) Vectors towards East and North with arrows correct by eye B1
 Complete triangle or rectangle for candidate's vectors B1
 Resultant with correct arrow B1
 Resultant 94 to 96 m/s by scale OR 95 m/s by calculation *Unit penalty applies B1
 Angle measured $13.5^\circ - 15.5^\circ$ OR 15° by calculation *Unit penalty applies B1 [6]
- *Apply unit penalty once only
- 2 (a) No resultant/net force OR no resultant force in any direction B1
 OR no resultant force in any two perpendicular directions
- No resultant/net moment/turning effect/couple/torque B1
 OR (total) clockwise moment = (total) anticlockwise moment
- Either order
- (b) (i) $F \times 120 / F \times 0.12$ C1
 $= 20 \times 500$ OR 20×0.5 C1
 $F = 83.3\text{N}$ at least 2 significant figures. Allow $83\frac{1}{3}$ *Unit penalty applies A1
- (ii) F/A or in words OR $83.3/0.0036$ ecf from (b)(i) C1
 $= 23100\text{ Pa} / \text{N/m}^2$ OR 2.31 N/cm^2 OR 23.1 kPa *Unit penalty applies A1 [7]
- *Apply unit penalty once only

- 3 (a) horizontal by eye M1
 arrow to left A1
 idea of airliner accelerating/changing direction AND caused by force in that direction o.w.t.t.e. OR centripetal force
 OR force/acceleration towards centre of circle B1 [3]
- (b) 2 lines approximately length ratio 1.16:1 at 30°/150° to each other M1
 parallelogram with line across short diagonal/triangle with original lines at 30° M1
 resultant to the left, horizontal by eye A1 [3]
 for first two marks ignore arrows, ignore labels unless they clarify an otherwise confusing diagram
- calculation route
 both forces used in cosine rule (M1)
 3rd force from previous line and correct angle used in sine rule (M1)
 calculation shows horizontal resultant (A1)
- (c) direction changing B1
 (therefore) velocity changing or speed/magnitude constant B1 [2]
- 4 (a) (i) (a =) v/t or 65/26 C1
 2.5 m/s^2 *Unit penalty applies A1
- (ii) (F =) ma or $3.4 \times 10^5 \times 2.5$ ecf from 3(a)(i) C1
 $8.5 \times 10^5 \text{ N}$ *Unit penalty applies ecf from 3(a)(i) A1
- (b) (i) any two of: KE or GPE or heat/internal energy/thermal energy B2
 (ii) chemical energy **not** heat B1
 (iii) thermal energy/sound is lost (to the atmosphere) or KE of air B1
- (c) perpendicular to path or towards centre of circle or centripetal B1 [9]

*Apply unit penalty once onl

- 5 (a) force AND perpendicular distance (of force) from the point. B1
- (b) downward arrow at centre of bar B1
- (ii) 0.5(0) m / 50 cm
- (iii) 40×1.2 OR 48 seen anywhere C1
 (+) 30×0.5 OR 15 seen anywhere C1
 = 63 Nm A
- (iv) $F \times 0.2 = 63$ C1
 $F = 63/0.2 = 315$ N A1
- (v) make bar / B longer
 OR move pivot / stone to the left
 OR increase distance between force and pivot (by moving pivot to left)
 OR increase mass of the bar / B B1 [9]