1   (a) Size / magnitude (NOT distance) <u>and</u> 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° – 15.5° 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
         OR no resultant force in any two perpendicular directions   B1

         No resultant/net moment/turning effect/couple/torque
         OR (total) clockwise moment = (total) anticlockwise moment   B1

         Either order

    (b) (i) $F \times 120 / F \times 0.12$ C1
             $= 20 \times 500$ OR 20×0.5 C1
             $F = 83.3$ N at least 2 significant figures. Allow $83^1/_3$ *Unit penalty applies   A1

        (ii) F/A or in words OR $83.3/0.0036$ ecf from (b)(i)   C1
            $= 23100$ Pa / 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 <u>AND</u> caused by force <u>in that</u>
        <u>direction</u> 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) <u>direction</u> 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 × 10^5 × 2.5   ecf from **3(a)(i)**   C1
             8.5 × 10^5 N *Unit penalty applies   ecf from **3(a)(i)**   A1

    (b) (i) any <u>two</u> 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 <u>of air</u> B1

    (c) perpendicular to path **or** towards centre of circle **or** centripetal   B1   [9]

    *Apply unit penalty once onl

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5 **(a** force AND
       <u>perpendicular</u> 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 0R 15 seen anywhere   C1
              = 63 N m   A

     (iv) F × 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]