Question	Answer	Mark
1(a)(i)	(momentum =) mv OR 70 × 20 = 1400 kg m / s OR N s	C1 A1
a)(ii)	same numerical answer as **(a)(i)** with either unit OR 1400 kg m / s	B1
(b)	(a =) change of velocity / time OR (v – u)/t OR 20 / 0.2 100 m / s^2	C1 A1
(c)	(F =) ma OR 70 × 80 5600 N	C1 A1
(d)	Force / impact on passenger or dummy less (than without seat belt / airbag) Passenger less likely to be injured / hurt / damaged	M1 A1

Total: 9

2   **(a**   mv – mu   OR   m(v – u)   OR   mv   OR   0.15 × 8.0   C1
        1.2 N s   or   kg m / s   A

      (b)   1.2 N s   or   kg m / s   B

      (c)   F = (mv – mu)/t   OR   F = mv / t   OR   impulse / t   OR   1.2 / 0.0015
          800 N   A1
          OR
          (F =) ma   OR   m[(v – u)/t]   OR   0.15 × 8 / 0.0015
          800 N   (A1)

[Total: 5]

3   **(a** $p = mv$ in any form, words or symbols   [1]
                0.16 kg m / s OR N s   [1

       (b)   use of principle of conservation of momentum in words, symbols or numbers   [1]
             use of combined mass 0.5(0) + 0.3(0) OR 0.8(0) (kg)   [1]
             0.2(0) m / s   [1]

4   **(a**   ($p =$) F/A OR in words OR 90/4.8 OR 90 / 0.00048   C1
             = 18.75 N/cm^2 OR 1.875 × 10^5 Pa OR 187500 Pa
             OR 187.5 kPa OR 0.1875 MPa   at least 2 s.f.   A1

       (b)   Area of Y bigger (than area of X so force greater)   B1

       (c)   Volume of oil moved at Y = volume of oil moved at X   B1
             Area of Y × distance moved by Y = Area of X × distance moved by X (so distance
             move by Y smaller)   B1
             OR
             Work done by piston X = work done on piston Y   (B1)
             Work = force × distance and F_2 is greater than F_1 so distance moved by Y smaller
             (than distance moved by X)   (B1)

       (d)   Air bubbles compress when pressure applied   M1
             More movement of piston X required for same movement of piston Y
             OR Y moves less (for same movement of X)
             OR Driver must push the brake pedal further / do more work
             OR Pressure reduced / force on Y reduced
             OR System is less efficient   A1

                                                                        [Total: 7]