MECHANICS 2 (A) TEST PAPER 8 : ANSWERS AND MARK SCHEME

1. Rebound speed = $0{\cdot}4(4) = 1{\cdot}6$ ms^{-1} — M1 A1
   K.E. lost = $\frac{1}{2} \times 2 \times (4^2 - 1{\cdot}6^2) = 13{\cdot}4$ J — M1 A1 A1 — 5

2. (a) When $v = 0$, $4t^2 = 9$ $t = 1{\cdot}5$ $a = 8t = 12$ ms^{-2} — M1 A1 A1
   (b) $s = \int_0^{1{\cdot}5} v\,dt = [\frac{4}{3}t^3 - 9t]_0^{1{\cdot}5} = 4{\cdot}5 - 13{\cdot}5$, so distance = 9 m — M1 M1 A1 A1 — 7

3. (a) $\mathbf{v} = e^t\mathbf{i} - 2\mathbf{j}$ (b) $\mathbf{a} = e^t\mathbf{i}$, so always in i-direction — M1 A1; M1 A1
   (c) When $|\mathbf{a}| = 12$, $t = \ln 12 = 2{\cdot}48$ s — M1 A1 A1 — 7

4. Let R = reaction at wall Resolve horizontally : $R = 12\mu$ — M1 A1
   Resolve vertically : $12 + \mu R = 1{\cdot}4g$ — M1 A1
   Hence $12 + 12\mu^2 = 1{\cdot}4g$ $1 + \mu^2 = 1{\cdot}143$ $\mu = 0{\cdot}38$ — M1 A1 M1 A1 — 8

5. (a) $25920 = k(36^2)(36)$ $k = 25920 \div 36^3 = \frac{5}{9}$ — M1 A1 M1 A1
   (b) $25920 = 25(\frac{5}{9}(25)^2 + 460a)$ $a = 1{\cdot}50$ ms^{-2} — M1 A1 A1 M1 A1 — 9

6. (a) PQR is a 3, 4, 5 Δ so angle $PQR = 90°$ — B1
   By property of medians, distances are (i) $\frac{1}{3} \times 24 = 8$ cm from PQ — M1 A1
   (ii) $\frac{1}{3} \times 18 = 6$ cm from QR — M1 A1
   (b) Equilibrium is about to be broken when G is above Q — M1
   Then $\tan\theta = 8/6$ $\theta = 53{\cdot}1°$ — M1 A1 A1 — 9

7. (a) Momentum : $36m - 24m = 9mv_A + 4mv_B$ $9v_A + 4v_B = 12$ — M1 A1 A1
   $v_A > 0$, so $4v_B < 12$ $v_B < 3$ — M1 A1
   (b) $(v_B - v_A)/(-6 - 4) = -e$ $e = (v_B - v_A)/10$ — M1 A1
   Now $v_B - v_A < v_B < 3$, so $e < \frac{3}{10}$ — M1 A1 A1
   (c) If $e = 0$, $v_B = v_A$ $13v_A = 12$ $v_A = v_B = \frac{12}{13}$ ms^{-1} — M1 M1 A1 A1 — 14

8. (a) $600 = \frac{1}{2}gt^2$ $t = \sqrt{122.45} = 11{\cdot}1$ s — M1 A1 A1
   (b) $x = 55t = 608{\cdot}6$ m — M1 A1
   (c) $v_x = 55$, $v_y = gt = 108{\cdot}4$ $v = \sqrt{(v_x^2 + v_x^2)} = \sqrt{14785} = 121{\cdot}6$ — M1 A1 M1 A1
   $121{\cdot}6 < 125$ so packet does not split open — A1
   (d) Need $v_x^2 + 108{\cdot}4^2 = 125^2 = 15625$ so $v_x = 62{\cdot}2$ ms^{-1} — M1 A1 A1
   (e) 11·1 s, as in (a) — A1
   (f) Leaflet is likely to drift due to wind and air resistance, so — B1
   particle model is not appropriate — B1 — 16