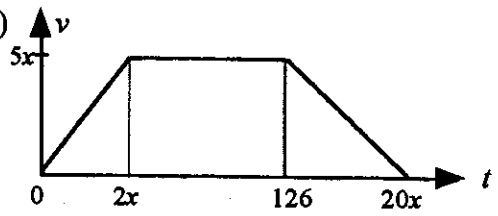
MECHANICS 1 (A) TEST PAPER 5 : ANSWERS AND MARK SCHEME

1. (a) $R = 2(5 \sin 55°) = 8{\cdot}19$ N (b) Bearing = 035° M1 A1 A1; M1 A1 5

2. (a) M(Z) : $0{\cdot}7(2g) = 2{\cdot}8(mg)$ $m = 0{\cdot}5$ kg M1 M1 A1 A1
   (b) Greater, as moment of weight larger and distance to stone less B1 B1 6

3. (a) $F - 400 = 2150 \times 0{\cdot}2$ $F = 400 + 430 = 830$ N M1 A1 A1
   (b) $F - 300 - T = 1800 \times 0{\cdot}2$ $T = 530 - 360 = 170$ N M1 A1 M1 A1 7

4. (a)


   B2 graph
   B2 labelling
   (b) Area $= \frac{1}{2} \times 5x(20x + 126 - 2x) = 45x^2 + 315x = 5400$ (given) M1 M1 A1
   $\div 45 : x^2 + 7x = 120$ A1
   (c) $x^2 + 7x - 120 = 0$ $(x - 8)(x + 15) = 0$ $x = 8$ M1 A1 A1 11

5. (a) $\overrightarrow{OP} = t(5\mathbf{i} + 2\mathbf{j})$ m, $\overrightarrow{OQ} = (4t\mathbf{i} + 6\mathbf{j})$ m B1 M1 A1
   (b) $\overrightarrow{PQ} = -t\mathbf{i} + (6 - 2t)\mathbf{j}$ $d^2 = (-t)^2 + (6 - 2t)^2 = 5t^2 - 24t + 36$ M1 A1 M1 A1 A1
   (c) $\frac{d}{dt}(d^2) = 10t - 24 = 0$ for min. $t = 2{\cdot}4$ M1 A1 A1
   (d) When $t = 2{\cdot}4$, $PQ = \sqrt{7{\cdot}2} = 2{\cdot}68$ m M1 A1
   Then $\overrightarrow{OP} = (12\mathbf{i} + 4{\cdot}8\mathbf{j})$ m, $\overrightarrow{OQ} = (9{\cdot}6\mathbf{i} + 6\mathbf{j})$ m B1 B1 15

6. (a) $8m \div m = 8$ ms^{-1} M1 A1
   (b) Momentum : $2m(6) = 2mv_A + 8m$ $v_A = 2$ ms^{-1} M1 A1 A1
   (c) $8m - 11m = mv_B$ $v_B = -3$, i.e. 3 ms^{-1} in reverse direction M1 A1 A1
   (d) B has moved 3 m in $\frac{3}{8}$ s, during which time A has moved 0·75 m M1 A1
   so A and B are 2·25 m apart. Let d = required distance : A1
   $d \div 3 = (2{\cdot}25 - d) \div 2$ $2d = 6{\cdot}75 - 3d$ $d = 1{\cdot}35$ m M1 A1 A1
   (e) Modelled as particles, so width of spheres is negligible B1 15

7. (a) Resolve // to plane : $\mu R + mg \sin 30° = kmg \cos 30°$ M1 A1
   Resolve perp. to plane : $R + kmg \sin 30° = mg \cos 30°$ M1 A1
   $\mu mg(\frac{\sqrt{3}}{2} - \frac{1}{2}k) = mg(k\frac{\sqrt{3}}{2} - \frac{1}{2})$ $\mu = \frac{k\sqrt{3} - 1}{\sqrt{3} - k}$ M1 A1 A1
   (b) With $k = \frac{3\sqrt{3}}{7}$, $\mu = (\frac{9}{7} - 1) \div \frac{4\sqrt{3}}{7} = \frac{2}{4\sqrt{3}} = \frac{2\sqrt{3}}{12} = \frac{\sqrt{3}}{6}$ M1 A1 A1
   (c) Force down plane $= \frac{1}{2}mg$ Max. friction $= \frac{\sqrt{3}}{6} \times mg\frac{\sqrt{3}}{2} = \frac{1}{4}mg$ B1 M1 A1
   so moves down with acceleration $\frac{1}{4}g = 2{\cdot}45$ ms^{-2} M1 A1
   (d) P is shown as a ball, in which case it would roll B1 16