MECHANICS 1 (A) TEST PAPER 10 : ANSWERS AND MARK SCHEME

1.   (a) Weight $= 19 - 18 = 1$ N, so mass $= 1 \div g = 0.102$ kg $= 102$ g   M1 A1 A1

    (b) M(0) : $1(15) + 18(10) = 11(5) + 8x$ $8x = 140$ $x = 17.5$ M1 A1 A1

    (c) Assumed it is a straight line with weight acting at mid-point   B1   7

2.   Resolve horizontally : $F \cos 30° = 2 \cos 45° + 0.25R$ M1 A1

    Resolve vertically : $R + 2 \sin 45° + F \sin 30° = 0.3g$ M1 A1

    $0.866F = 1.414 + 0.25(0.3g - 1.414 - 0.5F)$ M1 A1

    $0.991F = 1.796$ $F = 1.81$ A1   7

3.   (a) $250 = \frac{1}{2}(17 + 33)t$ $t = 500 \div 50 = 10$ s   M1 A1 A1

    (b) $v = u + at$: $33 = 17 + 10a$ $a = 1.6$ ms^{-2} M1 A1

    (c) $s = \frac{1}{2}(33 + 0) \times 6 = 99$ m   M1 A1   7

4.   (a) $F = ma$ for R : $0.5g - 2 = 0.5a$ $a = 5.8$ ms^{-2} M1 A1 A1

    (b) $T - 0.1g = 0.1a$ $T = 0.58 + 0.98 = 1.56$ N   M1 A1

        $2 - T = ma$ $5.8m = 0.44$ $m = 0.0759$ M1 A1 A1

    (c) String inextensible : if not, accelerations different   B1 B1

        Pulleys smooth : if not, tensions different either side of pulley   B1 B1   12

5.   (a) Momentum : $18u - 16u = -18(u/2) + 16v$ M1 A1 A1

        $2u = -9u + 16v$ $11u = 16v$ $v = \frac{11u}{16}$ M1 A1

    (b) Velocity of Q was negative, now positive, so direction reversed   B1

    (c) Impulse $= 16\,000(u + \frac{11u}{16}) = 27\,000u$ Ns   M1 A1 B1

    (d) $108\,000ut = 27\,000u$ $t = 0.25$ s   M1 A1 A1   12

6.   (a) (i) 1.5 ms^{-1} (ii) $-1\frac{1}{3}$ ms^{-1} B1 B1

    (b) 2×7 m $= 14$ m   M1 A1

    (c) Line from (2, 3) to (4, 7) is $y - 3 = 2(t - 2)$ $y = 2t - 1$ M1 A1 A1

    (d) Graph sketched : 6 horizontal line segments   B3

    (e) Steepest section has gradient -3, so max. speed $= 3$ ms^{-1} M1 A1 A1   13

7.   (a) $\overrightarrow{SO} = 10\mathbf{i} - 24\mathbf{j}$, having magnitude 26 km   B1 B1

        $\mathbf{v}_S = \frac{52}{26}(10\mathbf{i} - 24\mathbf{j}) = (20\mathbf{i} - 48\mathbf{j})$ km h^{-1} $\mathbf{v}_T = -50\mathbf{j}$ km h^{-1} M1 A1 A1

    (b) $\mathbf{r}_S = -10\mathbf{i} + 24\mathbf{j} + \frac{t}{60}(20\mathbf{i} - 48\mathbf{j}) = (\frac{1}{3}t - 10)\mathbf{i} + (24 - \frac{4}{5}t)\mathbf{j}$ M1 A1 A1

        $\mathbf{r}_T = 25\mathbf{j} + \frac{t}{60}(-50\mathbf{j}) = (25 - \frac{5}{6}t)\mathbf{j}$ M1 A1

    (c) $\overrightarrow{ST} = (10 - \frac{1}{3}t)\mathbf{i} + (1 - \frac{1}{30}t)\mathbf{j}$ $\tan\theta = (10 - \frac{1}{3}t) \div (1 - \frac{1}{30}t) = 10$ M1 A1 M1 A1

        Bearing $= 084.3°$ A1

    (d) When $t = 30$, $\mathbf{r}_S = \mathbf{r}_T = \mathbf{0}$, so trains collide at O M1 A1   17