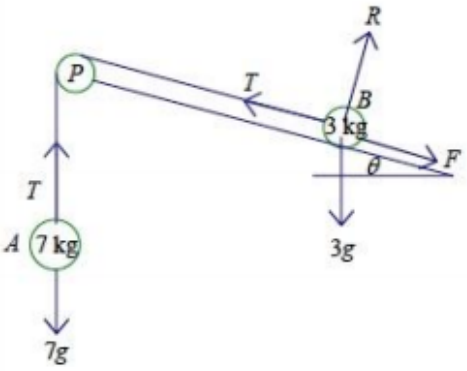
**1.**

| Question Number | Scheme | Marks |
|---|---|---|
| Q1 | $45 = 2u + \frac{1}{2}a2^2 \Rightarrow 45 = 2u + 2a$ | M1 A1 |
| | $165 = 6u + \frac{1}{2}a6^2 \Rightarrow 165 = 6u + 18a$ | M1 A1 |
| | eliminating either $u$ or $a$ | M1 |
| | $u = 20$ and $a = 2.5$ | A1 A1 **[7]** |

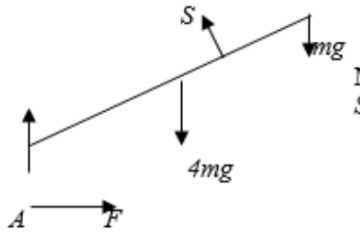
**2.**

| Question | Scheme | Marks |
|---|---|---|
| **2a** | $v = 3t^2 - 30t + 62$ | B1 |
| | Initial Velocity: $v = 3(0)^2 - 30(0) + 62$ | B1 |
| | $v = 62$ ($ms^{-1}$) | A1 |
| **2b** | $a = 6t - 30$ | B1 |
| | $t = 5$ | A1 |

**3.**

| Question Number | Scheme | Marks |
|---|---|---|
| **(a)** |  $\tan\theta = \frac{5}{12}$ $\sin\theta = \frac{5}{13}$ $\cos\theta = \frac{12}{13}$ | |
| | For A: $7g - T = 7a$ | M1 A1 |
| | For B: parallel to plane $T - F - 3g\sin\theta = 3a$ | M1 A1 |
| | perpendicular to plane $R = 3g\cos\theta$ | M1 A1 |
| | $F = \mu R = 3g\cos\theta = 2g\cos\theta$ | M1 |
| | Eliminating $T$, $7g - F - 3g\sin\theta = 10a$ | DM1 |
| | Equation in g and a: $7g - 2g\times\frac{12}{13} - 3g\frac{5}{13} = 7g - \frac{39}{13}g = 4g = 10a$ | DM1 |
| | $a = \frac{2g}{5}$ *oe* or 3.9 or 3.92 | A1 |
| | | (10) |
| **(b)** | After 1 m, | |
| | $v^2 = u^2 + 2as$, $v^2 = 0 + 2\times\frac{2g}{5}\times 1$ | M1 |
| | $v = 2.8$ | A1 |
| | | (2) |
| **(c)** | $-(F + 3g\ \sin\theta) = 3a$ | M1 |
| | $\frac{2}{3}\times 3g\times\frac{12}{13} + 3g\times\frac{5}{13} = 3g = -3a,\ a = -g$ | A1 |
| | $v = u + at,\ 0 = 2.8 - 9.8t,$ | DM1 |
| | $t = \frac{2}{7}$ oe, 0.29. 0.286 | A1 |
| | | (4) **[16]** |

**4.**

| | | |
|---|---|---|
| (a) |  <br>M($A$):<br>$S.3a = 4mg.2a\cos\alpha + mg.4a\cos\alpha$<br>$= \frac{48}{5}mga \Rightarrow S = \frac{16}{5}mg$ * | M1 A1<br>A1<br>**(3)** |
| (b) | R(↑): $R + S\cos\alpha = 5mg$<br>R(→): $F = S\sin\alpha$<br>$F \le \mu R \Rightarrow \mu \ge \frac{48}{61}$ * | M1 A1<br>M1 A1<br>dep on both previous M's<br>M1 A1<br>**(6)** |
| (c) | Direction of $S$ is perpendicular to plank<br>or No friction at the peg | B1<br>**(1)** |

**5.**

| Question Number | Scheme | Marks |
|---|---|---|
| (a) | → $x = u\cos\alpha t = 10$ | M1A1 |
| | ↑ $y = u\sin\alpha t - \frac{1}{2}gt^2 = 2$ | M1A1 |
| | $\Rightarrow t = \frac{10}{u\cos\alpha}$ | |
| | $2 = u\sin\alpha \times \frac{10}{u\cos\alpha} - \frac{g}{2} \times \frac{100}{u^2\cos^2\alpha}$ | M1 |
| | $= 10\tan\alpha - \frac{50g}{u^2\cos^2\alpha}$ (given answer) | A1<br>**(6)** |
| (b) | $2 = 10 \times 1 - \frac{100g \times 2}{2u^2 \times 1}$ | M1A1 |
| | $u^2 = \frac{100g}{8}$, $u = \sqrt{\frac{100g}{8}} = 11.1$ (m s$^{-1}$) | A1 |
| | $\frac{1}{2}mu^2 = m \times 9.8 \times 2 + \frac{1}{2}mv^2$ | M1A1 |
| | $v = 9.1ms^{-1}$ | A1<br>**(6)** |
| | | **[12]** |