| Question | Scheme | Marks |
|---|---|---|
| **3(a)** | Equation of motion for whole system. | M1 |
| | $F - 640 - 1100g\sin\alpha = 1100a$ | A1 A1 |
| | Use of $P=Fv$ $\quad F = \frac{15000}{12}\left(=1250\right)$ | M1 |
| | $a = 0.16\left(\text{m s}^{-2}\right)$ or $a = 0.163\left(\text{m s}^{-2}\right)$ | A1 |
| | | (5) |
| **3(b)** | Work-energy equation for the trailer. | M1 |
| | $\frac{1}{2}\times 200\times 14^2 = 240d + 200g\times\frac{1}{25}d$ | A1 A1 |
| | $\left(AB=\right)62\left(\text{m}\right)$ or $\left(AB=\right)61.6\left(\text{m}\right)$ | A1 |
| | | (4) |
| | | **(9)** |
| | Notes | |
| **3(a)** | | |
| | Over-accuracy or under-accuracy is penalised max **once** per complete question. Penalise final A mark in the appropriate part.<br>Use of g = 9.81 or 10 is penalised max **once** per complete question. Penalise final A mark in the appropriate part.<br>If both errors occur, could lose the final two A marks. | |
| **M1** | Equation of motion for whole system. All terms required. Dimensionally correct. Condone sign errors and sin/cos confusion. May form two equations of motion (van and trailer) and combine to eliminate *T*. Condone slip with zeroes for M mark. The forces on the LHS must be consistent with the mass in the '*ma*'.<br>Note that $\sin\left(\frac{1}{25}\right)$ is an accuracy error, **not** a method error. | |
| **A1** | Unsimplified equation in *F* or *P* with at most one error. Missing *g* from both weight terms counts as 1 error. | |
| **A1** | Correct unsimplified equation in *F* or *P* | |
| **M1** | Use of $P = Fv$. Condone slip with zeroes for M mark. | |
| **A1** | Correct answer, 2 sf or 3 sf. | |
| **3(b)** | | |
| **M1** | Work-energy equation. Condone slip with zeroes for M mark. Dimensionally correct, all terms required and with correct structure: KE, GPE, WD. No repeats. Must use mass of trailer only. Condone sign errors and sin / cos confusion. M0 for *suvat*.<br>Note that $\sin\left(\frac{1}{25}\right)$ is an accuracy error, **not** a method error. | |
| **A1** | Unsimplified equation with at most one error. | |
| **A1** | Correct unsimplified equation with mass replaced. | |
| **A1** | Correct answer, 2 sf or 3 sf No need for *AB* = | |