1. Fig. 8.1 shows a sledge of mass 40 kg. It is being pulled across a horizontal surface of deep snow by a light horizontal rope. There is a constant resistance to its motion.

The tension in the rope is 120 N.

Fig. 8.1

The sledge is initially at rest. After 10 seconds its speed is 5 ms^{-1}.

i. Show that the resistance to motion is 100 N.

[4]

When the speed of the sledge is 5 ms^{-1}, the rope breaks.

The resistance to motion remains 100 N.

ii. Find the speed of the sledge

A. 1.6 seconds after the rope breaks,

[3]

B. 6 seconds after the rope breaks.

[1]

The sledge is then pushed to the bottom of a ski slope. This is a plane at an angle of 15° to the horizontal.

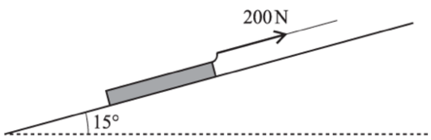


Fig. 8.2

The sledge is attached by a light rope to a winch at the top of the slope. The rope is parallel to the slope and has a constant tension of 200 N. Fig. 8.2 shows the situation when the sledge is part of the way up the slope.

The ski slope is smooth.

iii. Show that when the sledge has moved from being at rest at the bottom of the slope to the point when its speed is 8 ms^{-1}, it has travelled a distance of 13.0 m (to 3 significant figures).

[4]

When the speed of the sledge is 8 ms^{-1}, this rope also breaks.

iv. Find the time between the rope breaking and the sledge reaching the bottom of the slope.

[6]

2. The battery on Carol and Martin's car is flat so the car will not start. They hope to be able to "bump start" the car by letting it run down a hill and engaging the engine when the car is going fast enough. Fig. 6.1 shows the road leading away from their house, which is at A. The road is straight, and at all times the car is steered directly along it.

- From A to B the road is horizontal.
- Between B and C, it goes up a hill with a uniform slope of 1.5° to the horizontal.
- Between C and D the road goes down a hill with a uniform slope of 3° to the horizontal. CD is 100 m. (This is the part of the road where they hope to get the car started.)
- From D to E the road is again horizontal.

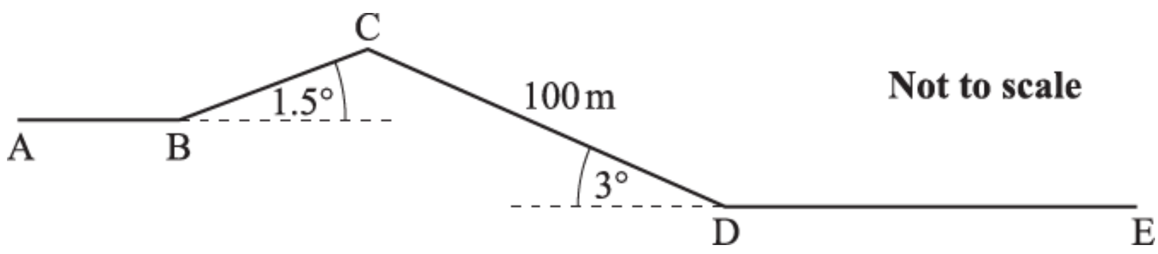


Fig. 6.1

The mass of the car is 750 kg, Carol's mass is 50 kg and Martin's mass is 80 kg.

Throughout the rest of this question, whenever Martin pushes the car, he exerts a force of 300 N along the line of the car.

i. Between A and B, Martin pushes the car and Carol sits inside to steer it. The car has an acceleration of 0.25 m s^{-2}.

Show that the resistance to the car's motion is 100 N.

[3]

Throughout the rest of this question you should assume that the resistance to motion is constant at 100 N.

ii. They stop at B and then Martin tries to push the car up the hill BC.

Show that Martin cannot push the car up the hill with Carol inside it but can if she gets out.

Find the acceleration of the car when Martin is pushing it and Carol is standing outside.

[6]

iii. While between B and C, Carol opens the window of the car and pushes it from outside while steering with one hand. Carol is able to exert a force of 150 N parallel to the surface of the road but at an angle of 30° to the line of the car. This is illustrated in Fig. 6.2.

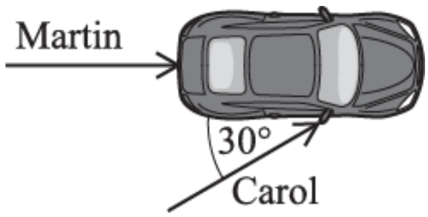


Fig. 6.2

Find the acceleration of the car.

[4]

iv. At C, both Martin and Carol get in the car and, starting from rest, let it run down the hill under gravity. If the car reaches a speed of 8 m s^{-1} they can get the engine to start.

Does the car reach this speed before it reaches D?

[5]

3. Fig. 3.1 shows a block of mass 8 kg on a smooth horizontal table.

This block is connected by a light string passing over a smooth pulley to a block of mass 4 kg which hangs freely. The part of the string between the 8 kg block and the pulley is parallel to the table.

The system has acceleration a ms^{-2}.

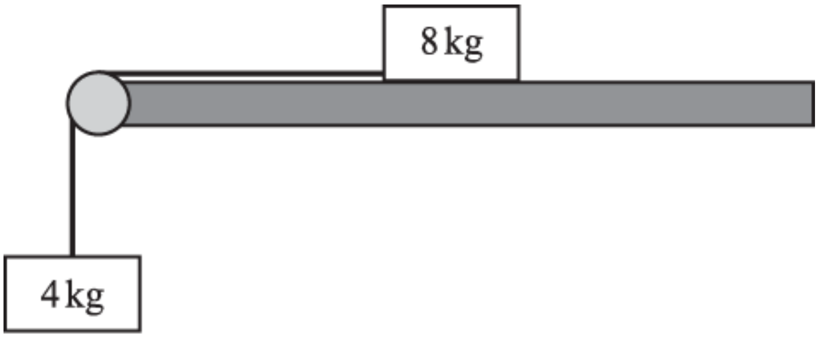


Fig. 3.1

i. Write down two equations of motion, one for each block.

[2]

ii. Find the value of a.

[2]

The table is now tilted at an angle of θ to the horizontal as shown in Fig. 3.2. The system is set up as before; the 4 kg block still hangs freely.

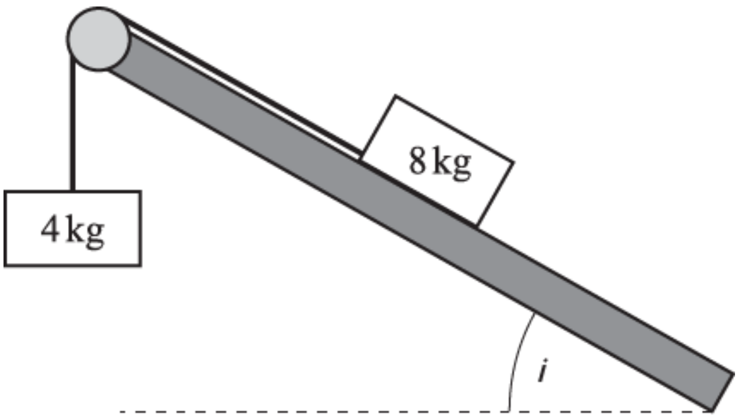


Fig. 3.2

iii. The system is now in equilibrium. Find the value of θ.

[4]

4. In an experiment a small box is hit across a floor. After it has been hit, the box slides without rotation. The box passes a point A. The distance the box travels after passing A before coming to rest is S metres and the time this takes is T seconds. The only resistance to the box's motion is friction due to the floor.
The mass of the box is m kg and the frictional force is a constant F N.

(a) (i) Find the equation of motion for the box while it is sliding.

(ii) Show that $S = kT^2$ where $k = \frac{F}{2m}$. [4]

(b) Given that $k = 1.4$, find the value of the coefficient of friction between the box and the floor. [4]

5. Austin pushes a curling stone of mass 18 kg on ice. He releases the stone and it slides 21 m in a straight line until coming to rest after 14 s. He models the motion by assuming that the frictional force is constant.

(a) Show that the speed of the stone at the moment that Austin releases it is 3 m s^{-1}. [2]

(b) Find the magnitude of the frictional force acting on the stone. [3]

(c) Calculate the coefficient of friction between the stone and the ice, giving your answer correct to 2 significant figures. [3]

6. A car pulls a caravan along a straight road uphill on a slope that makes an angle of 8° with the horizontal.
The mass of the car is 1700 kg and the mass of the caravan is 1300 kg. The driving force is 9000 N and the car and caravan experience resistances of 600 N and 1200 N respectively.
The coupling between the car and the caravan is light and parallel to the road.

(a) Draw a diagram showing all the forces acting on the car and all the forces acting on the caravan. [3]

(b) Find the acceleration of the car and caravan as they move up the hill. [4]

(c) Find the tension in the coupling between the car and the caravan. [3]

7. A block slides from rest down a line of greatest slope of a smooth plane inclined at 20° to the horizontal. Calculate the speed of the block when it has travelled 2 m. [4]

8. Fig. 9 shows a block of mass 2 kg resting on a rough horizontal table. It is attached to a ball of mass *m* kg by a light inextensible string that passes over a smooth pulley at the edge of the table. The ball hangs vertically below the pulley. The coefficient of friction between the block and the table is 0.6.

The system is held in equilibrium by a force of $5\sqrt{2}$ acting on the block at 45° above the horizontal. The block is on the point of sliding towards the pulley.

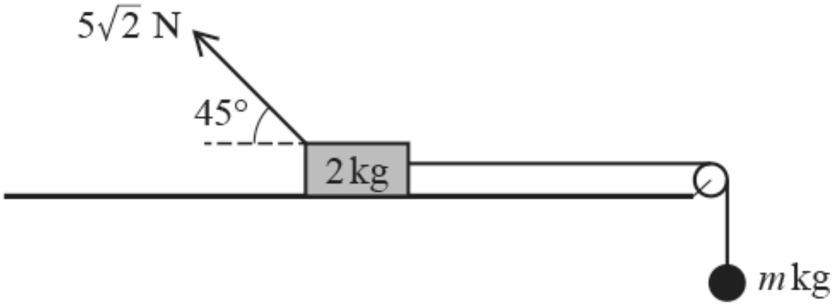


Fig. 9

(a) Complete the force diagram above to show all the forces acting on the block and the ball. [2]

(b) Calculate the frictional force acting on the block. [4]

(c) Calculate the value of *m*. [4]

9. Rory pushes a box of mass 2.8 kg across a rough horizontal floor against a resistance of 19 N. Rory applies a constant horizontal force. The box accelerates from rest to 1.2 ms^{-1} as it travels 1.8 m.

(a) Calculate the acceleration of the box. [2]

(b) Find the magnitude of the force that Rory applies. [2]

10. A model train consists of an engine of mass 0.3 kg and a truck of mass 0.2 kg. The train is pulled up a smooth plane inclined at 20° to the horizontal by a force of 2.5 N. This force is applied to the engine and acts parallel to a line of greatest slope of the plane.

(a) Show that the acceleration of the train is 1.65ms^{-2} correct to 3 significant figures. [3]

(b) Find the tension in the coupling between the engine and the truck. [2]

(c) Find the distance travelled by the train as it accelerates from 1ms^{-1} to 3ms^{-1}. [2]

END OF QUESTION paper

Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	$v = u + at$	M1	Use of a suitable constant acceleration formula
		i	$5 = 0 + a \times 10 \Rightarrow a = 0.5$	A1	Notice The value of a is not required by the question so may be implied by subsequent working
		i	$F = ma \Rightarrow 120 - R = 40 \times 0.5$	M1	Use of Newton's 2[nd] Law with correct elements
		i	$R = 100$N	E1	<u>Examiner's Comments</u> This question involved a sledge being pulled, initially horizontally and then up a slope. Part (i) asked for the resistance to motion and required the use of a constant acceleration formula and then Newton's 2nd Law. It was very well answered. A few candidates lost marks by using the given final answer in an argument that was less than a valid verification.
		ii	(A) $F = ma \Rightarrow -100 = 40a$	M1	Equation to find a using Newton's 2[nd] Law
		ii	$\Rightarrow a = -2.5$	A1	
		ii	When $t = 1.6$ $v = 5 + (-2.5) \times 1.6 = 1$ ms^{-1}	A1	CAO <u>Examiner's Comments</u> This question involved a sledge being pulled, initially horizontally and then up a slope. The situation changed because the rope pulling the sledge broke. Candidates were asked to find the speed of the sledge at a time when it was still moving.
		ii	(B) When $t = 6$, it is stationary. $v = 0$ ms^{-1}	B1	<u>Examiner's Comments</u> In part (ii) the situation changed because the rope pulling the sledge broke. In part (A) candidates were asked to find the speed of the sledge

					at a time when it was still moving and in part (B) at a later time when it would have come to a halt. Most candidates obtained the right answers to both parts. However, a few did not recognise that the acceleration changed when the rope broke and continued with the same value as they had in part (i). A more common mistake was to give a negative speed in part (B) rather than zero.
		iii	Motion parallel to the slope:	B1	Component of the weight down the slope, ie $40g\sin 15°$ (= 101.457…)
		iii	$200 - 40g\sin 15° = 40a$	M1	Equation of motion with the correct elements present. No extra forces.
		iii	$a = 2.463\ldots$		This result is not asked for in the question
		iii	$v^2 - u^2 = 2as \Rightarrow 8^2 = 2 \times 2.46\ldots \times s$	M1	Use of a suitable constant acceleration formula, or combination of formulae. Dependent on previous M1.
		iii	$\Rightarrow s = 12.989\ldots$ rounding to 13.0 m	E1	Note If the rounding is not shown for s the acceleration must satisfy $2.452\ldots < a < 2.471\ldots$ Examiner's Comments In part (iii) the sledge was being pulled up a smooth slope. There were many correct answers to this part but a few candidates were unable to use the component of the weight down the slope.
		iv	Let a be acceleration up the slope		
		iv	$-40 \times 9.8 \times \sin 15° = 40a$	M1	Use of Newton's 2nd Law parallel to the slope
		iv	$a = -2.536\ldots$, ie 2.536 ms^{-2} down the slope	A1	Condone sign error
		iv	$s = ut + \frac{1}{2}at^2$		
		iv	$-12.989\ldots = 8t + \frac{1}{2} \times (-2.536\ldots)t^2$	M1	Dependent on previous M1. Use of a suitable constant acceleration formula (or combination of formulae) in a relevant manner.

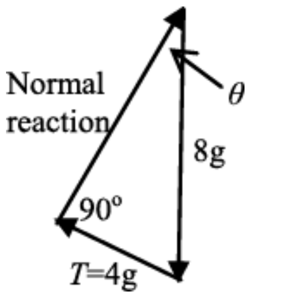
iv	$1.268\ldots t^2 - 8t - 12.989\ldots = 0$	A1	Signs must be correct
iv	$t = \dfrac{8 \pm \sqrt{64 - 4 \times 1.268\ldots \times (-12.989\ldots)}}{2 \times 1.268\ldots}$	M1	Attempt to solve a relevant three-term quadratic equation
iv	t = −1.339… or 7.647… , so 7.65 seconds	A1	
iv	**Alternative 2-stage motion**		
iv	Let *a* be acceleration up the slope		
iv	$-40 \times 9.8 \times \sin 15° = 40a$	M1	Use of Newton's 2nd Law parallel to the slope
iv	$a = -2.536\ldots$, ie 2.536 ms^{-2} down the slope	A1	Condone sign error
iv	Motion to highest point		
iv	$v = u + at \Rightarrow 0 = 8 - 2.536\ldots t$	M1	Dependent on previous M1. Use of a suitable constant acceleration formula, for either *t* or *s*, in a relevant manner.
iv	$t = 3.154\ldots$	A1	For either *t* or *s*
iv	$s = ut + \frac{1}{2}at^2 \Rightarrow s = 8 \times 3.154\ldots - \frac{1}{2} \times 2.536\ldots \times 3.154\ldots^2$		
iv	$s = 12.616\ldots$		
iv	Distance to bottom = 12.989… + 12. 616… = 25.605…		
iv	$s = ut + \frac{1}{2}at^2 \Rightarrow 25.605\ldots = \frac{1}{2} \times 2.536\ldots \times t^2$	M1	Use of a suitable constant acceleration formula
iv	$t = 4.493\ldots$		
iv	Total time = 3.154… + 4.493… = 7.647… s	A1	<u>Examiner's Comments</u> In part (iv), there was no longer a pulling force (the rope had broken again) and the sledge started moving up the slope, came to a stop and then slid down to the bottom of the slope. Candidates were asked to find how long this took. Many candidates knew what they had to do and there were plenty of correct answers; however, there were also many sign errors. This was the last question on the paper and several low-scoring candidates did not get started on it. There were also those who substituted completely wrong numbers into their constant

					acceleration formulae, indicating incorrect analysis of the situation.
			Total	18	
2		i	$F - R = ma$	M1	Use of Newton's 2nd Law
		i	$300 - R = (750 + 50) \times 0.25$	A1	Correct elements present
		i	$R = 100$	A1	This is a given result **Examiner's Comments** Generally this question was answered very well and many candidates got it completely right. Almost all candidates were successful on this part involving the use of Newton's 2nd Law. <u>Marking guidance</u> Follow through between parts of this question should be allowed for values found in parts (ii) and (iii) providing the questions are not simplified.
		ii	**Carol in** Component of weight down slope	M1	Resolving down the slope. Accept use of 750 instead of 800. For this mark only condone no g and allow sin-cos interchange.
		ii	$= 800g\sin 1.5°$ (= 205.2 N)	A1	Give M1 A1 for $800g\sin 15°$ seen
		ii	Martin has to overcome 305.2 N		
		ii	300 < 305.2 Martin cannot manage	A1	This mark may be awarded for an argument based on Newton's 2nd law leading towards $a = -0.006$
		ii	**Carol out** Martin has to overcome $750g\sin 1.5° + 100 = 292.4$N		
		ii	300 > 292.4 so Martin manages	B1	Explanation, based on correct working, that Martin can manage. This can be given retrospectively with a comment on a positive value for a.
		ii	$300 - 292.4 = 7.6 = 750a$	M1	Use of Newton's 2nd Law
		ii	The acceleration is 0.010 ms^{-2}	A1	Cao. Accept 0.01 or an answer that rounds to 0.01. **Examiner's Comments**

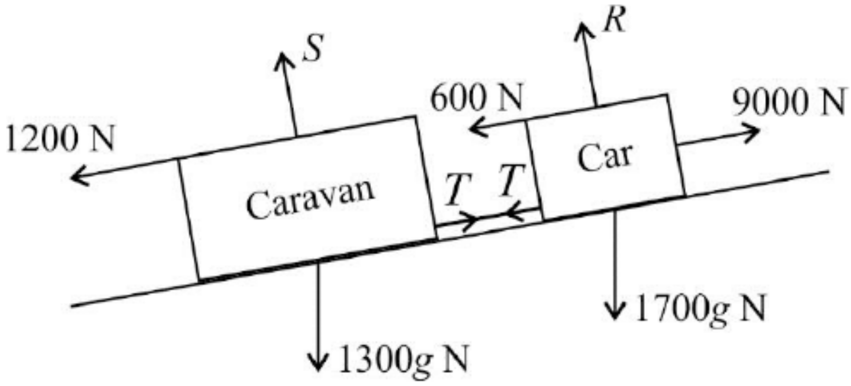
					Was about pushing a car up a slope. This was well-answered with most candidates resolving the weight correctly to find its component down the slope. Very few made the mistake of interchanging sin and cos.
		iii	Component of Carol's force parallel to the line of the car	M1	For attempt at resolution in the correct direction. For this mark only, condone sin-cos interchange.
		iii	= 150cos30° (= 129.9)	A1	Give M1 A1 for 150cos30° seen
		iii	Resultant forward force = 7.6 + 129.9 = 137.5 750a = 137.5	M1	All forces parallel to the slope present and correct. Sign errors condoned.
		iii	The acceleration is 0.183 ms^{-2}	A1	FT their force parallel to the slope from part (ii) (correct value 7.6 N) **Examiner's Comments** The car was still being pushed up the slope but an extra force was now involved. This meant that the equation of motion had five terms and some candidates lost marks by omitting one (or more) of them.
		iv	Component of weight down the slope = (750 + 50 + 80) × 9.8 × sin3°		
		iv	880a = 451.3 − 100	M1	Newton's 2nd law with correct elements present. No sin-cos interchange. The same mass must be used in both places.
		iv	a = 0.399 $v^2 - u^2 = 2as$	A1	
		iv	When v = 8, s = 8^2 ÷ (2 × 0.399)	M1	Selection and use of an appropriate formula (unless with $a = g$)
		iv	s = 80.1	A1	FT their value of a
		iv	80.1 < 100 so Yes they get the car started	A1	FT their value of a
		iv	**Alternative: Finding the speed after 100 m** Component of weight down the slope		

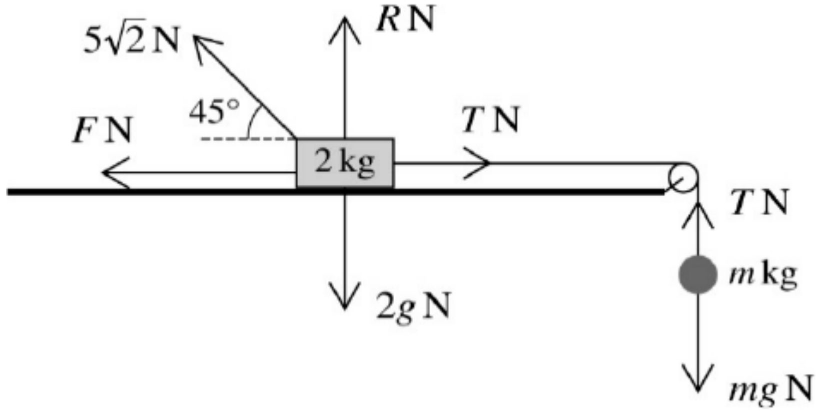
		iv	$= (750 + 50 + 80) \times 9.8 \times \sin 3°$	M1	Newton's 2nd law with correct elements present. No sin-cos interchange
		iv	$880a = 451.3 - 100$		
		iv	$a = 0.399$ $v^2 - u^2 = 2as$	A1	
		iv	$v^2 = (0^2) + 2 \times 0.399 \times 100$	M1	Selection and use of an appropriate formula (unless with $a = g$)
		iv	$v = (\sqrt{79.8}) = 8.93...$	A1	FT their value of a
		iv	($v > 8$) so they get the car started	A1	FT their value of a **Examiner's Comments** The car travelled down a slope and many candidates were able to select the right information and methods to deal with this new situation. Some lost marks by forgetting one of the terms, for example the resistance. Overall the response to this question was very pleasing.
			Total	**18**	
3		i	$T = 8a$	B1	
		i	$4g - T = 4a$	B1	Allow if a is in the upwards direction but the two equations must be consistent in this. **Examiner's Comments** Question 3 involved two connected particles in two different situations. In part (i) candidates were asked to write down the equation of motion of each particle. Most did this correctly but a common mistake was to introduce the weight of the block that was on a smooth horizontal table as an extra force.
		ii	Adding the two equations ⟹ $4g = 12a$	M1	Or equivalent method. No FT from part (i).
		ii	$a = \frac{g}{3}$ (≈ 3.27 ms^{-2})	A1	CAO but allow 3.26. **Examiner's Comments**

					The question then went on to ask candidates to solve the equations to find the acceleration of the system. Those who got the right equations in the previous part were almost entirely successful. By contrast those who made a mistake on one or both equations in part (i) were almost entirely unsuccessful. No follow through was allowed from wrong equations in part (i). Answer 3.27 ms^{-2}
		iii	Equilibrium equations		
		iii	$T - 4g = 0$	M1	Vertical equation
		iii	$T - 8g\sin\theta = 0$	M1	Award if $8g\sin\theta$ seen. Do not allow sin-cos interchange
		iii	$4g - 8g\sin\theta = 0$	A1	Correct equation with $T = 4g$ substituted
		iii			Note Award **M1 M1 A1** for going straight to $4g = 8g\sin\theta$ oe Allow **M1 M1 A0** for $4 = 8\sin\theta$ with no previous work
		iii	$\Rightarrow \theta = 30°$	A1	CAO **Examiner's Comments** In part (iii) the table was titled and the system was in equilibrium. Candidates were asked to find the angle of the table. There were many correct answers. The most common mistake was to try to work with the weight of the block on the table rather than its resolved component down the slope. A few candidates lost a mark by missing g out altogether. Answer 30°
		iii	**Alternative** $T - 4g = 0$	M1	
		iii	Triangle of forces for the 8 kg block	M1	Dependent on the other M mark There must be an attempt to use the triangle for this mark to be awarded.

					The triangle must be labelled with $4g$, $8g$ and θ. The right angle must be drawn close to 90°.
		iii	$\sin\theta = \dfrac{4g}{8g}$	A1	Dependent on both M marks.
		iii	$\theta = 30°$	A1	CAO
			Total	8	
4	a		**A** Let acceleration be a in the direction of motion. N2L in direction of motion gives $-F = ma$	M1(AO3.3)	Decide to use N2L to find acceleration
			so $a = -\dfrac{F}{m}$, which is constant.	A1(AO1.1)	No need to say 'constant'
	a		**B** (As a constant) use *suvat* , giving	B1(AO2.1)	Use appropriate (sequence of) *Suvat*
			$S = 0 \times T - \dfrac{1}{2} \times \left(-\dfrac{F}{m}\right) T^2$		
			so $S = \left(\dfrac{F}{2m}\right) T^2$, and $k = \dfrac{F}{2m}$	E1(AO2.4) [4]	
	b		As sliding, friction is limiting and $F = \mu R$	M1(AO3.3) A1(AO3.4)	In $F = \mu R$, substitute for F & R in terms of m and g
			$R = mg$	M1(AO1.1)	
			$k = \dfrac{F}{2m}$ so $k = \dfrac{\mu mg}{2m}$		
			Hence $\mu = \dfrac{2k}{g} = \dfrac{2 \times 1.4}{9.8} = \dfrac{2}{7}$	A1(AO2.2a) [4]	

					Or 0.286 (3s.f.)
			Total	8	
5		a	$21 = \frac{1}{2}(u+0)14$ $u = 3$ AG	M1(AO 1.1a) A1(AO 2.1) [2]	Use of *suvat* equation(s) to find u
		b	$0 = 3^2 + 2a \times 21$ $a = -\frac{3}{14}$ Magnitude of force $= \lvert ma \rvert = 18 \times \frac{3}{14}$ $= \frac{27}{7} = 3.86$ N	M1(AO 3.1b) M1(AO 1.1a) A1(AO 1.1b) [3]	Use of *suvat* to find acceleration Use of Newton II Must be magnitude (positive)
		c	$N = 18g$ $3.86 = \mu \times 18g$ $\mu = 0.022$ to 2 sf	B1(AO 3.1b) M1(AO 3.4) A1(AO 1.1b) [3]	soi Use of $F = \mu N$ to find μ Must be given correct to 2sf
			Total	8	

6		a	 Weights and normal reactions for each correctly shown 9000 N and force *T* in coupling correctly shown Resistances 600 N and 1200 N correctly shown	B1(AO 1.1a) B1(AO 3.3) B1(AO 3.3) [3]	The two force diagrams may be shown separately
		b	Resolve weights parallel to the slope $9000 - 600 - 1200 = 3000g\sin 8 - 3000a$ $7200 - 4091.689 = 3000a \Rightarrow a = 1.04 \text{ m s}^{-2}$	M1(AO 3.1a) M1(AO 3.3) A1(AO 1.1b) A1(AO 1.1b) [4]	Allow sin/cos errors here Newton II; all non-weight terms required All terms correct cao
		c	$T - 1200 - 1300g\sin 8 = 1300\times1.04$ **or** $9000 - 1700g\sin 8 - 600 - T = 1700\times1.04$ $T = 4320$ N (answer using *a* unrounded)	M1(AO 3.4) A1(1.1a) A1FT(AO 1.1b) [3]	Resolving parallel to the slope for car or caravan; all forces present, correct mass All terms in equation correct

					(for their *a*) FT their rounded / unrounded *a*
			Total	10	
7			Resolve down the slope, using Newtons' second law $mg \sin 20° = ma$ $v^2 = 0^2 + 2(g \sin 20°)s$ $v = \sqrt{13.407...} = 3.66 \text{ m s}^{-1}$	M1(AO3.3) A1(AO1.1b) M1(AO1.1a) A1(AO1.1b) [4]	Use of $v^2 = u^2 + 2as$
			Total	4	
8	a			B1(AO1.1a) B1(AO3.3) [2]	Weights and normal reaction labelled Tension correct in both parts of the string and friction in the correct direction Condone absence of units N in diagram Friction force could be shown as μ*R* or 0.6*R* and tension could be shown as *mg*
	b		$R + 5\sqrt{2}\sin 45° = 2g$ $R = 2g - 5$ (= 14.6) $F = 0.6(2g - 5)$	M1*(AO3.4) A1(AO1.1b) M1(AO1.1a)dep* A1(AO1.1b)	Resolve vertically for the block Numerical evaluation Allow sin or cos here

			$F = 8.76$ N	[4]	not needed here Use of $F = \mu R$, but do not allow if $R = 2g$
		c	$T = F + 5\sqrt{2}\cos 45° \quad (=13.76)$ $T = mg$ $m = \frac{13.76}{g} = 1.40$	M1(AO3.4) A1(AO1.1b) M1(AO1.1a) A1(AO1.1b) [4]	Resolve horizontally for the block — Allow sin or cos here Correct equation; evaluation not required for this mark Resolve vertically for the ball — soi
			Total	10	
9		a	$v^2 = u^2 + 2as$ $1.2^2 = 2 \times a \times 1.8$ $a = 0.4$ ms^{-2}	M1 (AO 3.3) A1 (AO 1.1b) [2]	Using suitable suvat equation(s) leading to value for a Examiner's Comments Most candidates successfully used the suvat equations to reach the correct answer.
		b	$F - 19 = 2.8a$ F = 20.12 (20.1 N to 3sf)	M1 (AO 3.3) A1 (AO 1.1b)	Using Newton's second law. All

				[2]	terms present. Allow 20 N FT their a **Examiner's Comments** Newton's second law was well understood and most candidates were successful here.
			Total	4	
10		a	Use of Newton's 2nd Law for the whole train Weight component parallel to the plane is $0.5g\sin20°$ $2.5 - 0.5g\sin20° = 0.5a$ $a = 1.65\ \text{ms}^{-2}$ to 3sf **Alternative solution** Equations for engine and truck separately N2L for engine: $2.5 - 0.3g\sin20° - T = 0.3a$ N2L for truck: $T - 0.2g\sin20° = 0.2a$ $a = 1.65\text{ms}^{-2}$ to 3sf	B1 (AO 3.3) M1 (AO 1.1a) A1 (AO 2.1) B1 M1 A1 [3]	May be implied by use in an equation N2L with at least one correct force — m = 0.5 used AG; must be clearly shown Correct weight component in at least one equation — m = 0.3 and/or 0.2 used Both equations attempted, plus attempt to eliminate T AG; must

					be clearly shown
		b	**Either** T – 0.2$g$sin° = 0.2 × 1.65 **Or** 2.5 – 0.3$g$sin20° – T = 0.3 × 1.65 T = 1 N	M1 (AO 3.3) A1 (AO 1.1b) [2]	Use of N2L for either engine or truck Allow awrt 1.00 / Equation must have all the forces and no extras
		c	$3^2 = 1^2 + 2 \times 1.65 \times s$ s = 2.42 m	M1 (AO 1.1a) A1 (AO 1.1b) [2]	Use of suvat leading to a value for s Or 2.43 from use of a = 1.6482…
			Total	7	