

1. 1.5 ms^{-2} (3)

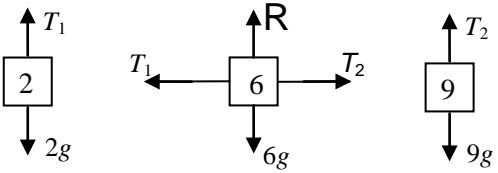
2. 0.625 ms^{-2} (3)

3. 9240 N (3)

4. 65 kg (3)

5. 0.12 ms^{-2} (3)
22.4 s

6		mark	notes
(a)	$\mathbf{F} = (10 - 8\cos 50)\mathbf{i} + 8\sin 50\mathbf{j}$ $= 4.85769\dots\mathbf{i} + 6.128355\dots\mathbf{j}$ so $4.86\mathbf{i} + 6.13\mathbf{j}$ (3 s. f.)	M1 A1 A1 3	Resolution. Accept $s \leftrightarrow c$. Condone resolution in only one direction. Award for a vector with either component correct or consistent $s \leftrightarrow c$ error is only mistake in the vector. Need not be evaluated. cao. Must be in $a\mathbf{i} + b\mathbf{j}$ or column format. Must be correct to 3 s. f.
(b)	$ \mathbf{F} = \sqrt{4.85769\dots^2 + 6.12835\dots^2} = 7.820101\dots$ so 7.82 (3 s. f.) angle is $\arctan \frac{4.857\dots}{6.128\dots}$ $= 38.40243\dots$ so 38.4° (3 s. f.)	B1 M1 F1 3	FT their F Or equivalent. FT their F . Accept $\arctan \frac{6.128\dots}{4.857\dots}$. Accept complementary angle and \pm signs FT only their F .
		6	

7	(a)		<p>B1 Diagrams for both 2 and 9 kg blocks. The tensions must be different from each other. No extra forces.</p> <p>B1 Tensions on 6 kg block. The tensions must be different from each other. No extra forces.</p> <p>B1 $6g$ and R on 6 kg block. No extra forces.</p> <p>Special Case When the tensions are given as T_1, T_2, T_3, T_4 (or equivalent) award up to SC1 SC0 for the first two marks.</p> <p>[3]</p>
	(b)	$9g - T_2 = 9a$ $T_2 - T_1 = 6a$ $T_1 - 2g = 2a$ $a = \frac{7}{17}g = 4.04 \text{ (m s}^{-2}\text{)}$ $T_1 = 27.7 \text{ (N)}$ $T_2 = 51.9 \text{ (N)}$	<p>M1 First equation correct</p> <p>M1 Both the remaining two equations correct. Do not give this mark if both tensions are shown as the same.</p> <p>A1 The final three marks are dependent on both M marks a, T_1 and T_2 may be found in any order and FT should be allowed from the first of these found</p> <p>A1</p> <p>A1</p> <p>[5]</p>
	(b)	<p>Alternative: Whole system</p> $9g - 2g = 17a$ $a = \frac{7g}{17} = 4.04$ $T_1 - 2g = 2a \text{ and } 9g - T_2 = 9a$ $T_1 = 27.7 \text{ (N)}$ $T_2 = 51.9 \text{ (N)}$	<p>M1</p> <p>A1</p> <p>M1 Both equations correct. Oe.</p> <p>A1 The final two marks are dependent on both M marks. T_1 and T_2 may be found in either order and FT should be allowed from their value for a.</p> <p>A1</p>

Question		Answer	Marks	Guidance
8	(a)	If the acceleration is to the right		
		Overall $30 - F = (4 + 6) \times 2$ $F = 10$	M1 A1	Newton's 2 nd Law in one direction. No extra forces allowed and signs must be correct.
		If the acceleration is to the left		
		$F = 50$	M1 A1	For considering second direction. No extra forces allowed and signs must be correct.
			[4]	
	(b)	6 kg block $30 - T = 6 \times 2$ $\Rightarrow T = 18$ In the other case $T = 42$	M1 A1 A1 [3]	Newton's 2 nd law with correct elements on either block CAO No follow through from part (i) CAO No follow through from part (i)

9		mark	comment	sub
	<p>either Overall, N2L → $135 - 9 = (5 + 4)a$</p> <p>$a = 14$ so 14 m s^{-2}</p> <p>For A, N2L → $T - 9 = 4 \times 14$ so 65 N</p> <p>or $135 - T = 5a$</p> <p>$T - 9 = 4a$ Solving $T = 65$ so 65 N</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p>	<p>Use of N2L. Allow $F = mga$ but no extra forces. Allow 9 omitted.</p> <p>N2L on A or B with correct mass. $F = ma$. All relevant forces and no extras. cao</p> <p>* 1 equation in T and a. Allow sign errors. Allow $F = mga$</p> <p>Both equations correct and consistent</p> <p>Dependent on M* solving for T. cao.</p>	<p>4</p>
		4		

10				
a)	$P - 800 = 20000 \times 0.2$ $P = 4800$	M1 A1 A1	N2L. Allow $F = mga$. Allow wrong or zero resistance. No extra forces. Allow sign errors. If done as 1 equ need $m = 20\,000$. If A and B analysed separately, must have 2 equns with ' T '. N2L correct.	3
(b)	New accn $4800 - 2800 = 20000a$ $a = 0.1$	M1 A1	$F = ma$. Finding new accn. No extra forces. Allow 500 N but not 300 N omitted. Allow sign errors. FT their P	2
(c)	$T - 2500 = 10000 \times 0.1$ $T = 3500$ so 3500 N	M1 A1	N2L with new a . Mass 10000. All forces present for A or B except allow 500 N omitted on A. No extra forces cao	2
				7

11 (a)	$0.6g - T = 0.6a$ $T - 0.2g = 0.2a$	M1 A1 A1	For applying Newton's second law to P or to Q (3 terms)
			<hr/> Allow B1 for $0.6g - 0.2g = (0.6 + 0.2)a$ as an alternative for either of the above A marks <hr/>
	Acceleration is 5 ms^{-2} Tension is 3 N	B1 A1 5	
(b)	$[0.9 = \frac{1}{2} 5t^2]$ Time taken is 0.6 s	M1 A1ft 2	For using $s = ut + \frac{1}{2} at^2$ ft $\sqrt{1.8/a}$

12 Tension is 40 N
[R + T = W]
Force exerted is 10 N

B

M1

A

[3]

For resolving forces on B vertically

13	(a) $[0.36 = \frac{1}{2}a(0.6)^2]$ Acceleration is 2 ms^{-2}	M1 A1	For using $s = (ut) + \frac{1}{2}at^2$ [2]
	(b) $[0.45g - T = 0.45 \times 2]$ Tension is 3.6 N	M1 A1ft	For applying Newton's second law to A ft $T = 0.45(10 - a)$ [2]
	(c) $[T - mg = 2m$ or $0.9 + 2m = 4.5 - 10m]$ $(2 + g)m = 3.6$ (must have m terms combined)	M1 A1ft	For applying Newton's second law to B or for using $(M + m)a = (M - m)g$ ft a and/or a non-zero value of T [3]
	Mass is 0.3 kg g	A1ft	ft $0.72 + 0.05u^2$
	(d) $u = 1.2$ $[0 = 1.44 - 20s \rightarrow 0.072]$ Maximum height is 0.792	B1ft M1	ft $u = 0.6a$ For using $0 = u^2 - 2gs$ [3]