Qu	Answer	Part Mark	Marks	Guidance
1 (i)	Trapezium seen	B1		v–t graph with three straight lines, with positive, zero and negative gradients, continuous
	0, 3, 9, 13 shown on the t axis	B1		
	$v = 2.7$ soi in either part	B1	[3]	
(ii)	$[0.5 \times (6 + 13) \times 2.7]$	M1		Using area of trapezium
	Total distance = 25.65 m	A1	[2]	Allow Distance = 513/20 m
Alternative method for 1(ii)				
(ii)	Stage 1 $s_1 = 0.5 \times 0.9 \times 3^2 = 4.05$ Stage 2 $s_2 = 2.7 \times 6 = 16.2$ Stage 3 $s_3 = 0.5 \times (2.7 + 0) \times 4 = 5.4$	M1		Complete method to find the total distance travelled by the lift using constant acceleration equations for all three stages
	Total distance = 25.65 m	A1	[2]	
2 (i)	WD = 40 × 36 = 1440 J	B1	[1]	
(ii)		M1		Using PE = mgh
	PE = 25 × g × 36 sin 20 = 3080 J	A1	[2]	[PE = 3078.18]
(iii)	WD by pulling force = **(i)** + **(ii)**	M1		For using WD by pulling force = Gain in PE + WD against F
	WD = 4520 J	A1	[2]	[WD = 4518.18]
Alternative for (iii)				
(iii)	$[(25g \sin 20 + 40) \times 36]$	M1		For attempting to find the pulling force and multiply it by 36 to find the work done
	WD = 4520 J	A1	[2]	[WD = 4518.18]

Qu	Answer	Part Mark	Marks	Guidance
3 (i)	Driving Force = 300	B1		Using DF = Resistance
	$P = 300 \times 40$	M1		Using $P = Fv$
	$P = 12000$ W = 12 kW	A1	[3]	Must give answer in kW
(ii)	$P = 0.9 \times 12000 = 10800$	B1√		ft on 12000
	$\frac{10\,800}{25} - 300 = 1000a$	M1		Applying Newton's second law with 3 terms to the car
	$a = 132/1000 = 0.132$ ms^{-2}	A1	[3]	
4	$P\cos\theta = 48\cos\alpha - 14\sin\alpha$ and/or $P\sin\theta = 50 - 48\sin\alpha - 14\cos\alpha$	M1		For resolving forces horizontally and/or vertically
	$P\cos\theta = 48(24/25) - 14(7/25)$ $= 42.16$	A1		Allow α = 16.3 used throughout
	$P\sin\theta = 50 - 48(7/25) - 14(24/25)$ $= 23.12$	A1		
		M1		For attempting to find P or θ
	$P = \sqrt{42.16^2 + 23.12^2} = 48.1$	A1		Allow $P = 34\sqrt{2}$
	$\tan\theta = \frac{23.12}{42.16}$ $\theta = 28.7$	B1	[6]	

Qu	Answer	Part Mark	Marks	Guidance
5	$R = 5g \cos \alpha = 4g$ $F = 0.5 \times 4g = 2g$	**B1**		For finding the normal reaction R acting on the 5 kg particle and using $F = \mu R$
		M1		For applying Newton's second law to one or both particles or to the system
	$T - 2g - 5g\sin \alpha = 5a \rightarrow$ $T - 5g = 5a$	**A1**		System equation is $10g - 5g \sin \alpha - 2g = 5g = 15a$
	$10g - T = 10a$	**A1**		
	$[5g = 15a]$	**M1**		For eliminating T and solve for a
	$a = g/3 = 3.33 \text{ ms}^{-2}$	**A1**		
	$T = 10g - 10(g/3)$ $= 20g/3 = 66.7$ N	**B1**	[7]	
6 (i)	$a = 12t - 30$	**M1**		For differentiating v to find a
	$t < 2.5$	**A1**	[2]	
(ii)	$v = 0$ at $t = 1$ and $t = 4$	**B1**		Using $v = 6(t - 4)(t - 1)$
	$s = \int \left(6t^2 - 30t + 24\right) dt$ $= \frac{6}{3}t^3 - \frac{30}{2}t^2 + 24t$	**M1**		For using integration to find s
	$s = \left[2t^3 - 15t^2 + 24t\right]_1^4$	**M1**		For using limits
	Distance = 27 m	**A1**	[4]	
(iii)	$2t^3 - 15t^2 + 24t = 0$	**M1**		State $s = 0$
	$2t^2 - 15t + 24 = 0$	**M1**		Reduce to a quadratic and attempt to solve
	$t = 2.31$ and $t = 5.19$	**A1**	[3]	

Qu	Answer	Part Mark	Marks	Guidance
7 (i) (a)	$200 - 30g \sin 20 = 30a$	M1		For applying Newton's second law with 3 terms parallel to the plane
	$a = 3.25$ ms^{-2}	A1	[2]	[$a = 3.2465$]
(b)	[$v^2 = 2 \times 3.2465 \times 12 = 77.9$]	M1		For using $v^2 = u^2 + 2as$ and attempting to find KE change
	KE change $= 0.5 \times 30 \times 77.9 = 1170$ J	A1	[2]	[KE = 1168.7 J]
Alternative method for 7(i)(b)				
(b)	KE change = $200 \times 12 - 30g \times 12 \sin 20$	M1		Using KE gain = WD by DF – PE gain
	KE change = 1170 J	A1	[2]	
(ii) (a)	$N = 30g \cos 20$	B1		[$N = 281.9$]
	$F = 0.12 \times 30g \cos 20$ [= 33.8]	M1		Using $F = \mu Na$
	$200 - 30g \sin 20 - 33.8 = 30a$	M1		For using Newton's second law with 4 terms applied to the particle
	$a = 2.12$ ms^{-2}	A1	[4]	
(b)	$N + 200 \sin 10 = 30g \cos 20$ [$N = 247.2$]	M1		For resolving forces perpendicular to the plane. Three term equation.
	$F = 0.12\,N$ [$= 0.12 \times 247.2 = 29.66$]	M1		N must be from a 3 term equation
	$200 \cos 10 - 29.66 - 30g \sin 20 = 30a$	M1		For using Newton's second law with 4 terms applied to the particle
	$a = 2.16$ ms^{-2}	A1	[4]	