MyStudyBro - Revision Exercise Tool

This Revision Handout includes the Questions and Answers of a total of 5 exercises!

Chapters:

Kinematics - M1 (Pearson Edexcel)

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6. A train travels for a total of 270 s along a straight horizontal track between two stations A and B. The train starts from rest at A and moves with constant acceleration for 60 s until it reaches a speed of V m s^{-1}. The train then travels at this constant speed V m s^{-1} before it moves with constant deceleration for 30 s, coming to rest at B.

(a) Sketch below a speed-time graph for the journey of the train between the two stations A and B.

(2)

Given that the distance between the two stations is 4.5 km,

(b) find the value of V,

(3)

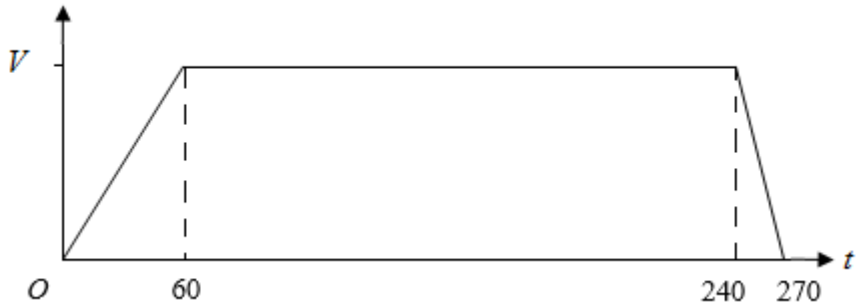
(c) find how long it takes the train to travel from station A to the point that is exactly halfway between the two stations.

(4)

The train is travelling at speed $\frac{1}{4}V$ m s^{-1} at times T_1 seconds and T_2 seconds after leaving station A.

(d) Find the value of T_1 and the value of T_2

(5)

Question Number	Scheme	Marks
6(a)		B1 Shape B1 Figs. and V (2)
(b)	$4500 = \frac{(270+180)}{2}V$ OR $4500 = \frac{1}{2}60V + 180V + \frac{1}{2}30V$ $V = 20$	M1 A1 A1 (3)
(c)	$\frac{(T+T-60)}{2}\times 20 = 2250$ OR $\frac{1}{2}60.20 + (T-60).20 = 2250$ $T = 142.5$ s	M1 A2 **ft** A1 (4)
(d)	$T_1 = \frac{1}{4}\times 60$ $= 15$ $T_2 = 270 - \left(\frac{1}{4}\times 30\right)$ OR $240 + \left(\frac{3}{4}\times 30\right)$ $= 262.5$	M1 A1 M1 A1 A1 (5) **14**
	Notes	
6(a)	First B1 for a trapezium (not to scale) starting and finishing on the t-axis but B0 if solid vertical lines included	
	Second B1 for 3 figs. (60, 270 and use of 30 with a delineator or 240) and V. 270 can be implied by 3 correct delineators	
6(b)	M1 for a complete method to produce an equation, in V only, with the correct structure i.e. one trapezium or two triangles + rectangle or triangle + trapezium or trapezium + triangle or rectangle – two triangles = 4500 (allow 4.5 for the M mark) (M0 if a single *suvat* equation is used)	
	First A1 for a correct unsimplified equation	
	Second A1 for $V = 20$	
6(c)	M1 for a complete method to produce an equation, in *ONE* variable e.g. t where $t = (T - 60)$, with the correct structure i.e. one trapezium or triangle + rectangle or rectangle – triangle = 2250 (allow 2.25 for the M mark) (M0 if a single *suvat* equation is used)	
	First and second A1's for a correct unsimplified equation **ft on their 20** -1 each error	
	Third A1 for 142.5 (s) cao Accept 143.	
6(d)	First M1 for a complete method to give an equation in T_1 *only*	

	First A1 for 15 (independent of V so allow even if their V is wrong)	
	Second M1 for a complete method to give an equation in T_2 *only*	
	Second A1 for a correct equation	
	Third A1 for 262.5 (independent of V so allow even if their V is wrong) **Accept 263**	
	N.B. Accept $T_1 = 262.5$ and $T_2 = 15$	

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5. A cyclist is travelling along a straight horizontal road. The cyclist starts from rest at point A on the road and accelerates uniformly at 0.6 m s^{-2} for 20 seconds. He then moves at constant speed for $4T$ seconds, where $T < 20$. He then decelerates uniformly at 0.3 m s^{-2} and after T seconds passes through point B on the road. The distance from A to B is 705 m.

(a) Sketch a speed-time graph for the motion of the cyclist between points A and B.

(2)

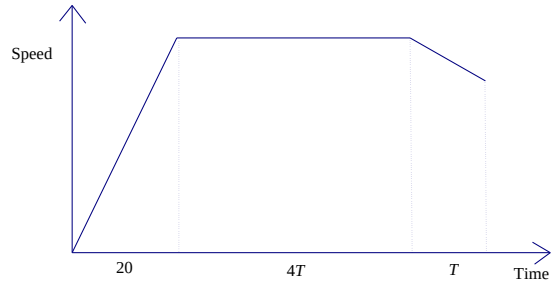
(b) Find the value of T.

(7)

The cyclist continues his journey, still decelerating uniformly at 0.3 m s^{-2}, until he comes to rest at point C on the road.

(c) Find the total time taken by the cyclist to travel from A to C.

(3)

Question Number	Scheme	Marks
5a		
	Basic shape 20, $4T$ and T placed correctly	B1 **DB**1
		(2)
5b	Use of $v=u+at$: constant speed $=0.6\times 20=12$ (ms^{-1})	M1A1
	(Speed at end $=12-0.3T$)	
	Using v-t graph: Distance: $705=\frac{12}{2}\left(4T+\left(20+4T\right)\right)+\frac{T}{2}\left(12+\left(12-0.3T\right)\right)$	M1A2
	$=48T+120+12T-0.15T^2=60T+120-0.15T^2$	
	Form 3 term quadratic and solve for T: $\Rightarrow 3T^2-1200T+11700=0 \quad \left(T^2-400T+3900=0\right)$	M1
	$\Rightarrow \left(T-10\right)\left(T-390\right)=0 \qquad T=10$ only	A1
		(7)
	Alternative:	
	Use of $v=u+at$: constant speed $=0.6\times 20=12$ (ms^{-1}) M1A1	
	Using $s=ut+\frac{1}{2}at^2$: $705=\left(0.3\times 400\right)+\left(4T\times 12\right)+\left(12T-0.15T^2\right)$ M1A2	
	$\Rightarrow 0.15T^2-60T+585=0 \ \left(T^2-400T+3900=0\right)$	
	$\Rightarrow \left(T-10\right)\left(T-390\right)=0 \qquad T=10$ only M1A1	
	(7)	
5c	Extra time: $(2\times 20)-$*their T* **OR** $\frac{12-0.3\times \textit{their}T}{0.3}$	B1
	Total time: $20+5T+40-T$ (*their T*)	M1
	$=100$ (s)	A1
		(3)
	Alternative: Total time to decelerate to rest = 12/0.3 = 40 B1	
	Total time A to C $=20+4T+40=100$ M1A1	
		[12]

Question Number	Scheme	Marks
	Notes for question 5	
5a	First B1 for basic shape. Allow if 'extra triangle' on end included, provided *B* clearly marked	
	Second **DB**1 : may use, 20, 20 + 4*T*, 20 + 5*T*	
5b	First M1 for attempt to find constant speed ($v = u + at$ or a = gradient) 20 x 0.6	
	First A1 for 12	
	Second (generous) M1 for clear attempt to use 705 = *total* area under the graph to give an equation in *T* only but must see ½ used somewhere **N.B.** M0 if just a trapezium oe is used	
	Second A1 and Third A1: for any correct equation, -1 e.e.o.o.	
	Third M1 for forming and attempt to solve a 3 term quadratic (need *evidence* of solving e.g. formula or factorising, if *T* values are incorrect) otherwise this M mark can be implied if they state that *T* = 10 with no working. (*T* = 390 NOT needed)	
	Fourth A1 for *T* = 10.	
	N.B. For total area, could see: Trapezium + Rectangle + Triangle $705 = \frac{12}{2}\left(4T + \left(20 + 4T\right)\right) + T(12 - 0.3T) + \frac{1}{2}T \times 0.3T$ Triangle + Rectangle + Trapezium $705 = \frac{1}{2}.20.12 + (4T \times 12) + \frac{1}{2}T\left(12 + 12 - 0.3T\right)$ Triangle + Rectangle + Rectangle + Triangle $705 = \frac{1}{2}.20.12 + (4T \times 12) + T(12 - 0.3T) + \frac{1}{2}T \times 0.3T$ Triangle + Rectangle + Trapezium (at top) $705 = \frac{1}{2}.20.12 + 5T(12 - 0.3T) + \frac{1}{2}0.3T(5T + 4T)$ Rectangle – triangle– triangle $705 = 12(20 + 5T) - \frac{1}{2}.20.12 - \frac{1}{2}T \times 0.3T$	
5c	B1 for either additional time is $\frac{12}{0.3} - T$ **or** time to decelerate is $\frac{12}{0.3}$	
	M1 for a correct method to find the total time, using *their T* $= 20 + 4T + T + \frac{12}{0.3} - T$ **or** $20 + 4T + \frac{12}{0.3}$	
	A1 for 100 cao	

1

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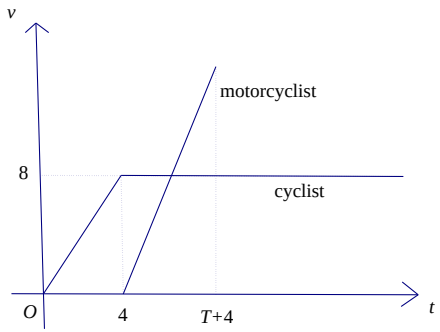
3. A cyclist starts from rest at the point O on a straight horizontal road. The cyclist moves along the road with constant acceleration $2\,\text{m s}^{-2}$ for 4 seconds and then continues to move along the road at constant speed. At the instant when the cyclist stops accelerating, a motorcyclist starts from rest at the point O and moves along the road with constant acceleration $4\,\text{m s}^{-2}$ in the same direction as the cyclist. The motorcyclist has been moving for T seconds when she overtakes the cyclist.

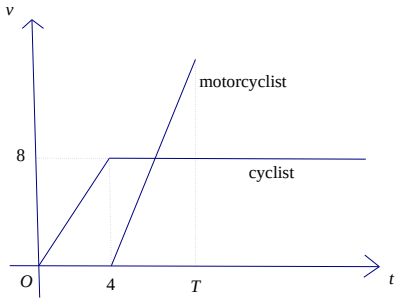
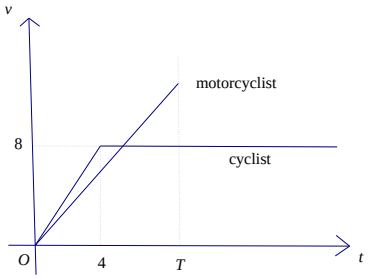
(a) Sketch, on the same axes, a speed-time graph for the motion of the cyclist and a speed-time graph for the motion of the motorcyclist, to the time when the motorcyclist overtakes the cyclist.

(4)

(b) Find, giving your answer to 1 decimal place, the value of T.

(6)

Question Number	Scheme	Marks	Notes
3a		B1 shape B1 figs B1 shape B1 figs (4)	Correct shape graph for cyclist 4 marked Motorcyclist graph in relatively correct position Must start at $t = 4$ and must continue beyond point of intersection of the graphs $T + 4$ marked Treat two separate graphs as two attempts and award the marks for the better attempt
3b	$\frac{1}{2}T.4T = \left(\frac{T+T+4}{2}\right)8$	M1	Equate distances to form equation in T
		A1	One distance correct
		A1	Both distances correct
	$T^2 - 4T - 8 = 0$	A1	Simplify to 3 term quadratic
	$T = 2 \pm \sqrt{12}$	M1	Solve a 3 term quadratic for T
	$T = 5.5$	A1	Q asks for answer to 1 dp. Must reject negative solution if seen.
		(6)	
		[10]	
			See over

Question Number	Scheme	Marks	Notes
SC1			B1B1 B1B0 $16+8(T-4)=\frac{1}{2}\times 4(T-4)^2$ M1A1A1 $T^2-12T+24=0$ (or equivalent) A1 $T=6+2\sqrt{3}=9.5$ M1A0 (marking the T as a misread)
SC2			B1B1 B0B0 $16+8(T-4)=\frac{1}{2}\times 4T^2$ M1A1A1 $2T^2-8T+16=0$ A0M0A0 (completely changed the question but some evidence of correct thinking)

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3. At time $t = 0$, a stone is thrown vertically upwards with speed $19.6\,\text{m s}^{-1}$ from a point A which is h metres above horizontal ground. At time $t = 3\,\text{s}$, another stone is released from rest from a point B which is also h metres above the same horizontal ground. Both stones hit the ground at time $t = T$ seconds. The motion of each stone is modelled as that of a particle moving freely under gravity.

Find

(i) the value of T,

(ii) the value of h.

(7)

Question Number	Scheme	Marks
3	**EITHER:** $h=-19.6(t+3)+\frac{1}{2}g(t+3)^2$ and $h=\frac{1}{2}gt^2$	M1A1A1
	OR : $h=-19.6T+\frac{1}{2}gT^2$ and $h=\frac{1}{2}g\left(T-3\right)^2$	M1A1A1
	$-19.6T+\frac{1}{2}gT^2=\frac{1}{2}g\left(T-3\right)^2$ **OR** $-19.6(t+3)+\frac{1}{2}g(t+3)^2=\frac{1}{2}gt^2$	M1
(i)	$T=4.5$	A1
(ii)	$h=\frac{1}{2}\times 9.8\times\left(T-3\right)^2$ oe	M1
	$=11$ or 11.0	A1 **[7]**
	Notes for qu 3	
3	First M1 for use of $s=ut+\frac{1}{2}at^2$ (or any other complete method) to produce an equation in *h* and *T only* or *h* and *t only* for stone 1 or 2, correct no. of terms but condone sign errors	
	First A1 for a correct equation for **stone 1** (*g* does not need to be substituted but if it is , it must be 9.8)	
	Second A1 for a correct equation for **stone 2** **N.B**. Both A marks can be earned if they use *s* (instead of *h* or -*h*) in one of the two equations and then use *s* consistently in the other equation. **N.B.** When *h* and *T* are used in any equation, they must be used correctly (including sign of *h*) to obtain A marks	
(i)	Second M1 for eliminating *h*	
	Third A1 for *T* = 4.5	
(ii)	Third M1 for using their *T* or *t* value in one of their equations to obtain an *h* value	
	Fourth A1 for *h* = 11 or 11.0	

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5.

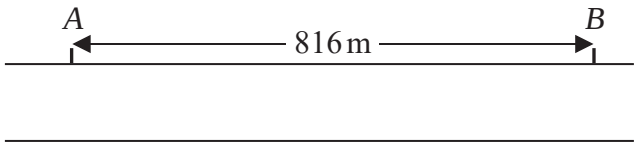


Figure 3

Two posts, A and B, are fixed at the side of a straight horizontal road and are 816 m apart, as shown in Figure 3. A car and a van are at rest side by side on the road and level with A. The car and the van start to move at the same time in the direction AB. The car accelerates from rest with constant acceleration until it reaches a speed of $24\,\text{m s}^{-1}$. The car then moves at a constant speed of $24\,\text{m s}^{-1}$. The van accelerates from rest with constant acceleration for 12 s until it reaches a speed of $V\,\text{m s}^{-1}$. The van then moves at a constant speed of $V\,\text{m s}^{-1}$. When the car has been moving at $24\,\text{m s}^{-1}$ for 30 s, the van draws level with the car at B, and each vehicle has then travelled a distance of 816 m.

(a) Sketch, on the same diagram, a speed-time graph for the motion of each vehicle from A to B.

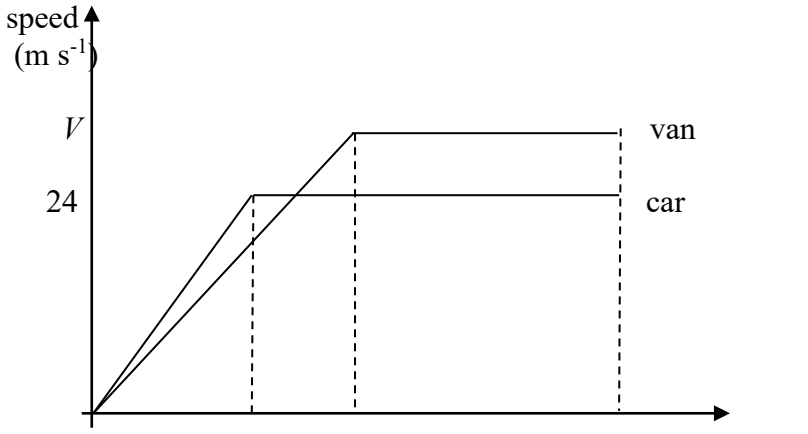
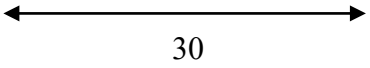
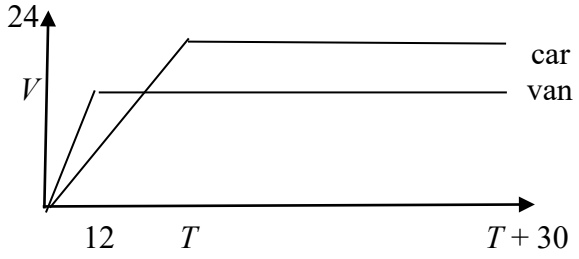
(3)

(b) Find the time for which the car is accelerating.

(3)

(c) Find the value of V.

(3)

Question Number	Scheme	Marks
5(a)	 **OR** 	B1 shape of either B1 shape of second (must cross first and end at the same t value) B1 V,24,12, T, T+30 oe with delineator B0 if vertical solid lines (3)
	N.B. 	**This graph can score all 3 marks.**
(b)	$\frac{1}{2}(T+30+30)\times 24=816$ **OR** $\frac{1}{2}\times T\times 24+30\times 24=816$ $T=8$ (s)	M1A1 A1 (3)
(c)	$\frac{1}{2}\big((T+30)+(T+18)\big)V=816$ **OR** $\frac{1}{2}\times 12V+V(18+T)=816$ $V=25.5$	M1A1 **ft** A1 (3) **[9]**
ALT	(b) Dist travelled while accelerating $=816-720=96$ m $s=\frac{u+v}{2}t \Rightarrow\left(\frac{0+24}{2}\right)T=96$ M1A1 $T=8$ (s) A1	

Question Number	Scheme	Marks
	(c) Dist travelled by the van $= \frac{1}{2} \times 12V + (18+T) \times V = 816$ M1A1**ft** $V = 25.5$ A1	
	Notes for qu 5	
5a	First B1 for shape of graph	
	Second B1 for shape of graph, crossing first graph	
	Third B1 for V, 12, 24, T and T+30 placed correctly oe e.g. with delineators. Allow their T and (their T + 30) where they find T in (b) first.	
5b	M1 for equation in T or t (= T + 30) *only* , using 816 distance travelled by CAR, *with correct structure* i.e. a trapezium or (triangle + rectangle)	
	First A1 for a correct equation	
	Second A1 for 8 (s)	
5c	M1 for equation in V *only* , using 816 distance travelled by VAN , *with correct structure* i.e. a trapezium or (triangle + rectangle) **N.B.** M0 if they assume the TOTAL time is 30 (or 42) when setting up the equation.	
	First A1 **ft** on their T value , for a correct equation	
	Second A1 for V = 25.5	