WJEC EDUQAS A-LEVEL PHYSICS · COMPONENT 1

PHYSICS



EXAM QUESTION PACK

1.2 KINEMATICS

SCORE	PERCENTAGE
/63	%

STEMUP

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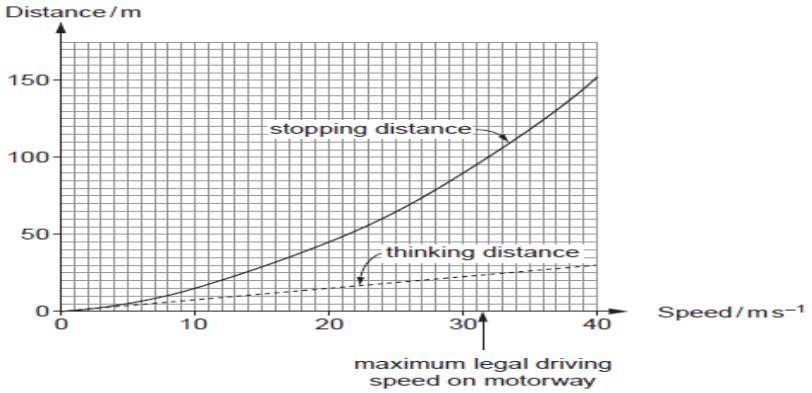
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#1

(a) The graphs show how a car driver's *stopping distance* and *thinking distance* are expected to depend on the speed at which the car is being driven (on a straight dry road).

thinking distance =	distance travelled between driver seeing a hazard ahead and starting to apply brakes
braking distance =	distance travelled while brakes are bringing car to rest (with constant deceleration)
stopping distance =	thinking distance + braking distance

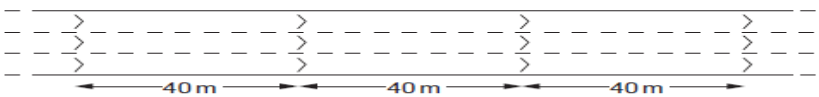


(i) Determine the time interval that has been assumed between the driver seeing the hazard and starting to apply the brakes. [1]

(ii) Determine the **braking** distance for a speed of 30 m s^{-1}. [1]

(iii) Evaluate whether or not a consistent value has been used for the car's deceleration while the brakes are being applied. [3]

(b) Marks, called 'chevrons', are painted at 40 m intervals on the road surface along a few stretches of motorway in the U.K.



Large notices say "Keep apart 2 chevrons". Using the information in part *(a)*, discuss whether the use of chevrons is likely to help prevent accidents on motorways. You may consider whether the scheme has disadvantages and whether it could be improved. [3]



Question taken from Eduqas examination paper 842101, November 2020

#2

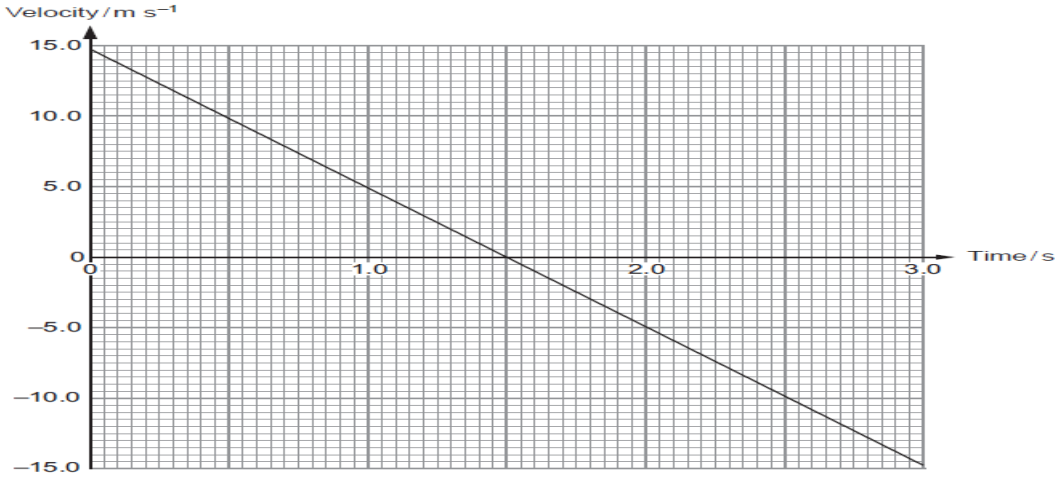
(a) (i) Define velocity. [1]

(ii) Give an example of a situation where an object has: [2]

I. a changing velocity but a constant speed;

II. acceleration in the opposite direction to velocity.

(b) Sarah throws a ball vertically upwards and catches it. A velocity-time graph for the flight of the ball is shown below. *Ignore the effects of air resistance.*

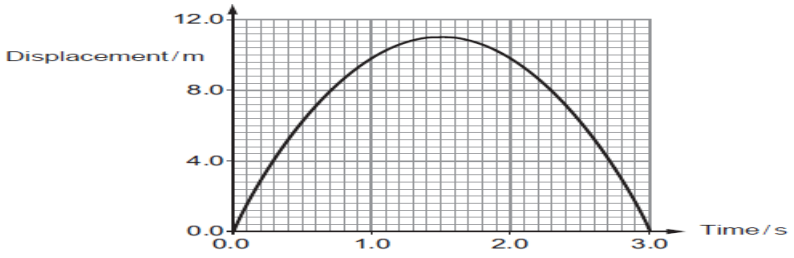


(i) Calculate the acceleration due to gravity. [2]

(ii) Calculate the maximum height of the ball from Sarah's hand. [2]

(iii) State the displacement of the ball from Sarah's hand after 3 seconds. [1]

(c) When Sarah was asked to sketch a displacement-time graph for the flight of the ball from the time it was first thrown until it was caught, she sketched the shape shown below. Evaluate whether you think she was correct. Further calculations are not required. [4]



Question taken from Eduqas examination paper 842001, June 2017

#3

7. *(a)* Ignoring the effects of air resistance, describe how, if at all, the vertical and horizontal components of a projectile's velocity change during flight on Earth. [2]

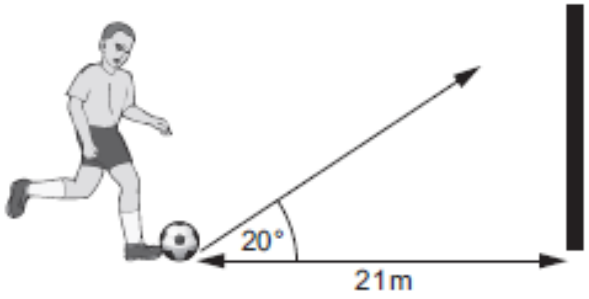
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(b) (i) A football player takes a free kick 21 m away from the goal. The ball leaves the ground at an angle of 20°. Show that the velocity he must strike the ball at is approximately 25 m s^{-1} if it is to reach its maximum height at the moment it reaches the goal. *Ignore the effects of air resistance.* [4]



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(ii) The height of the cross bar is 2.44 m above the ground. Justify numerically whether the ball crosses the goal line above or below the bar. [3]

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(iii) Discuss how air resistance might affect the height at which the ball reaches the goal. [2]

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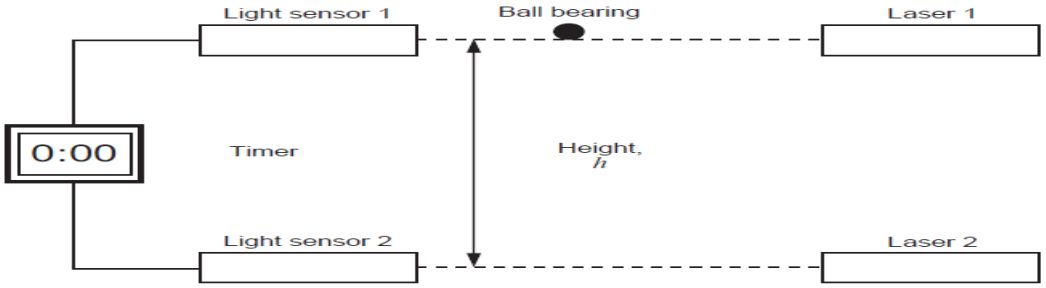
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Question taken from Eduqas examination paper 842001, June 2018

#4

George attempts to determine the acceleration due to gravity using the following apparatus. The ball bearing starts from rest just above the top beam of light. When the ball bearing cuts the top beam it starts the timer and when it breaks the bottom beam it stops the timer.



(a) (i) The vertical distance, h, between the two light beams was measured using a metre ruler of resolution 1 cm and was found to be 1.25 m. Determine the **percentage** uncertainty in this result. [1]

(ii) The time, t, taken to fall through the distance, h, was measured three times and the following results were obtained.

Time 1 / s	Time 2 / s	Time 3 / s
0.51	0.53	0.50

Determine the mean time taken for the ball bearing to fall along with its **percentage** uncertainty. [2]

(iii) Use the equation:

$$h = \frac{gt^2}{2}$$

to determine a value for the acceleration due to gravity along with its **absolute** uncertainty. [4]

(iv) State why the value you obtained in *(a)*(iii) is less than 9.81 $m\,s^{-2}$. [1]

(b) (i) Annabel suggests that the experiment would be more accurate if times were obtained for the ball bearing to fall different vertical distances and a graph was drawn. Do you believe Annabel is correct? Justify your answer. [2]

(ii) Explain which graph should be drawn to determine g and how it can be used to find a value for g. [2]

Question taken from Eduqas examination paper 842001, June 2017

#5

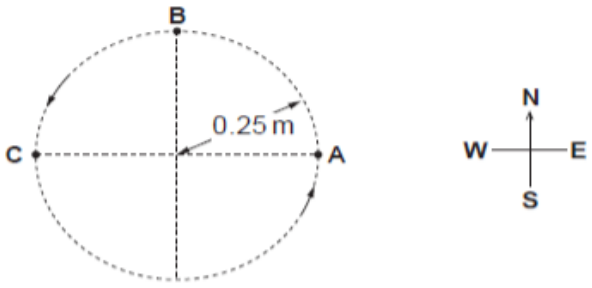
(a) State what is meant by a body's *mean acceleration* over a period of time. [1]

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(b) Protons are 'stored' by being made to go round and round a circular path of radius 0.25 m at constant speed. They perform 5.2×10^6 revolutions per second.



(i) Show clearly that the protons' speed is approximately $8 \times 10^6 \text{ m s}^{-1}$. [2]

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(ii) Determine the magnitude and direction of a proton's acceleration at point **B**. [3]

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(iii) Calculate a proton's mean acceleration over the semicircle **ABC**. [3]

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(c) Two students discuss the mean force on a proton over one revolution **ABCA**. Adam says that the mean force is the same as the force at B, because the force is the same all the way round. Brian says that the mean force is zero. Evaluate these opinions. [2]

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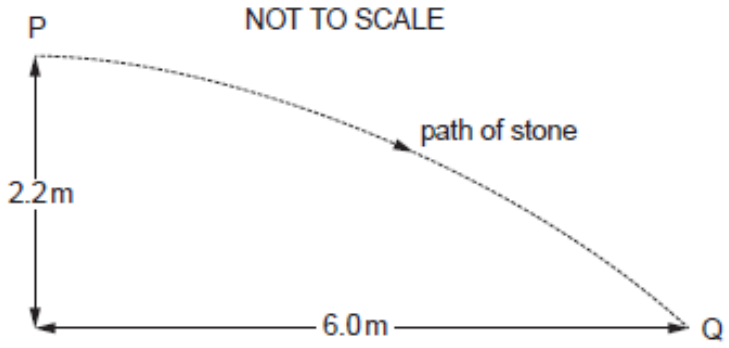
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Question taken from Eduqas examination paper 842101, November 2020

#6

1. *(a)* In an investigation of projectile motion, a student throws a stone. It is moving horizontally when it leaves his hand (at point P). It reaches the ground at point Q.



(i) By analysing a video of the stone's flight, its horizontal velocity component, v_h, is found to be almost constant. Discuss whether or not this is to be expected. [2]

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(ii) The approximate value of v_h obtained from the video was $9.0\,m\,s^{-1}$. Determine whether this value is consistent with the measured distances recorded in the diagram. Show your reasoning clearly. [3]

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(b) Calculate the magnitude **and direction** of the stone's velocity just before it hits the ground. [4]

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Question taken from Eduqas examination paper 842101, June 2019

Marking Scheme

#1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(a)	(i)		0.75 [±0.05] s		1		1	1	
		(ii)		68 m [±3 m]		1		1	1	
		(iii)		Figures correctly inserted into constant acc equation(s) at some chosen speed. For example, at 30 m s^{-1}, $0 = 30^2 + 2a \times 68$ [1] [Tolerate interchange of u and v and (for this mark only) stopping distance used instead of braking distance.] $a = -6.6$ m s^{-2} [±0.6 m s^{-2}; accept 6.6 m s^{-2}; **ecf** on 68 m] [1] Deceleration correctly calculated at one more speed **and** sensible conclusion drawn **ecf** [1] **Alternative:** For at least two points, $\frac{v_1}{v_2}$ compared with $\left(\frac{x_1}{x_2}\right)^2$ or equiv. [1] Comparison carried out with clear results [1] Sensible conclusion drawn, implying that square law relation is equivalent to same acceleration throughout [1]			3	3	2	
	(b)			Quantitative use made of data in (a), e.g. from graph, stopping distance [on dry road at maximum legal speed] is ≈ 95 m. [1] Some conclusion, e.g. 95 m is rather greater than two gaps between chevrons [or equiv] so idea good or inadequate. [1] Critical/supporting remarks [1] could include: • Not enough distance if roads wet or icy, or no help in fog • Even longer distance needed if maximum legal speed exceeded **or** equiv • Should be ignored in a traffic jam • Meaning of notice not clear: 2 chevrons or 2 gaps apart? • Arguably use of chevrons too infrequent to save many accidents • Drivers could be distracted by looking at chevrons on road			3	3	2	
				Question total	**0**	**2**	**6**	**8**	**6**	**0**

#2

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(a)	(i)	Rate of change of **displacement** / accept **displacement** ÷ time	1			1		
		(ii)	Circular motion with a constant speed / accept practical example (1) Object being thrown up in the air or object decelerating / accept practical example (1)		2		2		
	(b)	(i)	Gradient calculated (1) g = [-]9.8 m s^{-2} with units (1) **Alternative;** Use of $v^2 = u^2 + 2ax$ or other suitable equation of motion (1) g = [-]9.8 m s^{-2} with units (1)		2		2	2	
		(ii)	An attempt at an area calculation (1) Height = 11.[025] [m] (1) **Alternative:** Use of equation of motion (1) Height = 11.[025] [m] (1)		2		2	2	
		(iii)	Zero		1		1		
	(c)		Shape starts and ends at zero / graph is symmetric or parabolic (1) 11.025 m is the max height / gradient reduces to zero at max height (1) at a time of 1.5 s / time of flight is 3 s (1) Conclusion yes she is correct has to match with argument (1) Accept individual point checked as an alternative mark for either method			4	4	2	
			Question total	**1**	**7**	**4**	**12**	**6**	**0**

#3

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Horizontal remains constant (1) vertical decreases to zero then increases / downward component increases (1)	2			2		
	(b)	(i)	$u_y = u\sin 20$ and $u_x = u\cos 20$ (1) $t = 0.035u$ or $t = \frac{21}{u\cos 20}$ (1) Horizontally $x = u\cos 20\, t$ (1) $v = 25.3$ [m s^{-1}] (1)		4		4	4	
		(ii)	Use of $v^2 = u^2 + 2ax$ (1) Use $v^2 = 0$ and manipulation (1) $x = 3.82$ [m] ball is above the bar (1)			3	3	3	
		(iii)	Ball wouldn't go as high / horizontal velocity decreases (1) [Vertical] velocity falls to $v = 0$ quicker / ball on the way down by the time it crosses the line (1)			2	2		
			Question 7 total	**2**	**4**	**5**	**11**	**7**	**0**

#4

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(a)	(i)	0.8%		1		1	1	1
		(ii)	0.51 must be to 2 s.f. no unit penalty (1) 2.9 / 3 % max of 2 s.f. (1)		2		2	2	2
		(iii)	Rearrangement to: $g = \frac{2h}{t^2}$ (1) $g = 9.61$ m s^{-2} 2 or 3 s.f. with units **ecf** from (a)(ii) 0.5133 gives 9.49 m s^{-2} (1) % uncertainty 6.6 / 6.8 % **ecf** on (i) + 2 × (ii) (1) ± 0.6[3] / 0.6[5] (1)		4		4	4	4
		(iv)	Lower due to air resistance. Accept ball not starting at rest			1	1		1
	(b)	(i)	Yes (no marks) easy to spot anomalous results (1) Mean obtained from line of best fit / larger height reduces [%] uncertainty (1)			2	2		2
		(ii)	h [on y-axis] vs t^2 [on x-axis] or $\sqrt{h}$ vs t (1) gradient = $\frac{g}{2}$ (1) **Alternative (1)** h on x-axis vs t^2 on y-axis (1) gradient = $\frac{2}{g}$ (1) **Alternative (2)** $2h$ on x-axis vs t^2 on y-axis (1) gradient = g (1)			2	2	1	2
			Question total	**0**	**7**	**5**	**12**	**8**	**12**

#5

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(a)			$\frac{\text{final velocity - initial velocity}}{\text{time [taken to change]}}$ or equivalent [1]	1			1		
	(b)	(i)		[Distance gone per second] = $2\pi \times 0.25$ [m] $\times$ 5.2×10^6 [s^{-1}] [1] $= 8.2 \times 10^6$ [m s^{-1}] [1]	1	1		2	2	
		(ii)		acc = $\frac{(8.0\times10^6)^2}{0.25}$ [m s^{-2}] **or** $\frac{(8.17\times10^6)^2}{0.25}$ [m s^{-2}] [1] $= 2.6$ (or 2.7) $\times$ 10^{14} m s^{-2} **unit mark** [1] South or towards circle centre. Accept downwards. [1]	1 1	 1 		 3	 1	
		(iii)		Time for half revolution = $\frac{1}{2} \times \frac{1}{5.2\times10^6}$ s [$= 9.62 \times 10^{-8}$ s] [1] Final velocity – initial velocity = 1.63×10^7 [m s^{-1}] [South] [1] Mean acc = 1.7×10^{14} [m s^{-2}] **South** [Accept South for Δv] [1]		3		3	2	
	(c)			Adam is wrong because acc's (or force) *direction* keeps changing [1] Brian is right because final vel – initial vel = 0 or equiv [1]			2	2		
				Question total	**4**	**5**	**2**	**11**	**5**	**0**

#6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*	(i)		Constant horizontal velocity if/because no horizontal force [1] That is if air resistance ignored or air resistance would/will make horizontal velocity decrease [1]	2			2		
		(ii)		From horiz motion, e.g. $t = \frac{6.0}{9.0} = 0.667$ [s] [1] So from vertical motion, $y = \frac{1}{2}9.81\times\left(\frac{6.0}{9.0}\right)^2 = 2.18$ [m] ecf on t [1] Conclusion consistent [1] **Alternative:** From vertical motion, e.g. $t = \sqrt{\frac{2\times2.2}{9.81}} = 0.67$[0] [s] ecf on t [1] From horiz motion, $v_h = \frac{6.0}{0.67} = 8.96$ [m s^{-1}] ecf on t or $x = 9.0 \times 0.67 = 6.03$ [m] [1] Conclusion consistent [1] **Alternative**: Time from horiz motion = 0.67 [s] [1] Time from vertical motion = 0.67 [s] [1] Conclusion consistent [1]			3	3	2	
	(b)			Vertical velocity component, $v_v = 6.5$ [m s^{-1}] or 6.6 [m s^{-1}] [1] Diagram showing v_v, v_h and v_{res} **or by implication if correct answer** [1] Angle to horiz = 36° or angle to vertical = 54° [1] ecf on v_v Magnitude of velocity = 11 [m s^{-1}] [1] ecf on v_v		4		4	3	
				Question 1 total	**2**	**4**	**3**	**9**	**5**	**0**