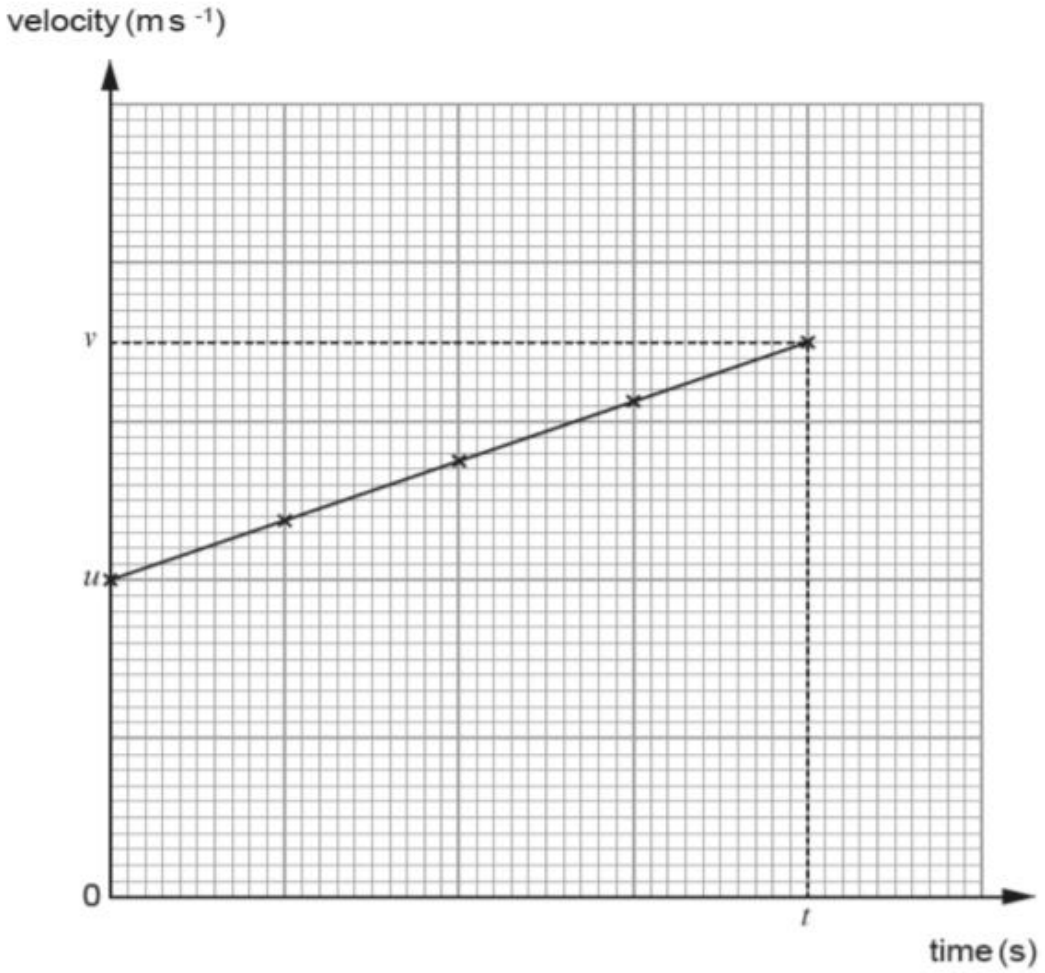
Projectiles Past Paper Questions A Level Physics WJEC

1.

. *(a)* A velocity-time graph is given for a toy car which is accelerating in a straight line in a laboratory.



(i) Using the symbols given on the graph, write down an expression for the area under the graph and state what it represents. [2]

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(ii) In practice, distance and time can be measured accurately with a video recorder and metre ruler. Explain how velocity (speed) can be measured accurately. [2]

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(b) A stone is kicked horizontally from the top edge of a cliff. Measured data for the flight of the stone are provided in the table.

Time of flight (s)	Distance from foot of cliff to point of impact (m)	Height of cliff (m)	Vertical velocity on impact ($m\,s^{-1}$)	Initial horizontal velocity ($m\,s^{-1}$)
5.00	10.00			

(i) Complete the table by filling in the gaps. Ignore air resistance. [6]

(Space is provided for your calculations.)

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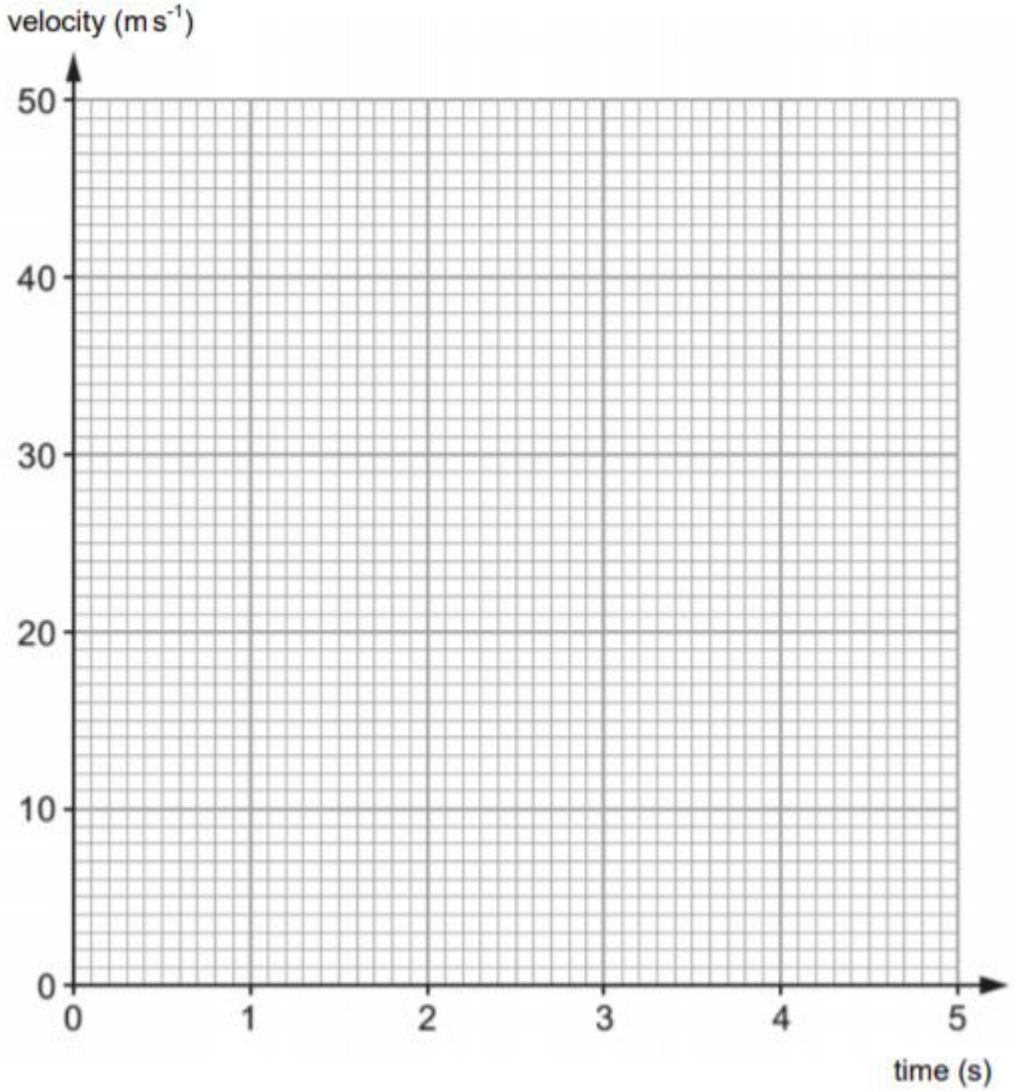
(ii) Plot, on the grid below, lines to represent **both** the vertical **and** horizontal velocities of the stone for the time of flight. [3]



(c) Discuss the effect that air resistance would have on the motion of the stone. [2]

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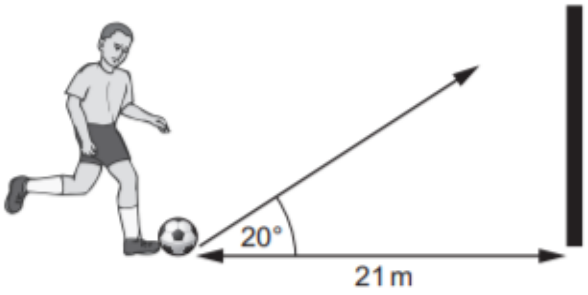
2.

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

(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]



(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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3.

3. *(a)* A paintball gun of mass 2.60 kg fires a pellet of mass 3.0×10^{-3} kg with velocity 85 m s^{-1}. Determine the recoil velocity of the gun. [2]

(b) The paintball gun is fired horizontally at a target 40 m away and the initial horizontal velocity of the paintball pellet is 85.0 m s^{-1}. Ignore the effects of air resistance.

(i) Determine how far the pellet has fallen by the time it reaches the target. [3]

(ii) Determine the angle between the pellet's velocity and the horizontal when it hits the target. [3]

(c) Now considering the effect of air resistance.

(i) How would your answer to *(b)*(ii) differ? [2]

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(ii) If air resistance caused the final horizontal speed of the pellet to decrease to $30\,m\,s^{-1}$ find the mean force of air resistance acting on the pellet. Take the distance travelled by the pellet as 40.0 m. [3]

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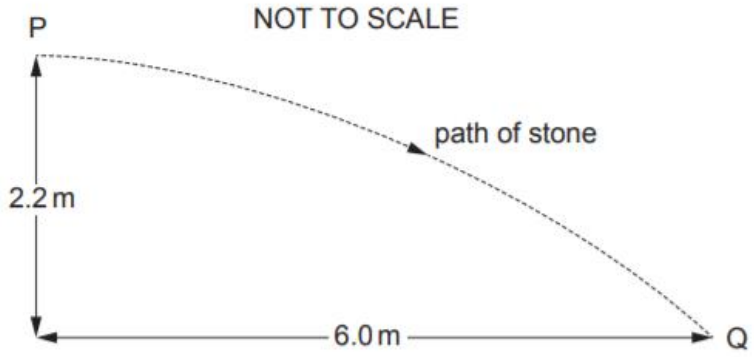
4.

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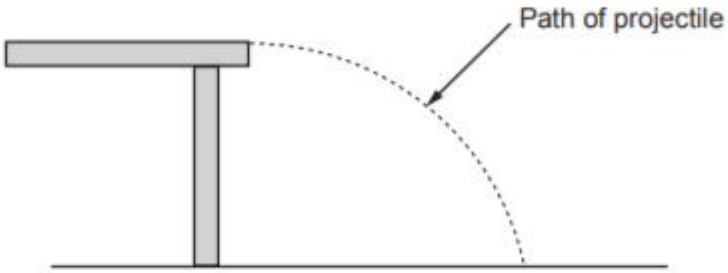
(b) Calculate the magnitude **and direction** of the stone's velocity just before it hits the ground. [4]

5.

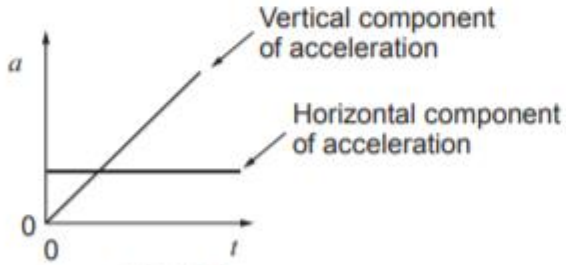
(a) Two equations of accelerated motion are $v = u + at$ and $v^2 = u^2 + 2ax$. Use these equations to show that, for a body accelerating uniformly from rest: [2]

$$x = \tfrac{1}{2}at^2$$

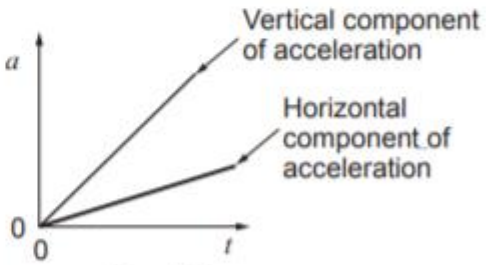
(b) The diagram shows the path of a projectile after it is launched horizontally from a table.



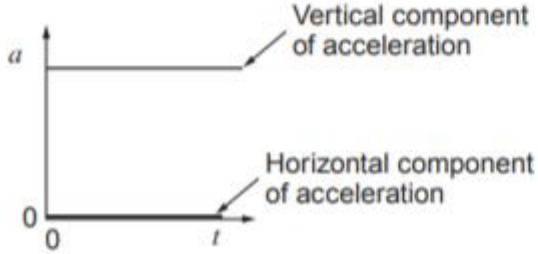
When considering the horizontal and vertical components of the motion, graphs of horizontal acceleration and vertical acceleration against time are sketched. **Only one** of the following sketch graphs shows a correct combination. *[Ignore air resistance for the remainder of the question.]*



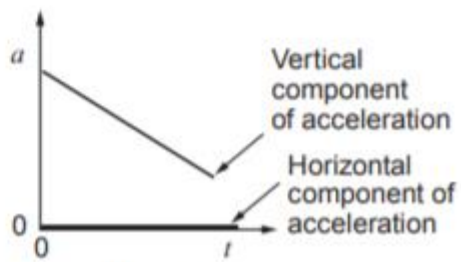
Graph 1



Graph 2



Graph 3



Graph 4

State which graph shows the correct combination and explain your answer. [3]

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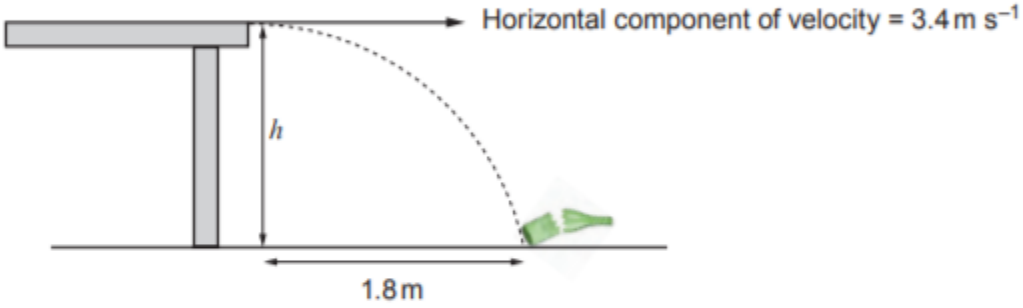
(c) A bottle is accidentally knocked from the table and follows the path shown.



(i) Calculate the height, h, of the table. [3]

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Examiner only

(ii) Calculate the magnitude of the velocity and the direction of travel of the bottle just before it hits the ground. [4]

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(d) State whether or not the following statement is correct and justify your answer. [2]

The flight time for the bottle in part (c) will depend on the horizontal velocity – the greater the horizontal velocity, the longer it will take for the bottle to hit the floor after leaving the table.

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6.

6. *(a)* A projectile is fired from the Earth's surface and follows a curved path as shown.

Describe and explain how, if at all, the vertical and the horizontal components of velocity of the projectile change during the flight. Ignore the effects of air resistance. [3]

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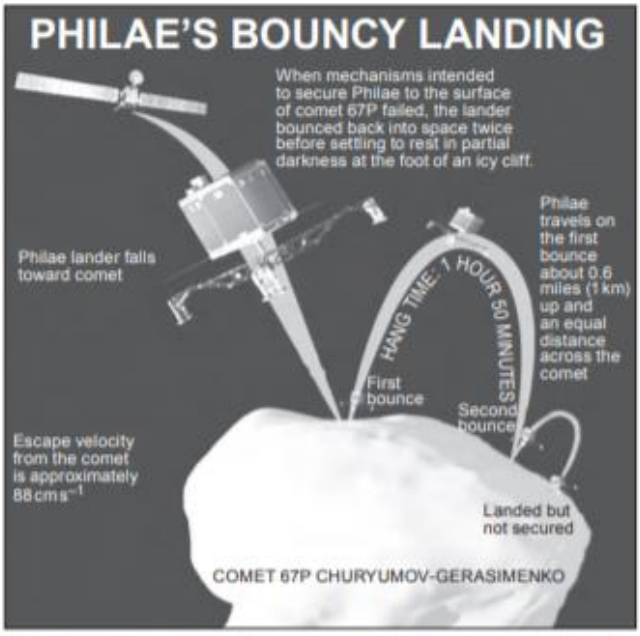
(b) In November 2014 the space probe 'Philae' was dropped onto comet 67P. Philae bounced twice before coming to rest. A national newspaper used the following image to describe the landing.



(i) Use information from the image to calculate the horizontal velocity of the lander between the first and second bounce. [1]

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(ii) By considering the first bounce, show that the value of the acceleration due to gravity on the comet is approximately $0.0002\,m\,s^{-2}$. [2]

(iii) Show that the vertical velocity of the lander immediately after the first bounce was greater than 60% of the escape velocity. [3]

(c) By considering the following facts discuss whether or not the mission was justified. [3]

- Cost of developing and sending the spacecraft to the comet: £1 billion over 10 years.
- Around 2 000 people involved in the development of the spacecraft and its instruments.
- Advanced solar cell technology developed.
- 28 000 landing announcement 're-tweets' in the first hour.
- Organic molecules detected on comet surface.