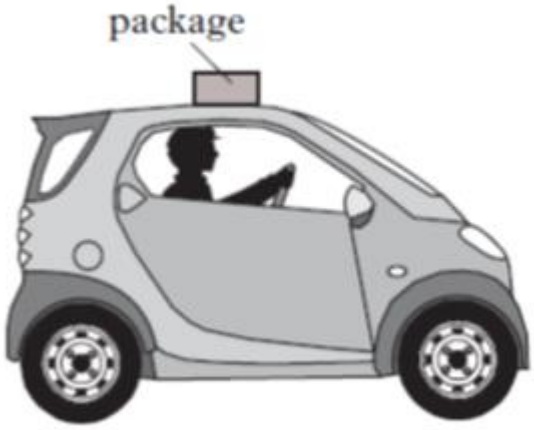
Projectile Motion

2011 C 13

1. A car driver exits a car park having accidentally left a package resting on the roof of the car. The car is travelling at a constant velocity of 15 m s^{-1} when the driver brakes suddenly and the car stops. The package continues to move forward.



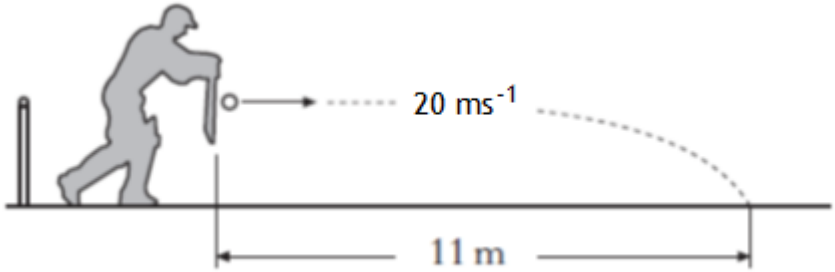
(a) (i) On the above diagram sketch the path taken by the package. 1

(ii) Explain why the package follows this path. 2

(b) The package takes 0.55 s to fall to the ground.
Calculate its vertical velocity as it reaches the ground. 4

2011 Int2 21

2. A cricketer strikes a ball. The ball leaves the bat horizontally at 20 m s^{-1}.
It hits the ground at a horizontal displacement of 11 m from the point where it was struck.



Assume that air resistance is negligible.

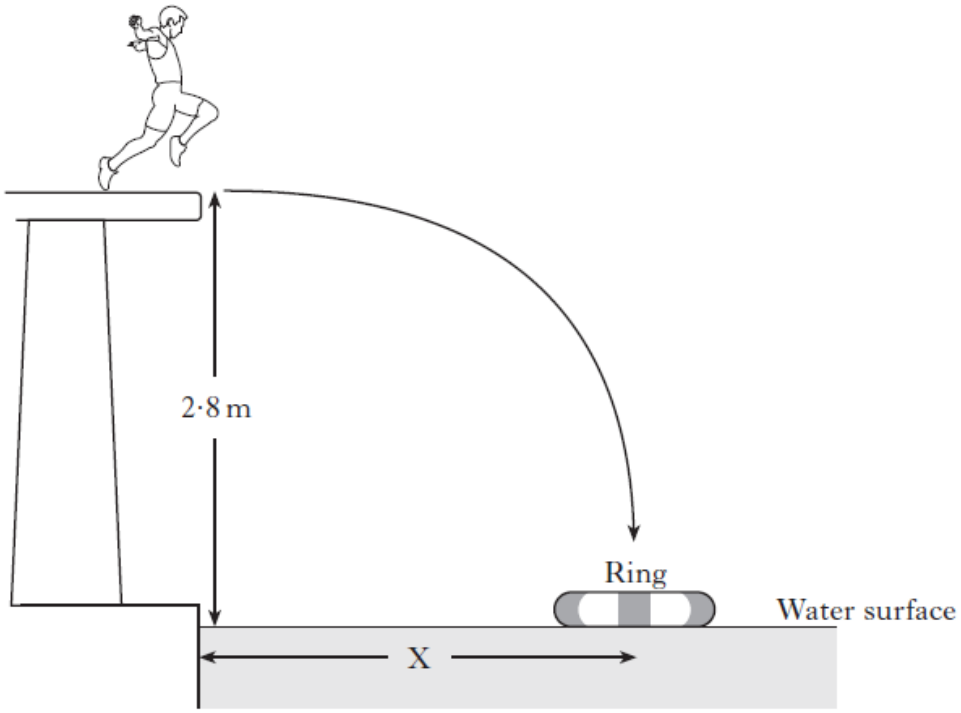
(a) Calculate the time of flight of the ball. 3

(b) Calculate the vertical velocity of the ball as it reaches the ground. 3

(c) Sketch a graph of vertical velocity against time for the ball.
Numerical values are required on both axes. 2

(d) Calculate the vertical displacement of the ball during its flight. 3

3. In a TV game show contestants are challenged to run off a horizontal platform and land in a rubber ring floating in a swimming pool.
The platform is 2.8 m above the water surface.



(a) A contestant has a mass of 60 kg.
He runs off the platform with a horizontal velocity of 2 m s^{-1}.
He takes 0•76 s to reach the water surface in the centre of the ring.

(i) Calculate the horizontal displacement X from the poolside to the centre of the ring. 3

(ii) Calculate the vertical velocity of the contestant as he reaches the water surface. 3

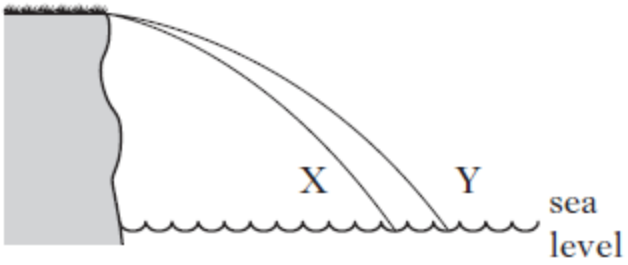
(b) Another contestant has a mass of 80 kg.

(i) State if she will need to run faster, slower or at the same horizontal velocity as the first contestant to land in the ring. 1

(ii) You must explain your answer to (b) (i). 1

2012 Int2 5 MC

4. Two identical balls X and Y are projected horizontally from the edge of a cliff.
The path taken by each ball is shown.



A student makes the following statements about the motion of the two balls.

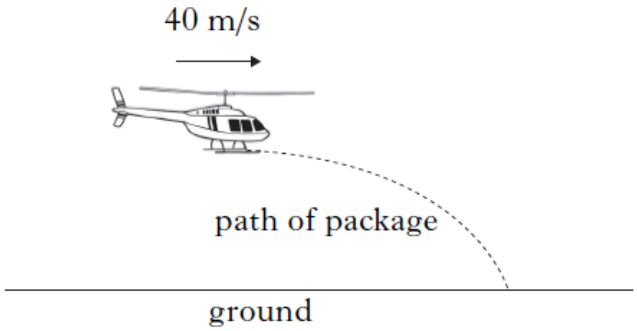
I They take the same time to reach sea level.
II They have the same vertical acceleration.
III They have the same horizontal velocity.

Which of these statements is/are correct?

A I only
B II only
C I and II only
D I and III only
E II and III only

2010 Int2 4 MC

5. A package is released from a helicopter flying horizontally at a constant speed of 40 ms^{-1}.



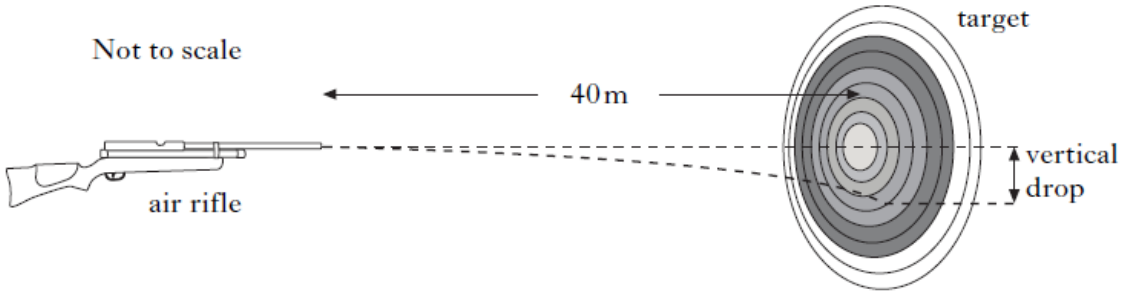
The package takes 3.0 s to reach the ground.
The effects of air resistance can be ignored.
Which row in the table shows the horizontal speed and vertical speed of the package just before it hits the ground?

	Horizontal speed (ms^{-1})	Vertical speed (ms^{-1})
A	0	30
B	30	30
C	30	40
D	40	30
E	40	40

1

2009 Int2 23ci

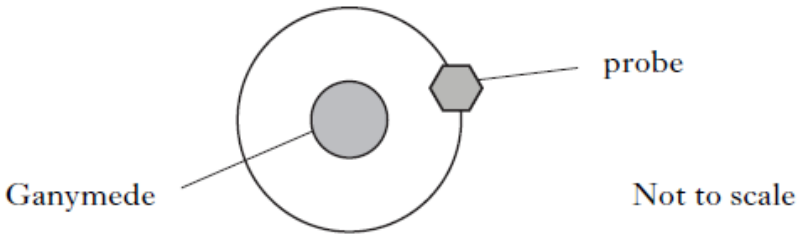
6. At a firing range a pellet is fired horizontally at a target 40 m away. It takes 0.20 s to reach the target.



Calculate the **vertical** velocity of the pellet on reaching the target. 3

2009 C 15cd

7. A space probe is in orbit around Ganymede, a moon of Jupiter.

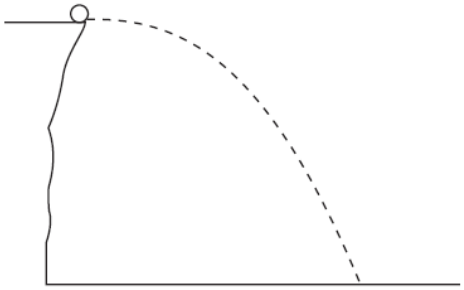


(a) Explain why the probe follows a circular path while in orbit. 2

(b) The probe has gas thrusters that fire to slow it down in order to land on Ganymede. In terms of Newton's laws, explain how these thrusters achieve this task. 2

2009 Int2 4 MC

8. A ball is thrown horizontally from a cliff as shown.



The effect of air resistance is negligible.
A student makes the following statements about the ball.

I The vertical speed of the ball increases as it falls.
II The vertical acceleration of the ball increases as it falls.
III The vertical force on the ball increases as it falls.

Which of the statements is/are correct?
A I only
B II only
C I and II only
D II and III only
E I, II and III 1

2007 C 15b

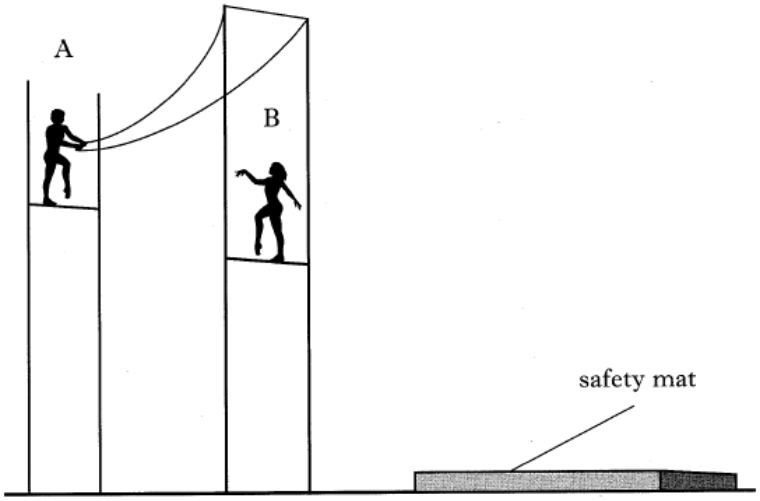
9. In June 2005, a space vehicle called Mars Lander was sent to the planet Mars. The Mars Lander released a rover exploration vehicle on to the surface of Mars. To collect data from the bottom of a large crater, the rover launched a probe horizontally at 30 ms^{-1}. The probe took 6 s to reach the bottom of the crater. (The gravitational field strength on the surface of Mars is 4 N kg^{-1}.)

(a) Calculate the horizontal distance travelled by the probe. 3

(b) Calculate the vertical speed of the probe as it reached the bottom of the crater. 3

2006 Int2 23c

10. In a circus trapeze act, gymnast A swings down on the trapeze and collides with gymnast B. At the point of the collision, gymnast A lets go of the trapeze and the two gymnasts move off together with a horizontal velocity of 4.8 ms^{-1}. They fall together for 0.65 s until they land on a safety mat.



(a) Calculate the horizontal distance they travel until they reach the mat. 3

(b) Calculate the **vertical** speed with which they strike the mat. 3

2005 Int2 3 MC

11. A seagull, flying horizontally at 8 ms^{-1} drops a piece of food. What will be the horizontal and vertical speeds of the food when it hits the ground 2.5 s later. Air resistance should be ignored. 1

	Horizontal speed (ms^{-1})	Vertical speed (ms^{-1})
A	0	8
B	8	20
C	8	25
D	25	25
E	33	50