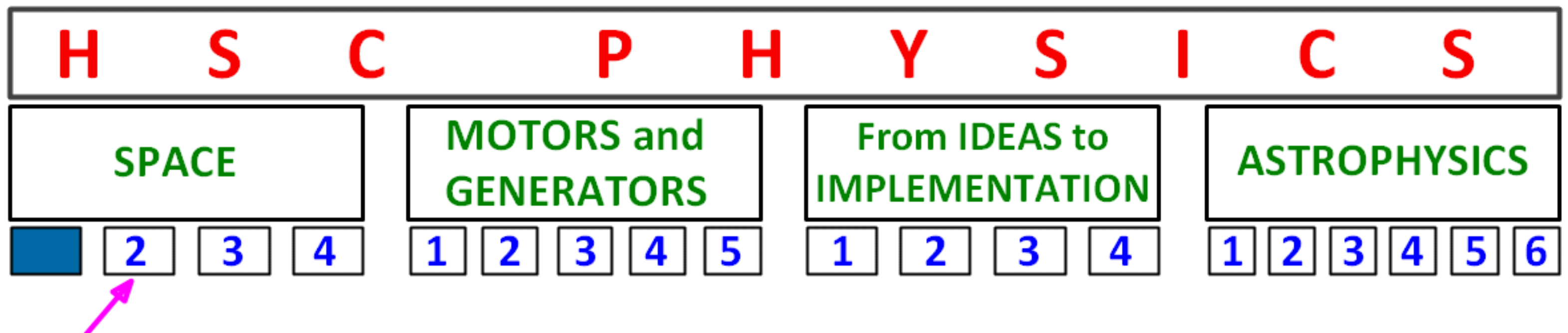


# SPACE

1<sup>st</sup> Quarter; Module 1

## PERIOD 7

Projectile Motion continued...



## Steps in solving PM questions.

Step 1 > Read the question.

Step 2 > Understand the question.

Step 3 > Make sure you understand "What is given/provided" and "What is asked".

Step 4 > Draw a diagram.

Step 5 > Select your interval (A to B). Mark A and B on your diagram.

Step 6 > Draw the data table and fill in the details as much as you can. Mark unknowns.

Step 7 > Select the appropriate formula and solve it for unknowns.



## YOUR FIRST PROJECTILE MOTION QUESTION!

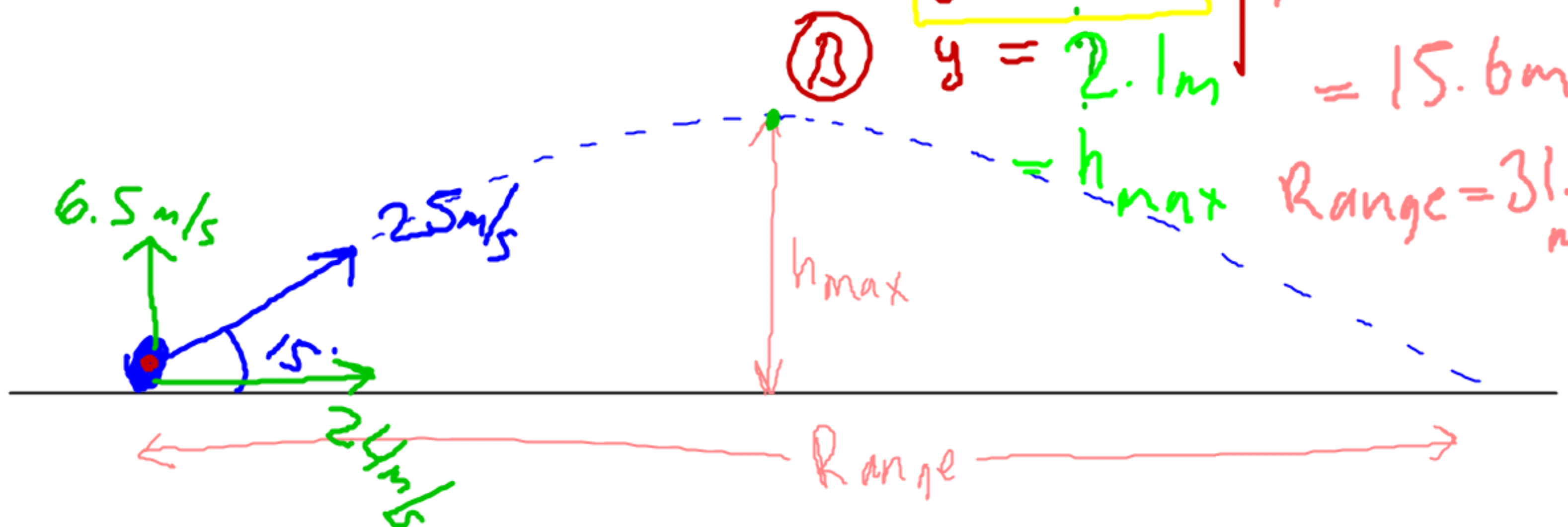
A tennis ball is struck at a velocity of 25 m/s  $15^\circ$  above horizontal.

- Calculate the maximum height reached by this ball.
- Determine the time it takes to return to the ground.
- Calculate the range of its trajectory.

$$v = u + at$$

$$0 = 6.5 + (-10) \cdot t$$

$$t = 0.65s$$



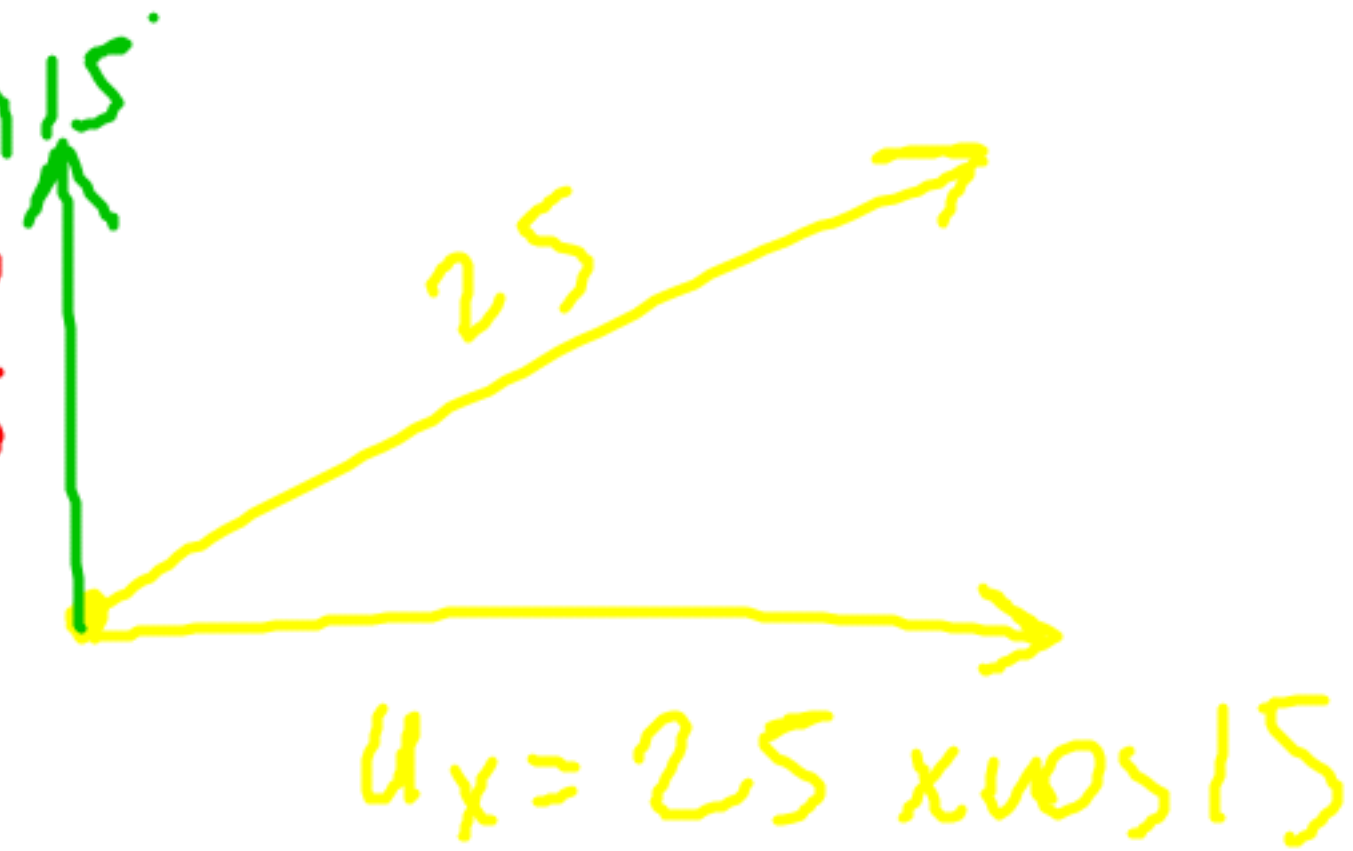
### Steps in solving PM questions.

1. Read the question.
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# VELOCITIES IN PROJECTILE MOTION

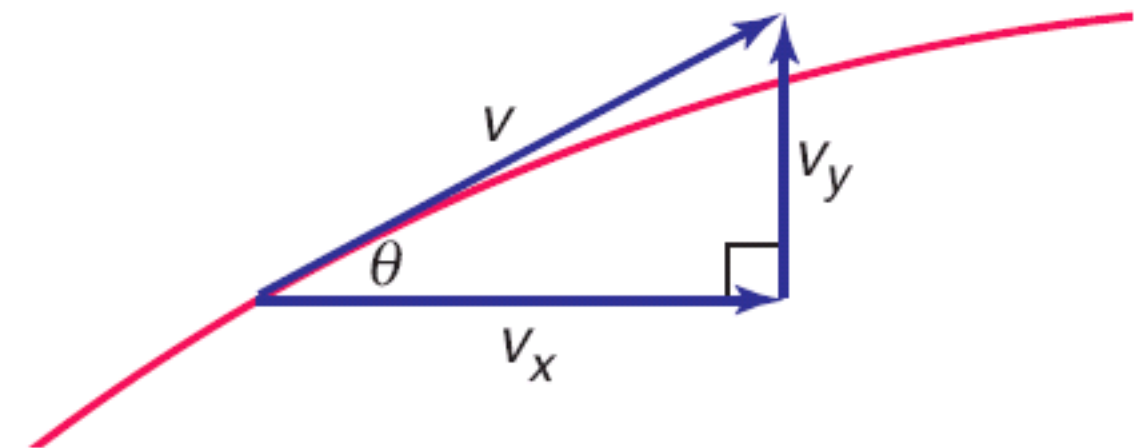
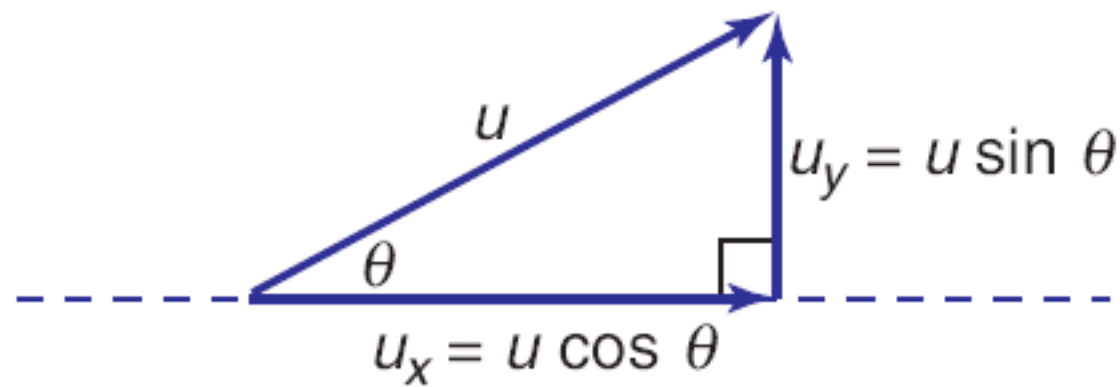
THE VELOCITY IS COMPOSED OF  
ITS VERTICAL COMPONENT  
AND  
ITS HORIZONTAL COMPONENT

$$u_y = 25 \times \sin 15^\circ$$
$$= 6.5 \text{ m/s}$$



A diagram showing a yellow vector labeled '25' originating from a point. It is resolved into two components: a vertical green component and a horizontal yellow component. The angle between the vector and the horizontal is 15 degrees.

$$u_x = 25 \times \cos 15^\circ$$
$$= 24 \text{ m/s}$$



VED

HOE, x

$$v^2 = u^2 + 2ay$$

$$0 = 6.5^2 + 2(-10)y$$

$$y = ut + \frac{1}{2}at^2$$

$$= 6.5 \times 0.65 + \frac{1}{2}(-10) \cdot 0.65^2$$

$$= 2.1$$

~~$$v = u + gt$$~~

~~$$0 = 6.5 + 10 \cdot t$$~~

~~$$-6.5 = 10t$$~~

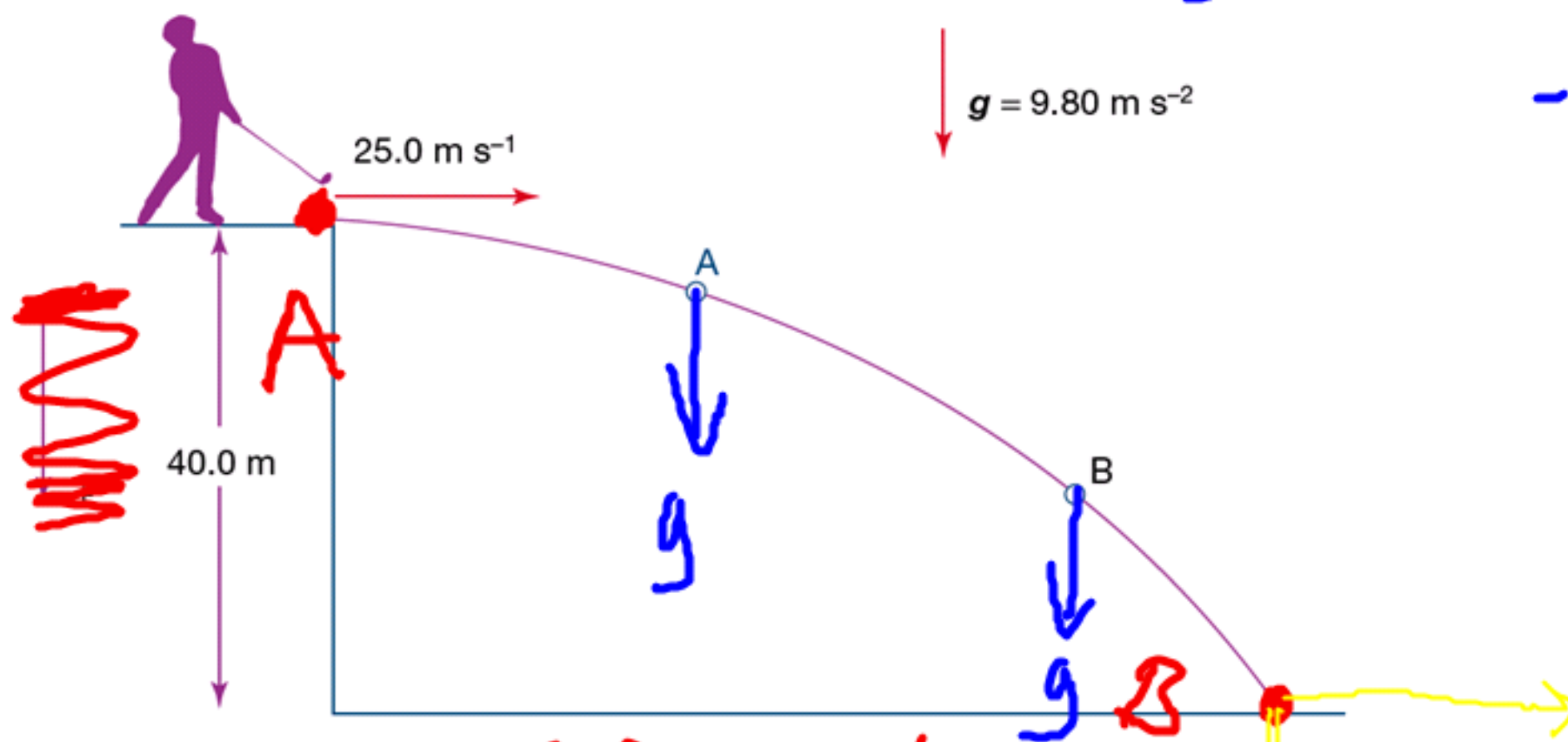
~~$$t = \frac{-0.65}{1}$$~~

~~$$= 0.65$$~~



**YOUR 2<sup>nd</sup> PM QUESTION:** A golf ball of mass 150 g is hit horizontally from the top of a 40.0 m high cliff with a speed of 25.0 m s<sup>-1</sup>. Assuming an acceleration due to gravity of 10 m/s<sup>2</sup> and ignoring air resistance, calculate:

- a the time that the ball takes to land
- b the distance that the ball travels from the base of the cliff
- c the velocity of the ball as it lands
- d the net force acting on the ball at points A and B
- e the acceleration of the ball at points A and B.



$$y = u_y \cdot t + \frac{1}{2} g t^2$$

$$g \cdot y - 40 = 0 \cdot t + \frac{1}{2} (-10) \cdot t^2$$

$$-40 = -5 t^2$$

$$t^2 = 8 \Rightarrow t = 2.8 \text{ s}$$

$$V_y = u_y + g t$$

$$= 0 + (-10) 2.8$$

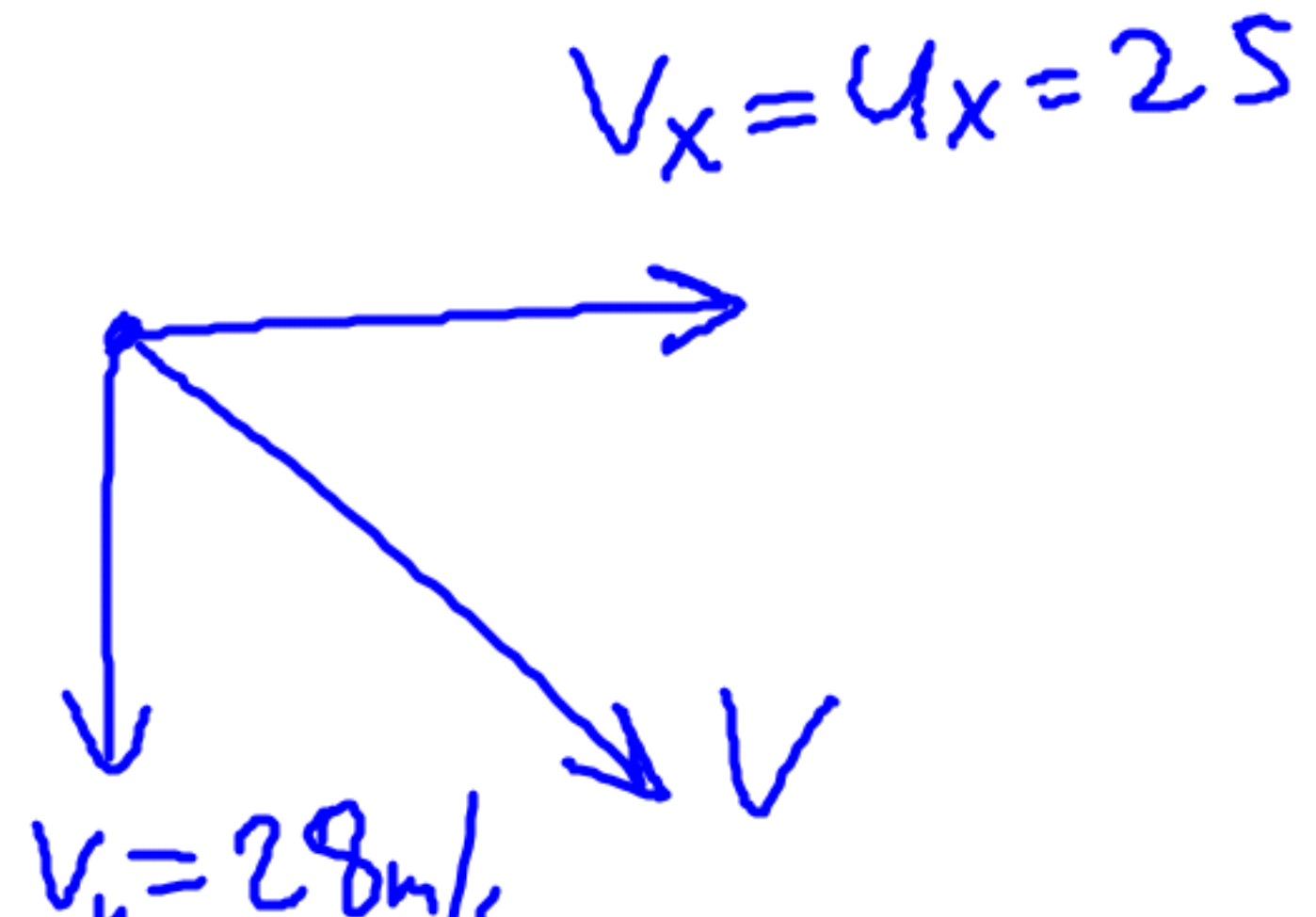
$$= -28 \text{ m/s}$$

VER	HOR
$u_y = 0$	$u_x = v_x = 25$
$v_y = ?$	$t = 2.8 \text{ s}$
$a = -10$	$x = v_x \cdot t$
$t = 2.8 \text{ s}$	$= 25 \times 2.8$
$y = -40 \text{ m}$	$= 70 \text{ m}$


$$u = u_x$$
$$u_y = 0$$

d)  $F_{\text{net}} = \text{Weight}$

$$= m \times g$$
$$= 0.15 \times -10$$
$$= -1.5 \text{ N} \downarrow$$


$$V_x = u_x = 25$$
$$V_y = 28 \text{ m/s}$$
$$v = \sqrt{V_y^2 + V_x^2}$$
$$= \sqrt{28^2 + 25^2}$$
$$= 37 \text{ m/s}$$

## Solution

- a** To find the time of flight of the ball, you need only consider the vertical component. The instant after it is hit, the ball is travelling only horizontally, so its initial vertical velocity is zero. Taking down as the positive direction:

$$u_v = 0, a = 9.80 \text{ m s}^{-2}, x = 40.0 \text{ m}, t = ?$$

Substituting in  $x = ut + \frac{1}{2}at^2$  for the vertical direction only:

$$40.0 = 0 + 0.5 \times 9.80 \times t^2, \text{ so:}$$

$$t = \sqrt{40.0 / (0.5 \times 9.80)}$$

$$= 2.86 \text{ s}$$

The ball takes 2.86 s to reach the ground.

- b** To find the horizontal distance travelled by the ball (i.e. the range of the ball), it is necessary to use the horizontal component.

$$u_h = 25.0 \text{ m s}^{-1}, t = 2.86 \text{ s}, x_h = ?$$

$$x_h = u_h t$$

$$x_h = 25.0 \times 2.86$$

$$= 71.5 \text{ m}$$

The ball lands 71.5 m from the base of the cliff (i.e. the range of the ball is 71.5 m).

- c** To determine the velocity of the ball as it lands, the horizontal and vertical components must be found separately and then added as vectors. From (a), the ball has been airborne for 2.86 s when it lands. The horizontal velocity of the ball is constant at  $25.0 \text{ m s}^{-1}$ .

The vertical component of velocity when the ball lands is:

$$u_v = 0, a = 9.80 \text{ m s}^{-2}, x = 40.0 \text{ m}, t = 2.86 \text{ s}$$

Substituting in  $v = u + at$  for the vertical direction only:

$$v = 0 + (9.80 \times 2.86)$$

$$= 28.0 \text{ m s}^{-1}$$

The actual velocity,  $v$ , of the ball is the vector sum of its vertical and horizontal components, as shown in the diagram. The magnitude of the velocity can be found by

using Pythagoras's theorem:

$$v = \sqrt{25.0^2 + 28.0^2}$$

$$= \sqrt{1409}$$

$$= 37.5 \text{ m s}^{-1}$$

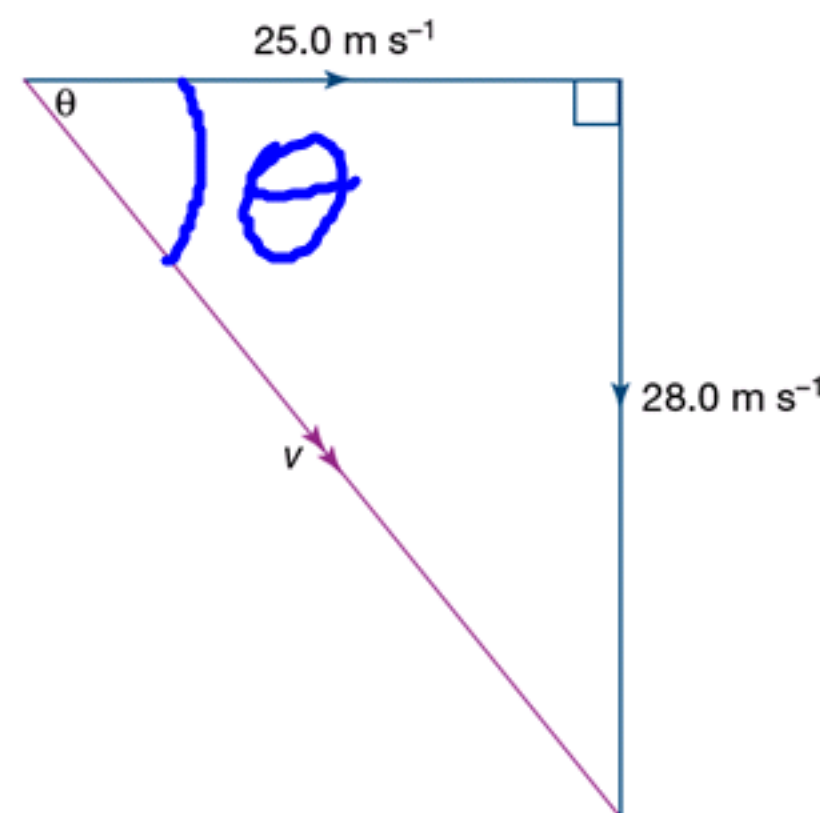
The angle at which it lands can be found by using trigonometry:

$$\tan \theta = \frac{28.0}{25.0}$$

$$= 1.12$$

$$\theta = 48.2^\circ$$

$$\tan^{-1}\left(\frac{28}{25}\right) = \theta$$



When the ball hits the ground, it has a speed of  $37.5 \text{ m s}^{-1}$  and is travelling at an angle of  $48.2^\circ$  below the horizontal.

- d** If air resistance is ignored, the only force acting on the ball throughout its flight is its weight. Therefore the net force that is acting at point A and point B (and everywhere else!) is:

$$\Sigma F = F_g = mg$$

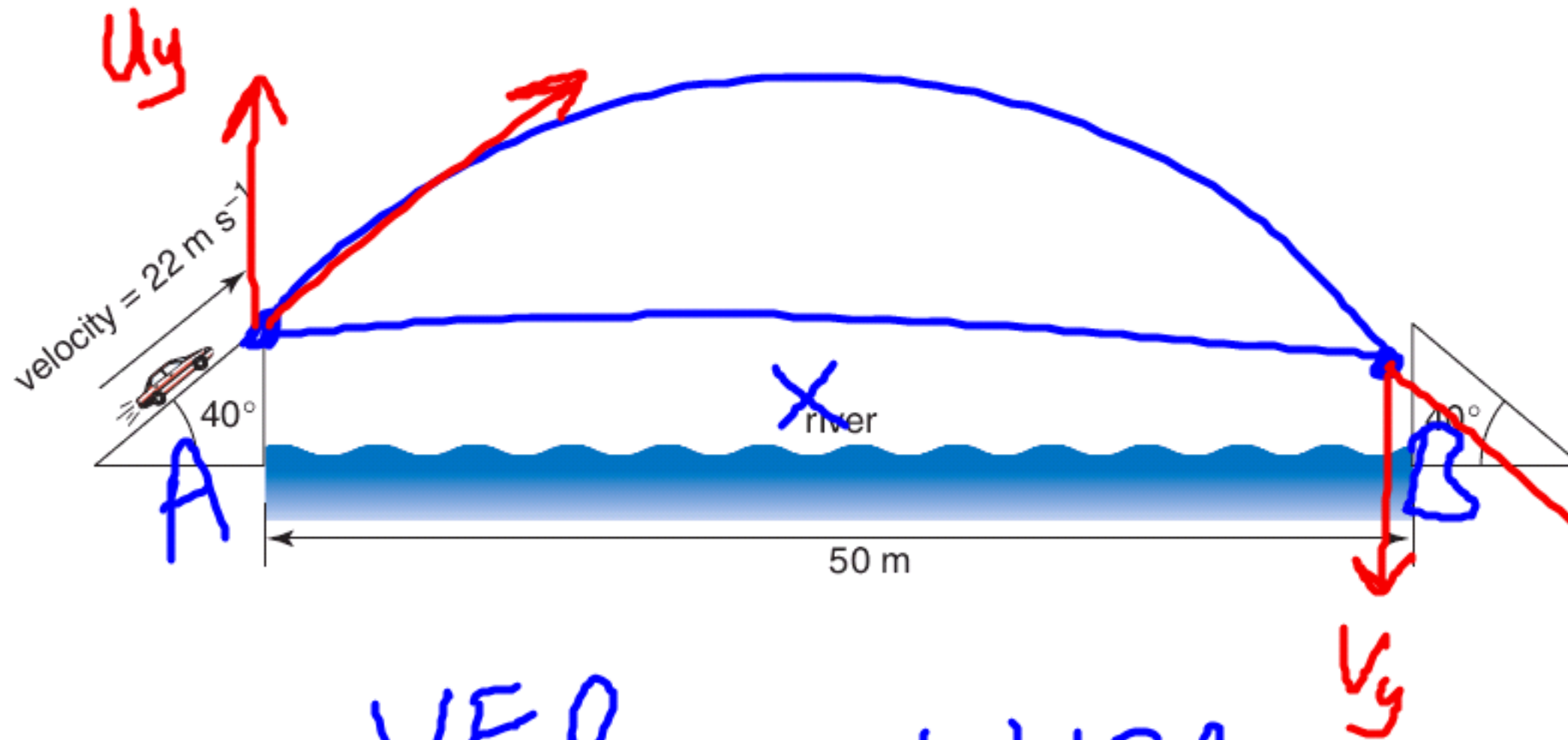
$$= 0.150 \times 9.80$$

$$= 1.47 \text{ N down}$$

- e** Since the ball is in free-fall, the acceleration of the ball at all points is equal to that determined by gravity, i.e.  $9.80 \text{ m s}^{-2}$  down.



**YOUR 3<sup>rd</sup> PM QUESTION:** A stunt driver is trying to drive a car over a small river. The car will travel up a ramp (at an angle of  $40^\circ$ ) and leave the ramp travelling at  $22 \text{ m s}^{-1}$ . The river is  $50 \text{ m}$  wide. Will the car make it?



$$X = ?$$

$$V_y = u_y + gt$$

$$14 = 14 - 10 \cdot t$$

$$10t = 28$$

$$t = 2.8 \text{ s}$$

VER

HOR

$$u_y = 14 \text{ m/s}$$

$$V_y = -14 \text{ m/s}$$

$$a = -10$$

$$t =$$

$$y = 0$$

$$u_x = v_x = 16 \text{ m/s}$$

$$t = 2.8 \text{ s}$$

$$X = 16 \times 2.8$$

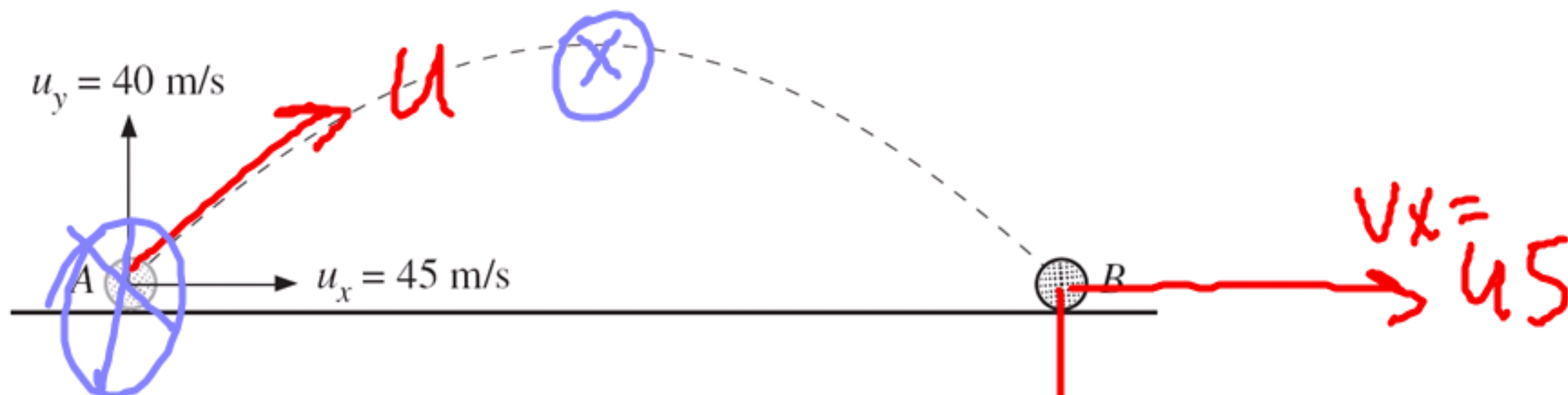
$$= 45 \text{ m}$$



# 2006 HSC PAPER

## Question 16 (6 marks)

A projectile leaves the ground at point A with velocity components as shown in the diagram. It follows the path given by the dotted line and lands at point B.



$$u = \sqrt{40^2 + 45^2}$$

$$= 60 \text{ m/s}$$

- (a) State the horizontal component of the projectile's velocity when it lands.

1

..... 45 m/s

- (b) Find the magnitude of the initial velocity of the projectile.

1

.....

.....

- (c) Calculate the maximum height attained by the projectile.

2

- (d) Calculate the range of the projectile, if it lands level with its starting position.

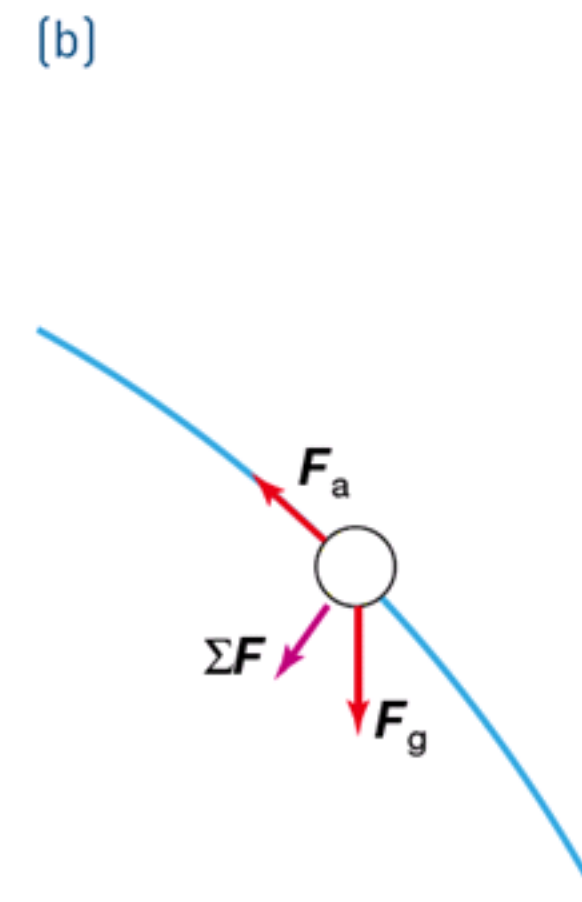
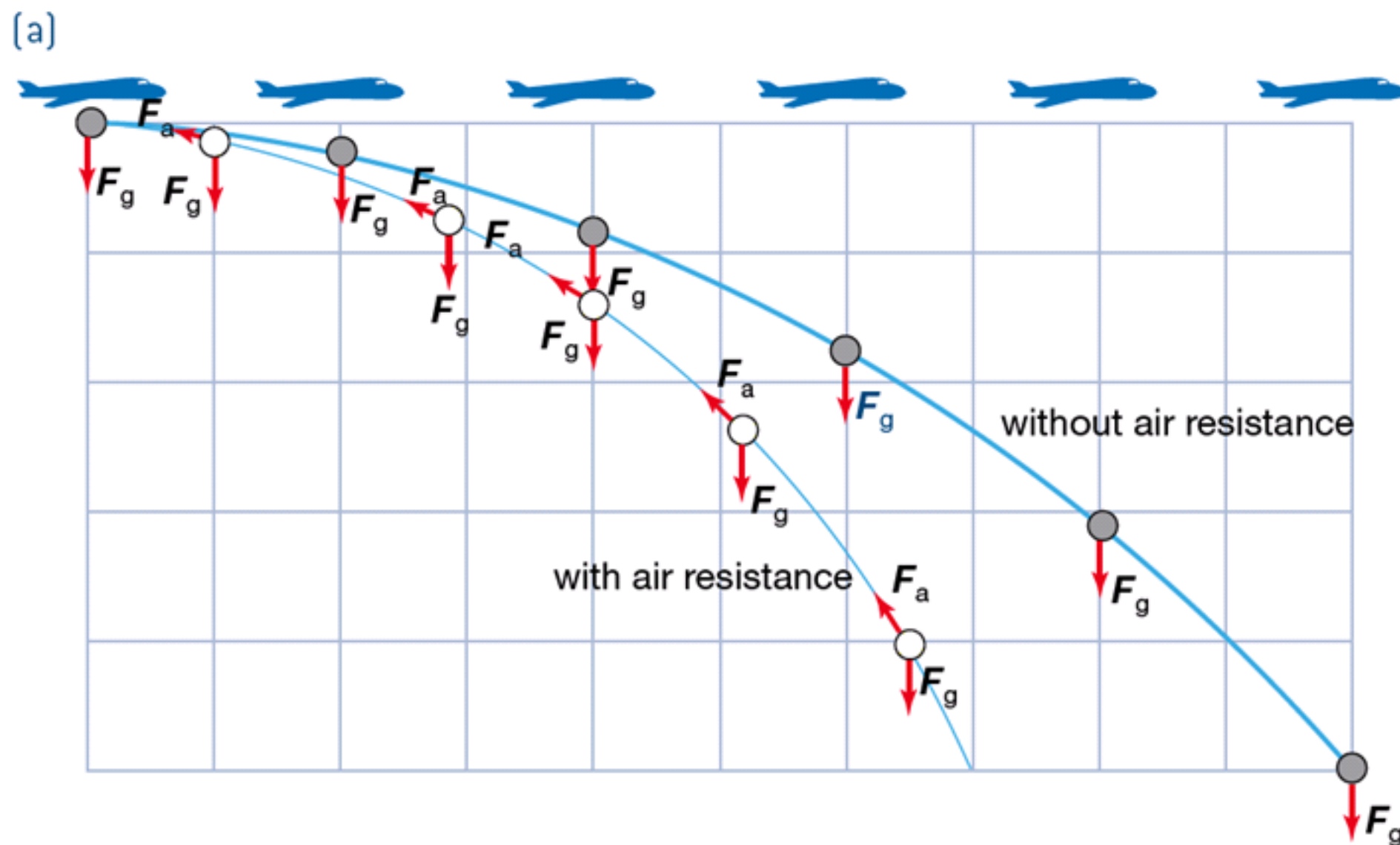
2

	VER	HOR
$u_y = 40$		
$v_y = 0$		
$a = -10$		
$t = 4 \text{ s}$		
$y = h_{\text{max}}$		



# THE EFFECT OF AIR RESISTANCE!

Figure 1.23 shows a food parcel being dropped from a plane moving at a constant velocity. If air resistance is ignored, the parcel falls in a parabolic arc. It would continue moving horizontally at the same rate as the plane; that is, as the parcel falls it would stay directly beneath the plane until it hits the ground. The effect of air resistance is also shown. Air resistance (or drag) is a retarding force and it acts in a direction that is opposite to the motion of the projectile. If air resistance is taken into account, there are now two forces acting—weight,  $F_g$ , and air resistance,  $F_a$ . Therefore, the resultant force,  $\Sigma F$ , that acts on the projectile is *not* vertically down. The magnitude of the air resistance force is greater when the speed of the body is greater.



**Figure 1.23** (a) The path of a food parcel dropped from a plane. If the plane maintains a constant speed and in the absence of air resistance, the parcel will fall in a parabolic path and remain directly below the plane. Air resistance makes the parcel fall more slowly, over a shorter path. (b) When air resistance is acting, the net force on the parcel is not vertically down.



## \\ WORKED EXAMPLE

A soccer ball is kicked at an angle of  $37.0^\circ$  to the horizontal with a velocity of  $25.0 \text{ m s}^{-1}$  as shown in Figure 2.3. (Neglect air resistance and any spinning of the ball.)

### Question 1

How long does the ball remain in the air before it falls back to the ground?

### Answer

Vertical component of motion:

$d$	$u$	$v$	$a$	$t$
?	$v_v = 25 \sin 37^\circ = 15.0 \text{ m s}^{-1}$	0	-10	?

$$\begin{aligned}
 v &= u + at \\
 \Rightarrow 0 &= 15 - 10t \\
 \Rightarrow t &= 1.5 \text{ s} \\
 \Rightarrow T = 2t &= 3.0 \text{ s}
 \end{aligned}$$

### Question 2

What is the maximum height to which the ball rises?

### Answer

$$\begin{aligned}
 d &= \frac{1}{2}(u + v)t \\
 \Rightarrow d &= \frac{1}{2}(15 + 0) \times 1.5 \\
 &= 11.3 \text{ m}
 \end{aligned}$$

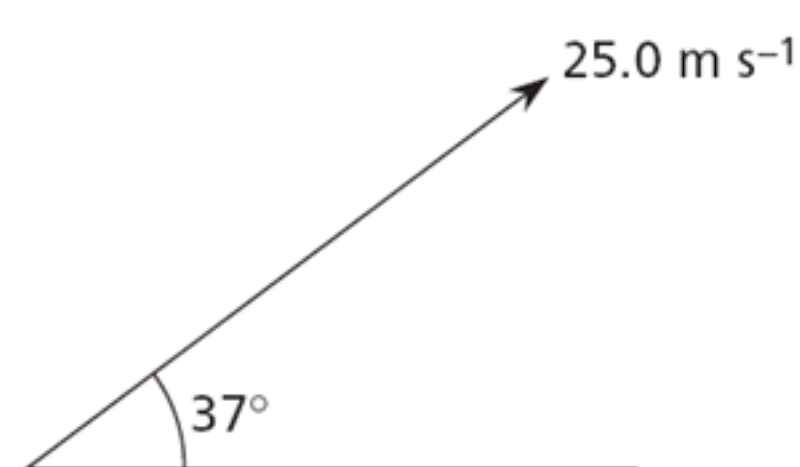


Figure 2.3

### Question 3

Calculate the horizontal distance travelled by the ball.

### Answer

Horizontal component of motion:

$$\begin{aligned}
 v_h &= 25 \cos 37^\circ = 20 \text{ m s}^{-1} \\
 \Rightarrow x_h &= 20 \times 1.5 \\
 &= 30 \text{ m}
 \end{aligned}$$

### Question 4

Determine the velocity at the maximum height.

### Answer

At the maximum height, the vertical component of the velocity is zero. There is only the constant horizontal component. Hence, the velocity at the greatest height is  $20.0 \text{ m s}^{-1}$ .

### Question 5

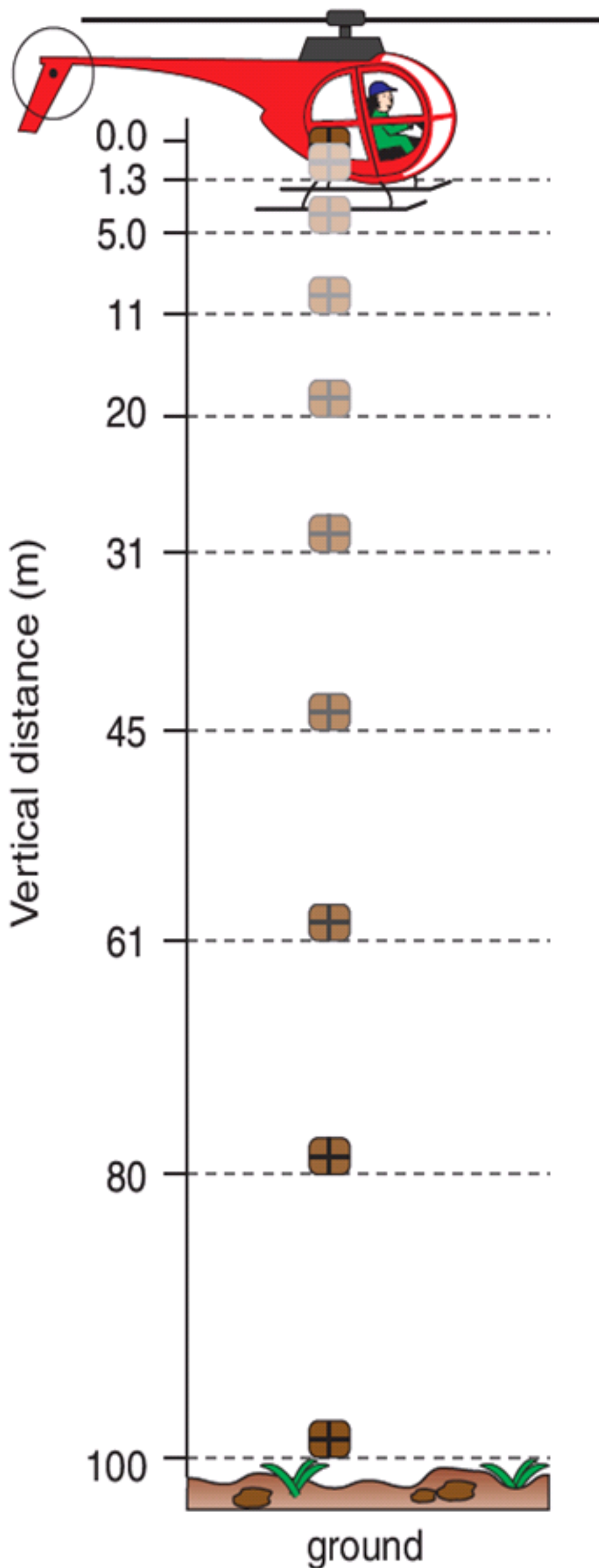
What is the acceleration at the maximum height?

### Answer

The acceleration at the maximum height is the same as at any other point in the parabolic path throughout the flight, namely  $10 \text{ m s}^{-2}$  downwards.

Note that even though the vertical velocity component is zero at the maximum height, the ball is still in the Earth's gravitational field so that it still experiences a force of attraction.

## Sample problem 3.1



A helicopter delivering supplies to a flood-stricken farm hovers 100 m above the ground. A package of supplies is dropped from rest, just outside the door of the helicopter. Air resistance can be ignored.

- Calculate how long it takes the package to reach the ground.
- Calculate how far from its original position the package has fallen after 0.5 s, 1.0 s, 1.5 s, 2.0 s etc. until the package has hit the ground. (You may like to use a spreadsheet here.) Draw a scale diagram of the package's position at half-second intervals.

(a)  $u = 0 \text{ m s}^{-1}$ ,  $x = 100 \text{ m}$ ,  $a = 10 \text{ m s}^{-2}$ ,  $t = ?$

$$x = ut + \frac{1}{2} at^2$$

$$100 \text{ m} = 0 \text{ m s}^{-1} \times t + \frac{1}{2} (10 \text{ m s}^{-2}) t^2$$

$$\frac{100}{5.0} = t^2$$

$$t = 4.5 \text{ s}$$

(Note: the negative square root can be ignored here as we are interested only in motion that has occurred after the package was released at  $t = 0$ , i.e. positive times.)

(b)  $t = 0.5 \text{ s}$ ,  $u = 0 \text{ m s}^{-1}$ ,  $a = 10 \text{ m s}^{-2}$ ,  $x = ?$

$$x = ut + \frac{1}{2} at^2$$

$$= 0 \times 0.5 \text{ s} + \frac{1}{2} (10 \text{ m s}^{-2}) (0.5 \text{ s})^2$$

$$= 1.23 \text{ m}$$

Repeat this for  $t = 1 \text{ s}$ ,  $1.5 \text{ s}$ ,  $2 \text{ s}$  etc. to gain the results listed in the following table and illustrated at left.



## Sample problem 3.2

Imagine the helicopter described in sample problem 3.1 is not stationary, but is flying at a slow and steady speed of  $20 \text{ m s}^{-1}$  and is  $100 \text{ m}$  above the ground when the package is dropped.

- (a) Calculate how long it takes the package to hit the ground.
- (b) What is the range of the package?
- (c) Calculate the vertical distance the package has fallen after  $0.5 \text{ s}$ ,  $1.0 \text{ s}$ ,  $1.5 \text{ s}$ ,  $2.0 \text{ s}$ , etc. until the package has reached the ground. (You may like to use a spreadsheet here.) Then calculate the corresponding horizontal distance, and hence draw a scale diagram of the package's position at half-second intervals.

Remember, the horizontal and vertical components of the package's motion must be considered separately.

**Solution:** (a) In this part of the question the vertical component is important. Vertical component:  $u = 0 \text{ m s}^{-1}$ ,  $x = 100 \text{ m}$ ,  $a = 10 \text{ m s}^{-2}$ ,  $t = ?$

$$x = ut + \frac{1}{2} at^2$$

$$100 \text{ m} = 0 \text{ m s}^{-1} \times t + \frac{1}{2} (10 \text{ m s}^{-2}) t^2$$

$$\frac{100}{5.0} = t^2$$

$$t = 4.5 \text{ s}$$

(Note: again, the positive square root is taken as we are concerned only with what happens after  $t = 0$ .)

- (b) The range of the package is the horizontal distance over which it travels. It is the horizontal component of velocity that must be used here.

Horizontal component:  $u = 20 \text{ m s}^{-1}$  (The initial velocity of the package is the same as the velocity of the helicopter in which it has been travelling.)

$a = 0 \text{ m s}^{-2}$  (No forces act horizontally so there is no horizontal acceleration.)

$t = 4.5 \text{ s}$  (from part (a) of this example)

$x = ?$

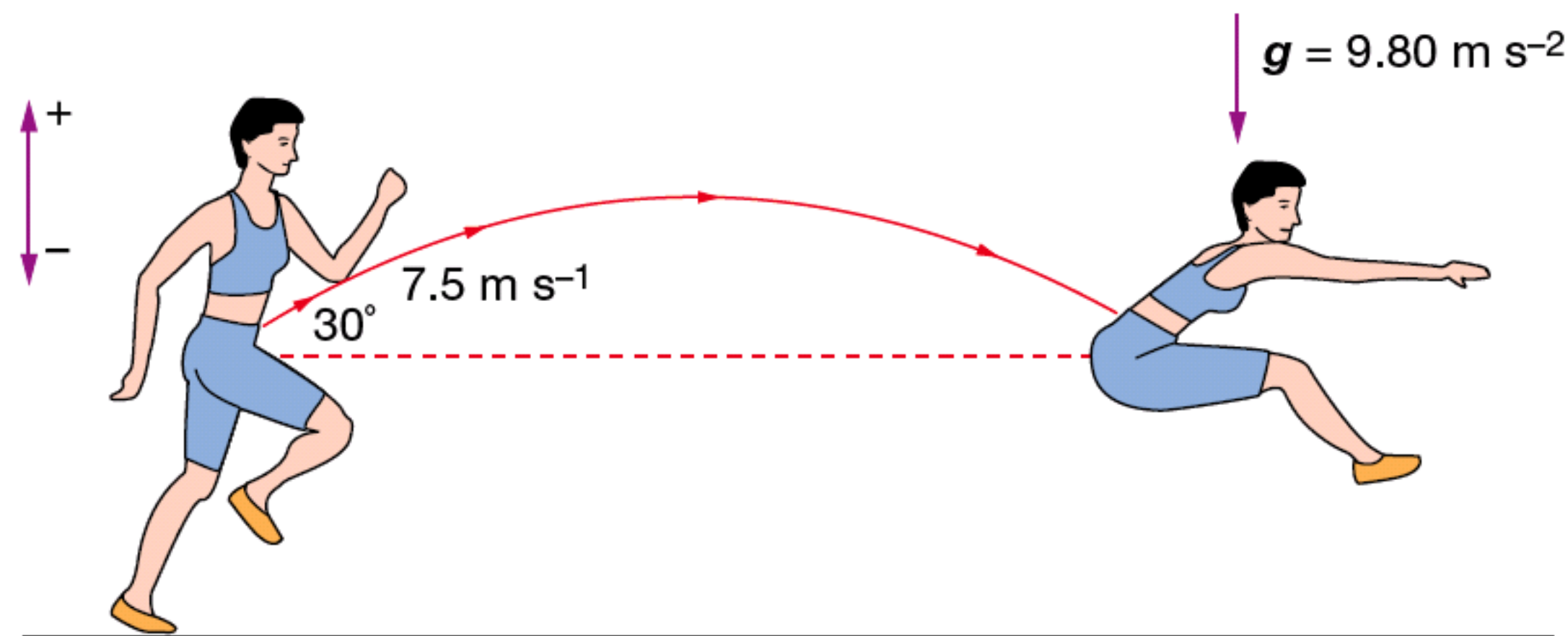
$$x = ut + \frac{1}{2} at^2$$

$$= 20 \text{ m s}^{-1} \times 4.5 \text{ s} + 0$$

$$= 90 \text{ m}$$

## Worked example 1.5B

### Launch at an angle



A 65 kg athlete in a long-jump event leaps with a velocity of  $7.50 \text{ m s}^{-1}$  at  $30.0^\circ$  to the horizontal. Treating the athlete as a point mass, ignoring air resistance, and using  $g$  as  $9.80 \text{ m s}^{-2}$ , calculate:

- a** the horizontal component of the initial velocity
- b** the vertical component of the initial velocity
- c** the velocity when at the highest point
- d** the maximum height gained by the athlete
- e** the total time for which the athlete is in the air
- f** the horizontal distance travelled by the athlete's centre of mass (assuming that it returns to its original height)
- g** the athlete's acceleration at the highest point of the jump.



## Solution

In this problem, the upward direction will be taken as positive. The horizontal and vertical components of the initial velocity can be found by using trigonometry.

**a** As shown in the diagram, the horizontal component,  $u_h$ , of the athlete's initial velocity is:

$$\begin{aligned}u_h &= 7.50 \times \cos 30.0^\circ \\&= 6.50 \text{ m s}^{-1} \text{ to the right}\end{aligned}$$

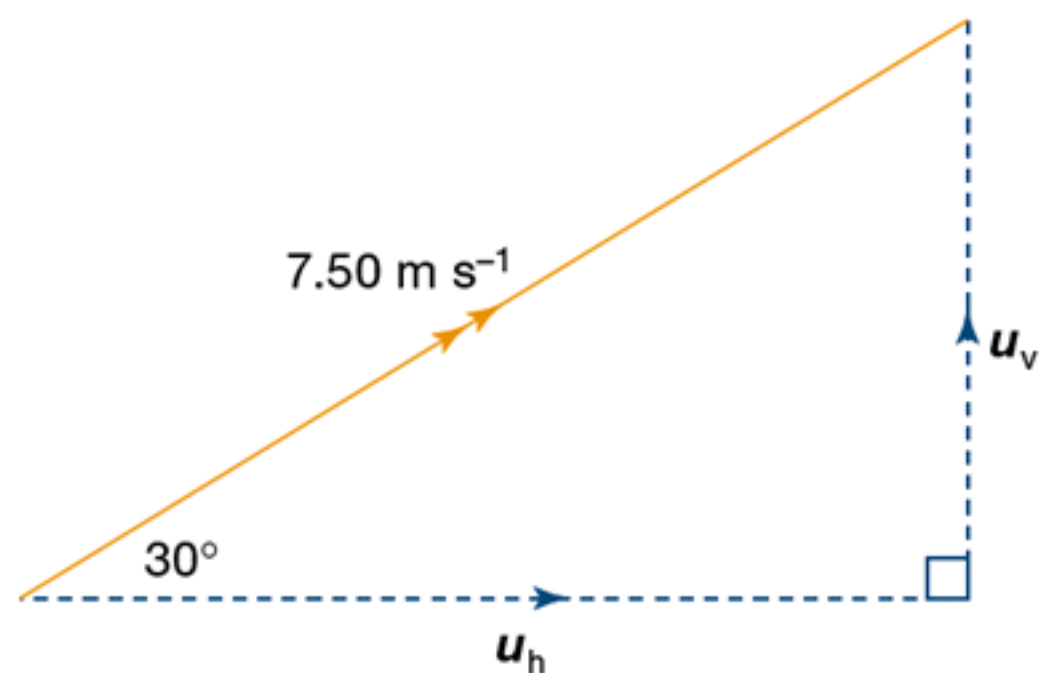
This remains constant throughout the jump.

**b** Again referring to the diagram, the vertical component,  $u_v$ , of the initial velocity of the athlete is:

$$\begin{aligned}u_v &= 7.50 \times \sin 30.0^\circ \\&= 3.75 \text{ m s}^{-1} \text{ upwards}\end{aligned}$$

**c** At the highest point, the athlete is moving horizontally. The vertical component of the velocity at this point is therefore zero. The actual velocity is given by the horizontal component of the velocity throughout the jump. This was found in (a) to be  $6.50 \text{ m s}^{-1}$  in the horizontal direction.

**d** To find the maximum height that is gained, we must work with the vertical component. As explained in (c), at the maximum height the athlete is moving horizontally and so



the vertical component of velocity at this point is zero. The vertical displacement of the athlete to the highest point is the maximum height that was reached:

$$u_v = 3.75 \text{ m s}^{-1}, v = 0, a = -9.80 \text{ m s}^{-2}, x = ?$$

$$v^2 = u^2 + 2ax$$

$$0 = 3.75^2 + (2 \times -9.80 \times x)$$

$$x = 0.717 \text{ m}$$

i.e. the centre of mass of the athlete rises by a maximum height of 72 cm.

**e** As the motion is symmetrical, the time to complete the jump will be double that taken to reach the maximum height. First, the time to reach the highest point must be found. Using the vertical component:

$$u_v = 3.75 \text{ m s}^{-1}, v = 0, a = -9.80 \text{ m s}^{-2}, t = ?$$

$$v = u + at$$

$$0 = 3.75 + (-9.80 \times t)$$

$$t = 0.383 \text{ s}$$

The time for the complete flight is double the time to reach maximum height, i.e. total time in the air:  $\Sigma t = 2 \times 0.383 = 0.766 \text{ s}$ .

**f** To find the horizontal distance for the jump, we must work with the horizontal component. From part e, the athlete was in the air for a time of 0.766 s and so:

$$t = 0.766 \text{ s}, v = 6.50 \text{ m s}^{-1}, x = ?$$

$$v = \frac{x}{t}, \text{ so}$$

$$x = v \times t$$

$$= 6.50 \times 0.766$$

$$= 4.98 \text{ m}$$

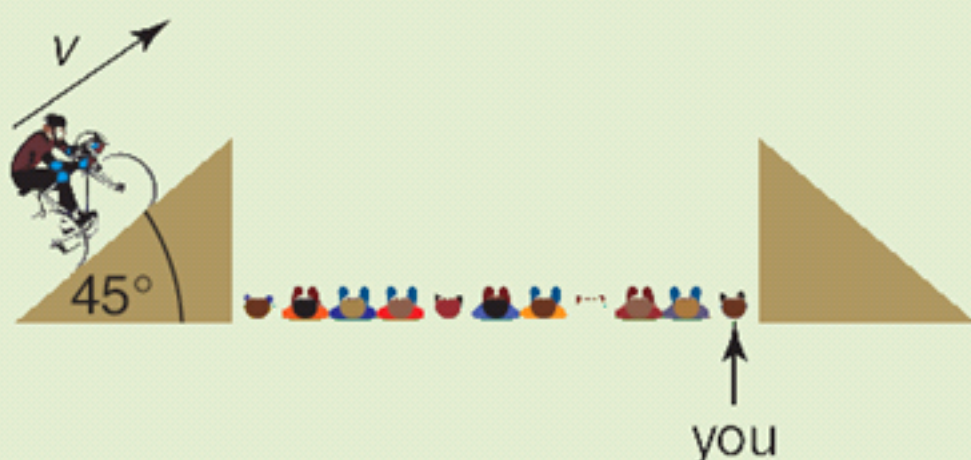
i.e. the athlete jumps a horizontal distance of 4.98 m.

**g** At the highest point of the motion, the only force acting on the athlete is that due to gravity (i.e. weight). The acceleration will therefore be  $9.80 \text{ m s}^{-2}$  down.



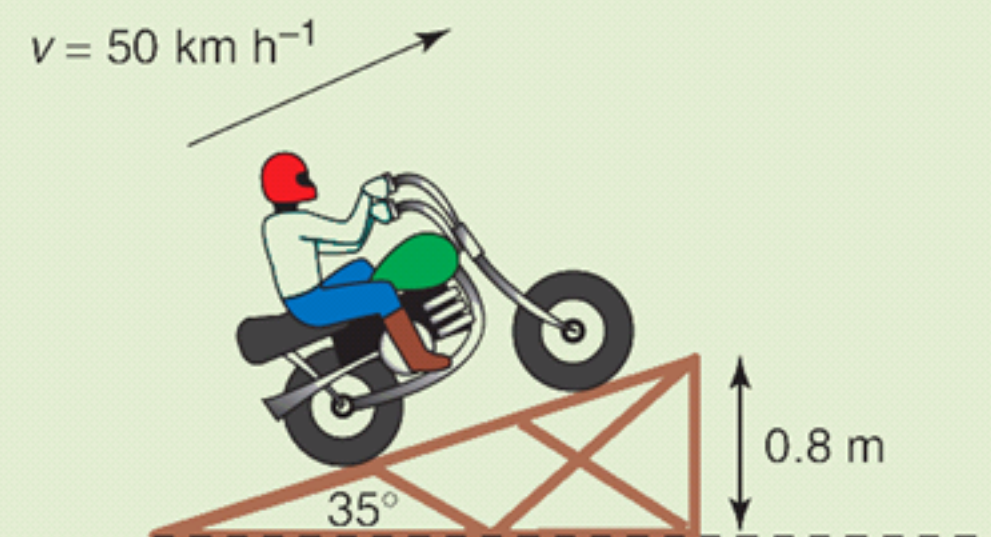
## MORE QUESTIONS (HOMEWORK)

12. A friend wants to get into the *Guinness Book of Records* by jumping over 11 people on his push bike. He has set up two ramps, as shown below and has allowed a space of 0.5 m for each person to lay down in. In practice attempts, he has averaged a speed of  $7.0 \text{ m s}^{-1}$  at the end of the ramp. Will you lay down as the eleventh person between the ramps?



13. You have entered the javelin event in your school athletics competition. Not being a naturally talented thrower, you decide to use your brain to maximise your performance. Using your understanding of the principles of projectile motion, decide on the best angle to release your javelin. Back up your answer with calculations.
14. A skateboarder jumps a horizontal distance of 2 m, taking off at a speed of  $5 \text{ m s}^{-1}$ . The jump takes 0.42 s to complete.
- What was the skateboarder's initial horizontal velocity?
  - What was the angle of take-off?
  - What was the maximum height above the ground reached during the jump?

16. A motocross rider rides over the jump shown below at a speed of  $50 \text{ km h}^{-1}$ .
- How long does it take the bike to reach the top of its flight?
  - How far vertically and horizontally has the bike travelled at this time?
  - How long does it take the bike to reach the ground from the top of its flight?
  - What is the total range of the jump?



17. A waterskier at the Moomba Masters competition in Melbourne leaves a ramp at a speed of  $50 \text{ km h}^{-1}$  and at an angle of  $30^\circ$ . The edge of the ramp is 1.7 m above the water. Calculate:
- the range of the jump
  - the velocity at which the jumper hits the water.
- (Hint: split the waterskier's motion into two sections, before the highest point and after the highest point, to avoid solving a quadratic equation.)
18. A gymnast wants to jump a distance of 2.5 m, leaving the ground at an angle of  $28^\circ$ . With what speed must the gymnast take off?
19. A horse rider wants to jump a 3.0 m wide stream. The horse can approach the stream with a speed of  $7 \text{ m s}^{-1}$ . At what angle must the horse take off?
- (Hint: you will need to use trigonometric identities from mathematics, or model the situation using a spreadsheet to solve this problem.)



### Question 1

An object is launched horizontally with an initial velocity of  $5.0 \text{ m s}^{-1}$ . What will be the equations for:

- a the  $y$ -coordinate of its displacement after time  $t$ ?
- b the  $x$ -coordinate of its displacement after time  $t$ ?

### Question 2

A body is projected horizontally with a velocity of  $2.0 \text{ m s}^{-1}$ .

- a What will the horizontal displacement be after  $2.0 \text{ s}$ ?
- b What will the vertical displacement be at this time?
- c When will the horizontal displacement be  $0.20 \text{ m}$ ?
- d What will the vertical displacement be when the horizontal displacement is  $0.20 \text{ m}$ ?

### Question 3

An object is projected horizontally. After  $t$  seconds it has a horizontal displacement of  $10.0 \text{ cm}$  and a vertical displacement of  $5.0 \text{ cm}$ .

- a What is the value of  $t$ ?
- b What is the magnitude of the initial velocity?

### Question 4

An object is projected horizontally with an initial velocity of  $3.0 \text{ m s}^{-1}$ .

- a When will the vertical displacement be  $5.0 \text{ m}$ ?
- b What will the horizontal displacement be at this time?

### Question 5

A stone is thrown horizontally out to sea from the top of a cliff, with a velocity of  $15 \text{ m s}^{-1}$ , and reaches the water below after  $3.0 \text{ s}$ .

- a How high is the cliff?
- b How far from the base of the cliff is the stone when it reaches the water?
- c What is the velocity of the stone just prior to striking the water?

### Question 6

A multiframe photograph is taken of an object that is projected horizontally. How can you tell from the photograph that the horizontal velocity component is constant and that the vertical velocity increases uniformly?

### Question 7

A ball of mass  $0.50 \text{ kg}$  rolls off a horizontal ledge  $4.0 \text{ m}$  above the ground with a speed of  $4.0 \text{ m s}^{-1}$ .

- a How long does it take the ball to reach the ground below the ledge?
- b How far, horizontally, from the ledge will the ball strike the ground?
- c What is the horizontal component of the ball's velocity when it strikes the ground?
- d What is the vertical component of the ball's velocity when it strikes the ground?
- e What is the kinetic energy of the ball just before it strikes the ground?
- f What is the speed of the ball as it strikes the ground?

### Question 8

Two balls, A and B, each of mass  $1.6 \text{ kg}$  are rolling along a horizontal table  $2.0 \text{ m}$  above the floor. Both balls roll off the end of the table and reach the floor below. A has a horizontal velocity of  $4.0 \text{ m s}^{-1}$  as it leaves the table, while B has a horizontal velocity of  $2.5 \text{ m s}^{-1}$ .

- a What is the time taken for:
  - i A to reach the floor?
  - ii B to reach the floor?
- b What is the kinetic energy of A just before it strikes the floor?
- c What is the kinetic energy of B just before it strikes the floor?
- d What is the difference in the horizontal distances travelled by A and B before they strike the floor?

### Question 9

A stone is projected with a velocity of  $100 \text{ m s}^{-1}$  at an elevation of  $30^\circ$  from a tower  $150 \text{ m}$  high. Find:

- a the time of flight
- b the horizontal distance from the tower at which the stone strikes the ground
- c the magnitude and the direction of the velocity of the stone as it strikes the ground

### Question 10

A boy throws a ball into the air at an angle to the horizontal. The ball reaches a vertical height of  $8.0 \text{ m}$  and travels a horizontal distance of  $16 \text{ m}$  before being at the same vertical position as at the point of release.

- a What is the magnitude of the vertical velocity component of the ball as it is thrown?
- b What is the time of flight of the ball?
- c What is the horizontal velocity component of the ball at its point of throwing?
- d What is the speed of the ball at its point of release?



# HOMEWORK

- ✦ Homework is an integral part of your "Learning Curve", take it seriously!
- ✦ Target minimum 1 hour of Physics everyday
- ✦ Divide your physics home study in three segments;
  - ✓ Revision (past)
  - ✓ Homework (present)
  - ✓ Tomorrow (future)
- ✦ Homework is due next period, unless otherwise stated
- ✦ If you cannot do all, at least do a few from each piece

*Apart from **reading the relevant pages from the textbook and solving the rest of the questions in this booklet** your homework is:*

1. PM Practice Booklet
2. All Questions in this booklet
3. Chapter 2 Questions 1-13

**NEXT PERIOD >**

**ESCAPE VELOCITY "HOW TO ESCAPE FROM EARTH'S GRAVITY"**