

RECOMMENDED PROBLEMS

CHAPTER 4



@GENERALPHYSICSA

Physics A - Serway

إعداد

أ. أنس فضل الشافعي

أ. إسماعيل جهاد تايه

معيدي قسم الفيزياء في الجامعة الإسلامية

1. A motorist drives south at 20.0 m/s for 3.00 min, then turns west and travels at 25.0 m/s for 2.00 min, and finally travels northwest at 30.0 m/s for 1.00 min. For this 6.00-min trip, find (a) the total vector displacement, (b) the average speed, and (c) the average velocity. Let the positive x axis point east.

3. Suppose the position vector for a particle is given as a function of time by $\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j}$, with $x(t) = at + b$ and $y(t) = ct^2 + d$, where $a = 1.00 \text{ m/s}$, $b = 1.00 \text{ m}$, $c = 0.125 \text{ m/s}^2$, and $d = 1.00 \text{ m}$. (a) Calculate the average velocity during the time interval from $t = 2.00 \text{ s}$ to $t = 4.00 \text{ s}$. (b) Determine the velocity and the speed at $t = 2.00 \text{ s}$.

4. The coordinates of an object moving in the xy plane vary with time according to the equations $x = -5.00 \sin \omega t$ and $y = 4.00 - 5.00 \cos \omega t$, where ω is a constant, x and y are in meters, and t is in seconds.
- (a) Determine the components of velocity of the object at $t = 0$. (b) Determine the components of acceleration of the object at $t = 0$. (c) Write expressions for the position vector, the velocity vector, and the acceleration vector of the object at any time $t > 0$. (d) Describe the path of the object in an xy plot.

7. The vector position of a particle varies in time according to the expression $\vec{r} = 3.00\hat{i} - 6.00t^2\hat{j}$, where $\vec{r}$ is in meters and t is in seconds. (a) Find an expression for the velocity of the particle as a function of time. (b) Determine the acceleration of the particle as a function of time. (c) Calculate the particle's position and velocity at $t = 1.00$ s.

- 9.** A fish swimming in a horizontal plane has velocity $\vec{v}_i = (4.00\hat{i} + 1.00\hat{j})$ m/s at a point in the ocean where the position relative to a certain rock is $\vec{r}_i = (10.0\hat{i} - 4.00\hat{j})$ m. After the fish swims with constant acceleration for 20.0 s, its velocity is $\vec{v} = (20.0\hat{i} - 5.00\hat{j})$ m/s. (a) What are the components of the acceleration of the fish? (b) What is the direction of its acceleration with respect to unit vector $\hat{i}$? (c) If the fish maintains constant acceleration, where is it at $t = 25.0$ s and in what direction is it moving?

18. A rock is thrown upward from level ground in such a way that the maximum height of its flight is equal to its horizontal range R . (a) At what angle θ is the rock thrown? (b) In terms of its original range R , what is the range $R_{\max}$ the rock can attain if it is launched at the same speed but at the optimal angle for maximum range? (c) **What If?** Would your answer to part (a) be different if the rock is thrown with the same speed on a different planet? Explain.

19. The speed of a projectile when it reaches its maximum height is one-half its speed when it is at half its maximum height. What is the initial projection angle of the projectile?

21. A firefighter, a distance d from a burning building, directs a stream of water from a fire hose at angle θ_i above the horizontal as shown in Figure P4.21. If the initial speed of the stream is v_i , at what height h does the water strike the building?

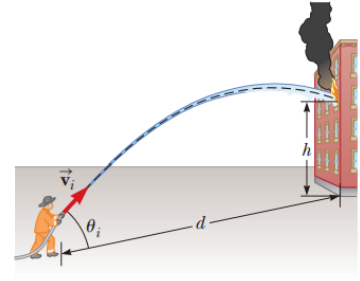


Figure P4.21

23. A placekicker must kick a football from a point 36.0 m (about 40 yards) from the goal. Half the crowd hopes the ball will clear the crossbar, which is 3.05 m high. When kicked, the ball leaves the ground with a speed of 20.0 m/s at an angle of 53.0° to the horizontal. (a) By how much does the ball clear or fall short of clearing the crossbar? (b) Does the ball approach the crossbar while still rising or while falling?

- 25.** A playground is on the flat roof of a city school, 6.00 m above the street below (Fig. P4.25). The vertical wall of the building is $h = 7.00$ m high, forming a 1-m-high railing around the playground. A ball has fallen to the street below, and a passerby returns it by launching it at an angle of $\theta = 53.0^\circ$ above the horizontal at a point $d = 24.0$ m from the base of the building wall. The ball takes 2.20 s to reach a point vertically above the wall. (a) Find the speed at which the ball was launched. (b) Find the vertical distance by which the ball clears the wall. (c) Find the horizontal distance from the wall to the point on the roof where the ball lands.

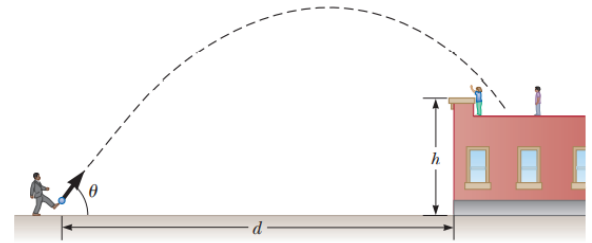


Figure P4.25

- 29.** A student stands at the edge of a cliff and throws a stone horizontally over the edge with a speed of $v_i = 18.0$ m/s. The cliff is $h = 50.0$ m above a body of water as shown in Figure P4.29. (a) What are the coordinates of the initial position of the stone? (b) What are the components of the initial velocity of the stone? (c) What is the appropriate analysis model for the vertical motion of the stone? (d) What is the appropriate analysis model for the horizontal motion of the stone? (e) Write symbolic equations for the x and y components of the velocity of the stone as a function of time. (f) Write symbolic equations for the position of the stone as a function of time. (g) How long after being released does the stone strike the water below the cliff? (h) With what speed and angle of impact does the stone land?

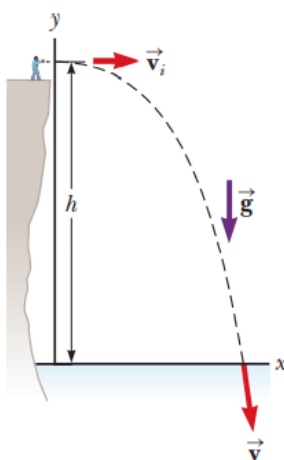


Figure P4.29

- 41.** A train slows down as it rounds a sharp horizontal turn, going from 90.0 km/h to 50.0 km/h in the 15.0 s it takes to round the bend. The radius of the curve is 150 m. Compute the acceleration at the moment the train speed reaches 50.0 km/h. Assume the train continues to slow down at this time at the same rate.

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42. A ball swings counterclockwise in a vertical circle at the end of a rope 1.50 m long. When the ball is 36.9° past the lowest point on its way up, its total acceleration is $(-22.5\hat{i} + 20.2\hat{j}) \text{ m/s}^2$. For that instant, (a) sketch a vector diagram showing the components of its acceleration, (b) determine the magnitude of its radial acceleration, and (c) determine the speed and velocity of the ball.

43. (a) Can a particle moving with instantaneous speed 3.00 m/s on a path with radius of curvature 2.00 m have an acceleration of magnitude 6.00 m/s^2 ? (b) Can it have an acceleration of magnitude 4.00 m/s^2 ? In each case, if the answer is yes, explain how it can happen; if the answer is no, explain why not.

44. The pilot of an airplane notes that the compass indicates a heading due west. The airplane's speed relative to the air is 150 km/h. The air is moving in a wind at 30.0 km/h toward the north. Find the velocity of the airplane relative to the ground.

- 45.** An airplane maintains a speed of 630 km/h relative to the air it is flying through as it makes a trip to a city 750 km away to the north. (a) What time interval is required for the trip if the plane flies through a headwind blowing at 35.0 km/h toward the south? (b) What time interval is required if there is a tailwind with the same speed? (c) What time interval is required if there is a crosswind blowing at 35.0 km/h to the east relative to the ground?

47. A police car traveling at 95.0 km/h is traveling west, chasing a motorist traveling at 80.0 km/h . (a) What is the velocity of the motorist relative to the police car? (b) What is the velocity of the police car relative to the motorist? (c) If they are originally 250 m apart, in what time interval will the police car overtake the motorist?

- 50.** A river has a steady speed of 0.500 m/s . A student swims upstream a distance of 1.00 km and swims back to the starting point. (a) If the student can swim at a speed of 1.20 m/s in still water, how long does the trip take? (b) How much time is required in still water for the same length swim? (c) Intuitively, why does the swim take longer when there is a current?

51. A river flows with a steady speed v . A student swims upstream a distance d and then back to the starting point. The student can swim at speed c in still water. (a) In terms of d , v , and c , what time interval is required for the round trip? (b) What time interval would be required if the water were still? (c) Which time interval is larger? Explain whether it is always larger.

54. A farm truck moves due east with a constant velocity of 9.50 m/s on a limitless, horizontal stretch of road. A boy riding on the back of the truck throws a can of soda upward (Fig. P4.54)

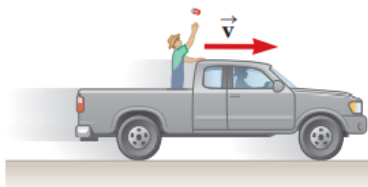


Figure P4.54

and catches the projectile at the same location on the truck bed, but 16.0 m farther down the road. (a) In the frame of reference of the truck, at what angle to the vertical does the boy throw the can? (b) What is the initial speed of the can relative to the truck? (c) What is the shape of the can's trajectory as seen by the boy? An observer on the ground watches the boy throw the can and catch it. In this observer's frame of reference, (d) describe the shape of the can's path and (e) determine the initial velocity of the can.

55. A ball on the end of a string is whirled around in a horizontal circle of radius 0.300 m. The plane of the circle is 1.20 m above the ground. The string breaks and the ball lands 2.00 m (horizontally) away from the point on the ground directly beneath the ball's location when the string breaks. Find the radial acceleration of the ball during its circular motion.

60. A basketball player is standing on the floor 10.0 m from the basket as in Figure P4.60. The height of the basket is 3.05 m, and he shoots the ball at a 40.0° angle with the horizontal from a height of 2.00 m. (a) What is the acceleration of the basketball at the highest point in its trajectory? (b) At what speed must the player throw the basketball so that the ball goes through the hoop without striking the backboard?

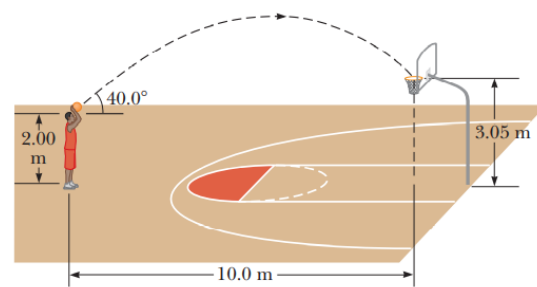


Figure P4.60

62. A boy throws a stone horizontally from the top of a cliff of height h toward the ocean below. The stone strikes the ocean at distance d from the base of the cliff. In terms of h , d , and g , find expressions for (a) the time t at which the stone lands in the ocean, (b) the initial speed of the stone, (c) the speed of the stone immediately before it reaches the ocean, and (d) the direction of the stone's velocity immediately before it reaches the ocean.

- 64.** Towns A and B in Figure P4.64 are 80.0 km apart. A couple arranges to drive from town A and meet a couple driving from town B at the lake, L. The two couples leave simultaneously and drive for 2.50 h in the directions shown. Car 1 has a speed of 90.0 km/h. If the cars arrive simultaneously at the lake, what is the speed of car 2?

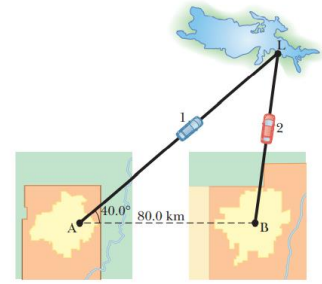


Figure P4.64

70. A pendulum with a cord of length $r = 1.00$ m swings in a vertical plane (Fig. P4.70). When the pendulum is in the two horizontal positions $\theta = 90.0^\circ$ and $\theta = 270^\circ$, its speed is 5.00 m/s. Find the magnitude of (a) the radial acceleration and (b) the tangential acceleration for these positions. (c) Draw vector diagrams to determine the direction of the total acceleration for these two positions. (d) Calculate the magnitude and direction of the total acceleration at these two positions.

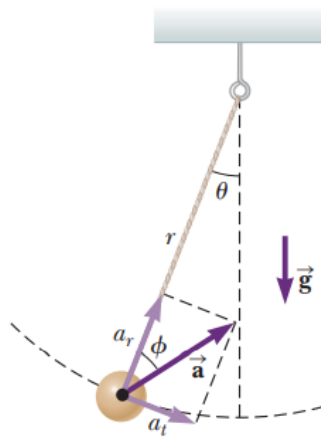


Figure P4.70

- 71.** A hawk is flying horizontally at 10.0 m/s in a straight line, 200 m above the ground. A mouse it has been carrying struggles free from its talons. The hawk continues on its path at the same speed for 2.00 s before attempting to retrieve its prey. To accomplish the retrieval, it dives in a straight line at constant speed and recaptures the mouse 3.00 m above the ground. (a) Assuming no air resistance acts on the mouse, find the diving speed of the hawk. (b) What angle did the hawk make with the horizontal during its descent? (c) For what time interval did the mouse experience free fall?

- 84.** A person standing at the top of a hemispherical rock of radius R kicks a ball (initially at rest on the top of the rock) to give it horizontal velocity $\vec{v}_i$ as shown in Figure P4.84. (a) What must be its minimum initial speed if the ball is never to hit the rock after it is kicked? (b) With this initial speed, how far from the base of the rock does the ball hit the ground?

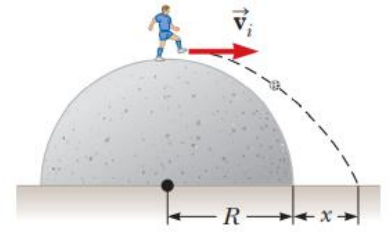


Figure P4.84

- 86.** A projectile is fired up an incline (incline angle ϕ) with an initial speed v_i at an angle θ_i with respect to the horizontal ($\theta_i > \phi$) as shown in Figure P4.86. (a) Show that the projectile travels a distance d up the incline, where

$$d = \frac{2v_i^2 \cos\theta_i \sin(\theta_i - \phi)}{g \cos^2 \phi}$$

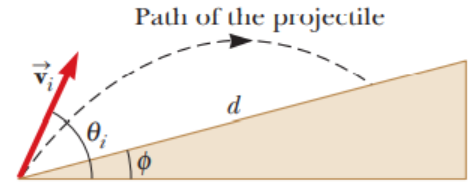
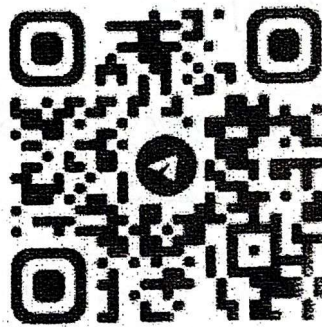


Figure P4.86

RECOMMENDED PROBLEMS

CHAPTER 4



@GENERALPHYSICSA

Physics A - Serway

إعداد

أ. إسماعيل جهاد تايه

أ. أنس فضل الشافعي

معيدي قسم الفيزياء في الجامعة الإسلامية

فَاخْرُجْ مَطْلَعٌ عَلَى الْأَسْرَارِ

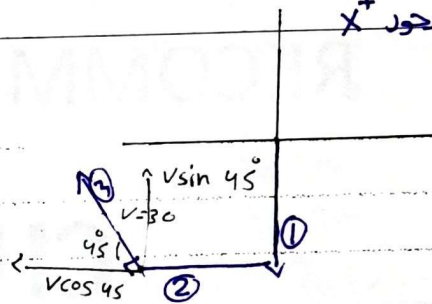
مَنْ كَرَّ مِنْهُ خُذْ وَلَا تَجْهَلْ بِهِ

المطلوب الأول: الإزاحة التي قطعها السائق في 6 دقائق

1. A motorist drives south at 20.0 m/s for 3.00 min, then turns west and travels at 25.0 m/s for 2.00 min, and finally travels northwest at 30.0 m/s for 1.00 min. For this 6.00-min trip, find (a) the total vector displacement, (b) the average speed, and (c) the average velocity. Let the positive x axis point east.

المطلوب الثاني: متوسط السرعة التي تحرك السائق بها

المطلوب الثالث: متوسط السرعة الاتجاهية

بالنسبة لمحور x^+ ① 20 m/s in south in $(3 \times 60) s$.② 25 m/s in west in $(2 \times 60) s$.③ 30 m/s in northwest in $(1 \times 60) s$.

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المطلوب الأول: الإزاحة في 6 دقائق

$$1. d = vt = 20 \times 3 \times 60 = -3600 \hat{j} m$$

$$2. d = vt = 25 \times 2 \times 60 = -3000 \hat{i} m$$

$$3. d = vt = 30 \times 1 \times 60 = 1800 m \text{ northwest}$$

الشكل الخفيف

$$\tan \theta = \frac{-4272.8}{-2327.2}$$

$$\theta = 28.6^\circ \text{ in southeast}$$

$$\sum d_x = -3000 - 1800 \cos 45^\circ = -4272.8 m \hat{i}$$

$$\sum d_y = 1800 \sin 45^\circ - 3600 = -2327.2 m \hat{j}$$

$$d = \sqrt{d_x^2 + d_y^2} = \sqrt{(-4272.8)^2 + (-2327.2)^2} = 4865.45 m$$

$$b) \text{ the average speed} = \frac{\text{total distance}}{\text{total time}} = \frac{3600 + 3000 + 1800}{6 \times 60} = 23.33 m/s$$

$$c) \text{ the average velocity} = \frac{\text{displacement}}{\text{time}} = \frac{4865.45}{6 \times 60} = 13.5 m/s$$

$$\theta = 28.6^\circ \text{ اتجاه السرعة في نفس اتجاه } d$$

3. Suppose the position vector for a particle is given as a function of time by $\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j}$, with $x(t) = at + b$ and $y(t) = ct^2 + d$, where $a = 1.00 \text{ m/s}$, $b = 1.00 \text{ m}$, $c = 0.125 \text{ m/s}^2$, and $d = 1.00 \text{ m}$. (a) Calculate the average velocity during the time interval from $t = 2.00 \text{ s}$ to $t = 4.00 \text{ s}$. (b) Determine the velocity and the speed at $t = 2.00 \text{ s}$.

افترض أنه الحادثة التالية تصف موضع الجسيم

$$\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j}$$

أجب السرعة الاتجاهية في الفترة (2) و (4)

أجب السرعة الاتجاهية والسرعة عند $t = 2 \text{ s}$

$$a = 1 \text{ m/s}$$

$$b = 1 \text{ m}$$

$$c = 0.125 \text{ m/s}^2$$

$$d = 1 \text{ m}$$

- (a) the average velocity during $t_1 = 2 \text{ s}$, $t_2 = 4 \text{ s}$

$$\vec{r}(t) = (1t + 1)\hat{i} + (0.125t^2 + 1)\hat{j}$$

$$\vec{r}(2) = (2 + 1)\hat{i} + (0.125 \times 4 + 1)\hat{j} = 3\hat{i} + 1.5\hat{j}$$

$$\vec{r}(4) = (4 + 1)\hat{i} + (0.125 \times 16 + 1)\hat{j} = 5\hat{i} + 3\hat{j}$$

$$\vec{v} = \frac{\Delta \vec{r}}{\Delta t} = \frac{(5\hat{i} + 3\hat{j}) - (3\hat{i} + 1.5\hat{j})}{4 - 2} = (1\hat{i} + 0.75\hat{j}) \text{ m/s}$$

- (b) the velocity and the speed at 2 s

$$\vec{v} = \frac{d\vec{r}}{dt} = 1\hat{i} + 0.25t\hat{j}$$

$$\left. \frac{d\vec{r}}{dt} \right|_{t=2} = 1\hat{i} + 0.5\hat{j} \text{ m/s}$$

$$\text{the speed} = \sqrt{(1)^2 + (0.5)^2} = 1.11 \text{ m/s}$$

4. The coordinates of an object moving in the xy plane vary with time according to the equations $x = -5.00 \sin \omega t$ and $y = 4.00 - 5.00 \cos \omega t$, where ω is a constant, x and y are in meters, and t is in seconds.
- (a) Determine the components of velocity of the object at $t = 0$. (b) Determine the components of acceleration of the object at $t = 0$. (c) Write expressions for the position vector, the velocity vector, and the acceleration vector of the object at any time $t > 0$. (d) Describe the path of the object in an xy plot.

المطلوب تحديد مكونات سرعة الجسم عند $t=0$

تحديد مكونات التسارع عند $t=0$

أكتب متجه الموقع والإزاحة والتسارع

عند $t > 0$ أكبر من 0

صف مسار الجسم على x, y

$$x = -5 \sin(\omega t)$$

$$y = 4 - 5 \cos(\omega t)$$

ثابت ω

(a) v at $t=0$

$$v_x = \frac{dx}{dt} = -5\omega \cos(\omega t) = -5\omega \hat{i} \text{ m/s}$$

$$\vec{v} = -5\omega \hat{i} \text{ m/s}$$

$$v_y = \frac{dy}{dt} = +5\omega \sin(\omega t) = 0 \hat{j} \text{ m/s}$$

(b) a at $t=0$

$$a_x = \frac{dv_x}{dt} = 5\omega^2 \sin(\omega t) = 0 \hat{i} \text{ m/s}^2$$

$$a_y = \frac{dv_y}{dt} = 5\omega^2 \cos(\omega t) = 5\omega^2 \hat{j} \text{ m/s}^2$$

$$\vec{a} = 5\omega^2 \hat{j} \text{ m/s}^2$$

(c)

$$\vec{r} = x\hat{i} + y\hat{j} = (-5 \sin(\omega t)\hat{i} + (4 - 5 \cos(\omega t))\hat{j})$$

$$\vec{v} = (-5\omega \cos(\omega t)\hat{i} + 5\omega \sin(\omega t)\hat{j})$$

$$\vec{a} = (5\omega^2 \sin(\omega t)\hat{i} + 5\omega^2 \cos(\omega t)\hat{j})$$

(d) the Path of the object.

a circle of radius 5m and the center is (0,4)m.

7. The vector position of a particle varies in time according to the expression $\vec{r} = 3.00\hat{i} - 6.00t^2\hat{j}$, where $\vec{r}$ is in meters and t is in seconds. (a) Find an expression for the velocity of the particle as a function of time. (b) Determine the acceleration of the particle as a function of time. (c) Calculate the particle's position and velocity at $t = 1.00$ s.

لتغير موضع الجسم بالنسبة للزمن
بواسطة المعادلة $\vec{r} = 3\hat{i} - 6t^2\hat{j}$

أ) جد سرعة الجسيم بدلالة الوقت

ب) حدد تسارع الجسيم

ج) احسب موضع الجسم وسرعته عند $t = 1$ s

① $v = \frac{dr}{dt} = -12t\hat{j} \text{ m/s}$

② $a = \frac{dv}{dt} = -12\hat{j} \text{ m/s}^2$

③ $\vec{r}$ at $t = 1 \text{ s} = (3\hat{i} - 6\hat{j}) \text{ m}$

$\vec{v} = \frac{dr}{dt} \bigg|_{t=1} = -12\hat{j} = -12\hat{j} \text{ m/s}$

9. A fish swimming in a horizontal plane has velocity $\vec{v}_i = (4.00\hat{i} + 1.00\hat{j})$ m/s at a point in the ocean where the position relative to a certain rock is $\vec{r}_i = (10.0\hat{i} - 4.00\hat{j})$ m. After the fish swims with constant acceleration for 20.0 s, its velocity is $\vec{v} = (20.0\hat{i} - 5.00\hat{j})$ m/s. (a) What are the components of the acceleration of the fish? (b) What is the direction of its acceleration with respect to unit vector $\hat{i}$? (c) If the fish maintains constant acceleration, where is it at $t = 25.0$ s and in what direction is it moving?

حركة تسبح في مستوى أفقي سرعتها $(4\hat{i} + 1\hat{j})$
بالنسبة للصخرة في المحيط $(10\hat{i} - 4\hat{j}) = r$
وبعد أن تسبح السمكة بتسارع ثابت تكون سرعتها $(20\hat{i} - 5\hat{j})$

أ) احسب تسارع السمكة

ب) ما هو اتجاه التسارع بالنسبة لمحيطه الوحدة

ج) عند ما يكون تسارع السمكة ثابت أي به موقعها عند $t = 25$ وأين اتجاهه

$$\vec{v}_i = (4\hat{i} + 1\hat{j}) \text{ m/s}$$

$$\vec{r}_i = (10\hat{i} - 4\hat{j}) \text{ m}$$

$$t = 20 \text{ s}$$

$$a = \text{constant}$$

$$\vec{v}_f = (20\hat{i} - 5\hat{j}) \text{ m/s}$$

① $\vec{v}_f = \vec{v}_i + a t = (20\hat{i} - 5\hat{j}) = (4\hat{i} + 1\hat{j}) + 20a$

$$a = (0.8\hat{i} - 0.3\hat{j}) \text{ m/s}^2 \quad \theta = \tan^{-1}\left(\frac{0.3}{0.8}\right) = 20.55^\circ$$

الربع الرابع

② $x: 20 = 4 + 20a_x \Rightarrow a_x = 0.8 \hat{i} \text{ m/s}^2$

$y: -5 = 1 + 20a_y \Rightarrow a_y = -0.3 \hat{j} \text{ m/s}^2$

③ $t = 25 \text{ s} \quad \vec{v}_f = ??$

$$\Delta x = v_{ix}t + \frac{1}{2}a_x t^2 \quad x_f - 10 = 4 \times 25 + \frac{1}{2} \times 0.8 \times 25^2 \Rightarrow x_f = 360 \hat{i} \text{ m}$$

$$\Delta y = v_{iy}t + \frac{1}{2}a_y t^2 \quad y_f + 4 = 1 + \frac{1}{2} \times 25^2 \times -0.3 \Rightarrow y_f = -72.7 \hat{j} \text{ m}$$

$$r|_{t=25} = (360\hat{i} - 72.7\hat{j}) \text{ m}$$

عنايه نجيب الاتجاه لازم نجيب السرعة

$$\vec{v}_f = \vec{v}_i + a t = (4\hat{i} + 1\hat{j}) + (0.8\hat{i} - 0.3\hat{j}) \times 25$$

$$\vec{v}_f = (24\hat{i} - 6.5\hat{j}) \text{ m/s}$$

$$\theta = \tan^{-1}\left(\frac{-6.5}{24}\right) = 15.15^\circ$$

تقذف صخرة لأعلى من سطح الأرض

18. A rock is thrown upward from level ground in such a way that the maximum height of its flight is equal to its horizontal range R . (a) At what angle θ is the rock thrown? (b) In terms of its original range R , what is the range $R_{\max}$ the rock can attain if it is launched at the same speed but at the optimal angle for maximum range? (c) What If? Would your answer to part (a) be different if the rock is thrown with the same speed on a different planet? Explain.

① جد زاوية قذف الصخرة

② جد $R_{\max}$ إذا اُطلقت بنفس السرعة لكن بزاوية القذف

③ هل ستتغير أجوبتك بسبب تغيير g

$R = H$

② $R = H$

$$\frac{v_i^2 \sin 2\theta}{g} = \frac{v_i^2 \sin^2 \theta}{2g} \Rightarrow \frac{2v_i^2 \sin \theta \cos \theta}{g} = \frac{v_i^2 \sin^2 \theta}{2g}$$

$$\tan \theta = 4 \Rightarrow \theta = 75.96^\circ$$

③ $r_{\max} = \text{range}$

$$R = \frac{v^2}{g} \sin(2 \times 75.96)$$

$$R_{\max} = \frac{v^2}{g} \times 47 \rightarrow \textcircled{1}$$

$$R_{\max} = \frac{v^2 \sin 2 \times 45}{g}$$

$$\boxed{R_{\max} = \frac{v^2}{g}} \rightarrow \textcircled{2}$$

نخوض ② في ①

$$R \leq R_{\max}, 47$$

$$\boxed{R_{\max} = 2.125 R}$$

③ the same because the answer doesn't depend on g .

19. The speed of a projectile when it reaches its maximum height is one-half its speed when it is at half its maximum height. What is the initial projection angle of the projectile?

تكون سرعة المقذوف عندما يصل إلى أقصى ارتفاع نصف سرعته عندما يكون عند نصف أقصى ارتفاع حسب زاوية المقذوف

at max height
 $v_{fy}^2 = v_{iy}^2 - 2gy$

$0 = v_{iy}^2 - 2gy$

$v_{iy} = \sqrt{2gy} \rightarrow (1)$

at half max height

$v_{fy}^2 = v_{iy}^2 - 2gy$

$v_{fy}^2 = v_{iy}^2 - gy \rightarrow (2)$

$v_{fy}^2 = 2gy - gy$

نحذف (1)

$v_{fy}^2 = gy$

$v_{fy} = \sqrt{gy}$

$v \text{ at max height} = 1/2 \text{ the speed at max}$

$v = \frac{1}{2} \sqrt{v_x^2 + v_y^2}$

$v^2 = \frac{1}{4} v_x^2 + \frac{1}{4} v_y^2$

$\frac{3}{4} v_x^2 = \frac{1}{4} v_y^2$

$v_x^2 = \frac{1}{3} v_y^2$

$v_x = \sqrt{\frac{gh}{3}}$

$\theta = \tan^{-1} \frac{v_y}{v_x}$

$\theta = \tan^{-1} \frac{\sqrt{gh}}{\frac{1}{3} \sqrt{gh}}$

$\theta = 67.8^\circ$

21. A firefighter, a distance d from a burning building, directs a stream of water from a fire hose at angle θ , above the horizontal as shown in Figure P4.21. If the initial speed of the stream is v_i , at what height h does the water strike the building?

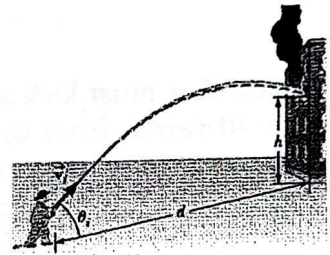


Figure P4.21

$$v_x = \frac{x}{t} \quad t = \frac{x}{v_x} \rightarrow (1)$$

جد الارتفاع H الذي يضرم فيه الماء بالمبنى

$$y = v_{iy} t - \frac{1}{2} g t^2 \rightarrow (2)$$

$$y = v_{iy} \frac{x}{v_x} - \frac{1}{2} g \frac{x^2}{v_x^2}$$

$$y = \frac{v_i \sin \theta x}{v_i \cos \theta} - \frac{1}{2} g \frac{x^2}{v_i^2 \cos^2 \theta}$$

$$y = x \tan \theta - \frac{g x^2}{2 v_i^2 \cos^2 \theta}$$

$$h = d \tan \theta - \frac{g d^2}{2 v_i^2 \cos^2 \theta}$$

نحذف θ في (2)

$$v_{iy} = v_i \sin \theta$$

$$v_{ix} = v_i \cos \theta$$

$$\tan \theta =$$

23. A placekicker must kick a football from a point 36.0 m (about 40 yards) from the goal. Half the crowd hopes the ball will clear the crossbar, which is 3.05 m high. When kicked, the ball leaves the ground with a speed of 20.0 m/s at an angle of 53.0° to the horizontal. (a) By how much does the ball clear or fall short of clearing the crossbar? (b) Does the ball approach the crossbar while still rising or while falling?

① ألا تبي مدى نبتة الكرة عند العارضة

② هل تقترب الكرة من العارضة بينما تزال ترتفع أو تنزل

$d = 36 \text{ m}$ $v_i = 20 \text{ m/s}$ $\theta = 53^\circ$
ارتفاع العارضة 3.05m

① $y = v_{iy}t + \frac{1}{2}gt^2$

$y = v_i \sin \theta t + \frac{1}{2}gt^2$

$y = 20 \sin 53^\circ \times 2.99 + \frac{1}{2} \times (2.99)^2 \times 9.8$

$y = 3.96 \text{ m}$

$v_x = \frac{x}{t}$

$t = \frac{x}{v_i \cos \theta}$

$t = \frac{36}{20 \cos 53^\circ}$ $t = 2.99$

- ② find t of max high if $2.99 < t_{\text{max high}} \Rightarrow \text{rising}$
 $2.99 > t_{\text{max high}} \Rightarrow \text{falling}$

$v_{y_f} = v_{y_i} - gt$

$0 = 20 \sin 53^\circ - 9.8t$ $t = 1.62 \text{ s}$

The ball was falling

25. A playground is on the flat roof of a city school, 6.00 m above the street below (Fig. P4.25). The vertical wall of the building is $h = 7.00$ m high, forming a 1-m-high railing around the playground. A ball has fallen to the street below, and a passerby returns it by launching it at an angle of $\theta = 53.0^\circ$ above the horizontal at a point $d = 24.0$ m from the base of the building wall. The ball takes 2.20 s to reach a point vertically above the wall. (a) Find the speed at which the ball was launched. (b) Find the vertical distance by which the ball clears the wall. (c) Find the horizontal distance from the wall to the point on the roof where the ball lands.

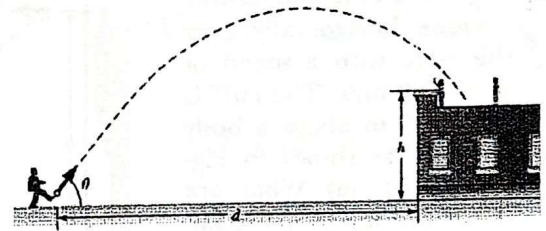


Figure P4.25

قصة الكرة من الملعب ورائها أحد المارة كلما رأى الملعب أن الكرة
بالحسن ولما سمع صوت الكرة أحب سرعة انطلاقة الكرة
بجهد المارة العمودية التي تقطعها الكرة
أوجه المارة الأفقية من الحائط إلى مكان هبوط الكرة

$$\theta = 53^\circ, d = 24 \text{ m}, t = 2.2 \text{ s}$$

(a)

$$x = v_x t + \frac{1}{2} a_x t^2 \quad a_x = \text{zero}$$

$$24 = v_i \cos 53^\circ \times 2.2 \quad \boxed{v_i = 18.12 \text{ m/s}}$$

(b) $y = v_y t - \frac{1}{2} g t^2$

$$y = v_i \sin \theta t - \frac{1}{2} g t^2$$

$$y = 18.12 \sin 53^\circ \times 2.2 - \frac{1}{2} \times 9.8 \times (2.2)^2 = \boxed{8.12 \text{ m}}$$

اجتاز الحائط
بـ 1.12 m

(c) 6 m على السطح

$$y = v_y t - \frac{1}{2} g t^2 \quad 6 = 20 \sin 53^\circ t - \frac{1}{2} \times 9.8 t^2 \quad t =$$

$$-4.9 t^2 + 14.47 t - 6 = 0 \quad t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad t = 0.49, \boxed{2.45}$$

أثناء 2.2

$$x = v_x t = v_i \cos \theta t = 18.12 \cos 53^\circ \times 2.45 = \boxed{2.71 \text{ m}}$$

from the wall.

29. A student stands at the edge of a cliff and throws a stone horizontally over the edge with a speed of $v_i = 18.0 \text{ m/s}$. The cliff is $h = 50.0 \text{ m}$ above a body of water as shown in Figure P4.29. (a) What are the coordinates of the initial position of the stone? (b) What are the components of the initial velocity of the stone? (c) What is the appropriate analysis model for the vertical motion of the stone? (d) What is the appropriate analysis model for the horizontal motion of the stone? (e) Write symbolic equations for the x and y components of the velocity of the stone as a function of time. (f) Write symbolic equations for the position of the stone as a function of time. (g) How long after being released does the stone strike the water below the cliff? (h) With what speed and angle of impact does the stone land?

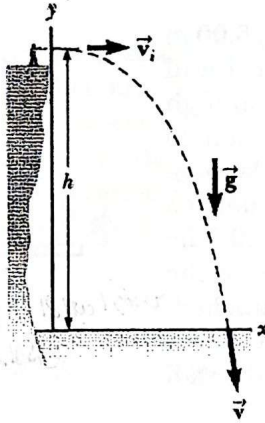


Figure P4.29

يقف طالب على صفا ويرمي حجر بشكل أفقي بسرعة 18 m/s

- (أ) حدد إحداثية الحجر الأولية
(ب) ماهي مكونات السرعة الابتدائية كل x, y
(ج) ماهو تحليل الحركة الصادية للحجر
(د) ماهو تحليل الحركة السنية
(هـ) ماكتب معادلات ل سرعة الحجر كل x, y
(و) اكتب معادلات لموضع الحجر
(ز) ما حدة اصطدام الحجر بالماء
(ح) بأي سرعة وزاوية يصطدم الحجر بالأرض

(أ) موضع الحجر الأولي $(0\hat{i} + 0\hat{j})$

(ب) $v_{ix} = 18 \text{ m/s}$ $v_{iy} = \text{zero}$

(ج) Free falling and constant acceleration $a_y = -g$

(د) the acceleration is zero and velocity is constant equal the initial velocity.

(هـ) $v_{xf} = v_{xi} + at$ $a = \text{zero}$ $v_{ix} = v_{fx}$

$v_{yf} = v_{yi} - gt$ $v_{yi} = \text{zero}$ $v_y = -gt$

(و) $x_f = v_{ix}t + \frac{1}{2}at^2$ $x_f = v_{ix}t$

$y_f = v_{iy}t - \frac{1}{2}gt^2$ $y_f = -\frac{1}{2}gt^2$

(ز) $y_f = -\frac{1}{2}gt^2$ $50 = -\frac{1}{2} \times 9.8 t^2$ $t = 3.19 \text{ s}$

(ح) $v_f = \sqrt{v_x^2 + v_y^2} = \sqrt{(-31.3)^2 + (18)^2} = 36.11 \text{ m/s}$

$\tan \theta = \frac{-31.3}{18}$

$\theta = 60.09^\circ$

$v_{iy} = 0$
 $v_y = -gt$
 $v_y = -9.8 \times 3.19$

$v_y = -31.3 \text{ m/s}$

41. A train slows down as it rounds a sharp horizontal turn, going from 90.0 km/h to 50.0 km/h in the 15.0 s it takes to round the bend. The radius of the curve is 150 m. Compute the acceleration at the moment the train speed reaches 50.0 km/h. Assume the train continues to slow down at this time at the same rate.

يتباطأ قطار عند منحنى حاد
في 15 س (90 إلى 50) كم/ساعة
150m = R حول المنحنى

(P) احسب التسارع عند السرعة 50

$$V_i = 90 \text{ km/h}$$

$$V_f = 50 \text{ km/h} \quad \text{in } 15 \text{ s} \quad R = 150 \text{ m}$$

$$V_i = \frac{90}{3600} \times 1000 = 25 \text{ m/s}$$

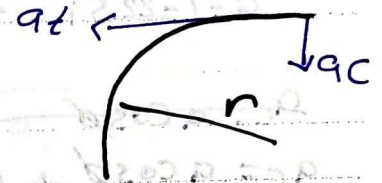
$$V_f = \frac{50}{3600} \times 1000 = 13.88 \text{ m/s}$$

$$\textcircled{1} \quad a_t = \frac{\Delta V}{\Delta t} = \frac{25 - 13.88}{15} = -0.74 \text{ m/s}$$

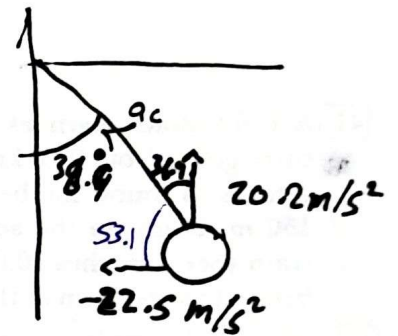
$$a_c = \frac{v^2}{r} = \frac{(13.88)^2}{150} = 1.28 \text{ m/s}^2$$

$$a = \sqrt{a_c^2 + a_t^2} = \sqrt{(1.28)^2 + (-0.74)^2} = 1.48 \text{ m/s}$$

$$\textcircled{2} \quad \theta = \tan^{-1} \frac{0.74}{1.28} = 30^\circ$$



42. A ball swings counterclockwise in a vertical circle at the end of a rope 1.50 m long. When the ball is 36.9° past the lowest point on its way up, its total acceleration is $(-22.5\hat{i} + 20.2\hat{j}) \text{ m/s}^2$. For that instant, (a) sketch a vector diagram showing the components of its acceleration, (b) determine the magnitude of its radial acceleration, and (c) determine the speed and velocity of the ball.



- (b) $r = 1.5 \text{ m}$ $\theta = 36.9^\circ$ $\phi = 53.1^\circ$ $a = (-22.5\hat{i} + 20.2\hat{j}) \text{ m/s}^2$

$$a_c = a \cos \phi = 22.5 \cos$$

$$a_c = a_x \cos \phi + a_y \cos \theta$$

a

$$a_c = 22.5 \cos 53.1 + 20.2 \cos 36.9$$

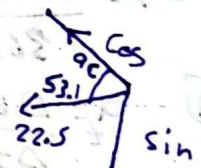
$$a_c = 29.66 \text{ m/s}^2$$

$$a_c = \frac{v^2}{r}$$

$$v = \sqrt{a_c r} = \sqrt{29.66 \times 1.5} = 6.67 \text{ m/s}$$

حدد مقدار التسارع

حدد سرعة الكرة واتجاه السرعة



43. (a) Can a particle moving with instantaneous speed 3.00 m/s on a path with radius of curvature 2.00 m have an acceleration of magnitude 6.00 m/s²? (b) Can it have an acceleration of magnitude 4.00 m/s²? In each case, if the answer is yes, explain how it can happen; if the answer is no, explain why not.

٥) هل يمكن لجسم يتحرك بسرعة لحظية 3 m/s أن يكون له تسارع 6 m/s² ؟
 ٦) هل يمكن أن يكون له تسارع 4 m/s² ؟

٥) $a_c = \frac{v^2}{r} = \frac{9}{2} = 4.5 \text{ m/s}^2$

the answer : yes , $6 > 4.5$

$$6 = \sqrt{4.5^2 + a_t^2}$$

٦) No , $4 < 4.5$

$$4 \neq \sqrt{4.5^2 + a_t^2}$$

44. The pilot of an airplane notes that the compass indicates a heading due west. The airplane's speed relative to the air is 150 km/h. The air is moving in a wind at 30.0 km/h toward the north. Find the velocity of the airplane relative to the ground.

ملاحظة قائد الطائرة أنه البوصلة تشير إلى الغرب
وحركة الطائرة بالنسبة للهواء 150 Km/h ، والهواء
يتحرك من الجنوب إلى الشمال بسرعة 30 Km/h
جد سرعة الطائرة بالنسبة للأرض

$$V_{PA} = 150 \text{ km/h} (-\hat{i})$$

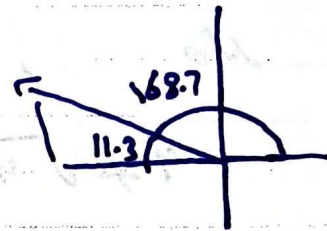
$$V_{AE} = 30 \text{ km/h} (\hat{j})$$

$$V_{PE} = ??$$

$$V_{PE} = \sqrt{(30)^2 + (150)^2} = 152.97 \text{ km/h}$$

$$\theta = \tan^{-1} \frac{30}{150} = 11.3^\circ$$

$$\theta = 168.7^\circ$$



نحافظ الطائرة على سرعة 630 km/h بالنسبة للهواء
نقوم برحلة إلى المدينة تبعد 750 km شمالاً

45. An airplane maintains a speed of 630 km/h relative to the air it is flying through as it makes a trip to a city 750 km away to the north. (a) What time interval is required for the trip if the plane flies through a headwind blowing at 35.0 km/h toward the south? (b) What time interval is required if there is a tailwind with the same speed? (c) What time interval is required if there is a crosswind blowing at 35.0 km/h to the east relative to the ground?

① ما الفاصل الزمني للرحلة إذا حلق في رياح بسرعة 35 km/h جنوباً
② ما الفاصل الزمني إذا كانت هناك رياح خلفية بنفس السرعة
③ ما الفاصل الزمني إذا كانت هناك رياح متعامدة بنفس السرعة

$$v_{AP} = 630 \text{ km/h } \hat{j} \quad y = 750 \text{ km}$$

Ⓐ find t at $v_{AE} = 35 \text{ km/h } (-\hat{j})$

$$v_{PE} = 630 - 35 = 595 \text{ km/h } (\hat{j})$$

$$t = \frac{y}{v} = \frac{750}{595} = 1.26 \text{ h}$$

Ⓑ find t at $v = 35 \text{ km/h } (\hat{j})$

$$v_{PE} = 630 + 35 = 665 \text{ km/h } (\hat{j})$$

$$t = \frac{750}{665} = 1.12 \text{ h}$$

Ⓒ $t = ??$ $v_{AE} = 35 \text{ km/h } (\hat{i})$

فقط تؤثر مركبة y

$$t = \frac{750}{630} = 1.19 \text{ h}$$

47. A police car traveling at 95.0 km/h is traveling west, chasing a motorist traveling at 80.0 km/h. (a) What is the velocity of the motorist relative to the police car? (b) What is the velocity of the police car relative to the motorist? (c) If they are originally 250 m apart, in what time interval will the police car overtake the motorist?

نتجه سيارة شرطة تسير بسرعة 95 km/h غرباً
نظام سائق يسير بسرعة 80 km/h

$$v_{PE} = 95 \text{ km/h west}$$

$$v_{ME} = 80 \text{ km/h west}$$

(P) ما هي سرعة السائق بالنسبة لسيارة الشرطة

(E) ما هي سرعة سيارة الشرطة بالنسبة للسائق

(C) إذا كانت المسافة بينهما 250 م في أي فترتين ستجاذب سيارة الشرطة السائق.

$$(a) v_{mp} = v_{ME} + v_{PE}$$

$$= 80 + 95 = 15 \text{ km/h east.}$$

$$(b) v_{mp} = v_{ME} + v_{PE}$$

$$= 95 - 80 = 15 \text{ km/h west.}$$

$$(c) t_s??$$

$$t = \frac{x}{v_s} = \frac{250}{15} = \frac{1}{60} \text{ h s } 1 \text{ min}$$

50. A river has a steady speed of 0.500 m/s. A student swims upstream a distance of 1.00 km and swims back to the starting point. (a) If the student can swim at a speed of 1.20 m/s in still water, how long does the trip take? (b) How much time is required in still water for the same length swim? (c) Intuitively, why does the swim take longer when there is a current?

سرعة النهر ثابتة = 0.5 m/s
يسبح الطالب إلى 1 km ثم يعود إلى مكانه
(أ) إذا كان يستطيع السباحة بـ 1.2 m/s في الماء الراكد
فكم وقتاً يستغرقه
(ب) كم الوقت المطلوب للبحار الراكد كي يستغرق السباحة
(ج) لماذا تستغرق السباحة وقتاً أطول في وجود تيار

$$v_{re} = 0.5 \text{ m/s} \quad x = 1000 \text{ m}$$

$$v_{se} = 1.2 \text{ m/s}$$

(a) find t $v = v_{re} + v_{se} = 1.7$

$$t_1 = \frac{x}{v_1} = \frac{1000}{1.7} = 588.5$$

$$t_2 = \frac{x}{v_2} = \frac{1000}{0.7} = 1428.5 \text{ s}$$

$$v_2 = 1.2 - 0.5 = 0.7 \text{ m/s}$$

$$t = t_1 + t_2 = 2016.5 \text{ s}$$

(b) $t = \frac{x}{v} = \frac{1000 + 1000}{1.2} = 1666.6 \text{ s}$

(c) السباحة مع التيار تستغرق وقتاً أكبر من السباحة ضد التيار

51. A river flows with a steady speed v . A student swims upstream a distance d and then back to the starting point. The student can swim at speed c in still water. (a) In terms of d , v , and c , what time interval is required for the round trip? (b) What time interval would be required if the water were still? (c) Which time interval is larger? Explain whether it is always larger.

حينه فقد صغر سرعة ثابتة ويسبح الطالب

أعلاه ثم يعود إلى نقطة البداية يستغرق

السباحة بسرعة على المياه الساكنة

ج. زعد الرحلة زحاجاً وإيجاباً

ب. إذا كان السباح ثابتاً ضد الزمن

د. ما هي الفترة الزمنية الأكبر

⑨ $t_1 = \frac{d}{v+c}$

سرعة الطالب c

سرعة النهر v

$t_2 = \frac{d}{-v+c}$

$t = \frac{d}{c+v} + \frac{d}{-v+c}$

⑥

$t = \frac{d}{c} + \frac{d}{c} = \frac{2d}{c}$

زعد السباحة عكس التيار، أكبر من السباحة مع التيار.

54. A farm truck moves due east with a constant velocity of 9.50 m/s on a limitless, horizontal stretch of road. A boy riding on the back of the truck throws a can of soda upward (Fig. P4.54)

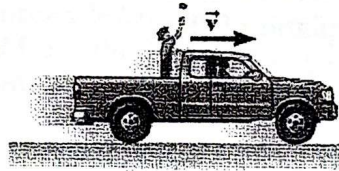


Figure P4.54

and catches the projectile at the same location on the truck bed, but 16.0 m farther down the road. (a) In the frame of reference of the truck, at what angle to the vertical does the boy throw the can? (b) What is the initial speed of the can relative to the truck? (c) What is the shape of the can's trajectory as seen by the boy? An observer on the ground watches the boy throw the can and catch it. In this observer's frame of reference, (d) describe the shape of the can's path and (e) determine the initial velocity of the can.

$$v = 9.5 \text{ m/s} \quad x = 16$$

ساحنة زراعية تتحرك شرقاً بسرعة 9.50 m/s ويريد صبي على ظهرها أن يلقي علبة مشروب غازي ويلتقطها في نفس الموقع على الصندوق لكنه محال بعد 16m .

⑤ ما الزاوية الرأسية التي رما بها الصبي الحجر؟
 ⑥ ما سرعة المقذوف الأولية؟
 ⑦ ما شكل مسار المقذوف كما يراه الصبي؟
 - صف شكل المقذوف
 - احس السرعة الابتدائية



① $\theta = 0$ straight up

② $x = v_x t \quad 16 = 9.5 t \quad \boxed{t = 1.68 \text{ s}}$

$$0 = v_{iy} t - \frac{1}{2} g t^2 \Rightarrow 0 = v_{iy} \times 1.68 - \frac{1}{2} \times 1.68^2 \times 9.8 = \boxed{8.25 \text{ m/s}}$$

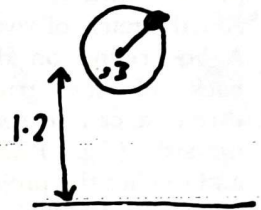
③ $v_i = \sqrt{v_{xi}^2 + v_{yi}^2} = \sqrt{9.5^2 + 8.25^2} = \boxed{12.6 \text{ m/s}}$

④ $\theta = \tan^{-1} \frac{8.25}{9.5} = \boxed{41^\circ}$

⑤ straight up and down.

⑥ parabola

كرة مثبتة بخيط تسير في مسار دائري نصف قطره 30 سم
ارتفع عند لحظة الانفصال 2.00 م. أتم ينكر الجبل وتنبأ
على بعد 2 م من مركز الجبل
أحسب التسارع المركزي



55. A ball on the end of a string is whirled around in a horizontal circle of radius 0.300 m. The plane of the circle is 1.20 m above the ground. The string breaks and the ball lands 2.00 m (horizontally) away from the point on the ground directly beneath the ball's location when the string breaks. Find the radial acceleration of the ball during its circular motion.

$$x = 2 \text{ m} \quad y = -1.2 \text{ m}$$

$$y = v_{iy}t - \frac{1}{2}gt^2$$

$$-1.2 = 0 - \frac{1}{2} \cdot 9.8 t^2 \quad (t = 0.49 \text{ s})$$

$$x = v_{ix}t$$

$$2 = v_{ix} \cdot 0.49 \Rightarrow v_{ix} = 4.08 \text{ m/s}$$

$$a_c = \frac{v^2}{r} = \frac{(4.08)^2}{0.3} = 55.4 \text{ m/s}^2$$

60. A basketball player is standing on the floor 10.0 m from the basket as in Figure P4.60. The height of the basket is 3.05 m, and he shoots the ball at a 40.0° angle with the horizontal from a height of 2.00 m. (a) What is the acceleration of the basketball at the highest point in its trajectory? (b) At what speed must the player throw the basketball so that the ball goes through the hoop without striking the backboard?

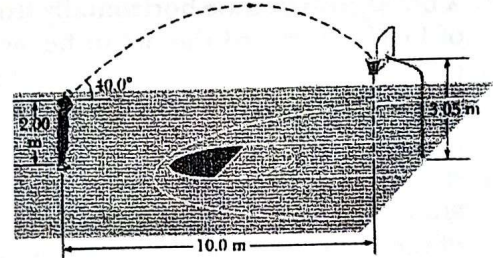


Figure P4.60

$$x = 10 \text{ m} \quad y = 3.05 \text{ m} \quad \theta = 40^\circ$$

تقذف اللاعب 2 م ويرمي الكرة

(a) In the top $a = g = \boxed{9.8 \text{ m/s}^2}$

- أحسب تايه الكرة عند أعلى نقطة
- بأي سرعة يجب رمي الكرة لتدخل في الدائرة

(b) $v_i = ??$

$$\Delta y = v_{iy}t - \frac{1}{2}gt^2$$

$$3.05 - 2 = v_i \sin 40^\circ t - 4.9t^2$$

$$x = v_i \cos 40^\circ t$$

$$10 = v_i \cos 40^\circ t$$

$$v_i = \frac{13.05}{t}$$

$$1.05 = \frac{13.05}{t} \times \sin 40^\circ t - 4.9t^2$$

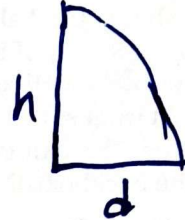
$$4.9t^2 = 7.33$$

$$\boxed{t = 1.22 \text{ s}}$$

$$v_i = \frac{13.05}{1.22} = \boxed{10.66 \text{ m/s}}$$

62. A boy throws a stone horizontally from the top of a cliff of height h toward the ocean below. The stone strikes the ocean at distance d from the base of the cliff. In terms of h , d , and g , find expressions for (a) the time t at which the stone lands in the ocean, (b) the initial speed of the stone, (c) the speed of the stone immediately before it reaches the ocean, and (d) the direction of the stone's velocity immediately before it reaches the ocean.

يترك صبي حجر بشكل أفقي من قمة ارتفاعه h
ويضربهم بالمحيط على بعد d من قاعدة البحر
- حدد زمن الهبوط
- السرعة الأولية
- السرعة النهائية
- زاوية السقوط



Ⓐ the time

$$y = v_{iy}t - \frac{1}{2}gt^2$$

$$h = \frac{1}{2}gt^2 \quad t = \sqrt{\frac{2h}{g}}$$

Ⓑ $v_i = ??$

$$x = v_{ix}t$$

$$d = v_{ix} \sqrt{\frac{2h}{g}}$$

$$v_i = \frac{d}{\sqrt{\frac{2h}{g}}}$$

Ⓒ $v_f = ??$

$$v_f = \sqrt{v_x^2 + v_y^2}$$

$$v_{xf}^2 = \frac{d^2 g}{2h}$$

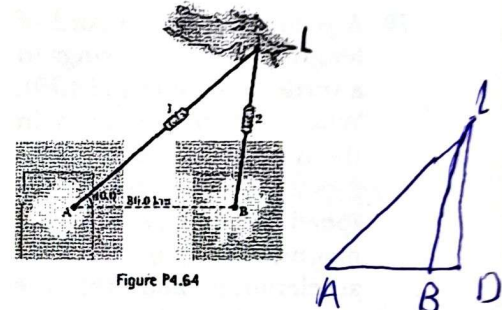
$$v_{yf} = -gt \Rightarrow v_{yf} = -g \sqrt{\frac{2h}{g}}$$

$$v_{yf}^2 = 2gh$$

$$v_f = \sqrt{2gh + \frac{d^2 g}{2h}}$$

$$d \theta = ?? \quad \tan \theta = \frac{\sqrt{2gh}}{\sqrt{d^2 g / 2h}} \Rightarrow \theta = \tan^{-1} \frac{2h}{d}$$

64. Towns A and B in Figure P4.64 are 80.0 km apart. A couple arranges to drive from town A and meet a couple driving from town B at the lake, L. The two couples leave simultaneously and drive for 2.50 h in the directions shown. Car 1 has a speed of 90.0 km/h. If the cars arrive simultaneously at the lake, what is the speed of car 2?



موضحة في الرسم Q = 40

$$\phi = 2.5h$$

Speed 1 = 90 km/h

speed 2 = ??

BL 77

$$BL = \sqrt{B^2 + B^2}$$

$$\cancel{BD} BL_s \sqrt{(92.4)^2 + (225 \sin 40)^2}$$

$$BL = 172 \text{ km}$$

$$V_s \frac{LB}{t} = \frac{172}{2.5} = \boxed{68.8 \text{ km/h}}$$

مدیریت منابع 80 ک

سيارة تحركت من A وسيارة تحركت من B داخل اتجاه A

ونفاد، وفي نفس الوقت 2.5h تبلغ سرعة السيارة A 90 km/h

إذا وهلت الساعة في نفس الوقت فما سرية؟

$$AL = \text{speed} \cdot t$$

$$90 \times 2.5 = 225 \text{ km}$$

$$BD = AD - AB$$

$$BD = AL \cos \theta = 80$$

$$= 225 \cos 40 - 80 = 92.4 \text{ km}$$

70. A pendulum with a cord of length $r = 1.00$ m swings in a vertical plane (Fig. P4.70). When the pendulum is in the two horizontal positions $\theta = 90.0^\circ$ and $\theta = 270^\circ$, its speed is 5.00 m/s. Find the magnitude of (a) the radial acceleration and (b) the tangential acceleration for these positions. (c) Draw vector diagrams to determine the direction of the total acceleration for these two positions. (d) Calculate the magnitude and direction of the total acceleration at these two positions.

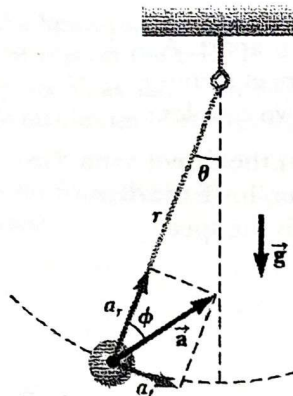


Figure P4.70

عندما يكون البندول في زاوية $90^\circ, 270^\circ$
تكون سرعته 5 m/s

- جد التسارع المركزي
- جد التسارع المماسي
- جد التسارع الكلي

$$r = 1 \text{ m}$$

$$\theta = 90^\circ, 270^\circ$$

$$|v| = 5 \text{ m/s}$$

① $a_c = ?$

$$a_c = \frac{v^2}{r} = \frac{5^2}{1} = 25 \text{ m/s}^2$$

② $a_t = g$ because the velocity doesn't change so the Tangential only acceleration is the gravity

$$a = \sqrt{a_t^2 + a_c^2} = \sqrt{25^2 + 9.8^2} = 26.85 \text{ m/s}^2$$

$$\theta = \tan^{-1} \frac{a_t}{a_c} \Rightarrow \theta = 21.4^\circ$$

71. A hawk is flying horizontally at 10.0 m/s in a straight line, 200 m above the ground. A mouse it has been carrying struggles free from its talons. The hawk continues on its path at the same speed for 2.00 s before attempting to retrieve its prey. To accomplish the retrieval, it dives in a straight line at constant speed and recaptures the mouse 3.00 m above the ground. (a) Assuming no air resistance acts on the mouse, find the diving speed of the hawk. (b) What angle did the hawk make with the horizontal during its descent? (c) For what time interval did the mouse experience free fall?

يحلط صقراً أفقياً بسرعة 10 m/s
فوق سطح الأرض بـ 200 m لمدة 2 s
ويقف على الفأر، ~~بشكل مستقيم~~ بسرعة ثابتة
ويطير بارتفاع 3 m عن الأرض
- احس سرعة انقضاه خلال الصق
- ما الزوية التي صنعها الصق أثناء الهبوط
- أجب الزمن

⑨ $V = \frac{d}{t}$ $V_{iy} = 0$ $t = 2$

$d = \sqrt{x^2 + y^2}$ $x = V_x t$ $y = 200 - 3 = 197 m$

$y = V_{iy} t - \frac{1}{2} g t^2$

$197 = 0 - \frac{1}{2} \times 9.8 t^2$ $t = 6.345$ المطلوب ⑩

$x = V_x t \Rightarrow x = 100 \times (6.34 - 2) = 434 m$

$d = \sqrt{x^2 + y^2} = \sqrt{434^2 + 197^2} = 476.6 m$ $\theta = \tan^{-1} \frac{197}{434} = 65.5^\circ$

⑪ $\theta = \tan^{-1} \frac{y}{x} = \tan^{-1} \frac{197}{434} = 65.5^\circ$

84. A person standing at the top of a hemispherical rock of radius R kicks a ball (initially at rest on the top of the rock) to give it horizontal velocity $\vec{v}_i$ as shown in Figure P4.84. (a) What must be its minimum initial speed if the ball is never to hit the rock after it is kicked? (b) With this initial speed, how far from the base of the rock does the ball hit the ground?

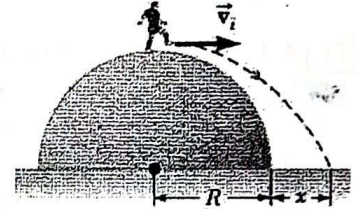


Figure P4.84

يقتل شخص على صخرة كروية ويدرك كرة لا تسفل
يكبها سرعة أفقية v

- ما هو الحد الأدنى للسرعة الإبدئية إذا لم تضرب الكرة الصخرة
- بهذه السرعة، إلى أي مدى ممكنة أن تدنقل الكرة

⑨ v_{min}

$$\Delta y = v_{iy} t - \frac{1}{2} g t^2$$

$$y_b = y_r - \frac{1}{2} g t^2$$

$$y_b = y_r - \frac{1}{2} g \frac{x^2}{v_{ix}^2} \quad t = \frac{x}{v_{ix}}$$

$$y_b > y_r \quad y_r^2 + R^2 = r^2 \quad y_r = R$$

$$y_b^2 + x^2 > R^2$$

$$\left(R - \frac{1}{2} g \frac{x^2}{v_{ix}^2} \right)^2 + x^2 > R^2$$

$$R^2 - \frac{g x^2 R}{v_{ix}^2} + \frac{g^2 x^4}{4 v_{ix}^4} + x^2 > R^2$$

$$\frac{g^2 x^4}{4 v_{ix}^4} + x^2 > \frac{g x^2 R}{v_{ix}^2} \quad x=0$$

$$1 > \frac{g R}{v_{ix}^2} \Rightarrow v_{ix} > \sqrt{R g}$$

$$0 = R - \frac{g x^2}{2 g R}$$

$$x = R \sqrt{2}$$

$$x - R = R(\sqrt{2} - 1)$$

86. A projectile is fired up an incline (incline angle ϕ) with an initial speed v_i at an angle θ_i with respect to the horizontal ($\theta_i > \phi$) as shown in Figure P4.86. (a) Show that the projectile travels a distance d up the incline, where

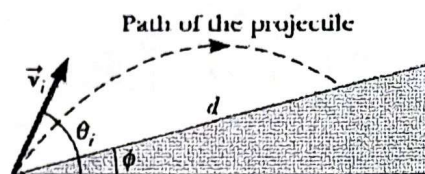


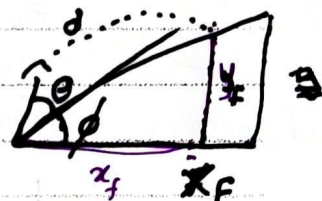
Figure P4.86

$$d = \frac{2v_i^2 \cos \theta_i \sin(\theta_i - \phi)}{g \cos^2 \phi}$$

(a) $x_f = v_{fx} t$

٥) أثبت أنه المحذوف يتطابق مع Δ أصل المحذور، خاصة بالمرى

$$t = \frac{x_f}{v_i \cos \theta}$$



$$y_{fs} = v_{iy} t - \frac{1}{2} g t^2 \Rightarrow = v_i \sin \theta \left(\frac{x_f}{v_i \cos \theta} \right) - \frac{1}{2} g \left(\frac{x_f^2}{(v_i \cos \theta)^2} \right)$$

$$y_f = \tan \theta \cdot x_f - \frac{x_f^2 g}{2 \cos^2 \theta \cdot v_i^2} \quad \text{--- (1)}$$

$$y_f = d \sin \phi \quad \text{--- (2)}$$

$$x_p = d \cos \theta \quad \text{---} \rightarrow (3)$$

مقوضہ (2) و (3) ۽ (1)

$$\cancel{d \sin \phi} = \tan \theta \quad \cancel{d \cos \phi} - \frac{d^2 \cos^2 \phi}{2 \cos^2 \theta \lambda^2}$$

$$\frac{2V_1^2 \cos^2 \theta}{(2V_1^2 \cos^2 \theta)} \times d \cos^2 \phi g = (\tan \theta \cos \phi - \sin \phi) \times 2V_1^2 \sin^2 \theta$$

$$\cos^2 \phi$$

$$\cos^2 \phi \cdot g$$

$$d = \frac{(\tan \theta \cos \phi - \sin \phi) \times 2v_i^2 \cos^2 \theta}{\cos^2 \phi \cdot g}$$

tanθ تنگ

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

ناتجة من هذا المبدأ

$$d = \frac{2v_i^2 \cos^2 \theta \left(\frac{\sin \theta}{\cos \theta} \cos \phi - \sin \phi \right)}{\cos^2 \phi g}$$

$$= \frac{2v_i^2 \cos \theta \left(\sin \theta \cos \phi \cancel{\cos \theta} - \sin \phi \cos \theta \right)}{\cos^2 \phi g}$$

$$d = \frac{2v_i^2 \cos \theta (\sin \theta \cos \phi - \sin \phi \cos \theta)}{\cos^2 \phi g}$$

نلاحظ
 $\sin(\theta - \phi)$

$$d = \frac{2v_i^2 \cos \theta \sin(\theta - \phi)}{\cos^2 \phi g}$$

تم بحمد الله