

RECOMMENDED PROBLEMS

CHAPTER 2



Physics A - Serway

إعداد

أ. إسماعيل جهاد تايه

أ. أنس فضل الشافعي

معيدي قسم الفيزياء في الجامعة الإسلامية

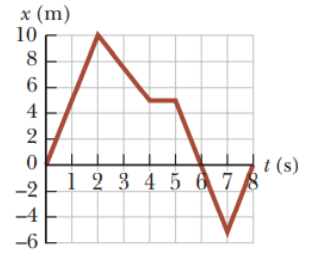


Figure P2.1 Problems 1 and 9.

- 1.** The position versus time for a certain particle moving along the x axis is shown in Figure P2.1. Find the average velocity in the time intervals (a) 0 to 2 s, (b) 0 to 4 s, (c) 2 s to 4 s, (d) 4 s to 7 s, and (e) 0 to 8 s.

W

- 3.** A person walks first at a constant speed of 5.00 m/s along a straight line from point **A** to point **B** and then back along the line from **B** to **A** at a constant speed of 3.00 m/s . (a) What is her average speed over the entire trip? (b) What is her average velocity over the entire trip?

7. A position–time graph for a particle moving along the x axis is shown in Figure P2.7. (a) Find the average velocity in the time interval $t = 1.50$ s to $t = 4.00$ s. (b) Determine the instantaneous velocity at $t = 2.00$ s by measuring the slope of the tangent line shown in the graph. (c) At what value of t is the velocity zero?

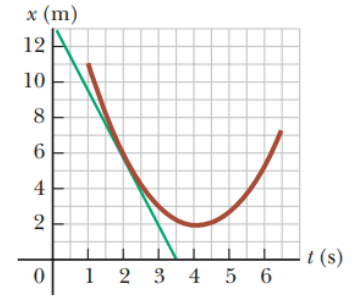


Figure P2.7

- 13.** A person takes a trip, driving with a constant speed of **M** 89.5 km/h, except for a 22.0-min rest stop. If the person's average speed is 77.8 km/h, (a) how much time is spent on the trip and (b) how far does the person travel?

- 21.** A particle moves along the x axis according to the equation $x = 2.00 + 3.00t - 1.00t^2$, where x is in meters and t is in seconds. At $t = 3.00$ s, find (a) the position of the particle, (b) its velocity, and (c) its acceleration.

- 35.** The driver of a car slams on the brakes when he sees a tree blocking the road. The car slows uniformly with an acceleration of -5.60 m/s^2 for 4.20 s , making straight skid marks 62.4 m long, all the way to the tree. With what speed does the car then strike the tree?

AMT

W

37. A speedboat travels in a straight line and increases in speed uniformly from $v_i = 20.0$ m/s to $v_f = 30.0$ m/s in a displacement Δx of 200 m. We wish to find the time interval required for the boat to move through this

AMT

GP

displacement. (a) Draw a coordinate system for this situation. (b) What analysis model is most appropriate for describing this situation? (c) From the analysis model, what equation is most appropriate for finding the acceleration of the speedboat? (d) Solve the equation selected in part (c) symbolically for the boat's acceleration in terms of v_i , v_f , and Δx . (e) Substitute numerical values to obtain the acceleration numerically. (f) Find the time interval mentioned above.

- 38.** A particle moves along the x axis. Its position is given **W** by the equation $x = 2 + 3t - 4t^2$, with x in meters and t in seconds. Determine (a) its position when it changes direction and (b) its velocity when it returns to the position it had at $t = 0$.

41. An object moves with constant acceleration 4.00 m/s^2 and over a time interval reaches a final velocity of 12.0 m/s . (a) If its initial velocity is 6.00 m/s , what is its displacement during the time interval? (b) What is the distance it travels during this interval? (c) If its initial velocity is -6.00 m/s , what is its displacement during the time interval? (d) What is the total distance it travels during the interval in part (c)?

49. It is possible to shoot an arrow at a speed as high as 100 m/s. (a) If friction can be ignored, how high would an arrow launched at this speed rise if shot straight up? (b) How long would the arrow be in the air?

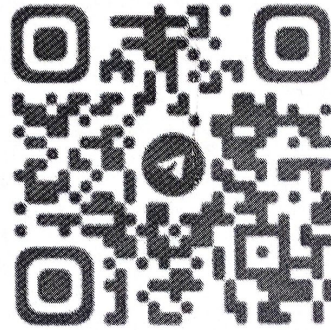
51. A ball is thrown directly downward with an initial
W speed of 8.00 m/s from a height of 30.0 m . After what
time interval does it strike the ground?

- 53.** A student throws a set of keys vertically upward to her sorority sister, who is in a window 4.00 m above. The second student catches the keys 1.50 s later. (a) With what initial velocity were the keys thrown? (b) What was the velocity of the keys just before they were caught?

- 65.** A ball starts from rest and accelerates at 0.500 m/s^2 while moving down an inclined plane 9.00 m long. When it reaches the bottom, the ball rolls up another plane, where it comes to rest after moving 15.0 m on that plane. (a) What is the speed of the ball at the bottom of the first plane? (b) During what time interval does the ball roll down the first plane? (c) What is the acceleration along the second plane? (d) What is the ball's speed 8.00 m along the second plane?

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@GENERALPHYSICSA

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أ. إسماعيل جهاد تايه

أ. أنس فضل الشافعي

معيدي قسم الفيزياء في الجامعة الإسلامية

مُحَمَّد لَا نَتَرْتَفِعُ هَيْئًا نَقِيبَ .. وَإِذَا هِيَ نَشْأَتِي

يُبين الشكل التالي العلاقة بين موضعي جسم والزمن.
مطلوب حساب السرعة المتوسطة خلال الفترات الموضحة.

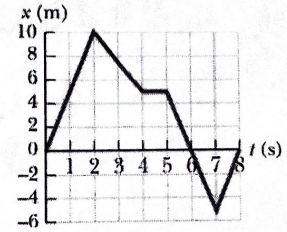


Figure P2.1 Problems 1 and 9.

- 1.** The position versus time for a certain particle moving along the x axis is shown in Figure P2.1. Find the average velocity in the time intervals (a) 0 to 2 s, (b) 0 to 4 s, (c) 2 s to 4 s, (d) 4 s to 7 s, and (e) 0 to 8 s.

a) 0 - 2

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{10 - 0}{2 - 0} = 5 \text{ m/s}$$

0 - 4

$$b) \bar{v} = \frac{\Delta x}{\Delta t} = \frac{5 - 0}{4 - 0} = 5/4 \text{ m/s}$$

c) 2 - 4

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{5 - 10}{4 - 2} = -2.5 \text{ m/s}$$

d) 4 - 7

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{-5 - 5}{7 - 4} = -10/3 \text{ m/s}$$

e) 0 - 8

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{0 - 0}{8 - 0} = 0 \text{ m/s}$$

يمشي رجل بسرعة ثابتة مقدارها (5 m/s)

من النقطة A إلى B

ثم يرجع إلى B بسرعة ثابتة مقدارها

(3 m/s) مطلوب حساب

ave. speed

ave. velocity

3. A person walks first at a constant speed of 5.00 m/s along a straight line from point A to point B and then back along the line from B to A at a constant speed of 3.00 m/s. (a) What is her average speed over the entire trip? (b) What is her average velocity over the entire trip?

$$a) \text{ average speed} = \frac{\text{distance } A \rightarrow B + \text{distance } B \rightarrow A}{t_{AB} + t_{BA}}$$

دلالة الزمن يساوي

$$t_{AB} = d/v_{AB}$$

$$t_{BA} = d/v_{BA}$$

So,

$$\text{average speed} = \frac{2d}{\frac{d}{v_{AB}} + \frac{d}{v_{BA}}} = \frac{2d}{\frac{d v_{BA} + d v_{AB}}{v_{AB} v_{BA}}}$$

$$= \frac{2d v_{AB} v_{BA}}{d(v_{BA} + v_{AB})}$$

$$= \frac{2 \times 5 \times 3}{5 + 3} = \frac{30}{8} = \boxed{3.75 \text{ m/s}}$$

$$b) \text{ average velocity} = \boxed{0}$$

لأنها رجعت إلى النقطة
البداية

الشكل يبين العلاقة بين الموضع والزمن. المطلوب حساب السرعة المتوسطة
والسرعة اللحظية عند الثانية الثانية من خلال أخذ منحار لتلك

7. A position-time graph for a particle moving along the x axis is shown in Figure P2.7. (a) Find the average velocity in the time interval $t = 1.50$ s to $t = 4.00$ s. (b) Determine the instantaneous velocity at $t = 2.00$ s by measuring the slope of the tangent line shown in the graph. (c) At what value of t is the velocity zero?

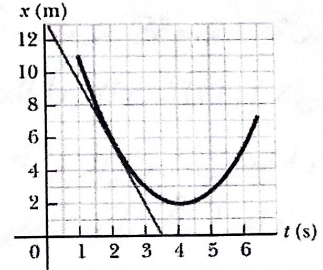


Figure P2.7

$$a) \quad \bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{2 - 8}{4 - 1.5} = -2.4 \text{ m/s}$$

$$b) \quad v = \frac{dx}{dt} = \frac{11 - 0}{0.5 - 3.5} = 3.66 \text{ m/s}$$

يتم حساب ميل المنحار # لتلك النقطة
لحساب السرعة اللحظية.

$$c) \quad t = 4s$$

السرعة تساوي صفر عند المنحار
الافقي أي عند $t = 4s$
أد عند تغير اتجاه السرعة
من سالب إلى موجب أو العكس.

شخص أخذ جولة بسرعة 89.5 km/h

13. A person takes a trip, driving with a constant speed of 89.5 km/h , except for a 22.0-min rest stop. If the person's average speed is 77.8 km/h , (a) how much time is spent on the trip and (b) how far does the person travel?

بأحد مدة 22 min توقف فيها الشخص، إذا كانت السرعة المتوسطة

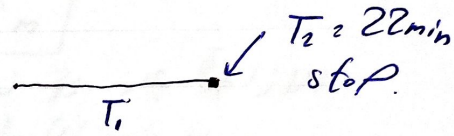
77.8 km/h ، احسب زمن الرحلة والمسافة التي قطعها.

a) time of trip.

السرعة المتوسطة $\times$ الزمن الكلي = سرعة الجسم $\times$ زمن السرعة

$$X = Vt$$

$$= 89.5 \times T_1 = 77.8 (T_1 + 22 \text{ min})$$



$$89.5 T_1 = 77.8 T_1 + 77.8 \times 0.366$$

$$11.7 T_1 = 28.47 \Rightarrow T_1 = 2.43 \text{ h}$$

$$T = 2.43 + 0.366 = 2.79 \text{ h}$$

b)

km/h

$$X = 89.5 \times 2.43 \text{ h}$$

$$= 217.48 \text{ km}$$

المعادلة المعطاة تمثل دسفي

جسم يتحرك بطول حساب

الدسفي والسرعة اللحظية

النتيجة اللحظية عند $t=3s$

21. A particle moves along the x axis according to the equation $x = 2.00 + 3.00t - 1.00t^2$, where x is in meters and t is in seconds. At $t = 3.00$ s, find (a) the position of the particle, (b) its velocity, and (c) its acceleration.

a) the position.

$$x = 2 + (3 \times 3) - (1 \times 3^2) = \boxed{2m}$$

الازاحة بعد 3s تساوي 2m
من الدسفي الاكبر.

b) The velocity.

$$v = \frac{dx}{dt} = 3 - 2t$$

$$v|_{t=3s} = 3 - (2 \times 3) = \underline{-3m/s}$$

c) The acceleration.

$$a = \frac{dv}{dt} = \underline{-2m/s^2}$$

سائق سيارة ضغط على المكابح
عندما رأى شجرة في الطريق
تباطأت السيارة بشكل منتظم
بتسارع -5.6 m/s^2
خلال 4.2 s وبقيت سائبة
 62.4 m احسب سرعة اصطدام السيارة
بالشجرة.

- 35.** The driver of a car slams on the brakes when he sees a tree blocking the road. The car slows uniformly with an acceleration of -5.60 m/s^2 for 4.20 s , making straight skid marks 62.4 m long, all the way to the tree. With what speed does the car then strike the tree?

$$V_f = V_i + at$$

$$V_f = V_i - 5.6 \times 4.2$$

$$V_f = V_i - 23.52 \quad \text{--- (1)}$$

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

$$62.4 = V_i \times 4.2 - \frac{1}{2} \times 5.6 \times 4.2^2 \Rightarrow V_i = 26.61 \text{ m/s}$$

From (1)

$$V_f = 26.61 - 5.6 \times 4.2 \Rightarrow V_f = 3.09 \text{ m/s}$$

تتحرك قارب بخط مستقيم

سرعة ابتدائية $v_i = 20 \text{ m/s}$

إلى سرعة نهائية $v_f = 30 \text{ m/s}$

في إزاحة مقدارها 200 m

~~السرعة~~

37. A speedboat travels in a straight line and increases in speed uniformly from $v_i = 20.0 \text{ m/s}$ to $v_f = 30.0 \text{ m/s}$ in a displacement Δx of 200 m . We wish to find the time interval required for the boat to move through this

displacement. (a) Draw a coordinate system for this situation. (b) What analysis model is most appropriate for describing this situation? (c) From the analysis model, what equation is most appropriate for finding the acceleration of the speedboat? (d) Solve the equation selected in part (c) symbolically for the boat's acceleration in terms of v_i , v_f , and Δx . (e) Substitute numerical values to obtain the acceleration numerically. (f) Find the time interval mentioned above.

a) Draw a coordinate system for this situation



b) analysis model ??

the speed is increasing, the particle under a constant acceleration model should be used

c) $v_f^2 = v_i^2 + 2a\Delta x$) solve a التسارع

d) $a = \frac{v_f^2 - v_i^2}{2\Delta x}$
 $= \frac{30^2 - 20^2}{2 \times 200} = \boxed{1.25 \text{ m/s}^2}$

f) Time interval الزمن الإزاحة التسارع

$v_f = v_i + at$ $\Rightarrow t = \frac{v_f - v_i}{a} = \frac{30 - 20}{1.25} = \boxed{8 \text{ sec}}$

38. A particle moves along the x axis. Its position is given by the equation $x = 2 + 3t - 4t^2$, with x in meters and t in seconds. Determine (a) its position when it changes direction and (b) its velocity when it returns to the position it had at $t = 0$.

يُتحرك جسم على محور (x)

حسب المعادلة المعطاة

- احسب موضعي الجسم

عندما تتغير اتجاه حركته

- السرعة عندما يعود لموضعه الذي بدأ منه

a) when the position change in direction $\Rightarrow v_f = 0$

$$v = \frac{dx}{dt} = 3 - 8t = 0 \Rightarrow \boxed{t = \frac{3}{8} \text{ s}}$$

نقدر فيه الزمن في معادلة الموضعي

$$x = 2 + 3 \times \frac{3}{8} - 4 \left(\frac{3}{8} \right)^2$$

$$\boxed{x = 2.56 \text{ m}}$$

b) v_{ab} $\boxed{x_f = x_i}$

$$3t - 4t^2 = 0 \Rightarrow t(3 - 4t) = 0$$

$$\boxed{t = \frac{3}{4} \text{ s}}$$

$$v = 3 - 8t = 3 - \left(8 \times \frac{3}{4} \right) = \boxed{-3 \text{ m/s}}$$

الاجابة: يمكنه ههنا
باجهة ضرب الزمن
($t = \frac{3}{4}$)

في [2] لانه زمنه

الذهاب يباري زمنه الاياب

جسم يتحرك بتسارع مقدار 4 م/ث²

إذا، وكل سرعة، 12 م/ث = v_f بعد مدة
صغرى من الزمن.

41. An object moves with constant acceleration 4.00 m/s^2 and over a time interval reaches a final velocity of 12.0 m/s . (a) If its initial velocity is 6.00 m/s , what is its displacement during the time interval? (b) What is the distance it travels during this interval? (c) If its initial velocity is -6.00 m/s , what is its displacement during the time interval? (d) What is the total distance it travels during the interval in part (c)?

a) إذا كانت السرعة الابتدائية $v_i = 6 \text{ m/s}$ أوجد إزاحة الجسم

$$v_f^2 = v_i^2 + 2ad$$

$$12^2 = 6^2 + 2 \times 4 \times d \Rightarrow d = 13.5 \text{ m}$$

b) أوجد المسافة التي قطعها الجسم
المسافة التي قطعها الجسم متساوية للإزاحة لأن الجسم يتحرك في خط
مستقيم ولم يعود للخلف
distance = 13.5 m

c) إذا كانت السرعة الابتدائية $v_i = -6 \text{ m/s}$ أوجد إزاحة الجسم

$$v_f^2 = v_i^2 + 2ad$$

$$12^2 = (-6)^2 + 2 \times 4 \times d \Rightarrow d = 13.5 \text{ m}$$

$v_f = 0$ 4.5

d) أوجد المسافة التي قطعها الجسم

$$1) v_f^2 = v_i^2 + 2ad$$

$$0 = (-6)^2 + 2 \times 4 \times d \Rightarrow d = 4.5 \text{ m}$$

لا يوجد إزاحة موجبة
تقسيمها إلى نصفين

$$2) v_f^2 = v_i^2 + 2ad$$

$$12^2 = 0^2 + 2 \times 4 \times d \Rightarrow d = 18 \text{ m}$$

$$\text{distance} = 18 + 4.5$$

$$= 22.5 \text{ m}$$

لا حظ أن $18 + 4.5$
 $= 13.5 = \text{displacement}$

49. It is possible to shoot an arrow at a speed as high as 100 m/s. (a) If friction can be ignored, how high would an arrow launched at this speed rise if shot straight up? (b) How long would the arrow be in the air?

a) $V_i = 100 \text{ m/s}$
 $y = ??$

$$V_f^2 = V_i^2 - 2gy$$

$$0^2 = 100^2 - 2 \times 9.8 \times y \Rightarrow \boxed{y = 510.2 \text{ m}}$$

b) $2T = ??$

$$V_f = V_i - gt$$

$$0 = 100 - 9.8t \Rightarrow \boxed{t = 10.2 \text{ s}}$$

$$t = 2T = 2 \times 10.2 = \boxed{20.4 \text{ s}}$$

إذا تم إطلاق سهم لأعلى
بسرعة 100 م/ث، فماذا
يكون أقصى ارتفاع
يصل إليه السهم؟

ارتفاع السهم
والزمن الذي يقضيه السهم في الهواء.

سرعة السهم في البداية
تبدأ من ارتفاع
صافي الجسم النهائي
تساوي صفر.

زمن الوصول لأقصى
ارتفاع.

زمن التخليص
= 2 × زمن أقصى
ارتفاع.

51. A ball is thrown directly downward with an initial speed of 8.00 m/s from a height of 30.0 m. After what time interval does it strike the ground?

رسيه كره لا ينزل بسرعه

$v_i = 8 \text{ m/s}$

ساره ارتقاى $y = 30 \text{ m}$

اريد زنه اكلها من قبل ان ترضى

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

$$-30 = -8t - \frac{1}{2} \times 9.8 t^2$$

$$-4.9 t^2 - 8t + 30 = 0$$

$$a = -4.9, \quad b = -8, \quad c = 30$$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$t = \frac{+8 \pm \sqrt{(-8)^2 - 4 \times -4.9 \times 30}}{2 \times -4.9}$$

$$t = 1.79 \text{ s}$$

لانه السرعه لا ينزل فيها
بإتجاه الحالب
 $v_i = -8 \text{ m/s}$

رسيه الانزاله لا ينزل
نقطة الحالب $y = -30 \text{ m}$

مر طالب مجموعته من المفاتيح
لأمر لأخيه التي تقف
كل شئ بالمرتفع من
الأرض (4m)
فإذا أسكت المفاتيح
بعد (1.5s)

53. A student throws a set of keys vertically upward to her sorority sister, who is in a window 4.00 m above. The second student catches the keys 1.50 s later. (a) With what initial velocity were the keys thrown? (b) What was the velocity of the keys just before they were caught?

أ. بعد السرعة الابتدائية التي رست بها المفاتيح

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

$$4 = v_i \times 1.5 - \frac{1}{2} \times 9.8 \times 1.5^2 \Rightarrow \boxed{v_i = 10 \text{ m/s}}$$

ب) السرعة النهائية قبل أن تسقط بالمفاتيح

$$v_f = v_i - g t$$

$$= 10 - 9.8 \times 1.5$$

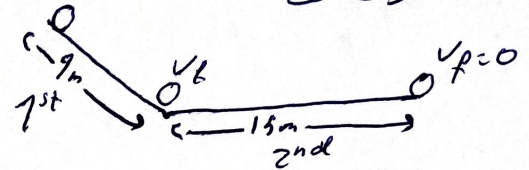
$$= -4.7 \text{ m/s}$$

كانت المفاتيح متجهة
لأعلى قبل أن تسقط
بها.

65. A ball starts from rest and accelerates at 0.500 m/s^2 while moving down an inclined plane 9.00 m long. When it reaches the bottom, the ball rolls up another plane, where it comes to rest after moving 15.0 m on that plane. (a) What is the speed of the ball at the bottom of the first plane? (b) During what time interval does the ball roll down the first plane? (c) What is the acceleration along the second plane? (d) What is the ball's speed 8.00 m along the second plane?

بدأت الكرة من السكون بتسارع (0.5 m/s^2)

بالتحرك على سطح مائل طوله (9 m) وعندما وصلت لا تفلت
توقفت بعد عرج (15 m) ثم



a) أريد سرعة الكرة أسفل المائل

$$v_f^2 = v_i^2 + 2ad$$

$$= 0^2 + 2 \times 0.5 \times 9$$

$$\sqrt{v_f^2} = \sqrt{9} \Rightarrow \boxed{v_f = 3 \text{ m/s}}$$

b) الزمن اللازم للوصول لا تفل المائل

$$v_f = v_i + at$$

$$3 = 0 + 0.5t \Rightarrow \boxed{t = 6 \text{ s}}$$

c) التسارع في السطح الثاني (الأفقي)
السرعة الابتدائية للسطح الثاني هي نفسها السرعة الابتدائية للسطح الأول.

$$v_f = 0, v_i = 3 \text{ m/s}$$

$$v_f^2 = v_i^2 + 2ad$$

$$0 = 3^2 + 2 \times a \times 15 \Rightarrow \boxed{a = -0.3 \text{ m/s}^2}$$

تباطؤ

d) سرعة الكرة على بعد (8 m) في السطح الثاني

$$v_f = ??$$

$$v_f^2 = v_i^2 + 2ad$$

$$= 3^2 + 2 \times -0.3 \times 8 \Rightarrow \boxed{v_f = 2.04 \text{ m/s}}$$