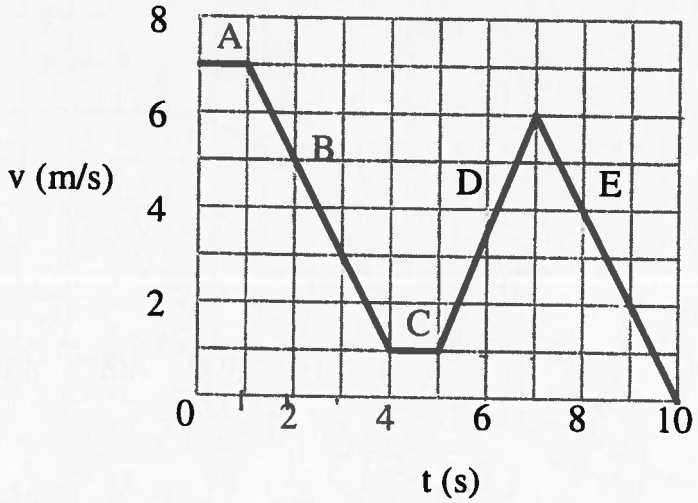
 Key

Graphing in Kinematics 2 - Practice

Examine this graph carefully to answer questions 1.



1. Above is a graph representing the motion of an object. For each section of that motion, labeled **A** through **E**, calculate the acceleration of the object.

A 0

B $-2\ m/s^2$

C 0

D $2.5\ m/s^2$

E $-2\ m/s^2$

2. How long will it take a truck moving at 35 m/s to stop if it accelerates at -5.0 m/s^2? (show work)

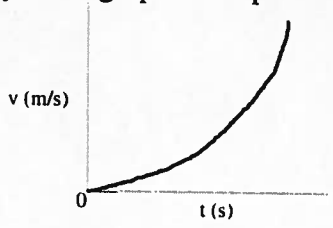
$\vec{a} = \frac{\Delta v}{\Delta t} = -5.0\ m/s^2 = \frac{-35\ m/s}{t}$ $t = 7s$

3. A plane upon landing accelerates at -1.5 m/s^2 for 1.0 minute until it stops. How fast was it going before it started to slow down? (show work)

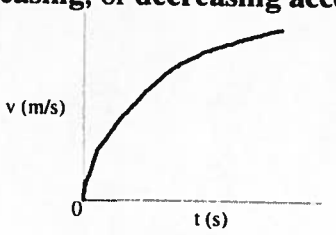
4. A car hitting a tree loses 40.0 m/s in 0.100 s. What is its acceleration? (show work)

5. Classify these graphs as representing **constant, increasing,** or **decreasing acceleration.**

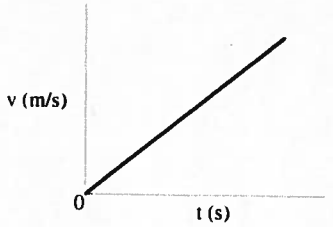
(a)



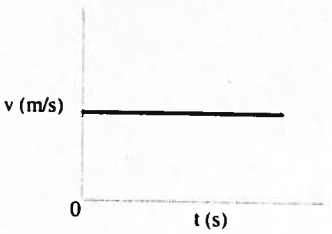
(b)



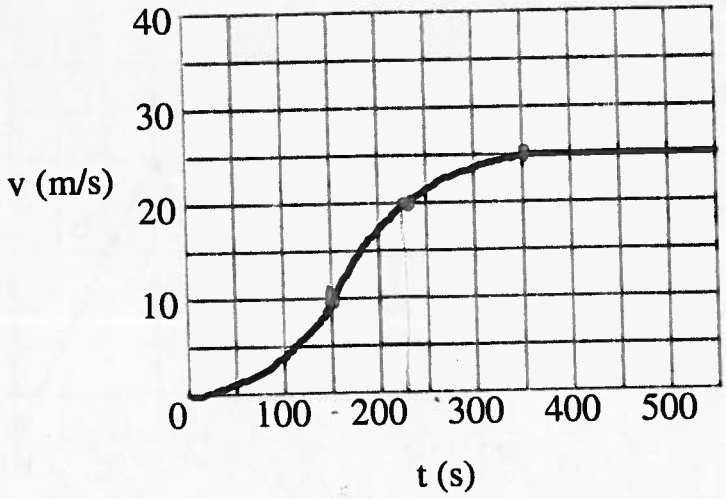
(c)



(d)



6. This graph represents the motion of a truck that begins to move from rest.



From the graph, calculate the **average acceleration** of the truck over the following time intervals. (show work)

(a) 0 s to 150 s. $\vec{a} = \frac{\Delta v}{\Delta t} = \frac{10\ m/s}{150\ s} = 0.067\ m/s^2$

(b) 150 s to 225 s. $\vec{a} = \frac{\Delta v}{\Delta t} = \frac{10\ m/s}{75\ s} = 0.13\ m/s^2$

(c) 150 s to 350 s. $\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{15\ m/s}{200\ s} = 0.075\ m/s^2$

(d) 0 minutes to 6 minutes. $\vec{a} = \frac{\Delta v}{\Delta t} = \frac{25\ m/s}{360\ s} = .069\ m/s^2$

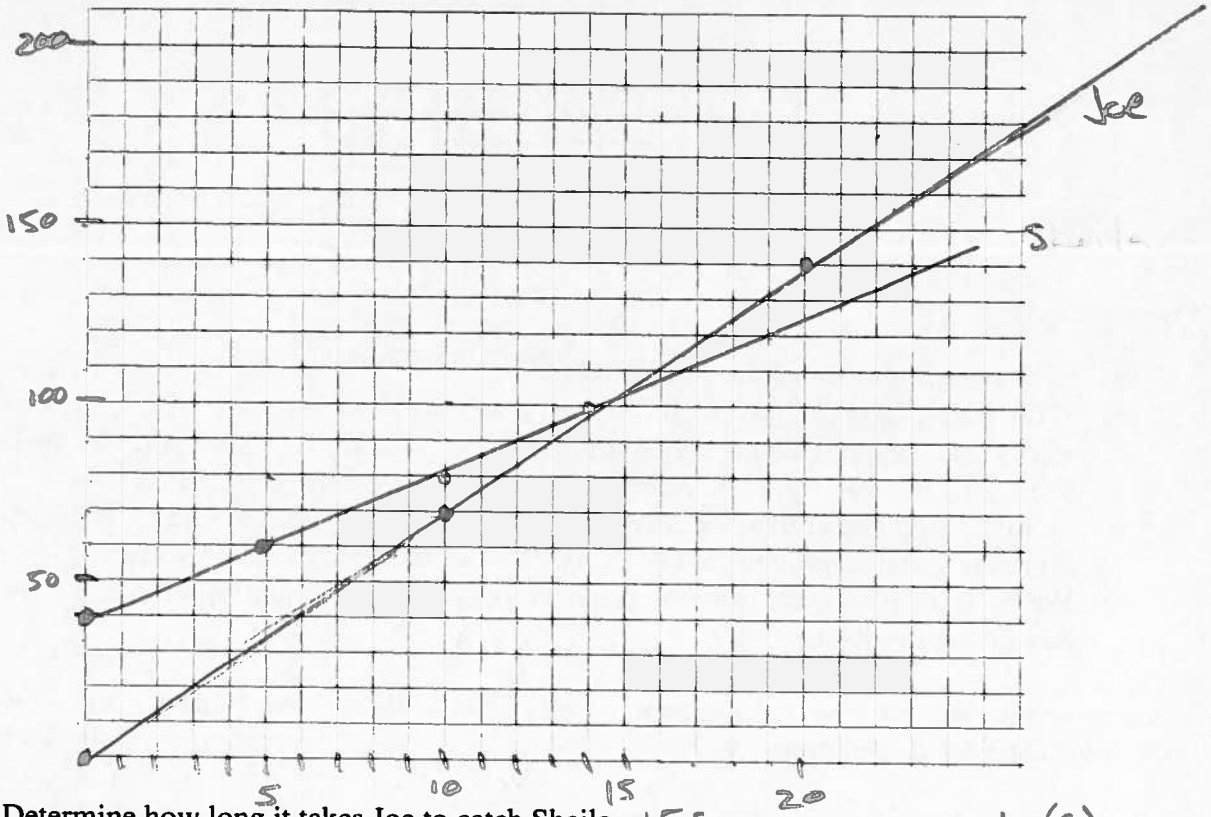
$v = \frac{d}{t}$ $d = vt$ $d = vt$

$200 = 7(t)$ $d = 4(28.6)$

$t = 28.6\,s$

Kinematics Review

1. Joe can run at 7.0 m/s. Sheila can run at 4.0 m/s. Joe gives Sheila a 40 m head-start. Using a distance *vs* time graph...



a) Determine how long it takes Joe to catch Sheila. 15 s
b) Determine how far Joe travels by the time he catches Sheila. 105 m
c) At what time will Joe be 10 m ahead of Sheila? 19 s
d) When Joe has run 200 m, how far has Sheila run? 154.3 m
e) Write equations for Joe's motion and Sheila's motion. $y = mx + b$

Joe → $d = 7t$ | Sheila: $d = 4t + 40$

2. A motorcyclist accelerates from 3.0 m/s to 27 m/s in 4.0 s. What is his acceleration?

$a = \frac{\Delta v}{\Delta t} = \frac{24}{4} = 6\,m/s^2$

3. A car accelerates at 5.0 m/s^2 from an initial velocity of 14 m/s. How long will it take to reach a velocity of 65 m/s?

$t = \frac{\Delta v}{a} = \frac{51}{5} = 10.2\,s$

v_f 168
v_i 0
d ?
a 12 m/s^2
t 14 s

4. A car accelerates form rest at 12.0 m/s^2 for 14.0 s.
   a) How fast is it moving after 14.0 s?
   b) How far has it traveled in this time?

$v = at = 12(14) = 168\,m/s$

$d = v_i t + \frac{1}{2} a t^2$

$d = 0 + \frac{1}{2}(12)196 = 1176\,m$

5. A skier accelerates down a slope with an acceleration of 4.2 m/s^2. She passes the first timing gate at 18 m/s. 6.0 s later she passed a second timing gate.
   a) How fast is she going as she passes the second gate?
   b) What is the distance between the gates?

v_f ?
v_i 18 m/s
d
a 4.2 m/s^2
t 6 s

a) $v_f = v_i + at$

$= 18 + 4.2(6)$

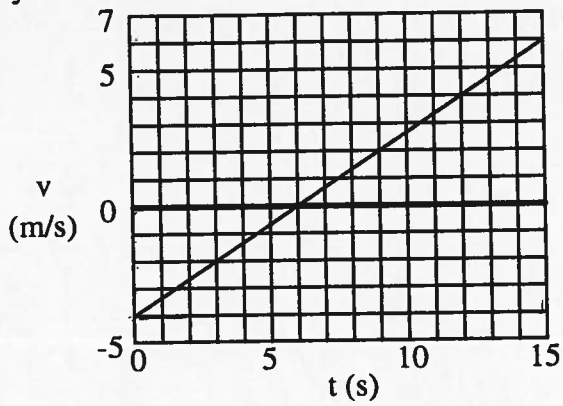
$v_f = 43.2\,m/s$

b) $d = v_i t + \frac{1}{2} a t^2$

$= 18(6) + \frac{1}{2}(4.2)36$

$= 108 + 75.6 = 183.6\,m$

6. Examine the Velocity *vs.* time below:



a) Find the acceleration of the object. $a = \frac{10\,m/s}{15s} = 0.67\,m/s^2$
b) Write the equation for the graph. $v = 0.67t - 4$
c) Verify that your equation is correct by showing a "check", i.e. pick a point on the line, take its value for *t* and see if you get the appropriate value for *v* (or vice versa).
d) From the graph determine the DISTANCE traveled by the object in 15 seconds. 150 m
e) From the graph determine the DISPLACEMENT of the object at 15 seconds.
f) Verify the displacement from the graph by using the appropriate equation and show your calculation for displacement. $d = \left(\frac{v_i + v_f}{2}\right)t = \frac{1}{2}(15) = 7.5\,m$

7. A motorcyclist starting from rest ***averages*** 24 m/s along a 500 m track. What was his acceleration? (Assume constant acceleration) $v_{av} = \frac{d}{t}$ $t = \frac{d}{v_{av}} = \frac{500}{24} = 20.8\,s$ $500 = \frac{1}{2}a(432.64)$ $a = 2.3\,m/s^2$

8. A block of wood was sliding along on level ice. Its initial speed was 18 m/s. If it took 15 seconds to come to a complete stop, what was the acceleration due to friction?
$v_f = v_i + at \rightarrow 0 = 18 + a(15)$ $-1.2\,m/s^2 = a$

9. An object is dropped from rest near the surface of the Moon. The acceleration due to gravity on the Moon is 1.67 m/s^2. What is the speed of the object after it has dropped 54 m?
$v_f^2 = v_i^2 + 2ad$ / $v_f^2 = 0 + 2(1.67)54$ / $v_f^2 = 180.36$ / $v_f = 13.4\,m/s$

10. A skier passes a photogate traveling at 12 m/s. 30 m further down the slope she passes another photogate and is found to be traveling at 18 m/s. Assuming a constant slope what is the skier's acceleration?
$324 = 144 + 2(a)30$ / $324 = 144 + 60a$ / $a = 3.0\,m/s^2$

11. An astronaut jumps off a 3.0 m ledge on the moon. What is the astronaut's speed as he hits the ground? What would be the final speed of someone jumping off a similar ledge on earth? (Assume negligible friction). $v_f^2 = v_i^2 + 2ad$
$v_f^2 = 2(1.67)(3)$ $v_f = 3.2\,m/s$

12. A ball is thrown vertically upwards at an initial speed of 26 m/s. The acceleration due to gravity is -9.8 m/s^2 (downwards!). How long will the ball take to reach its maximum height? What is its maximum height?

$v_f = 0$, $v_i = 26$, $d =$, $a = -9.8$, $t = ?$

$v_f = v_i + at$
$0 = 26 + 9.8(t)$
$26 = 9.8t$
$2.7\,s = t$

$d = v_i t + \frac{1}{2}at^2$
$= 26(2.7) + \frac{1}{2}(9.8)\,7.29$
$= 70.2 + 35.7$
$= 105.9\,m$

