Five Easy Pieces

1. A car is traveling at $25.0\,m/s$ when the driver hits the brakes causing a constant deceleration of $3.00\,m/s^2$. How far does the car go while stopping?

(a) $104\,m$	(b) $208\,m$	(c) $52\,m$	(d) $1250\,m$

2. A man runs $80.0\,m$ in the positive x direction with an average speed of $2.00\,m/s$. He immediately turns around and runs 180.0 m in the opposite direction with an average speed of $6.00\,m/s$. What is his average speed for the entire trip?

(a) $4.00\,m/s$	(b) $-2.00\,m/s$	(c) $3.71\,m/s$	(d) $-1.43\,m/s$

3. A man on the top of a $132\,m$ high cliff throws a ball upwards at $16\,m/s$. If air resistance can be ignored, which of the following is the correct set of data for the ball after it is thrown.

(a) $y_0 = 0$, $v_0 = 16\,m/s$, $a = -9.8\,m/s^2$	(b) $y_0 = 132\,m$, $v_0 = 16\,m/s$, $a = -9.8\,m/s^2$
(c) $y_0 = 0$, $v_0 = -16\,m/s$, $a = +9.8\,m/s^2$	(d) Any of these three can be used .

4. A car starts from rest at the origin. If it travels $15.0\,km$ in $3.00\,minutes$, what was its constant value of acceleration?

(a) $.926\,m/s^2$	(b) $3.33\,m/s^2$	(c) $1.67\,m/s^2$	(d) $.463\,m/s^2$

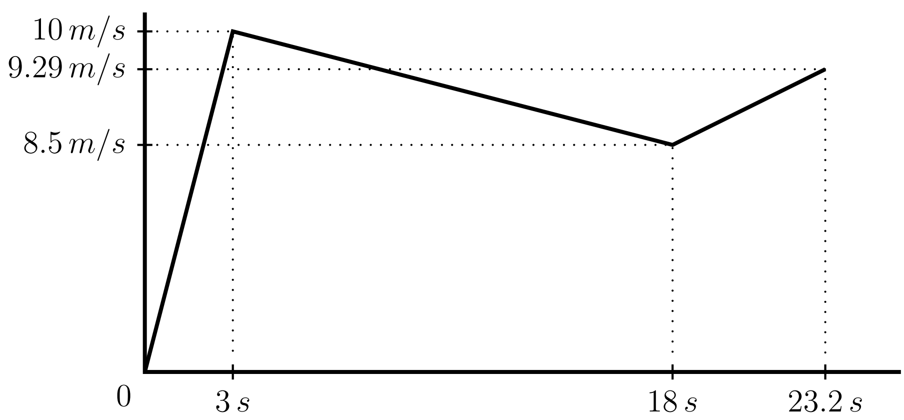
5. A car with initial velocity vector $\vec{\mathbf{v}}_0 = 25\,m/s$ at $53°$ has a constant acceleration $\vec{\mathbf{a}} = 6\,m/s^2$ at $22°$. What is the car's speed after $2.00\,s$? Assume all angles are relative to the positive x axis.

(a) $37.0\,m/s$	(b) $50.6\,m/s$	(c) $50.0\,m/s$	(d) $35.8\,m/s$

She Had Polio As A Kid!

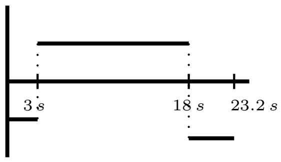
Questions 6 through 10 refer to the following setup and figure.

Wilma Rudolph was the first American woman to ever win three gold medals at the olympics. (And was the 20th of 22 children!!!) In the 1960 games in Rome, she won the $200\,m$ dash with a time of $23.2\,s$. Assume that when plotted, Wilma's velocity as a function of time had the following shape. (Please notice that for clarity, this graph and the ones on the next page are not to scale. You may assume that the graphs have either straight lines or parabolic curves.)

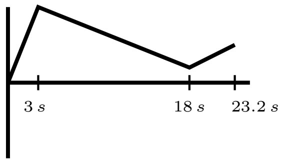


6. Which of the following **acceleration** versus time graphs is correct?

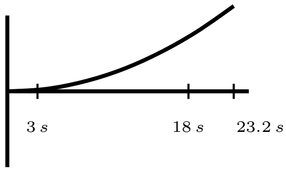
(a)



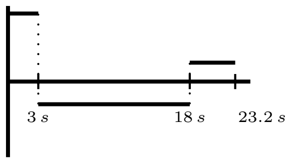
(b)



(c)

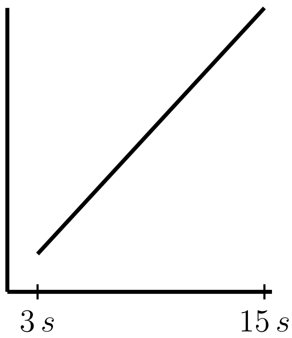


(d)

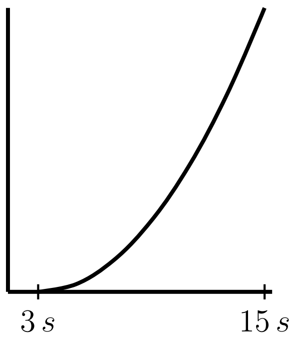


7. Assuming that the position origin is set at Wilma's $t = 0$ location, which of the following **position** versus time graphs is correct for times between $3\,s$ and $15\,s$?

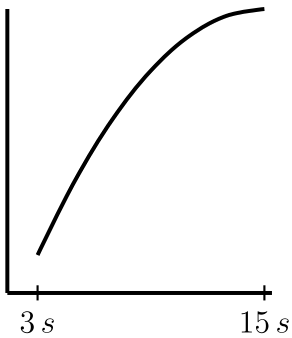
(a)



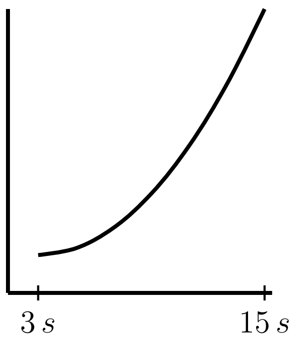
(b)



(c)



(d)



8. For all times between 18 s and 23.2 s, what was the acceleration value?

(a) $-0.152\, m/s^2$	(b) $0.152\, m/s^2$	(c) $-0.034\, m/s^2$	(d) $0.034\, m/s^2$

9. What distance did she cover during the first 3 s of the race?

(a) $16.1\, m$	(b) $30\, m$	(c) $15\, m$	(d) $1.61\, m$

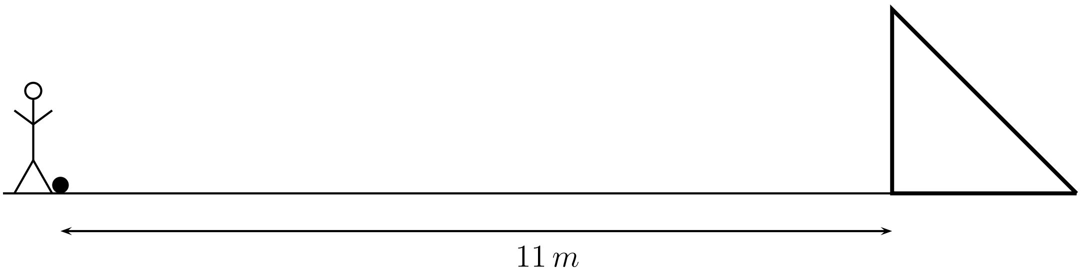
10. At $t = 25\, s$, how fast was she going?

(a) $3.8\, m/s$	(b) $12.3\, m/s$	(c) $9.56\, m/s$	(d) Cannot be determined

Futball

Questions 11 through 15 refer to the following setup and figure.

One of the most psychologically grueling aspects of soccer (aka football) is the penalty kick. A penalty kick is taken $11\,m$ away from the goal. During a practice session, West Ham United's Carlton Cole kicks a football from the penalty spot with a speed of $15\,m/s$ and at an 18° angle.



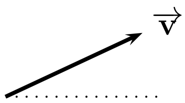
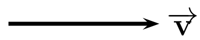
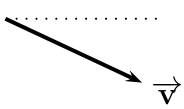
11. Which of the following is the correct pair of initial velocity components?

(a) $v_{0,x} = 15\,m/s$, $v_{0,y} = 18\,m/s$	(b) $v_{0,x} = 11\,m/s$, $v_{0,y} = 15\,m/s$
(c) $v_{0,x} = 4.64\,m/s$, $v_{0,y} = 14.3\,m/s$	(d) $v_{0,x} = 14.3\,m/s$, $v_{0,y} = 4.64\,m/s$

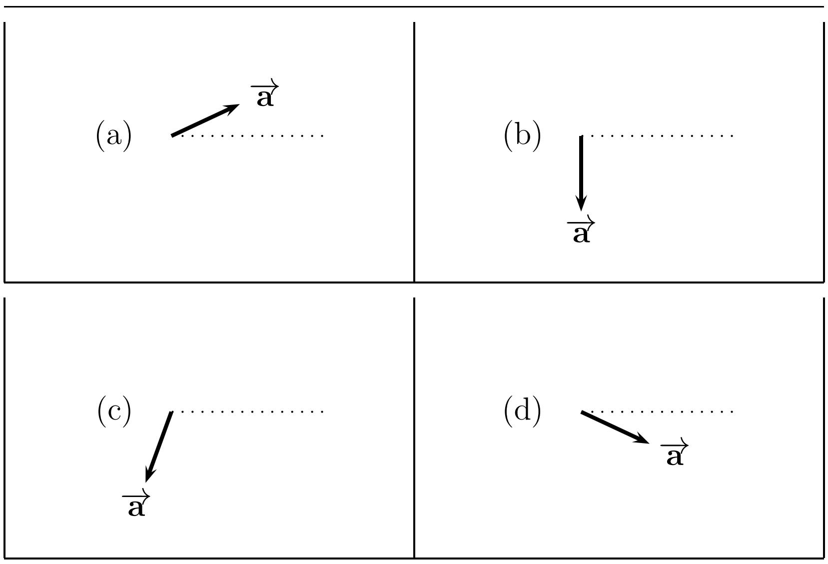
12. Ignoring air resistance, what is the maximum height reached by the ball?

(a) $3.3\,m$	(b) $2.19\,m$	(c) $10.4\,m$	(d) $9.8\,m$

13. Ignoring air resistance, which of the vectors below gives the correct direction for the ball's velocity at its maximum height?

(a) 	(b) 
(c) 	(d) $\vec{v} = 0$ at maximum height

14. If we were to include air resistance, which of the following vectors would give the correct direction for the ball's acceleration at its maximum height? **HINT**: At the maximum height, gravity is causing a change in direction while air resistance would be causing a decrease in speed.



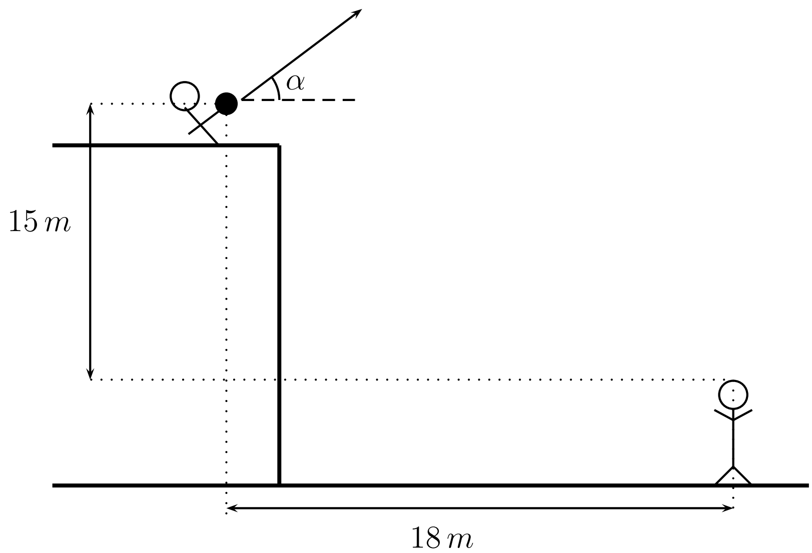
15. Ignoring air resistance, in what direction is the ball traveling as it enters the goal (at $x = 11\,m$)?

(a) $-18°$	(b) $-11.6°$	(c) $0°$	(d) $-3.44°$

I Know You Want To!

Questions 16 through 20 refer to the following setup and figure.

One day you find in yourself in the following unlikely situation: You are standing on top of a building when you spot your instructor standing 18.0 m away and 15.0 m below you. (See the figure.) The unlikely (though fun) part is that you happen to have a water balloon launcher with you. You decide that you wish to hit the top of your instructor's head 3.0 s after launch. Ignore air resistance in all calculations.



16. Which of the following equations would be used to find the balloon's launch angle, α?

(a) $\tan^{-1}\left(\frac{v_y}{v_x}\right)$	(b) $\alpha = \tan^{-1}\left(\frac{y}{x}\right)$	(c) $\tan^{-1}\left(\frac{v_{0,y}}{v_{0,x}}\right)$	(d) $\tan^{-1}\left(\frac{y_0}{x_0}\right)$

17. Which **TWO** of the following choices are correct listings of initial and final position values of the water balloon? Both answers are required for full credit.

(a) $x_0 = 0,\ y_0 = 0,\ x = 15\,m,\ y = -18\,m$	(b) $x_0 = 0,\ y_0 = 0,\ x = 18\,m,\ y = -15\,m$
(c) $x_0 = 0\,m,\ y_0 = 15\,m,\ x = 18\,m,\ y = 0$	(d) $x_0 = 0,\ y_0 = 18\,m,\ x = 15\,m,\ y = 0$

18. What initial velocity x-component ($v_{0,x}$) is necessary to hit the top of your instructor's head?

(a) $6.0\,m/s$	(b) $18\,m/s$	(c) $5.0\,m/s$	(d) $8.7\,m/s$

19. What initial velocity y-component ($v_{0,y}$) is necessary to hit the top of your instructor's head?

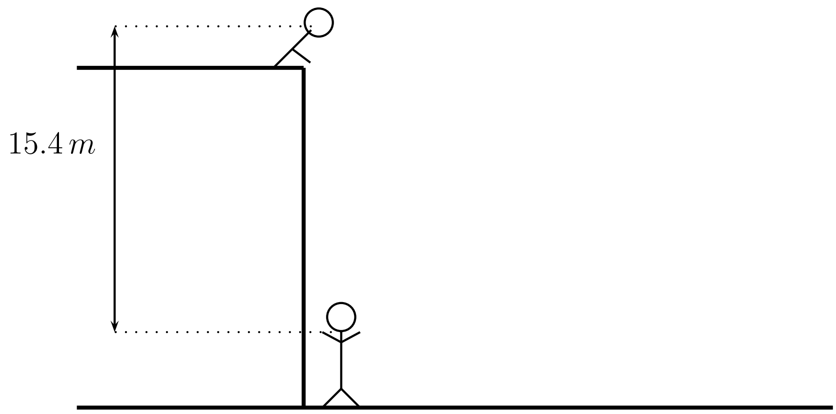
(a) $6.0\,m/s$	(b) $9.7\,m/s$	(c) $5.0\,m/s$	(d) $8.7\,m/s$

20. The instant the balloon hits the top of your instructor's head, which of the following statements is true?

(a) v_x is zero.	(b) v_y is zero.
(c) Both v_x and v_y are zero.	(d) Neither v_x nor v_y are zero.

21. **Revenge!**

In retaliation for his soaking, your instructor get his OWN water balloon launcher! He stands directly below you and launches the balloon upwards. Ignore air resistance in all calculations.



(a) Through other methods (not currently available to you), your instructor determines that his water balloon needs a speed of at least $5.0\,m/s$ in order to burst upon contact with your face. With what minimum speed must your instructor launch his balloon in order to hit your face which is $15.4\,m$ directly above the launch point?

(b) Not content to be hit in the face with a water balloon, you grab your launcher and fire directly downwards with a speed of $35\,m/s$, just $.62\,s$ after your instructor launches his balloon. When and where do the two balloons collide? Use your answer from part (a) for the initial speed of your instructor's balloon. If you were unable to find that value, use $20.0\,m/s$.