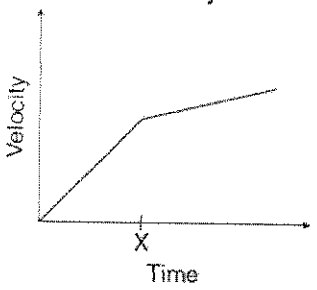
Motion Unit Review
State Test Questions

1. **To create real-time graphs of an object's displacement versus time and velocity versus time, a student would need to use a**
A motion sensor
B low-g accelerometer.
C potential difference probe.
D force probe.

2. **A student applied a constant force to a toy truck. A graph of the truck's movement is shown below**

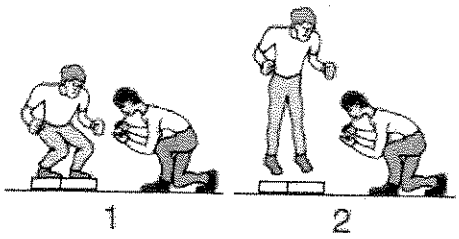


Which of the following could *best* explain the change in velocity at time X?
A The truck's momentum became greater than its inertia.
B The truck went from moving in a straight path to moving in a curved path.
C The truck began traveling up a slightly sloped surface.
D The truck went from rolling on a rough surface to rolling on a polished surface.

3. **A student attempts to measure the mass of a brick by measuring the force required to accelerate it at 1 m/s^2 on a level surface. The force required is 2 N, and the student concludes that the brick has a mass of 2 kg. A balance shows that the mass of the brick is really 1.5 kg. The experimental error is *most* likely due to**
A gravity
B work
C friction
D inertia

$F = ma$

4. **A student in a lab experiment jumps upward off a common bathroom scale as the lab partner records the scale reading.**



What does the lab partner observe during the instant the student pushes off?

A The scale reading will remain unchanged during the entire time the student is in contact with the scale.
B The scale reading will increase momentarily then will decrease as the student is moving upward from the scale.
C The scale reading will increase during the entire time the student is in contact with the scale.
D The scale reading will decrease momentarily then will increase as the student is moving upward from the scale.

$1\,yd = 1\,m$

5. **How much time will it take for a person to walk the length of a football field (100 yards) at a constant speed of 5 m/s?**
A 20 seconds B 33 seconds C 60 seconds D 166 seconds

$V = d/t \Rightarrow t = d/V = 100\,yd/5\,m/s$

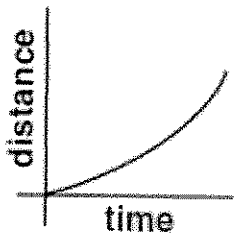
6. **A ball is dropped from rest from a height 6.0 meters above the ground. The ball falls freely and reaches the ground 1.1 seconds later. What is the average speed of the ball?**

$V = \frac{d}{t} = \frac{6\,m}{1.1\,s} = 5.45\,m/s$

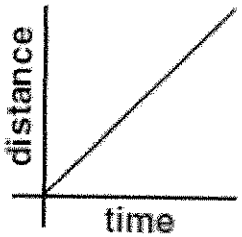
A 5.5m/s
B 6.1m/s
C 6.6m/s
D 11m/s

7. An object moves away from a motion detector with a constant speed. Which graph *best* represents the motion of the object?

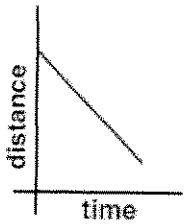
A



B



C



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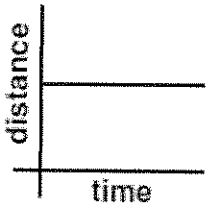


8. A 10-newton force and a 15-newton force are acting from a single point in opposite directions. What additional force must be added to produce equilibrium?

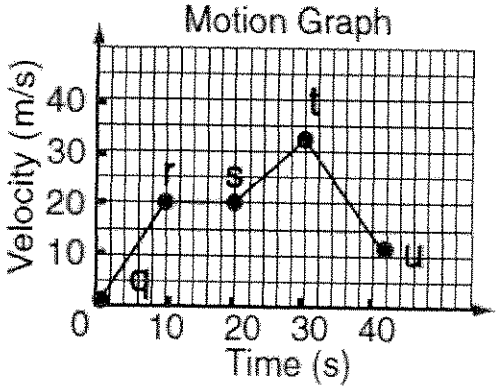
A 5 N acting in the same direction as the 10-N force
B 5 N acting in the same direction as the 15-N force
C 10 N acting in the same direction as the 10-N force
D 25 N acting in the same direction as the 15-N force

10 N → □ ← 15 N
+5
15 N

9. A student holds a book at rest in an outstretched hand. The force exerted on the book by the student is equal to the book's

A mass.
B weight.
C volume.
D density.

10. The graph below shows the velocity of a car that is moving in a straight line.



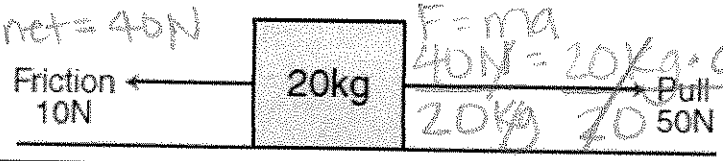
During which of the following intervals are forces on the car balanced?

A q to r
B r to s
C s to t
D t to u

11. The figure shows a block that is being pulled along the floor. According to the figure, what is the acceleration of the block?

A 2 m/s² C 4 m/s² B 3 m/s² D 6 m/s²

Fnet = 40N

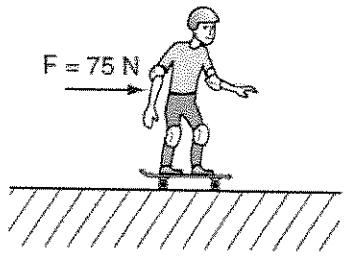


F = ma
40N = 20kg · a
20kg 20

12. A 50-kg child on a skateboard experiences a 75-N force as shown. What is the expected acceleration of the child?

F = ma a = F/m = 75N / 50kg = 1.5 m/s²

A 0.67 m/s² B 1.50 m/s² C 6.70 m/s² D 25.00 m/s²



13. A soccer player kicks a 0.5-kilogram stationary ball with a force of 50 Newtons. What is the force on the player's foot?

A 0 N
B 25 N
C 50 N
D 100 N

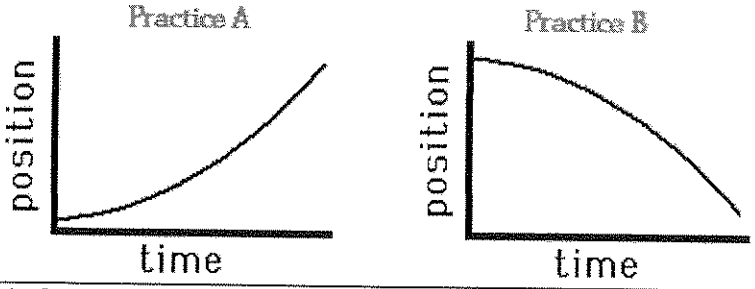
For every action there is an equal, opposite!

Class Questions

14. Determine whether the following values are scalar or vector quantities:

a. 8 m/s ✓ B. 3 blocks East ✓ C. -3 m/s/s S 5 ft S

15. Use the principle of slope to describe the motion of the objects depicted by the two plots below. In your description, be sure to include such information as the direction of the velocity vector (i.e., positive or negative), whether there is a constant velocity or an acceleration, and whether the object is moving slow, fast, from slow to fast or from fast to slow. Be complete in your description.

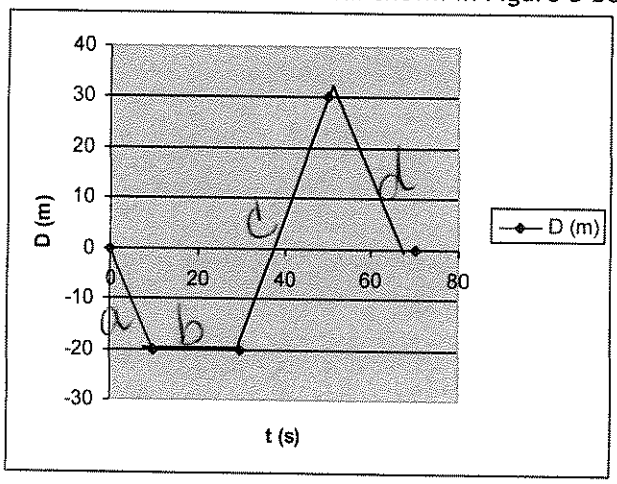


A	B
Speeding up +v moving rt! +a slow → fast	speeding up moving left slow to fast −v −a

16. Convert the units of the following average velocities.
a. speed of a sprinter: 10 m/s into km/h

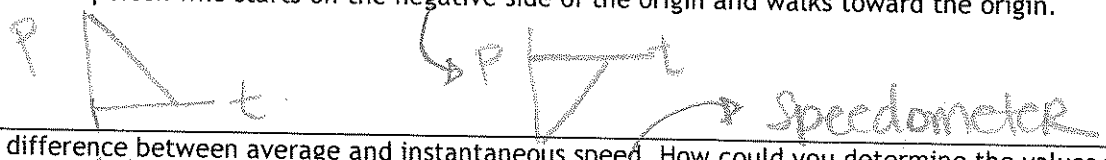
$10\ \frac{m}{s}\left(\frac{1\ km}{1000\ m}\right)\left(\frac{3600\ sec}{1\ hr}\right) = 36\ km/hr$

Describe the motion of the car shown in Figure B below:



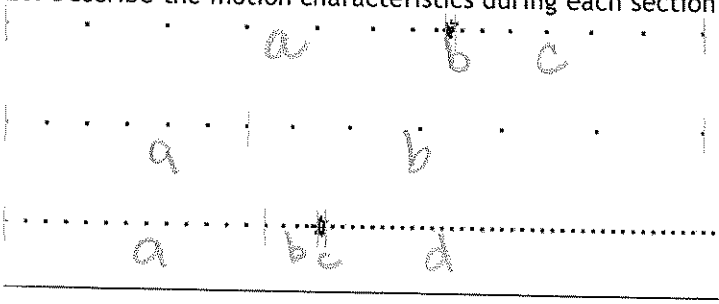
17. Answer the following questions about the car whose motion is graphed in Figure B above.
a. When was the car 20 m west of the origin? 10 sec
b. Where was the car at 50 s? 30 m East
c. The car suddenly reversed direction. When and where did that occur? 5 | sec
d. What is the total distance traveled? ~101 m
e. What is the displacement? 0 m

18. Draw a position-time graph for a person who starts on the positive side of the origin and walks with uniform motion toward the origin. Repeat for a person who starts on the negative side of the origin and walks toward the origin.



19. Describe the difference between average and instantaneous speed. How could you determine the values for these?
avg = $\bar{v} = d/t$ takes all speeds into account over time!

20. Describe the motion characteristics during each section of the diagrams below.



a) fast → slow b) stop c) speeds up

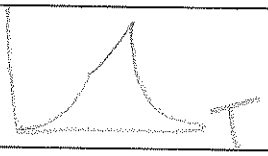
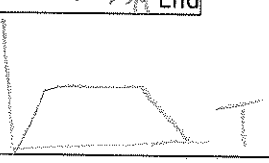
a) constant slow b) slowly speeds up

a) constant slow b) slowing down c) stop d) constant very slow

21. Newton's second law of motions is : F=ma

22. Use the particle model to draw a motion diagram for a car that starts from rest, speeds up to a constant speed, and then slows to a stop. Then draw a PT graph and a VT graph for this motion.

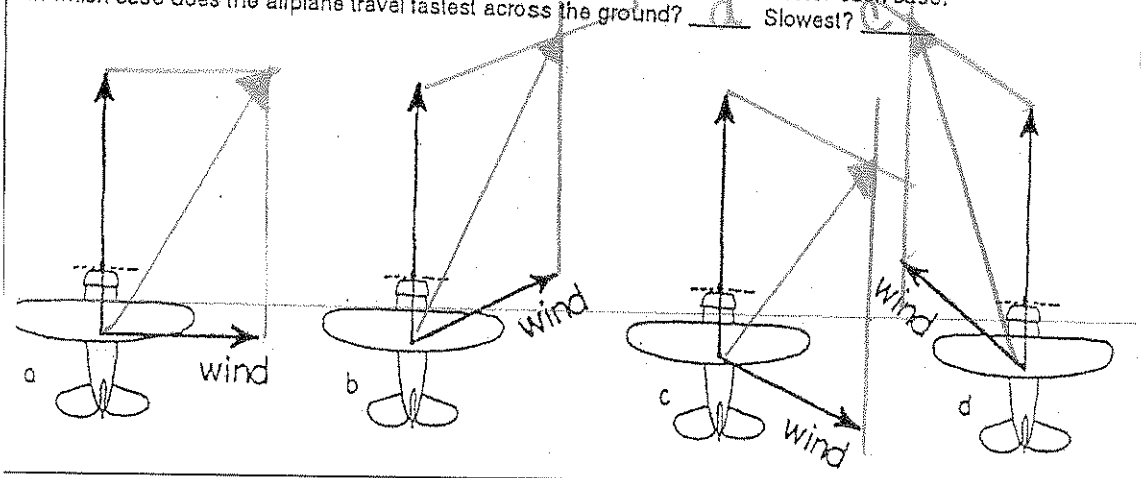
Begin ● . . . . . End

P  V 

23.

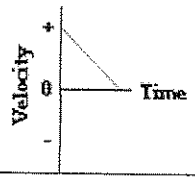
Below we see a top view of an airplane being blown offcourse by wind in various directions. Use the parallelogram rule to show the *resulting* speed and direction of travel for each case. In which case does the airplane travel fastest across the ground? d Slowest? c

Be Sure to draw arrow!



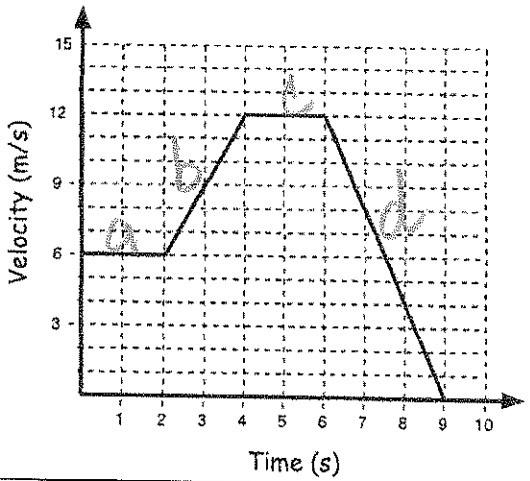
24. Consider the graph at the right. The object whose motion is represented by this graph is ... (circle or highlight all that are true):

- ✓ moving in the positive direction.
- moving with a negative velocity.
- changing directions.
- moving with a positive acceleration.
- ✓ moving with a constant velocity.
- ✓ slowing down.
- speeding up.
- ✓ moving with a constant acceleration.



25.

2. The graph below shows the velocity vs time for an object in motion. Give a description of what the object is doing during each of the intervals listed in the table below



Region	Start Time (s)	End Time (s)	Description of Motion
a	0	2	constant 6 m/s, rt, a=0
b	2	4	speeding constant a (+) rt $\frac{12-6}{2}=3\,m/s^2$
c	4	6	const. v, a=0 v=12 m/s
d	6	9	Const $-a=\frac{9-12}{3}=-1\,m/s^2$ slowing down, +v

26. What is the difference between speed, velocity and acceleration?

a. What does the slope in a position vs. time graph represent? velocity

b. What does the slope in a velocity vs. time graph represent? acceleration

speed = $\frac{d}{t}$ no direction (scalar)

velocity = $\frac{\vec{d}}{t}$ = speed w/ direction (vector)

acceleration = $\frac{\Delta v}{t}$ = rate of Δ speed

27.

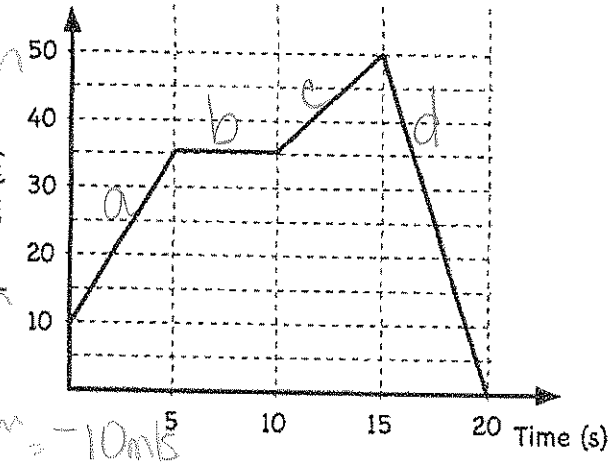
3. The graph below is a graph of position versus time. Use this graph to create a graph of velocity vs. time.

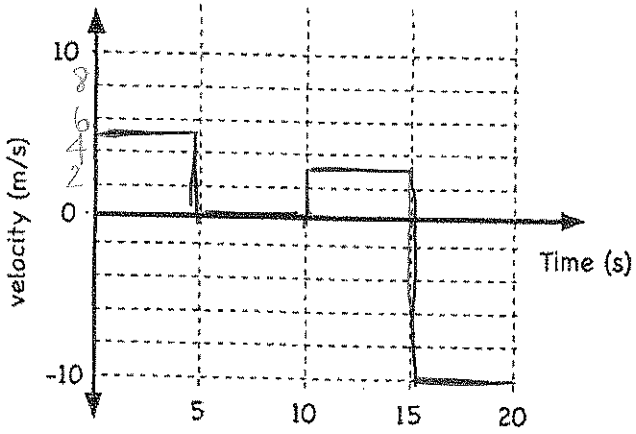
a) $\frac{35-10\ m}{5\ sec} = 5\ m/s$

b) $= 0$

c) $\frac{50-35\ m}{5\ sec} = 3\ m/s$

d) $\frac{0-50\ m}{5\ sec} = -10\ m/s$





28.

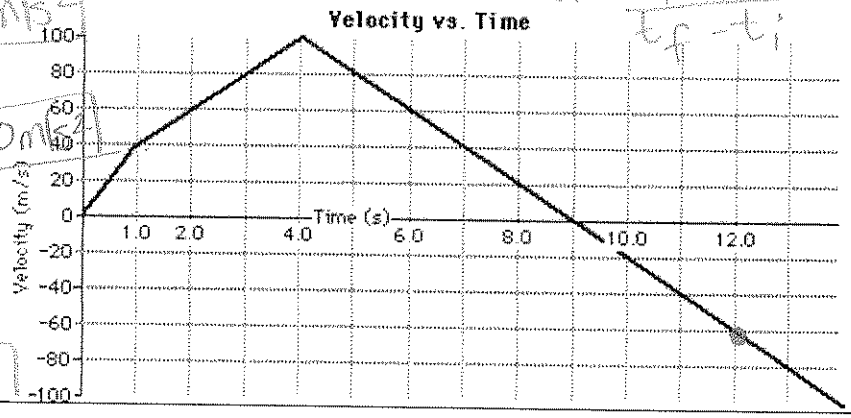
The velocity-time graph for a two-stage rocket is shown below. Use the graph and your understanding of slope calculations to determine the acceleration of the rocket during the listed time intervals. **Show your work!!!**

$a = \frac{v_f - v_i}{t_f - t_i}$

a. t = 0 - 1 second! $\frac{40-0\ m/s}{1\ sec} = 40\ m/s^2$

b. t = 1 - 4 second $\frac{100-40}{3\ sec} = \frac{60}{3} = 20\ m/s^2$

c. t = 4 - 12 second $\frac{-60-100}{8\ sec} = \frac{-160}{80} = -2\ m/s^2$



29.

Look at the v-t graph below of the toy train.

a. During which time interval or intervals is the speed constant?

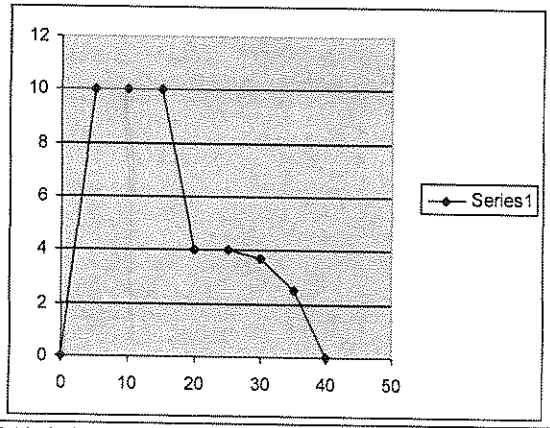
5-15 s ; 20-25 s

b. During which interval or intervals is the train's acceleration positive?

0-5 sec

c. During which time interval is its acceleration the most negative?

15-20 sec



Using the figure above, find the average acceleration during the following time intervals:

a. 0 to 5 s $\frac{10-0}{5} = 2\ m/s^2$

b. 15 to 20 s $\frac{4-10}{5} = -\frac{6}{5} = -1.2\ m/s^2$

c. 0 to 40 s $\rightarrow 10\ m/s^2$

30. An object is pulled with 20 N of force to the right against a friction force of 10 N. What is the net force? What directions if the friction force?

10N ← □ → 20N

Left Ff

$F_{net} = 10\ N$, right

31. What is the net force on a car at a stop sign? $F_{net} = 0N$

What is the net force on a car moving at a constant speed and straight line? $F_{net} = 0N$

Ff ← 5N 5N → Fapp

32. A dragster exerts 3000 N of force on the tires causing an acceleration of 10 m/s/s. What is the mass of the car?

$F = ma$ $m = F/a = 3000N/10\ m/s^2 = 300\ kg$

33. Two students push on a box in the same direction and another pushes in the opposite direction. What is the net force if each pushes with 100 N?

→ □ ← $F_{net} = 200N - 100N = 100N$

34. You push a box with a force of 80 N. If the net force on the box is 50 N, what is the force on the box due to sliding friction?

30N ← □ → 80N $F_{net} = 50N = 80N - x$ $x = 30N$

35. The downward force of gravity and the upward force of air resistance on a falling ball are both 5N. What is acceleration?

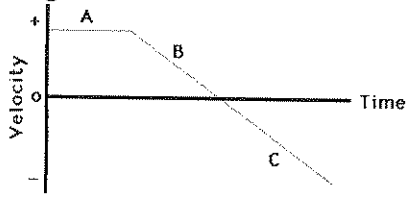
0 m/s² b/c falling at constant v (terminal)

36. Compare the size of forces due to static, sliding and rolling friction between two surfaces?

Static > sliding > rolling Hint: think about moving dresser

37. . Describe the motion depicted by the following velocity-time graphs. In your descriptions, make reference to the direction of motion (+ or - direction), the velocity and acceleration and any changes in speed (speeding up or slowing down) during the various time intervals (e.g., intervals A, B, and C).

Diagram A



Description

a) constant +v, a = 0, moving rt

b) +v, constant −a, moving rt; slowing

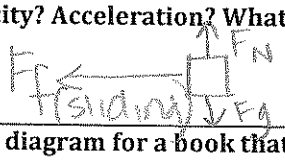
c) −v, constant −a, moving left, speeding

38. A golf ball rolls up a hill toward a miniature golf hole. Assign the direction toward the hole as being positive.

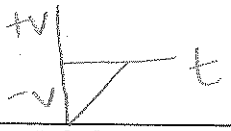
a. If the ball starts with a speed of 2.0 m/s and slows at a constant rate of 0.50 m/s², what is the velocity after 2.0 s? = 1m/s

$v_2 = v_1 + (a \times t) = 2\,m/s + (-0.5\,m/s^2 \times 2\,sec) = 2\,m/s + (-1\,m/s)$

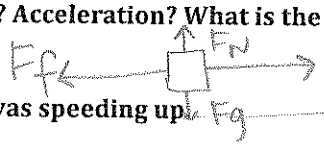
39. Draw a free body diagram for a book that is sliding across the table with no applied force. Label all vectors. What direction if the Velocity? Acceleration? What is the motion of the book?



−v, +a slowing down



40. Draw a free body diagram for a book that is being pushed across a table at a constant velocity. Label all vectors. What direction if the Velocity? Acceleration? What is the motion of the book?



+v, a = 0, constant v

$F_{net} = 0$

Repeat for a book that was speeding up.

Fapp +v, +a, speeding; $F_{net} > 0$

41. Assume you pulled a classroom textbook with a constant applied force of 4N. What would the Sliding friction be if the book was moving at a constant speed? $F_f = 4N$

42. It take 4 N to pull one book at a constant velocity and 7 N to quickly accelerate the same book. (Mass = 3.2 kg) When two books are pulled at a constant velocity at 8 N, what would you predict would be the Force applies to quickly accelerate 2 books? 14N

43. What is the relationship between the net force and the acceleration of the book? if F↑ then a↑

44. What happens to the applied force as the books are accelerating? What about the net force?

F = ma

45. A car starting from rest accelerates at a rate of 8.0 m/s/s. What is its final speed at the end of 4.0 seconds?

$\text{Acceleration} = \frac{\text{Final speed} - \text{Beginning speed}}{\text{Time}}$

$v_2 = v_1 + (a \times t) = 0 + (8\,m/s^2 \times 4\,s) = 32\,m/s$

$a = \frac{v_2 - v_1}{t}$

46. After traveling for 6.0 seconds, a runner reaches a speed of 10 m/s. What is the runner's acceleration?

$a = \frac{v_2 - v_1}{\Delta t} = \frac{10\,m/s - 0\,m/s}{6\,sec} = 1.7\,m/s^2$

$v_2 = v_1 + (a \times t)$

$t = \frac{v_2 - v_1}{a}$

47. A cyclist accelerates at a rate of 7.0 m/s². How long will it take the cyclist to reach a speed of 18 m/s?

$t = \frac{v_2 - v_1}{a}$ $\frac{18\,m/s - 0\,m/s}{7\,m/s^2} = \frac{18\,m/s}{7\,m/s^2} = 2.6\,sec$