KEY

**Physics Unit Review**

1) A ball rolls 10.0 m [S] in a time of 6.00 s, hits a wall and rolls back a distance of 15.0 m [N] in a time of 10.00 s. Determine:

a) distance traveled

$d = 25.0\text{ m}$

b) final displacement

$\vec{d} = 5.0\text{ m [N]}$

c) average speed

$v = \frac{d}{t} = \frac{25.0\text{ m}}{16.0\text{ s}} = 1.5625\text{ m/s} = \boxed{1.56\text{ m/s}}$

d) average velocity

$\vec{v} = \frac{\vec{d}}{t} = \frac{5.0\text{ m [N]}}{16.0\text{ s}} = 0.3125 = \boxed{0.31\text{ m/s [N]}}$

2) A shuttle craft accelerates from rest to a velocity of 50m/s [upwards] in 4.00 s. What is its rate of acceleration?

$a = ?$
$v_i = 0$
$v_f = 50\text{ m/s [up]}$
$\Delta t = 4.00\text{ s}$

$a = \frac{v_f - v_i}{\Delta t} = \frac{50 - 0\text{ m/s}}{4.00\text{ s}} = 12.5\frac{\text{m}}{\text{s}^2}\text{ [up]} = \boxed{13\frac{\text{m}}{\text{s}^2}\text{ [up]}}$

3) A car travels at a speed of 45 km/h then speeds up to 95 km/h in 20s. Find the car's rate of acceleration.

$a = ?$
$v_i = 45\text{ km/h}$
$v_f = 95\text{ km/h}$
$\Delta t = 20\text{ s}$

$a = \frac{v_f - v_i}{\Delta t} = \frac{95 - 45\text{ km/h}}{20\text{ s}} = \boxed{2.5\frac{\text{km/h}}{\text{s}}}$

4) A boy on a bike is traveling at a velocity of 20 km/h [W] and comes to a stop in 1.0 minute. What was the bike's rate of acceleration (deacceleration in this case)?

$a = ?$
$v_f = 0$
$v_i = 20\text{ km/h}$
$\Delta t = 1.0\text{ min}$

$a = \frac{v_f - v_i}{\Delta t} = \frac{0 - 20\text{ km/h [W]}}{1.0\text{ min}} = \boxed{-20\frac{\text{km/h}}{\text{min}}\text{ [W]}}$

5) What force is required to move a 50.0 kg object at an acceleration of 56.5 m/s$^2$?

$F = ?$
$m = 50.0\text{ kg}$
$a = 56\text{ m/s}^2$

$F = ma$
$= (50.0\text{ kg})(56.5\text{ m/s}^2) = 2825\text{ N} = \boxed{2.83 \times 10^3\text{ N or } 2.83\text{ kN}}$

6) A force of 65 N is required to move a rock at 16.2 m/s$^2$. What is the rock's mass?

$F = 65\text{ N}$
$m = ?$
$a = 16.2\text{ m/s}^2$

$F = ma$
$65\text{ N} = m(16.2\text{ m/s}^2)$ $\quad m = 4.012...\text{ kg} = \boxed{4.0\text{ kg}}$

7) A furniture mover applied a force of 75 N to move a chair that weighed 65 kg. What was the rate of acceleration as it moved across the floor?

$F = 75\text{ N}$
$m = 65\text{ kg}$
$a = ?$

$F = ma$
$75\text{ N} = (65\text{ kg})\,a$ $\quad a = 1.153...\text{ m/s}^2 = \boxed{1.2\text{ m/s}^2}$

8) Calculate the work required to move a 15.5 kg child off the floor a distance of 1.15 m off of the floor?

$W = ?$
$m = 15.5\text{ kg}$
$a = 9.81\text{ m/s}^2$
$d = 1.15\text{ m}$

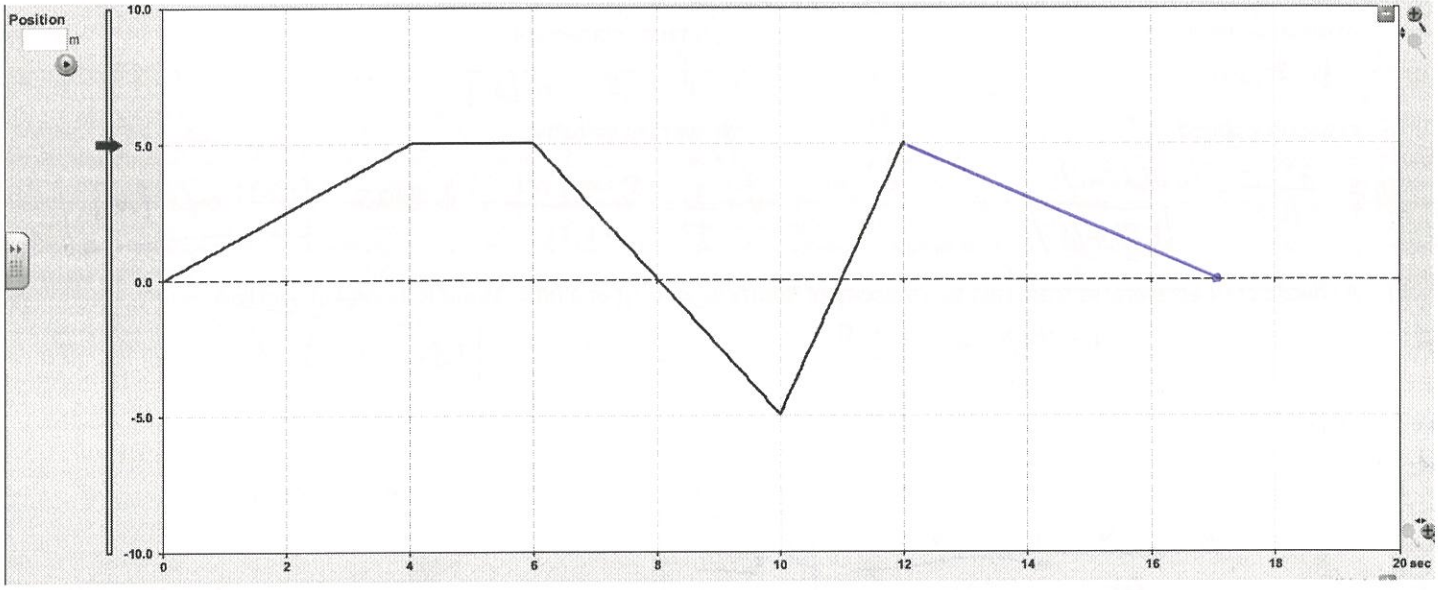
$W = mad$
$= (15.5\text{ kg})(9.81\text{ m/s}^2)(1.15\text{ m})$
$= 174.863...\text{ J} = \boxed{175\text{ J}}$

9) Joe used a force of 95.00 N to give Joanne a piggyback ride for a distance of 21.0 m. How much work did Joe do?

$W = Fd$
$F = 95.00\text{ N}$
$d = 21.0\text{ m}$

$W = Fd$
$= (95.00\text{ N})(21.0\text{ m})$
$= 1995\text{ N} = \boxed{2.00 \times 10^3\text{ N or } 2.00\text{ kN}}$

Position-Time graph of an 82.0 kg runner




10) Calculate the **distance** travelled by the runner.

25 m

11) Calculate the average speed of the runner over the 12 s.

$v = \frac{d}{t} = \frac{25\,m}{12\,s} = 2.08\ldots\,m/s$

12) Calculate the velocity of the runner in the first 4 s.

$\vec{v} = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{5.0\,m}{4\,s} = 1.25\,m/s\ [\ ]$

13) Calculate the velocity of runner from 6 – 10 s.

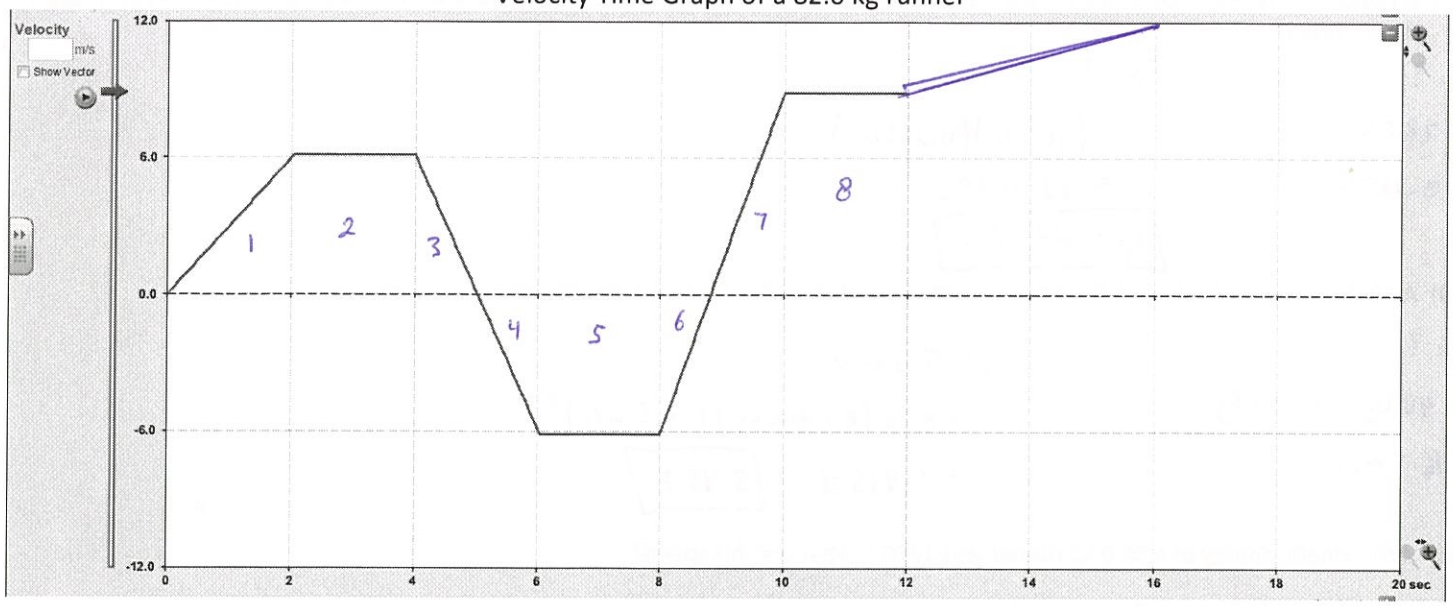
$\vec{v} = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{-10.0\,m}{4.\,s} = -2.5\,m/s\ [\ ]$

14) What time frame did the runner have the fastest speed during?

$t = 10 - 12\,s$ , his speed was $5.0\,m/s$

15) Starting where the line ends, draw a line representing the runner moving with a velocity of -1.0 m/s for 5 s.

Velocity Time Graph of a 82.0 kg runner




16) Calculate the displacement of the runner for the 12 s.

$\vec{d} = (1 + 2 + 3) - (4 + 5 + 6) + (7 + 8)$

$= (6\text{m} + 12\text{m} + 3\text{m}) - (3\text{m} + 12\text{m} + 3\text{m}) + (4.5\text{m} + 18\text{m})$

$\vec{d} = 25.5\text{m}$

17) When did the runner have the fastest acceleration? What time period was this during? What was the fastest acceleration?

$t = 8 - 10\text{s}$

$a = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{15.0\text{m/s}}{2\text{s}} = 7.5\text{m/s}^2$

18) Starting at the end of the existing line on the graph, draw a line showing constant acceleration of 0.75 $m/s^2$ for 4 s.

19) A hunter stretched a bowstring back a distance of 0.265 m with a force of 78.5 N. What was the elastic potential energy of the drawn bow?

$E_p = ?$
$F = 78.5\,N$
$d = 0.265\,m$

$E_p = Fd$
$= (78.5\,N)(0.265\,m)$
$= 20.8025\,J$
$E_p = 20.8\,J$

20) A 40.0 g arrow was released from the bow at a speed of 16.5 m/s. What was the arrow's kinetic energy?

$E_k = ?$
$m = 40.0\,g = 0.0400\,kg$
$v = 16.5\,m/s$

$E_k = 0.5mv^2$
$= 0.5(0.0400\,kg)(16.5\,m/s)^2$
$= 5.445\,J = 5.45\,J$

21) If the kinetic energy of a 56.0 kg runner was 1250 J, what was his speed?

$E_k = 1250\,J$
$m = 56.0\,kg$
$v = ?$

$E_k = 0.5mv^2$
$1250\,J = 0.5(56.0\,kg)v^2$
$\sqrt{v^2} = \sqrt{44.64\ldots}$
$v = 6.6815\ldots\,m/s = 6.68\,m/s$

22) A 0.300 kg billiard ball is propelled from a table at a horizontal speed of 1.50 m/s. If the table is 1.30 m above the floor, what is the mechanical energy of the ball the moment it leaves the table?

$m = 0.300\,kg$
$h = 1.30\,m$
$v = 1.50\,m/s$

$E_m = E_p + E_k$
$E_m = mgh + 0.5mv^2$
$= (0.300\,kg)(9.81\,m/s^2)(1.30\,m) + (0.5)(0.300\,kg)(1.50\,m/s)^2$
$E_m = 3.8259\,J + 0.3375\,J = 4.1634\,J = 4.16\,J$

23) A rock climber dropped his backpack that weighed 15.0 kg down the mountain. The backpack dropped 69.5 m. What was the speed of the pack at the bottom of its fall?

$E_{p\,top} = mgh = (15.0\,kg)(9.81\,m/s^2)(69.5\,m) = 10226.925\,J = E_{k\,bottom}$

$E_k = 0.5mv^2$
$10226.925\,J = 0.5(15.0\,kg)v^2$
$v^2 = 1363.59$
$v = 36.92\ldots\,m/s = 36.9\,m/s$

24) It takes $1.56 \times 10^5$ J of energy of fuel to start a car. If the motor's output energy is $4.52 \times 10^4$ J, how efficient is the motor?

$E_I = 1.56 \times 10^5\,J$
$E_O = 4.52 \times 10^4\,J$
$\%\,Eff = ?$

$\%\,Eff = \frac{E_O}{E_I} \times 100$
$= \frac{45200\,J}{156000} \times 100$
$= 28.974\ldots\,\%$
$\%\,Eff = 29.0\,\%$