Pre-Comp Review Questions - 8th Grade Answers

Section 1- Units

1. Fill in the missing SI and English Units

Measurement	SI Unit	SI Symbol	English Unit	English Symbol
Time	second	**s**	**second**	s.
Temperature	**Kelvin**	K	Fahrenheit	**°F**
Length	**metre**	**m**	**Feet**	ft.
Volume (solid)	Cubic Metre	**m^3**	**Cubic Feet**	ft^3
Weight (Force)	**Newton**	N.	Pounds	**lbs**
Mass	Kilogram	**kg**	**slug**	sl

2. Fill in the missing metric prefix and/or numerical value

Metric Prefix	Symbol	Numerical Multiplier	Exponential Multiplier (scientific notation)
Tera	**T**	**1,000,000,000,000**	10^{12}
Giga	G	**1,000,000,000**	**10^9**
Mega	M	**1,000,000**	**10^6**
Kilo	**k**	**1,000**	**10^3**
Hecto	h	**100**	**10^2**
Deca	da	10	10^1
Base Unit	______________	1	10^0
Deci	**d**	**0.1**	**10^{-1}**
Centi	**c**	**0.01**	10^{-2}
Milli	**m**	**0.001**	**10^{-3}**
Micro	µ	0.000001	**10^{-6}**
Nano	n	**0.000000001**	10^{-9}
Pico	**p**	**0.000000000001**	10^{-12}

3. Convert 7651 pm to cm
   $7.651 * 10^{-7}$ cm

4. Convert 1.54kg to cg
   154000 cg *($1.54 * 10^5$)*

5. Convert 7.38 TC to hC
   $7.38 * 10^{10}$ hC

6. Convert $25 cm^3$ to m^3

   $2.5 * 10^{-5}$ m^3

   The conversion factor between cm^3 to m^3 is

   $1,000,000\ cm^3 = 1\ m^3$

   or

   $106\ cm^3 = 1\ m^3$

   How do you get that? Start with the conversion from cm to m.

   100 cm = 1 m

   A cubic meter is a cube 1 metre wide, 1 metre deep and 1 metre tall.

   $1\ m^3 = 1\ m \times 1\ m \times 1\ m$

   Substitute the conversion factor for meter to centimetre

   $1\ m^3 = (100\ cm) \times (100\ cm) \times (100\ cm)$

   $1\ m^3 = 1,000,000\ cm^3 = 106\ cm^3$

7. Convert 30 m/s to mi/hr

   67.1 mi/hr

1 mi/hr = 0.44704 m/sec (approx)
In other words,
0.44704 m/sec = 1 mi/hr

$$1\ m/sec = \frac{1}{0.44704}\ mi/hr = 2.236936\ mi/hr\ (approx)$$

Section 2- Motion

For the following words, write the definition and equation when applicable, and indicate if the quantity is a vector or a scalar

1. Reference Point **When we try to define a location of our object we need another point from which we will tell the distance or direction or both to pin point the location. The another point is the reference point.**
2. Motion **A change in position of an object over time.**
3. Distance **How much ground an object has covered.**
   Vector or Scalar? **Scalar**

Equation:

$$speed, time, distance$$

$$d = t \times s$$

4. Displacement **"How far an object is from a reference point", it is an object's overall change in position.**

   Vector or Scalar **Vector**

   Equation: **$s = s_f - s_i$**

   s = displacement, s_i = initial position, s_f = final position

5. Speed **How fast an object is moving.**

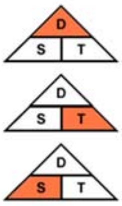
Vector or Scalar **Scalar**

Equation:

speed, time, distance

$$s = \frac{d}{t} \qquad t = \frac{d}{s}$$

$$d = t \times s$$



6. Average Speed **Total distance travelled by an object divided by the time to cover that distance.**

Vector or Scalar **Scalar**

Equation:

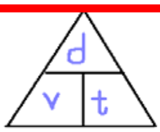
$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}}$$

7. Velocity **The rate at which an object changes its position.**

Vector or Scalar **Vector**

Equation:

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



d = displacement

8. Instantaneous Velocity **Velocity of an object in motion at a specific point in time.**

9. Average Velocity **Displacement divided by the time.**

Equation:

$$A.V. = \frac{\text{change in position}}{\text{time traveled}}$$

10. Acceleration **The rate at which an object changes its velocity.**

Vector or Scalar **Vector**

Equation:

$$a = \frac{v_F - v_i}{t}$$

11. Directly Proportional **As one amount increases, another amount increases at the same rate.**

Example of 2 quantities that are directly proportional:

How much you earn is directly proportional to how many hours you work

Work more hours, get more pay; in direct proportion.

- **If you work 2 hours you get paid $40**
- **If you work 3 hours you get paid $60**
- **etc ...**

12. Inversely Proportional **When one value decreases at the same rate that the other increases.**

Example of 2 quantities that are inversely proportional:

Speed and travel time are Inversely Proportional because the faster we go the shorter the time.

- **As speed goes up, travel time goes down.**
- **And as speed goes down, travel time goes up.**

13. What are the 3 ways an object can accelerate?

1) increase speed 2) decrease speed 3) change direction

14. Indicate whether the object will be speeding up, slowing down, or not changing speed given the directions of velocity and acceleration

Velocity	Acceleration	Speeding up/ Slowing down/ No change
+	+	**Speeding up**
+	-	**Slowing down**
+	0	**No change**
-	+	**Slowing down**
-	-	**Speeding up**
-	0	**No change**

15. Give an example of when an object has a velocity of 0 m/s but is accelerating
When it is changing velocity from 0 m/s to either a positive or negative velocity, at the point it is at 0 m/s, it is still accelerating. For example: when you throw something up, it will eventually stop (0 m/s) and then accelerate back down.

Problems

16. An object moves in the y direction with a position as a function of time given by the equation $y(t)=10+6t-4.9t^2$.
    a. What is the initial position of the object?
    $y(t) = 10 + (6 * 0) – (4.9 * 0^2)$
    = 10 m

    b. What is the initial velocity of the object?
    $$\Delta x = \boldsymbol{v_i} t + \frac{1}{2}at^2$$
    *The initial velocity is the coefficient for the middle term (? * t).*
    6 m/s

    c. What is the position of the object after 2s?
    $y(2) = 10 + (6 * 2) – (4.9 * 2^2)$
    = 2.4 m

    d. What is the acceleration of the object?
    $$\Delta x = v_i t + \frac{\mathbf{1}}{\mathbf{2}}\boldsymbol{a}t^2$$
    The acceleration is the 2 * the coefficient for the squared term (? * t^2).
    2 * 4.0 = 9.8m/s²

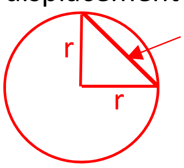
17. A person hikes 2120 meters east in 25mins, takes a break for lunch for half hour, and hikes back 1640m west in 20 mins. What was the person's distance, displacement, and average speed for the trip (in m/s)?
    distance = 2120m + 1640m = **3760m**
    displacement = 2120m (East) - 1640m (West) = **480m (East)**
    time = 25mins + 30mins + 20mins = 75mins = 75 * 60 s = 4500s
    average speed = distance / time = 3760m / 4500s = **0.84 m/s**
    average velocity = displacement / time = 480m (East) / 4500s = **0.1 m/s (East)**

18. A car moves around a circular track with a radius of 10m. The car travels at a constant speed of 30 m/s. If the car travels ¾ of the way around the track, find the cars
    a. distance travelled

    C *(circumference)* = 2πr = 2π * 10m = 62.8m *(r = radius)*

    ¾ * 62.8m = **47.1m**

    b. displacement



    Pythagoras
    $\text{Displacement}^2 = r^2 + r^2 = 2r^2$
    Displacement = $\sqrt{2r^2} = \sqrt{(2 * 10^2)}$ = **14.14m**

    c. average velocity
    s = d / t, t = d / s = 47.1m / 30m/s = 1.57s
    average velocity = displacement / time = 14.1m / 1.57s = **8.9 m/s**

d. If the car continues to drive and ends at the place it started, what will be its distance, displacement, and average velocity then?

distance = *circumference* = **62.8m**

displacement = **0m**, **average velocity** = **0 m/s**

19. An airplane starts from rest and reaches a speed of 70 km/h in 50s before taking off.

a. What was the airplanes acceleration (in m/s^2)?

70 km/h = 19.4 m/s

1 km = 1000 m; 1 hr = 3600 s

1 km/hr = 1000/3600 m/s = 5/18 m/s

To convert km/hr into m/s, multiply the number by 5 and then divide it by 18.

acceleration = $(v_f - v_i)/t$ = (19.4 m/s - 0 m/s)/50s = **0.4 m/s^2**

b. How far does the airplane travel in that time? (you must use kinematic equations to get the correct answer)

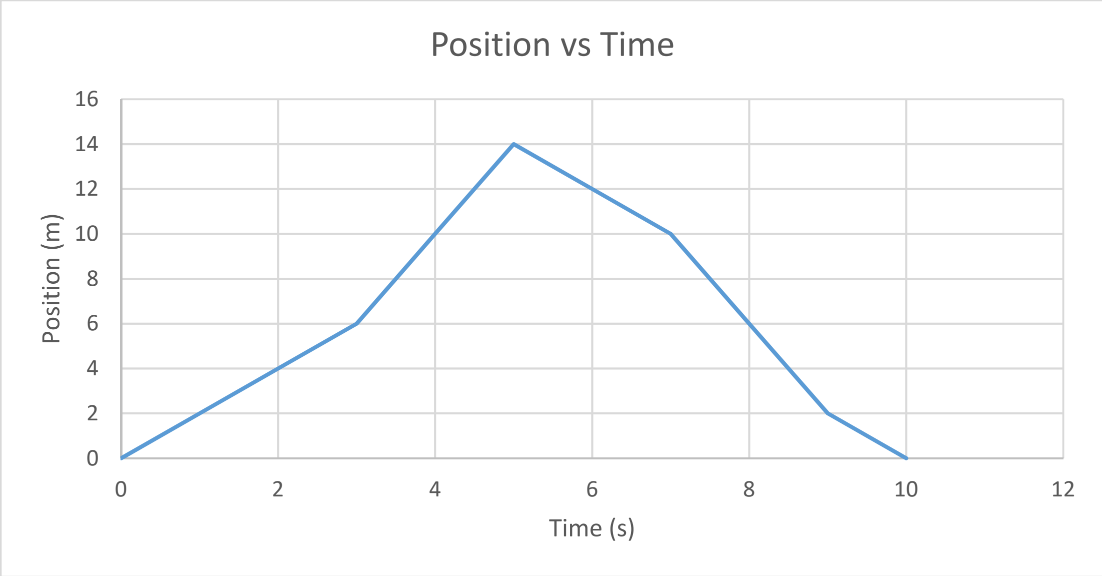
$$\boldsymbol{\Delta x} = v_f t - \frac{1}{2}at^2$$

= (19.4 * 50) – (0.5 * 0.4 * 50^2) = **470m**

20. An object is moving at a constant velocity of 10m/s east for 20s. What is the acceleration of the object?

constant velocity = no acceleration = **0 m/s^2**

21. Use the graph below to answer the following questions



a. What is the object's distance travelled between 0 and 4 sec?
10 m

b. What is the object's displacement between 0 and 4 sec?
10 m

c. What is the object's distance travelled between 4 and 8 sec?
4m + 8m = **12m**

d. What is the object's displacement between 4 and 8 sec?
6m - 10m = **-4m**

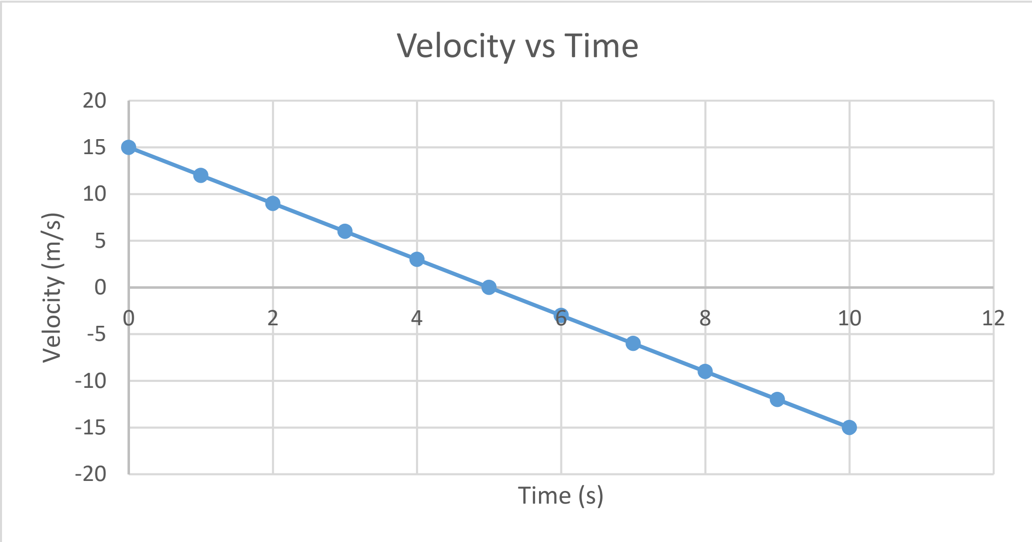
e. What is the object's distance travelled between 0 and 10 sec?
14m + 14m = **28m**

f. What is the object's displacement between 0 and 10 sec?
0m

g. In what time interval is the objects displacement negative: 0-3 sec, 3-5 sec, or 8-10sec?
8-10s

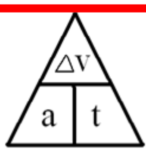
h. What is the objects average acceleration between 0-10s (hint- no calculation required)?
As average displacement = 0m, average velocity = 0m/s so **acceleration = 0m/s^2**

22. Use the graph below to answer the following questions. Remember, displacement can be negative!!!



a. What is the object's acceleration during this time?

$$a = \frac{v_F - v_i}{t}$$



a = (-15m/s - 15m/s)/10s **= -3 m/s²**

b. What is the object's displacement from 0-3s?

Area under the graph from 0-3s = area under graph from 0-5s - area under graph from 3-4s =

area under graph from 0-4s = area of triangle = ½ * 5 * 15 = 37.5 m

area under graph from 3-4s = area of triangle = ½ * 2 * 6 = 6 m

Area under the graph from 0-3s = 37.5 m - 6 m **= 31.5 m**

c. What is the object's displacement from 5-7s?

Area under the graph from 5-7s = area of triangle = ½ * 2 * -6 **= -6 m**

d. What is the object's displacement from 0-10s?

Area under the graph from 0-10s = 0m

Section 3- Forces and Newton's Laws

For the following words, write the definitions and equations when applicable

1. Force - **A push or pull upon an object resulting from the object's interaction with another object.**

2. Newton's 1st law **An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.**

3. Inertia **The tendency of objects to keep moving in a straight line at a constant velocity.**

4. Newton's 2nd Law **The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object.**

   Equation:

   F = ma

5. Newton's 3rd Law **For every action, there is an equal and opposite reaction.**
   Equation:
   $F_A = -F_B$

6. What is the statement we use to determine the action-reaction force pairs for N3L?

If one object A exerts a force FA on a second object B, then B simultaneously exerts a force FB on A, and the two forces are equal in magnitude and opposite in direction.

7. Weight **The force exerted on a body by gravity.**

Equation:
W = mg

g on Earth = **9.8 m/s2** *or* **9.8 N/kg**

8. Normal Force **The support force exerted upon an object that is in contact with another stable object.**
   Normal forces oppose **gravity**.

9. Tension Force **The force that is transmitted through a string, rope, cable or wire when it is pulled tight by forces acting from opposite ends.**
   Tension Forces oppose **forces on the other end string, rope, cable or wire.**

10. Newton's Law of universal gravitation (NLUG) equation

$$F_g = G\frac{m_1 m_2}{r^2}$$

F_g = **Force of gravity**

G= **Gravitational Constant 6.75 x 10^{-11} N m^2/kg^2**

m_1, m_2 = **masses of 2 objects**

r = **distance between the 2 objects**

11. Friction Force **The force exerted by a surface as an object moves across it or makes an effort to move across it.**

    Equation:

    $F_{frict} = \mu \bullet F_{norm}$

12. Static Friction **The friction that exists between an object and a surface on which it is not sliding.**

13. Kinetic Friction **The friction that exists between an object and a surface on which it is sliding.**

14. Net Force **When an object is subject to several forces, the resultant force is the force that alone would produce the same effect as all those forces.**
    Equation:
    R = F1 + F2 + ... *(vector sum)*

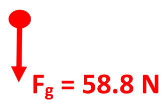
15. Conditions for Equilibrium
1. **The resultant force acting on the object is zero.**
2. **It is not turning or changing direction** *(net torque must be zero)*.

16. Static Equlibrium **(balanced forces, no net force) & 0 m/s constant velocity (not moving)**

17. Dynamic Equilibrium **(balanced forces, no net force) & non 0 m/s constant velocity (moving)**

18. 4 steps in drawing a Free-Body Diagram
   a. **Identify the object you will draw a diagram for.**
   b. **Identify all the forces acting directly on the object and the object exerting them.**
   c. **Draw a dot to represent the object of interest and a vector to represent each force.**
      i **Each force should start from the dot and its length should be relative to its size.**
      ii **Label the type and strength of each force.**
   d. **If the object is stationary or is moving at a constant velocity, the vectors should graphically add up to zero. If the object is accelerating, the sum of the vectors should produce a vector in the same direction as the acceleration.**

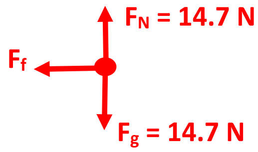
19. Draw a free-body diagram for 6kg object falling through the air



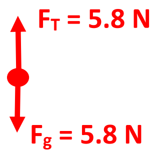
W = mg

on Earth = 9.8 m/s^2 or 9.8 N/kg

20. Draw a free body diagram for a 1.5kg soccer ball rolling along a rough surface



21. Draw a free body diagram for a pendulum with a mass of 60g suspended from a string.



22. What are the 4 fundamental forces in the universe? List from weakest to strongest
   1. **Gravitational Force**
   2. **Weak Nuclear Force**
   3. **Electromagnetic Force**
   4. **Strong Nuclear Force**

23. Contact force **Any force that requires contact to occur.**
   Examples:
   Frictional Force, Tension Force, Normal Force, Air Resistance Force, Applied Force, Spring Force

24. Action-at-distance Force **Any force that requires contact to occur.**
   Examples:
   Gravitational Force, Electrical Force, Magnetic Force

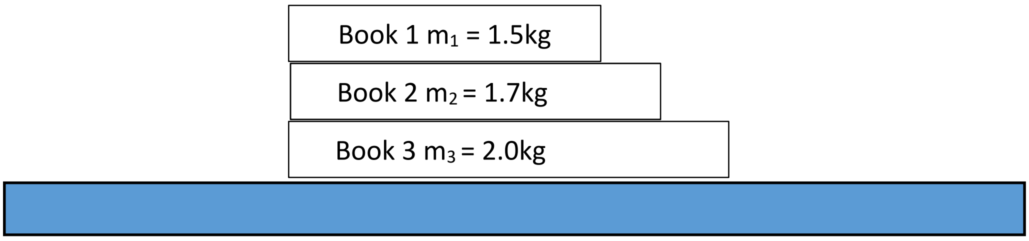
Problems

25. Two planets are separated by 24Tm and experience a gravitational attraction of 2.6×10^4N. Find the force of gravity between them if the separation is doubled

$$F_g = G\frac{m_1 m_2}{r^2}$$

Separation doubled means F_g is reduced by ¼ , ¼ * 2.6×10^4N = **6500N**

26. There are 3 books stacked on a table as shown.



a. Find the Normal Force acting on each book.

F_{N1} = 14.7N, F_{N2} = 16.6N, F_{N3} = 19.6N *W = mg*

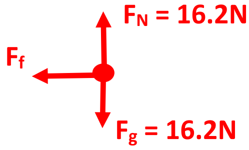
on Earth = 9.8 m/s² or 9.8 N/kg

b. If a person pushes down on the stack with a force of 10N, what will the normal force on book 2 be (hint- addition)?

F_{N2} = 16.6N + 10N = **26.6N**

27. A soccer ball is rolling in the grass. It has a mass of 1.65kg. The coefficient of friction between the ball and the grass is 0.8.

a. Draw a free-body diagram for the soccer ball.



W = mg

on Earth = 9.8 m/s² or 9.8 N/kg

b. Find the frictional force acting on the ball.

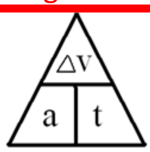
F_{frict} = μ • F_{norm} = 0.8 * 16.2N = **13N**

c. If the ball has an initial velocity of 10 m/s, how much time will it take for the friction force to bring the ball to a stop?

F = ma,

a = F/m = -13N/1.65kg = -7.9m/s²

$$a = \frac{v_F - v_i}{t}$$



t = (v_f – v_i)/a = (0 m/s - 10 m/s) / -7.9m/s² **= 1.3s**

d. Using the kinematic equations, find the total distance the ball will travel in that time

$$\boldsymbol{\Delta x} = \boldsymbol{v_i}t + \frac{1}{2}at^2$$

= (10 * 1.3) + (0.5 * -7.9 * 1.3^2) **= 6.3m**

28. A mass of 0.65kg is hung from a spring and the spring stretches a distance of 25cm. Find the spring constant of the spring

$F_g = mg = 0.65kg * 9.8m/s^2 = 6.37N$, x = 25cm = 0.25m

F = kx, **k** = F/x = 6.37N / 0.25m **= 25.5 N/m**

29. A person has a weight of 655N on Earth. How much would they weigh on Jupiter where the acceleration due to gravity is 26.2 m/s^2

$F_g = mg$, $m = F_g / g = 655N / 9.8m/s^2 = 66.8kg$

$\mathbf{F_{gJ}} = mg_J = 66.8kg * 26.2m/s^2$ **= 1750.2N**

30. An astronaut on the moon weighs 165N. If the action force is the weight of the astronaut, what is the magnitude and direction of the reaction force and what object is the reaction force acting on? (Hint- fill in the blanks "The force on **the astronaut** by **moon** is equal in magnitude but opposite in direction of the force on **the moon** by **astronaut**." What is object 1 and object 2 in this case?)

31. A person is pushing a shopping cart with a force of 15N. The mass of the shopping cart is 20kg. If the net acceleration of the cart is $0.5m/s^2$, find the coefficient of friction between the ground and the cart

$F_g = mg = 20kg * 9.8m/s^2 = 196N$, $F_N = F_g = 196N$

$F_{Net} = ma = 20kg * 0.5m/s^2 = 10N$

$F_{Net} = F_a - f_{ke}$, $f_{ke} = F_a - F_{Net} = 15N - 10N = 5N$

$f_{ke} = \mu_{ke}F_N$, $\boldsymbol{\mu_{ke}} = f_{ke} / F_N = 5N / 196N$ **= 0.02**

<u>Section 4- Work, Power, and Energy</u>

For the following words, write the definition and include the equation when applicable

1. Work **Measure of energy transfer that occurs when an object is moved over a distance by an external force at least part of which is applied in the direction of the displacement.**

Equation:

Work = Force • Distance

W = F • d

2. Conditions for a force to do work
   a. **Must be some displacement in the body.**
   b. **The direction of force should not be perpendicular to the direction of motion.**

3. Fill in the blanks:
   a. The work needed to lift an object to a given height is equal to **height moved** times the **force required**.
   b. When an applied force is at angle to the direction of motion, the work done by the force **component in the same direction of the movement**.
   c. Forces that are perpendicular to the direction of motion do **not do any** work.

4. The units of work **are Joules (J)**.

5. If an object is subject to a **force**, it may be set in **motion**. This means that **work** has been done on the object and its **energy** has transferred forms. A moving object has the ability to do **work** on another object.

6. Power **Rate of doing work, the amount of energy transferred per unit time.**
   Equation:

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{\text{Force} \cdot \text{Displacement}}{\text{Time}}$$

$$\text{Power} = \text{Force} \cdot \frac{\text{Displacement}}{\text{Time}}$$

$$\boxed{\text{Power} = \text{Force} \cdot \text{Velocity}}$$

   Units: **Watt (W)**

7. Energy - **The capacity for doing work.**

   Units of energy **Joules (J)**

Forms of Energy

8. Gravitational Potential Energy **The energy an object has due to its position above Earth.**

   Equation:

$$E_P = mgh$$

E_p = Potential Energy
m = Mass
g = Gravitational Field Strength
h = Vertical Height

9. Elastic Potential Energy **Potential energy stored as a result of deformation of an elastic object.**

10. Spring Potential Energy **Potential energy stored as a result of deformation of a spring.**

Equation:

$$PE_{spring} = \frac{1}{2} * k * x^2$$

where k= spring constant
x= amount of compression
(relative to equilibrium pos'n)

11. Kinetic Energy **The energy that it possesses due to its motion.**

Equation:

$$E_k = \frac{1}{2}mv^2$$

E_k = *kinetic energy of object*
m = *mass of object*
v = *speed of object*

12. Total Mechanical Energy **The sum of the potential energy and the kinetic energy.**
Equation:
TME = PE + KE

13. Law of Conservation of Energy **In a closed system, i.e., a system that isolated from its surroundings, the total energy of the system is conserved.**
Equation for Conservation of Total Mechanical Energy:
$ME_i = ME_f$

14. Work-Kinetic Energy Theorem **The work done by the sum of all forces acting on a particle equals the change in the kinetic energy of the particle.**
Equation:

$$W = \frac{1}{2} m v^2 - \frac{1}{2} m u^2$$

$$\text{or, } \frac{1}{2} m v^2 = W + \frac{1}{2} m u^2$$

$$\text{or, } (K.E.)_f = W + (K.E.)_i$$

Problems-

15. An object with a mass of 53kg is lifted to a height of 4.2m.
    a. How much work is done to lift the object?
       *Weight = 53kg * 9.8 N/Kg = 519.4N*
       W = Fd = 519.4N * 4.2 = 2181.5 J **= 2.2 kJ**

    b. If the object is lifted in 1.1 mins, how much power was used to lift it?
       1.1mins = 66s
       P = W/t = 2181.5J / 66s **= 33W**

16. A person kicks a soccer ball with a mass of 0.8kg and gives it a velocity of 15 m/s.
    a. What is the kinetic energy of the ball?
       KE = ½ mv^2 = 0.5 * 0.8 * 15^2 **= 90J**

    b. If the velocity of the ball is doubled, by what factor does the kinetic energy of the ball increase? (hint, you don't need to recalculate KE)
       ***4**

    c. If the velocity of the ball is halved, by what factor is the kinetic energy of the ball reduced? (hint, you don't need to recalculate KE)
       /4

    d. If the distance the ball travels is 20m, find the force of friction that acted on the ball to bring it to a stop (hint Work-KE theorem)

$$W = \frac{1}{2} m v^2 - \frac{1}{2} m u^2$$

$$\text{or, } \frac{1}{2} m v^2 = W + \frac{1}{2} m u^2$$

$$\text{or, } (K.E.)_f = W + (K.E.)_i$$

       W = 0J - **90J = -90J**
       W = $F_f d$, $\mathbf{F_f}$ = W /d = -90J / 20m **= -4.5N**

17. A person jumps from a burning building into one of the inflatable rescue mats set up by firefighters. Describe the energy transformations that occur from the time the person jumps to when they reach the lowest point in their motion (Assume they stop bouncing after one bounce and are at ground level)
    GPE – KE – GPE – KE – Sound & Heat

18. A ball with a mass of 0.8kg is launched from ground level with a velocity of 22.4 m/s.

a. Find the balls total mechanical energy when it is first released.

TME = KE only *(as at ground level so no GPE)* = ½ mv^2 = ½ * 0.8 * 22.4^2 **= 200.7J**

b. Find the balls gravitational potential energy at a height of 3m

GPE = mgh = 0.8kg * 9.8m/s^2 * 3m **= 23.5 J**

c. Find the ball's velocity at a height of 3m

$ME_i = ME_f$

$TME = ME_i + ME_f$

KE = TME - PE = 200.7J – 23.5J = 177.2J

KE = ½ mv^2, **V** = √(2KE/m) **= 21m/s**

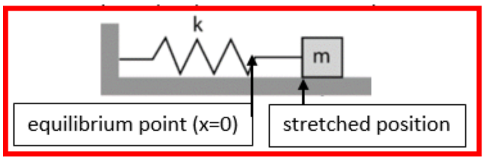
d. What will the maximum height of the ball be (hint, remember when the ball reaches its' maximum height, it comes to a stop)

TME = GPE only as stopped = 200.7J

GPE = mgh, **h** = GPE/mg = 200.7J / (0.8kg * 9.8m/s^2) **= 25.6m**

19. A spring with a force constant k=150N/m attached to a wall is hooked onto a box with a mass of 1.5kg and stretched 30cm from its equilibrium position and held in place

a. Draw a diagram of the box-spring system, labeling the springs equilibrium point (x=0) and its' stretched position.



b. How much elastic potential energy does the system have when the box is stretched to 30cm?

X = 30cm = 0.3m

EPE = ½ kx^2 = 0.5 * 150 * 0.3^2 **= 6.75J**

c. Assume the box is on ground level. How much total mechanical energy does the block-spring system have when the block is held in place at 30cm?

TME = EPE only *(as at ground level so no GPE and held in place so not moving, so no KE)* = **6.75J**

d. Use conservation of energy to determine the velocity of the box-spring system if the box is released when it reaches the spring's equilibrium

$ME_i = ME_f$

TME = $ME_i + ME_f$

KE only *(as at ground level so no GPE and at equilibrium, so no EPE)* = ½ mv^2 = **6.75J**

v = √(2EPE/m) = √(2 * 6.75J / 1.5kg) **= 3 m/s**

e. How far past the equilibrium point will the block compress the spring before the block finally comes to a stop?

$ME_i = ME_f$

TME at stop = EPE only *(as at ground level so no GPE and stopped, so no KE)* = 6.75J

X = 0.3m = 30cm *(Same as initial stretch, just the other direction!)*

20. A child pulls a wagon (m=20kg) with a force of 25N along a surface with coefficient of friction 0.1 a distance of 15m. Find the final velocity of the wagon.

F_g = mg = 20kg * 9.8m/s^2 = 196N, F_N = F_g = 196N

F_{KE} = μ_{KE} F_n = 0.1 * 196N = 19.6N

F_{NET} = F_A - F_{KE} = 25N – 19.6N = 5.4N

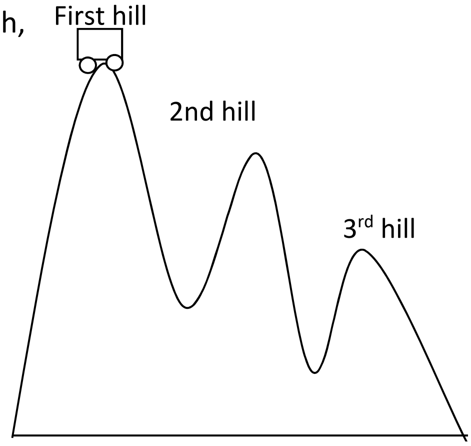
F_{NET} = ma

a = F_{NET} / m = 5.4N / 20kg = 0.27 m/s^2

$v_f^2 = v_i^2 + 2a\Delta x$

V_f = $\sqrt{(v_i^2 + 2a\Delta x)}$ = $\sqrt{(0^2 + 2*0.27*15)}$ **= 2.8 m/s**

21. In the diagram, a 650 kg roller coaster car starts from rest at the top of the first hill of its track, which is 24m high, and glides freely to the end of the ride. [Neglect friction.]



a. Where will the car have the most gravitational potential energy? Why?
First hill as highest point.

b. Where will the car have the most kinetic energy? Why?
End as lowest point.

c. Calculate the total gravitational potential energy of the car and passenger at the top of the first hill.
GPE_1 = mgh = 650kg * 9.8m/s^2 * 24m **= 152880J**

d. If the 3rd hill is at a height of 12m, calculate the gravitational potential energy at that point
GPE_3 = ½ * GPE_1 = ½ * 152880J **= 76440J**

e. Find the velocity of the car and passengers on top of the 3rd hill

$ME_1 = ME_3$

TME = ME_i + ME_f

ME_1 = GPE only *(As car starts from rest at the top of the first hill.)*

GPE_1 = KE_3 + GPE_3

KE_3 = GPE_1 - GPE_3 = 152880J - 76440J = 76440J = ½ mv^2

v = √(2KE/m) = √(152880J/650kg) **= 15 m/s**

f. How fast will the car be going at the end of the ride?

$ME_1 = ME_{END}$

TME = ME_i + ME_f

ME_1 = KE only *(As car is at 0m.)* = 152880J = ½ mv^2

v = √(2KE/m) = √((2 * 152880J)/650kg) **= 22 m/s**