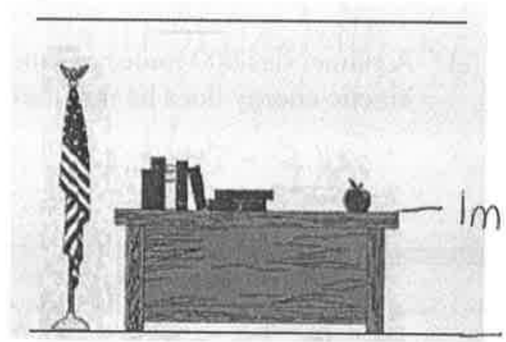
$g = 10\,m/s^2$

1. a) Estimate the gravitational potential energy of this apple.



1m

0m

$PE_g = mgh$ $\quad m = 0.1Kg$

$(0.1Kg)(10\frac{m}{s^2})(1m) = 1J$

Base level (Reference Level, Zero Level):

$PE_g = \emptyset \quad h = \emptyset m$

level from which height is measured

b) Does PE_g depend on the choice of a base level?

yes

c) When does an object have:

(+) ↕ (−)

i) Positive PE_g? above the base level

ii) Zero PE_g? at base level

iii) Negative PE_g? below base level

d) Does the change in potential energy (ΔPE_g)depend on the choice of a base level?

no

2. A 900. kilogram car drives off the edge of a 45 meter high cliff at a speed of 25 meters per second. How much energy does the car have at this point?

45m (+) ↕ (−) 0m

$m = 900.Kg \quad V = 25\frac{m}{s} \quad h = 45m$

$E_T = PE_g + KE$

$E_T = mgh + \frac{1}{2}mv^2$

$(900.Kg)(9.81\frac{m}{s^2})(45m) + \frac{1}{2}(900.Kg)(25m/s)^2 =$

$\boxed{6.8 \times 10^5 J}$

3. A runner has 800 joules of kinetic energy. If he doubles his speed, how much kinetic energy does he now have?

$KE = \frac{1}{2}mv^2 = 800J$

if v is "2v" then multiply 800J by 2^2

$= \boxed{3200J}$

4. A spring whose spring constant is 125 newtons per meter is compressed 0.50 meter.

K X

a) Determine how much energy is stored in the spring.

$PE_s = \frac{1}{2}Kx^2$

$\frac{1}{2}\left(125\frac{N}{m}\right)(0.50m)^2 = \boxed{16J}$

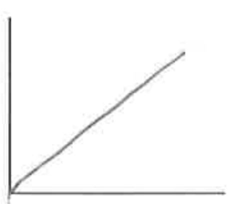
b) How much force was needed to compress the spring?

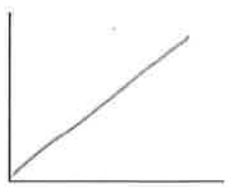
$F = Kx$

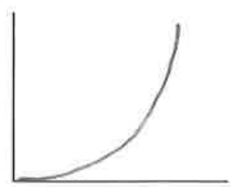
$125\frac{N}{m}(0.50m) = \boxed{63N}$

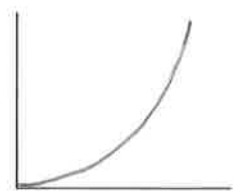
$PE_g = mgh \quad KE = \frac{1}{2}mv^2 \quad PE_s = \frac{1}{2}Kx^2 \quad F = KX$

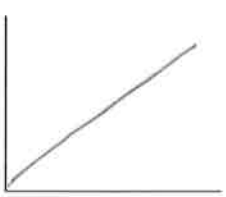
5. Sketch the following relationships:

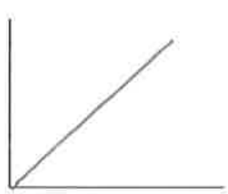
PE_g

mass

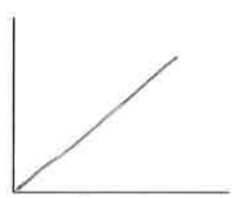
PE_g

~~speed~~ "g"

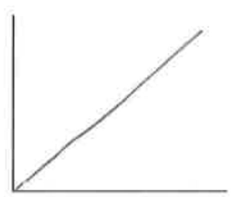
KE

speed

PE_S

stretch "X"

PE_g

height

KE

mass

PE_S

spring constant

F_S

stretch

Conservation of Energy

IB 11

Transformation: conversion of energy from one form (type) to another

Transfer: passing energy from one object to another

Describe the energy transformations and energy transfers in each example below:

1) Basketball is dropped

Transformation: $PE_g \rightarrow KE$

Transfer: gravitational field strength → ball

2) Arrow is shot by archer

Transformation: $PE_s \rightarrow KE$

Transfer: bow string → arrow

3) Bus skids to a halt

Transformation: $KE \rightarrow Q$

Transfer: bus tires → the ground → surrounding air

4) Light bulb is lit

Transformation: chemical energy → electrical energy → light

Transfer: battery → wire → bulb

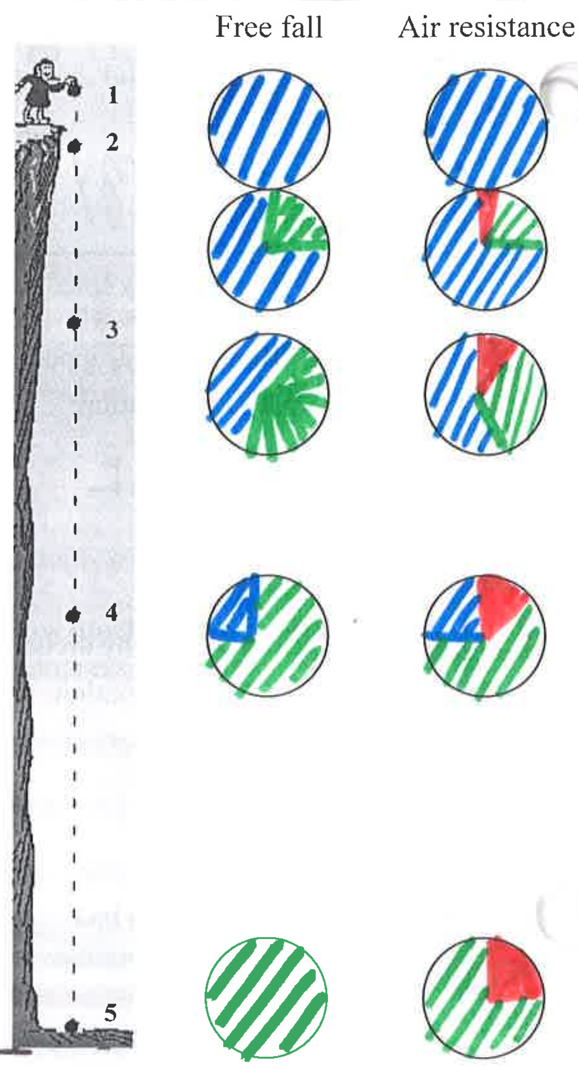
Conservation of Energy Principle The total energy of an isolated system remains constant.

Meaning: Energy is neither created nor destroyed; it is transferred from one object to another or transformed from one type to another.

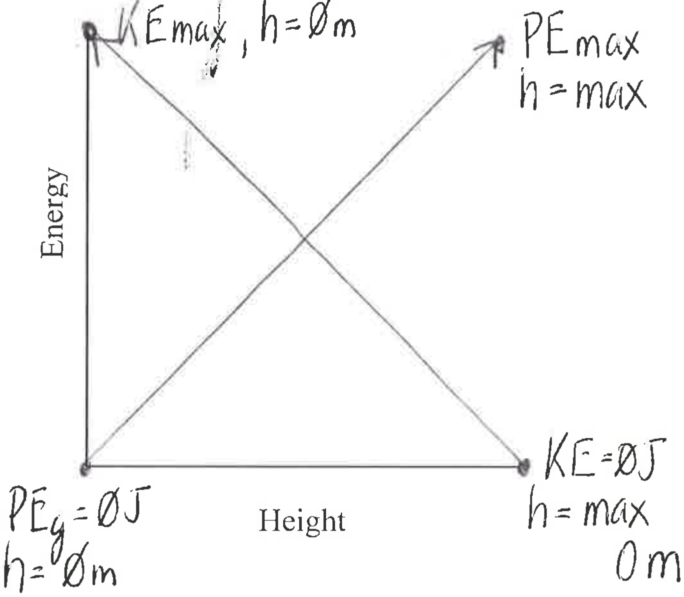
Isolated system: closed system

-PE -KE -Q

1. a) A student drops a ball from the edge of a cliff. Each snapshot shows where the ball is at the end of each 1.0 second of free fall. Fill in a pie-chart showing the relative amounts of each type of energy the ball has in each snapshot. Neglect air resistance.



b) Sketch graphs of the kinetic energy, gravitational potential energy, and total energy of the ball as a function of its height above the ground.



c) Make a statement about the gravitational potential energy and the kinetic energy of the ball as it falls.

PEg is transformed into KE as the ball falls.

d) Make a statement about the total energy of the ball as it falls.

Total energy is conserved.

e) Discuss the energy of the ball if air resistance is not neglected.

Mechanical is not conserved with air resistance. Some of the mechanical energy is transformed to thermal energy.

f) Complete the pie charts above for the case in which air resistance is NOT negligible.

$E_{T_i} = E_{T_f}$

Conservation of Energy Formula: $PE_i + KE_i + Q_i = PE_f + KE_f + Q_f$

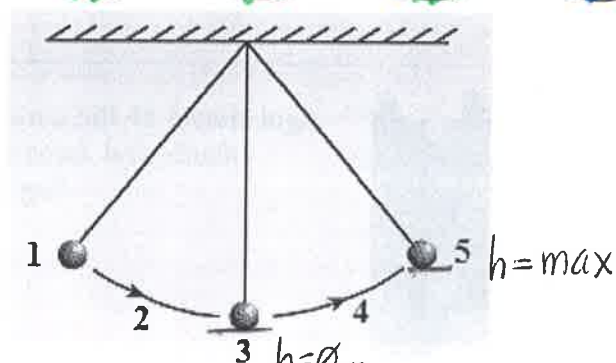
(in a vacuum)

2. A pendulum starts from rest at position 1 and swings freely back and forth.

-PE
-KE

a) Complete the energy pie charts.

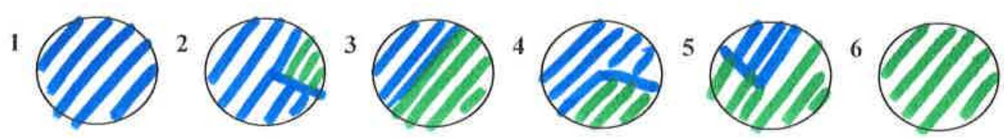
b) A student braves the "bowling ball of death" by releasing it at their nose level. Estimate the speed of the ball at its lowest level.



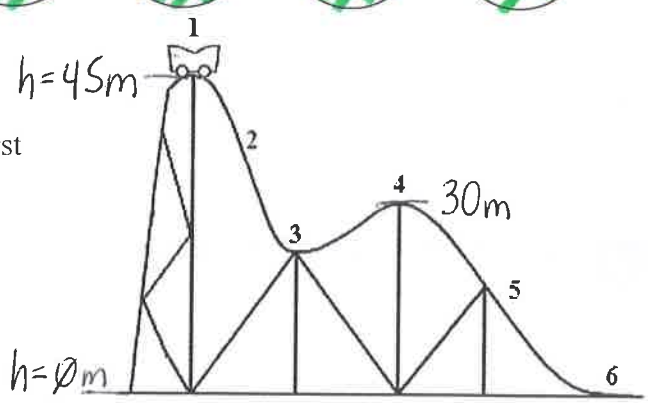
$PE_{g\,TOP} = KE_{BOTTOM}$

$mgh_{TOP} = \frac{1}{2}mv^2_{BOTTOM}$

3. A rollercoaster starts from rest and rolls freely downhill, neglecting friction.



a) Complete the energy pie charts.



b) A 750. kg car starts at the top of the 45 meter high first hill and rolls downhill. Calculate how fast it is traveling at position 4 which is 30 meters high..

$PE_{g_i} + KE_i = PE_{g_f} + KE_f$

$mgh_1 + \frac{1}{2}mv^2 = mgh_4 + \frac{1}{2}mv_4^2$

$v = \emptyset\ m/s$

$\emptyset = -gh_1 + gh_4 + \frac{1}{2}v_4^2$

$v_4^2 = 2(gh_1 - gh_4)$

$v = \sqrt{2(9.81\frac{m}{s^2})(45_m - 30m)}$

$v^2 = 2g(\Delta h)$

$v = \sqrt{2g\Delta h}$

$v = 17\frac{m}{s}$

c) Where will the car be traveling the fastest? Why?

#6 all energy is transformed into KE.