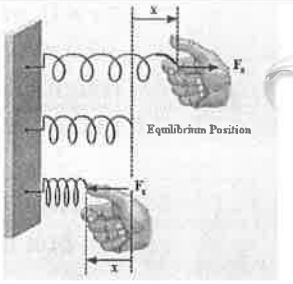
Springs

1. Does the force needed to stretch or compress a spring remain constant? Explain.



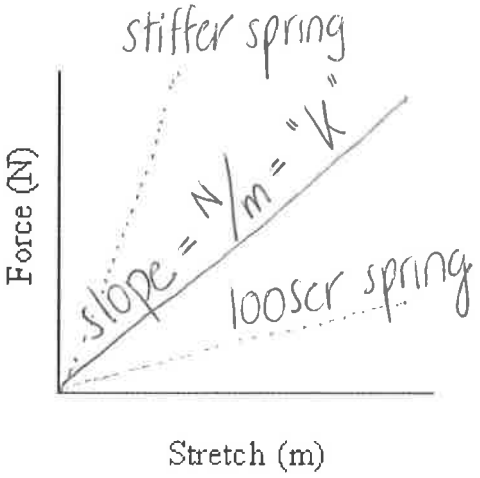
No. As the amount of stretch or compression increases, so does the amount of force.

2. Sketch the expected relationship on the axes at right.

$F = -kx$ ← displacement

restorative force

spring constant



3. What is the significance of the slope of the graph?

The slope is the value of the spring constant or "k."

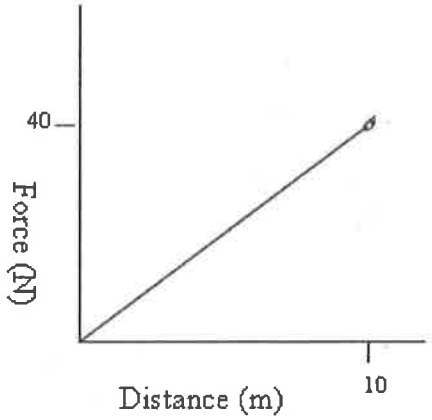
4. Sketch on the graph the relationship for a stiffer spring.

Variable:	F_s	k	x
Quantity:	Force of spring	spring constant	change in spring length from equilibrium
Units:	N	N/m	m
Type:	vector	scalar	scalar

5. If it takes 20. newtons of force to compress a spring 8.0 cm, what is its spring constant?

$F = kx$ $\quad k = \frac{F}{x}$ $\quad \frac{20.\text{N}}{0.08\text{m}} = 250\frac{\text{N}}{\text{m}}$

6. The graph at right shows the amount of force needed to stretch a bungee cord a certain distance. Calculate:



a) the spring constant of the bungee cord.

$K = \frac{F}{X}$ $\frac{40N}{10m} = \frac{4N}{m}$

b) the amount of work needed to stretch the bungee cord 10. meters.

$W = F_{AVG} \cdot d$

$W_s = \frac{1}{2}Kx \cdot x = \frac{1}{2}Kx^2$ $\frac{1}{2}\left(\frac{4N}{m}\right)(10.m)^2 = 200J$

NOTE: Use average force to calculate work

$\frac{F_i + F_f}{2} = F_{AVG}$ where $F_i = Kx$ and $x = 0$ at equilibrium

c) the area under the curve.

$\frac{1}{2}bh$ $\frac{1}{2}(10m)(40N) = 200J$

NOTE: Area under the curve of a Force vs. distance graph for a spring is equal to the work done.

7. How much work is done stretching a spring 0.50 meter if the spring constant is 40. N/m?

$W = \frac{1}{2}Kx^2$ $\frac{1}{2}\left(40.\frac{N}{m}\right)(0.50m)^2 = 5.0J$

Energy

IB 11

Identify the types of energy displayed in the pictures below, using the concept tree provided.

A 

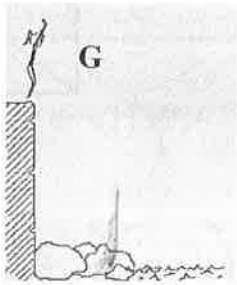
B 

C 

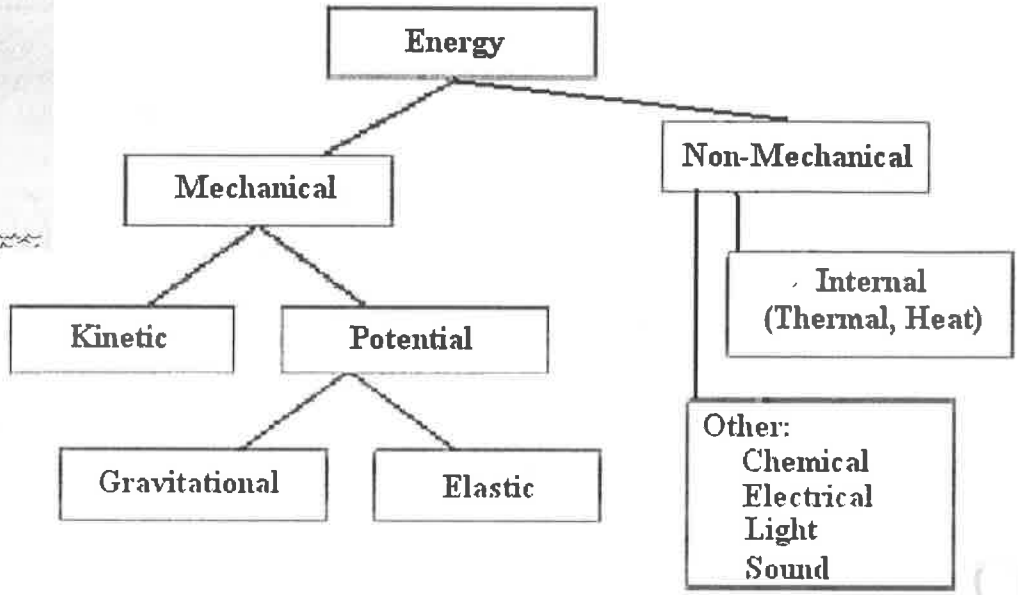
D 

E 

F 

G 

H 



Variable	KE	PE_g	PE_S or PE_E	Q
Quantity	Kinetic Energy	Gravitational Potential Energy	Elastic or Spring Potential Energy	Thermal or Heat Energy
Characteristic	object in motion	object above ground level or reference of Ø m	stretched or compressed	friction is present or heat is present
Formula	$KE = \frac{1}{2}mv^2$	$PE_g = mgh$	$PE_s = \frac{1}{2}Kx^2$	$Q = mc_p\Delta t$
Units	$kg \cdot \frac{m^2}{s^2} = J$	$kg \cdot \frac{m}{s^2} \cdot m = J$	$N/m \cdot m^2 = J$	$kg\left(\frac{J}{kg°C}\right)(°C)$ J
Type	scalar	scalar	scalar	scalar

Mechanical Energy: $PE_g + PE_s + KE$ Total Energy: $E_T = KE + PE + Q$