IB Physics SL Y2 – Paper 1 and Paper 2 Review – Topic 2 (Mechanics)

Name: ____ Date: _____________________ Period: _______

Objectives:
2.1 Kinematics
2.2 Forces and dynamics
2.3 Work, energy, and power
2.4 Uniform circular motion

2.1.1 Define displacement, velocity, speed and acceleration.

2.1.2 Explain the difference between instantaneous and average values of speed, velocity and acceleration.

2.1.3 Outline the conditions under which the equations for uniformly accelerated motion may be applied.

2.1.4 Identify the acceleration of a body falling in a vacuum near the Earth's surface with the acceleration g of free fall.

2.1.5 Solve problems involving the equations of uniformly accelerated motion.

2.1.6 Describe the effects of air resistance on falling objects.
Only qualitative descriptions are expected. Students should understand what is meant by terminal speed.

2.1.7 Draw and analyze distance–time graphs, displacement–time graphs, velocity–time graphs and acceleration–time graphs.
Students should be able to sketch and label these graphs for various situations. They should also be able to write descriptions of the motions represented by such graphs.

2.1.8 Calculate and interpret the gradients of displacement–time graphs and velocity–time graphs, and the areas under velocity–time graphs and acceleration–time graphs.

2.1.9 Determine relative velocity in one and in two dimensions.

2.2.1 Calculate the weight of a body using the expression W = mg.

2.2.2 Identify the forces acting on an object and draw free-body diagrams representing the forces acting.
Each force should be labelled by name or given a commonly accepted symbol. Vectors should have lengths approximately proportional to their magnitudes.

2.2.3 Determine the resultant force in different situations.

2.2.4 State Newton's first law of motion.

2.2.5 Describe examples of Newton's first law.

2.2.6 State the condition for translational equilibrium.

2.2.7 Solve problems involving translational equilibrium.

2.2.8 State Newton's second law of motion.
Students should be familiar with the law expressed as: $F = ma$ and $F = \frac{\Delta p}{\Delta t}$

2.2.9 Solve problems involving Newton's second law.

2.2.10 Define linear momentum and impulse.

2.2.11 Determine the impulse due to a time-varying force by interpreting a force–time graph.

2.2.12 State the law of conservation of linear momentum.

2.2.13 Solve problems involving momentum and impulse.

2.2.14 State Newton's third law of motion.

2.2.15 Discuss examples of Newton's third law.
Students should understand that when two bodies A and B interact, the force that A exerts on B is equal and opposite to the force that B exerts on A.

2.3.1 Outline what is meant by work.
Students should be familiar with situations where the displacement is not in the same direction as the force.

2.3.2 Determine the work done by a non-constant force by interpreting a force–displacement graph.
A typical example would be calculating the work done in extending a spring.

2.3.3 Solve problems involving the work done by a force.

2.3.4 Outline what is meant by kinetic energy.

2.3.5 Outline what is meant by change in gravitational potential energy.

2.3.6 State the principle of conservation of energy.

2.3.7 List different forms of energy and describe examples of the transformation of energy from one form to another.

2.3.8 Distinguish between elastic and inelastic collisions.
Students should be familiar with elastic and inelastic collisions and explosions. Knowledge of the coefficient of restitution is not required.

2.3.9 Define power.

2.3.10 Define and apply the concept of efficiency.

2.3.11 Solve problems involving momentum, work, energy and power.

2.4.1 Draw a vector diagram to illustrate that the acceleration of a particle moving with constant speed in a circle is directed towards the center of the circle.

2.4.2 Apply the expression for centripetal acceleration.

2.4.3 Identify the force producing circular motion in various situations.
Examples include gravitational force acting on the Moon and friction acting sideways on the tires of a car turning a corner.

2.4.4 Solve problems involving circular motion.
Problems on banked motion (aircraft and vehicles going round banked tracks) will not be included.

$$s = \frac{u+v}{2}t$$

$$s = ut + \tfrac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$F = ma$$

$$p = mv$$

$$F = \frac{\Delta p}{\Delta t}$$

$$\text{Impulse} = F\Delta t = m\Delta v$$

$$W = Fs\cos\theta$$

$$E_K = \tfrac{1}{2}mv^2$$

$$E_K = \frac{p^2}{2m}$$

$$\Delta E_P = mg\Delta h$$

$$\text{power} = Fv$$

$$a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

s: displacement (m)
u: initial velocity (ms^{-1})
v: final velocity (ms^{-1})
t: time (s)
a: acceleration (ms^{-2})
F: net force (N)
m: mass (kg)
p: momentum (kg ms^{-1} or Ns)
Δp: change in momentum/impulse (kg ms^{-1} or Ns)
W: work (J)
E_K: kinetic energy (J)
ΔE_P: potential energy (J)
g:gravitational acceleration (ms^{-2})
Δh: change in height (m)
r:radius (m)
T: period (s)