Dear Grade 11 Physics Students,

Congratulations on your decision to take part in IBDP Physics! Also, congratulations for the EASIEST summer holiday assignment ever! You will self-study two objectives (projectile motion and momentum and impulse) from Topic 2 Mechanics so that you can be successful starting from day one in grade 11. The following document will tell you exactly what you need to cover for your self-study and 9 practice problems and answers.

To test your knowledge, **you will have a quiz on the first day of class on these two objectives 😊**

Side note: If you have access to the online textbook, Kognity, read sections 2.1.4 (projectile motion) and 2.4 (all of momentum and impulse)

Happy learning and studying!

Much love,

Your physics teachers

<table>
<thead>
<tr>
<th>Objective 1- Projectile Motion</th>
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<tbody>
<tr>
<td><strong>Applications and Skills</strong></td>
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<tr>
<td>• Analyzing projectile motion, including the resolution of vertical and horizontal components of acceleration, velocity and displacement.</td>
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<td><strong>Guidance:</strong></td>
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<tr>
<td>• Calculations will be restricted to those neglecting air resistance</td>
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<td>• Projectile motion will only involve problems using a constant value of $g$ close to the surface of the Earth</td>
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<td>• The equation of the path of a projectile will not be required</td>
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<tr>
<td><strong>Data booklet reference:</strong></td>
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<tr>
<td>• $v = u + at$</td>
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<tr>
<td>• $s = ut + \frac{1}{2} at^2$</td>
</tr>
<tr>
<td>• $v^2 = u^2 + 2as$</td>
</tr>
<tr>
<td>• $s = \frac{(v+u)t}{2}$</td>
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## Objective 2 - Momentum

### Understandings:
- Newton’s second law expressed in terms of rate of change of momentum
- Impulse and force–time graphs
- Conservation of linear momentum
- Elastic collisions, inelastic collisions and explosions

### Applications and skills:
- Applying conservation of momentum in simple isolated systems including (but not limited to) collisions, explosions, or water jets
- Using Newton’s second law quantitatively and qualitatively in cases where mass is not constant
- Sketching and interpreting force–time graphs
- Determining impulse in various contexts including (but not limited to) car safety and sports
- Qualitatively and quantitatively comparing situations involving elastic collisions, inelastic collisions and explosions

### Guidance:
- Students should be aware that $F = ma$ is equivalent of $F = \frac{\Delta p}{\Delta t}$ only when mass is constant
- Solving simultaneous equations involving conservation of momentum and energy in collisions will not be required
- Calculations relating to collisions and explosions will be restricted to one-dimensional situations
- A comparison between energy involved in inelastic collisions (in which kinetic energy is not conserved) and the conservation of (total) energy should be made

### Data booklet reference:
- $p = mv$
- $F = \frac{\Delta p}{\Delta t}$
- $E_k = \frac{p^2}{2m}$
- Impulse $= F \Delta t = \Delta p$
1. A circus performer is shot out of a cannon at an angle of 40° to the horizontal, with a speed of 30 m·s⁻¹. He lands in a net at the same height as the end of the cannon, a distance \( x \) from it (as shown).

Assuming that the net and the cannon are at the same height and ignoring air resistance, what is the value of \( x \)? Give your answer in metres, correct to 1 significant figure.

2. A body collides with an identical body that is initially at rest. They stick together. What is the percentage of kinetic energy that has been transferred to other forms of energy in the collision?

3. A soccer ball, mass 600 g, is sliding to the right on a wet pitch at a velocity of 2 m·s⁻¹, until it is kicked to the left. A force of 20 N is applied in the kick for a duration of 150 ms. What is the new velocity of the ball? Give your answer in m·s⁻¹ to one significant figure, with a sign (± or −) and without units.

4. A pressure washer uses a high-velocity jet of water to clean surfaces. Every second, 17.0 kg of water is expelled at a velocity of 24.0 m·s⁻¹. What is the magnitude of the force from the water onto a surface? Assume that the water velocity is reduced to zero when it hits a surface. Give your answer in Newtons, correct to three significant figures without a unit.
Consider the situation shown below.

![Velocity Diagram]

The velocity of the heavier ball after the collision is 3.50 m·s⁻¹ to the right. Is the collision elastic; yes or no?

A tennis ball is lightly thrown vertically upwards to be struck by the racquet at the peak of the trajectory of the ball. A 350 g tennis racquet hits the ball with a velocity of 30. m·s⁻¹. Both racquet and ball move with a horizontal velocity of 25 m·s⁻¹ immediately after the collision. What is the mass of the ball, in grams?

A train coasts into a station stop. To slow it down, two braking forces are applied: initially, a 5 MN force is applied for 10 s, and then a 7.5 MN force is applied until it stops. If the train is travelling at 40. m·s⁻¹ before the breaks are applied and has a mass of $3.4 \times 10^6$ kg, for how long must the 7.5 MN force be applied, to the nearest second? Give your answer to two significant figures without a unit.

A rocket engine uses 275 kg·s⁻¹ of fuel and expels gas particles at an average speed of 1250 m·s⁻¹. What is the thrust produced by the engine? Give your answer in kN without units and to an appropriate number of significant figures.

A loaded gun, with mass 975 g, fires a 9.15 g bullet horizontally with a muzzle velocity of 300 m·s⁻¹. What is the recoil velocity of the gun? Give your answer in m·s⁻¹ correct to two significant figures, with the correct sign and without a unit.
Answers

1. 90 m
2. 50%
3. -3
4. 408
5. Yes
6. 70 g
7. 11
8. 344
9. -2.8