Physics of Sports

**Goal:** Explain the physics behind a particular aspect of your favorite sport.

**Overview:**

In this project, you will tie together all of the physics principles you’ve learned about in order to describe what is going on in one simple action of your sport. You will analyze this motion using graphing, kinematics formulas, forces (Newton’s Laws), momentum, energy and power. You will also give a written explanation of what’s going on and why things happen the way they do. For example, why do football players lower their body before attempting to tackle another player?

**Instructions:**

Choose a very brief situation from sports to which you can apply the principles of physics you have learned. The situation should involve an impact, change in momentum, and/or transformation of energy as well as an object as a projectile at some point.

Ideas:

|  |  |
| --- | --- |
| A bat, club, racquet, or hand hitting a ball | A wrestling or martial arts maneuver |
| A football tackle | Skeet shooting |
| Drag racing | Shooting an arrow |
| Pitching a baseball | The high jump or pole vault |
| A gymnastics maneuver | Flying a frisbee |

**Necessary components of the project –**

Graphs (position vs time and velocity vs time)

Kinematics analysis (formulas and solutions)

Projectile Motion analysis (formulas, drawings and solutions)

Free-Body Diagram showing forces involved

Momentum analysis (formulas and solutions)

Work, Power and Energy analysis (diagrams, formulas & solutions)

Video analysis with Logger Pro done for one of the above components with descriptive paragraph & solutions

Written descriptions – 1 paragraph for each of the above elements

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| --- | --- | --- | --- | --- | --- |
|  | 5 | 4 | 3 | 2 | 1 |
| Graphs | Done on computer; contains all qualities of a good graph (title, labels, units, legend, best-fit line where appropriate) | Done on computer; missing 1 element. | Done on computer but missing 2 elements; done by hand very neatly with all elements. | Done by hand neatly; missing 1-2 elements. | Done by hand; messy; missing elements. |
| Kinematics of linear motion | Clearly and thoroughly explains the motion of the object using graphs and formulas. Paragraph is descriptive and accurate. | Uses graphs & formulas to thoroughly explain motion; mostly accurate. | Relates graphs to motion & formulas; could be more clear and thorough. | Relates graphs/formulas to motion; not very clear or thorough. | Relationship between graphs and formulas is unclear and poorly described. |
| Free-Body Diagram | Superb, neat FBD of object and the forces acting on it. Length of arrows proportional to magnitude of force. All forces labeled correctly. Each force and its effects clearly described. | Pretty neat FBD, all forces shown, lengths indicate magnitudes. 1 element missing. Not all effects explained. | Could be neater, lengths do not indicate magnitude. 1-2 elements missing. Not all effects explained. | Some forces missing; lengths and labels not accurate. Forces not described clearly or accurately. | Poorly done FBD; missing several elements without appropriate descriptions. |
| Projectile Motion | Neatly labeled drawing used to show velocity vectors on projectile; Use of formulas describes the motion of the object. Paragraph is descriptive and accurate. | Drawing labeled with velocity vectors; use of formulas somewhat describes the motion of the object. Paragraph is mostly accurate. | Drawing & labels could be neater; velocity vectors partially accurate. Paragraph could be more clear and thorough. | Drawing not labeled with vectors. Formulas used but not clearly described in paragraph. | Poorly done drawing; missing several elements without clear description in paragraph. |
| Momentum | Momentum and impulse thoroughly and clearly described through use of formulas and solutions. Paragraph is descriptive and accurate. | Formulas and solutions used to accurately describe momentum. Paragraph is mostly accurate. | Connection between formulas and description of momentum could be more clear and thorough. | Relationships not very clear or thorough. | Poorly described connection between formulas and momentum. |
| Power, Work & Energy | Work, Power and Total Mechanical Energy thoroughly and clearly described through the use of formulas and solutions. Paragraph is descriptive and accurate. | Formulas and solutions used to accurately describe work, power and energy. Paragraph is mostly accurate. | Connection between formulas and description of work, power & energy could be more clear & thorough. | Relationship between work, power and energy not very clear or thorough. | Poorly described connection between work, power & energy. |
| Video Analysis | Video captured shows plotted data points; Data collected is used appropriately in formulas and solutions. Paragraph thoroughly and clearly describes the motion analysis done. | Video captured shows plotted data points; data collected is used in formulas and solutions; Paragraph is mostly accurate. | Video captured shows plotted data points; data is used in formulas somewhat; paragraph could be more clear. | Video captured shows plotted data points; data not used in formulas or solutions; paragraph not very clear or thorough. | Video captured without any plotted data; paragraph poorly describes motion using data. |
| Effort/quality of work | All elements are neat, easy to read, typed, correct spelling, well-formatted. High quality! | Most elements are neat, easy to read, typed, etc. Good. | Some elements meet expectations. Could have been better. | Many elements lacking in quality. | Didn’t really even try. |