# VIGNAN HIGH SCHOOL

Evaluation Spectrum

Class : Class 7

Subject : IIT Foundation Physics

Chapters : Work,Energy,7 Power,Friction

Exam : IIT / NEET CUMULATIVE TEST - 2 (Foundation)

Subject Avg : 18

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**Overall Performance Analysis**

| Assessment Area | Observed Strengths | Notable Weaknesses | Recommendations |
|-----------------|--------------------|--------------------|-----------------|
| **Basic Work–Energy Relations** | • Most students correctly linked the magnitude of the applied force work (mgh), the negative work of gravity (–mgh), and the zero net work when no acceleration is involved.
• The calculation of work in simple “force × distance” scenarios (e.g., $50\ \mathrm{N}$ over $20\ \mathrm{m}$) and the inclusion of the directional factor ($\cos 60^\circ$) were handled with reasonable accuracy. | • The distinction between “work done by the resultant force” versus “net work” was sometimes confused, leading to the failure to select the appropriate zero-work conclusion. | • Provide more practice problems that explicitly plot and interpret the force–distance graph, reinforcing that a zero net force results in zero net work even if individual forces perform work. |
| **Dynamics & Energy Transitions** | • Students universally applied the energy conservation principle to determine the speed of falling water and the velocity of a body whose gravitational potential equals its kinetic energy.
• The conversion from potential energy to kinetic energy in free-fall scenarios and the calculation of terminal velocity from $v = \sqrt{2gh}$ were accurately executed. | • A small fraction mis-applied the formula for gravitational potential energy (using $PE = mgh$ with incorrect units) or incorrectly evaluated the square root of $2gh$. | • Incorporate unit-check exercises and spreadsheets that automatically flag inconsistent units before calculations. |
| **Power & Work vs. Time Graphs** | • The majority of students identified the slope of the work-vs-time graph as power. | • Some students incorrectly linked power to “capacity” or “time” instead of the rate of work. | • Use real-time demonstrations or simulation tools where students can see how the area under a power-time curve corresponds to work, and calculate instantaneous power from recorded data. |
| **Momentum & Kinetic Energy Relationships** | • Students recognised that the product $p \times v = mv^2$ equals **twice** the kinetic energy, and that a smaller mass (with equal momentum) yields a larger kinetic energy. | • Misconceptions arose regarding how a constant momentum translates into kinetic energy, leading to erroneous labeling of the heavier body as having more energy. | • Design counter-intuitive

examples: give two particles the same momentum but with different masses; ask for kinetic energy comparison, and then physically model the system to visualize speed differences. |
| **Friction Concepts** | • A majority understood that friction opposes the direction of motion when walking and that adding sand to tracks increases friction to reduce slip. | • Confusing "maximum value of static friction" (limiting friction) with "static friction" vs "rolling friction", and some pupils incorrectly answered that friction increases with temperature. | • Clarify terminology with clear diagrams: show static, kinetic, rolling, and limiting static friction in a single composite figure. Emphasise empirical observations: friction coefficients generally decline with temperature, except in certain lubricated or abrasive systems. |
| **Power in Fluid Flow** | • Some students performed the kinetic-energy-per-second calculation for an air stream, recognising that $P = \frac{1}{2}\dot{m}v^2$. | • Errors in unit conversion (grams to kilograms), misapplication of the factor $1/2$, or uptake of incorrect numerical options (seeing 7.84 W instead of 78 W). | • A worked-through example with step-by-step unit conversion should be distributed; practice converting small mass-flow rates and squaring velocity to obtain realistic power values. |

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## Strengths Summary
* Strong grasp of fundamental work–energy and kinetic-potential relationships.
* Accurate handling of scalar work with direction via cosine factors.
* Correct interpretation of power as the slope of a work–time graph.

## Weaknesses Summary
* Slight conceptual ambiguity regarding the outcome of zero net force (zero net work).
* Under-appreciation of the difference between *static friction*, *limiting static friction*, and *rolling friction*.
* Inadequate unit management in kinetic-energy-per-second problems, resulting in selecting the wrong numeric answer.
* Mislabeling the role of temperature on friction, possibly due to conflating different material systems.

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## Recommendations for Improvement

1. **Interactive Simulations** – Use physics engines (e.g., PhET "Work, Energy & Power") where students can manipulate forces, masses, and friction coefficients, observing immediately the effect on work and power.

2. **Layered Problem Sets** – Start each worksheet with a *verbal* description, then provide a quantitative statement. Have students first write the relevant equations (e.g., $W = Fd$, $W_{\text{net}} = \Delta K$, $PE = mgh$), then substitute numbers. This reinforces conceptual steps before computation.

3. **Unit-Check Protocol** – Implement a "brown-paper" checkpoint: after choosing an equation, students

write all expected units on a sticky note. If units don't match, they revisit the conversion steps. A weekly quiz on unit balancing could solidify this habit.

4. **Friction Lab Module** – Build a low-cost lab where students measure static and kinetic friction coefficients under varying temperatures using a simple inclined plane and a force sensor. Direct observation of friction decreasing with temperature will reinforce the rule.

5. **Group Discussion on "Limiting Static Friction"** – Present scenarios of how static friction ramps up until it reaches its limiting value. Then prompt the class to identify this in everyday contexts (e.g., a person holding a book, a car's traction limits). This contextualizes the terminology.

6. **Real-world Application Projects** – Assign a mini-report where students explore the design of a "sand-tape" train track or the power output of a wind-turbine; they must calculate relevant energy and work figures, justifying each step.

7. **Peer-Instruction Sessions** – Pair students with contrasting strengths: those proficient in energy problems paired with those struggling on friction. They can explain concepts to each other, reinforcing learning through teaching.

By systematically addressing these areas, the class will convert minor misconceptions into robust understanding of mechanics, preparing them for more advanced study and real-world problem-solving.