

**Topic 4: Newton's Laws and Connected Particles**

**1) Useful Formulae/Rules:**

<p><b>a) Formulae:</b></p> <p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>➤ All the formulae below are in the Tables (pgs 50 - 57)</li> </ul> <p><b>Newton's 2<sup>nd</sup> Law:</b></p> <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: fit-content; margin: 10px auto;"> <math display="block">F = ma</math> </div> <p><b>Friction:</b></p> <div style="display: flex; align-items: center; margin: 10px auto;"> <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: fit-content;"> <math display="block">\text{Friction} = \mu R</math> </div> <div style="margin-left: 20px;"> <math>\mu = \text{coefficient of friction}</math> </div> </div> <p><b>Work:</b></p> <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: fit-content; margin: 10px auto;"> <math display="block">\text{Work} = \text{Force} \times \text{Displacement} (W = Fs)</math> </div> <p><b>Power:</b></p> <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: fit-content; margin: 10px auto;"> <math display="block">\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{W}{t}</math> <math display="block">\text{Power} = \text{Force} \times \text{Velocity} = Fv</math> </div>	<p><b>b) Other important rules:</b></p> <p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>➤ Always draw diagrams showing all forces acting.</li> <li>➤ If there is no acceleration in vertical direction =&gt; Forces Up = Forces Down</li> <li>➤ If there is no acceleration in horizontal direction =&gt; Forces Left = Forces Right</li> <li>➤ If there is acceleration in one direction =&gt; Net Force = Forces in direction of acceleration - Any opposing forces</li> <li>➤ Generally, we always resolve forces that are at awkward angles to one another, so that we can compare them in the parallel and perpendicular direction.</li> </ul>
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**2) Particles/Pulleys:**

<p><b>a) 1 Pulley and 2 Particles:</b></p>	<p><b>b) 1 Fixed Pulley and 1 Moveable Pulley:</b></p>
<p><b>c) 1 Moveable Pulley and 2 Particles:</b></p>	<p><b>d) Particles on a Slope:</b></p>

**3) General Tips for Exam Question:**

- Do draw a force diagram for each particle separately.
- Do show the acceleration to one side of the diagram.
- Do write down the equation ( $F = ma$ ) of motion for each particle.
- Don't assume all accelerations are 'a'.
- Don't fret if you get a negative acceleration: it just means the goes the other way.....unless friction is at play.