Das Teknik von Physik

AS

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Abstract

The main reason of this document is to note all the techniques that I personally will try to do as I face the challenges in a problem. Certainly my wisdom in art of problem solving is quite frustrating and have less intellect, I will try to briefly make a note on what I am supposed to think in case of favorable conditions.

1 Ideas and reasonings

Above all, You do too many mistakes, so better preserve and *Learn* from them.

- Turn all the problem into a system that you are familiar with. No need to stress over for finding a parameter that are you are not sure exists. Use an outlook that dissolves the problem into something learned.
  Example: *Find the velocity of a particle that rotates around a circle, whose radius is R and the position vector $\vec{r}$ from the point of the trajectory path to particle rotates at ω.* Using the idea that the ω_0 from the center of the circle is the angular velocity, and using the isosceles identity of the circle, a relation can be built with the point with the center of the circle that efficiently solves the problem.

- From *Thomas Foster's* solution on the added mass problems, and also this year **Physics Cup 2020**, also the main idea behind **PC 2019 -PR01**, **Electric Fields** are mathematically analogue to **Liquid Fluid Flow** aided by **Maxwell's Equations**.

- Just a sub for above
$$\mathbf{E} = \sigma \mathbf{J} \tag{1}$$

- How about adding the Friction Force vector and the Normal ?
$$\vec{f_r} + \vec{N} = \vec{P} \tag{2}$$

- Leave the way that doesn't sort out, say, "Keine Ahnung" and return to it later. **DON'T REPEAT** that came out not to work, ensure it was mathematically done correctly but something initially was wrong.

- Use the focus of the parabola that a projectile would take. The component of the focus-launch point distance is the range of the projectile, ideal for the extremum calculation. The distance of the focus from the point of launch is
$$l = \frac{v_0^2}{2g} \tag{3}$$

- If the problem seems to be hopeless, then without moving for the **Target Variable**, wander about the mathematical boundary and assume something simple as you work.

- In case it is an Olympiad or a competition where you don't have the time to work on the problem for long, then keep doing the things that you know or are confirm and confident that you can finish it leaving enough time for all other problems. If it turns out that you have some simple problems after the one you are currently solving for, and the current one is taking **around 2 minutes 30 seconds** to **3 minutes 30 seconds**, then immediately postpone the problem keeping the theme in head.
  As because you (actually I) want to think on the problem the same time you complete a thing that won't take that much of thinking. A watch will save the day.

- NEVER hesitate to make any assumptions that seems indispensible, it might not be in what the problem tells, but if things are okay then it'll vanish. Remember, derivatives of constants vanish, sometimes some way a parameter can return too. Like if we are looking for the cube of c that is in an equation $a + b = c$, then simply the cube is $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$. But we know that $a + b = c$ and are left with $c^3 = a^3 + b^3 + 3abc$. I just want to explicate how a variable in another format might return. Same example that $IPhO - 1998$ or the $KaldaThermPr01$. Where by the chain rule the same happens.

- Like above, suppose that you are to get rid of t, then bring it in the two side of the =.

- Be careful on how the velocity are you are tracking of, specially when they are circular or somewhat non-linear, carefully trace the way how velocity would work from an outside stable place. Remember the mistakes that you did while solving for the Morin Problem of finding Equation of Motion of a mass m inside a cylinder.[1]A safe method is nicely tracing how the position is then taking its derivative.

- **Vector approaches** go well some times, specially when the problem asks, *When will the net velocity vectors of these two falling particles with the x axis velocity vectors pointing towards opposite ways turn perpendicular mutually?* Then use the fact that in this case the $\vec{v} \cdot \vec{u} = 0$. In other ways depending on the topic this comes handy, remember that it's more usable as it yields a $Scalar$!

- Formally, rather than the theory, keep this equation below in mind than the above one.

$$\frac{\vec{v} \cdot \vec{u}}{vu} = \cos\theta \tag{4}$$

- The solution of that Irodov problem of three particles each at the vertex of an Equilateral Triangle is an idea itself. Whenever you face that the length changing in this and this way, then note that it is as sign that there is a $\dfrac{dl}{dt} = v_0$ in the situation.

  Example: *Three particles are in the vertex of an equilateral triangle with length l. Each starts to move towards the one in front in a cyclic order, as particle 1 move to 2; and 2 to 3 and 3 to 1 at a velocity v. Find when the triangle shall converge to a point.* I tried to lamely trace the triangle to infinity, that was useless. Note that the particles are causing the length of the triangle in a way that

$$\frac{dl}{dt} = -v - v\cos\frac{\pi}{3}$$

  Making an integration to t time till the $l \to 0$ shall do it.

- Symmetries are simplifications, success lies in using it.[2]

- For specially *Thermodynamics*, analysis of the First state and Final State not regarding the Middle phase helps, recall that Irodov initial cylinder joint gas problem.[3]

- **Reduce things by Subtraction** as you found in that Ariyan's SAT problem. Find $x+$ and $x + d$, then by a subtraction, you can find d ($x + d - x = d = f(t)$, where $f(t)$ is sought).

- **Improve your Geometry** as Prof Zhang said.

- How about **Energy conservation and Momentum conservation or Jellet's Integral**?

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[1]Pr 14, Topic Lagrange method

[2]I mean something very deep as the *Noether's Theorem*

[3]You fool, that took you months to do, remember?

- From Irodov Mechanics, calculus derivatives can be acrobated like normal algebra

$$\frac{ds}{dt} = v,\ \frac{dv}{dt} = a,\ a = \frac{dv}{dt} = \frac{dv}{dt} \times \frac{dt}{ds} = v\frac{dv}{ds}$$

  This same sort of technique in Thermodynamics,

$$P = \frac{dQ}{dt} = C_v \frac{dT}{dt} \tag{5}$$

- **Euler-Lagrangian** can be applied outside the mechanics to do **extremum** type problems. Reference to the Morin Mechanics.

- Recall that the derivative of the pV^{γ} made it possible to find the *Bulk Modulus* and put it into the,

$$v = \sqrt{\frac{B}{\rho}} \tag{6}$$

  that yield the tractable sound velocity in a gas with it's parameters known, M is the Mass per mole and γ the Adiabatic constant.

$$v = \sqrt{\frac{\gamma RT}{M}} \tag{7}$$

- Luck favor's those who are $\mathbf{P}^5$, I mean

  PRAYING
  PREPARED
  PRACTISED
  PATIENT
  PLUGGED.

- Look, sometimes it is as diappointing as it was to the New Zealander's, do as many learn ups and "Theka" at home, don't make the Examination Room the learning place, make it the Field to shot a HomeRun.

- Non inertial forces act simply as if they were a gravity.

- Problems can be reduced to finding some simple perimeters, given that such a problem *Find the shape of a glass that would direct all light coming towards it in parallel F away from the Pole Center.* Your wisdom (if enough) will tell you that it is actually an *Elliptical* shape, hence you just need to work on a special ratio that would yield the eccentricity, then use F for the scale factor. *Directrix* technique is useful enough.