# The **LiteSolution** Template 🖋

Xia Mingyu, Hangzhou Dianzi University

xiamyphys@gmail.com

15/11/2023,　　Version 1.0a

This is the document for LiteSolution template, which provides a lite design of the solution of test paper.

Some designs of this template currently only support **Simplified Chinese (Mainland)**. If necessary, you can change some Chinese characters to the language you want in the `*.cls` file.

## 1.  Introduction

### 1.1  The purpose of this template

This template provides a lite and fresh template, and mainly used for typesetting solutions of final, textbooks' and other exercises. This template is developed based on ElegantBook and VividBooK, ported and improved the chapter design module code of The Legrand Orange Book. I'd like to express my gratitude to the template authors above for their previous work.

If you meet bugs when using this template, or you have better suggestions or ideas, or you want to participate in the development of the template or other templates by me, welcome to contact via email xiamyphys@gmail.com.

Also, you can join my LaTeX Template Discussion QQ Group:  760570712 to communicate with me and get the insider preview edition of the template.

### 1.2  Loading **LiteSolution** and its modes

Update all the packages to the latest version or switch to portable version instead by implementing the commands

```
tlmgr update --self
tlmgr update --all
tlmgr update --self --all --reinstall-forcibly-removed
```

To learn more, please refer to How do I update my TEX distribution?

Save the file `litesolution.cls` to your project's root directory, and then create a `.tex` file, just input the command `\documentclass{litesolution}` on the first line.

The template provides 3 modes, answer, mtpro2 and counter. Just add the options of the modes you want separately in the square bracket of the command `\documentclass[options]{litesolution}` in your `.tex` file.

## 2.  Modes of **LiteSolution**

### 2.1  The **answer** mode

This mode has two options, ans and noans, which can show and hide answers respectively. After you choose the noans, the contents in the environment solution, the command ans and the answers in the multiple choice questions will all become the same color as the pagecolor. So the area that originally contained the answer will be replaced by an area of the same blank size. You can generate exams without answers and solutions by enabling noans.

### 2.2  The **mtpro2** mode

If you've installed the Mathtime Pro 2 Lite font in your computer, then you can use this mode to change the math font.

### 2.3  The **counter**

This mode has two options, separate and continuous, which can make the page counter between chapters be remaked or continuous.The page numbers between each test question will be continuous when you use the continuous mode or the page number of each test question will start from 1 when you use the separate.

## 3.  Commands of **LiteSolution**

### 3.1  The **chapterimage** command

```
\chapterimage{cover1.png}
```

This command can assign the title background image for each subsequent chapter.

### 3.2  The **chapterfont** command

This command can assign the title font for each subsequent chapter, if you do not use this command, the title font will be songti in Chinese and Libertinus in English.

### 3.3  The **ans** command

This command can underlines the answer and changes the color of the answer to Blue Sapphire.

**If mode noans is enabled, the answer will disappear, leaving only a horizontal line the same width as the answer.**

## 3.4  The watermark command

```
\watermark{ctanlion.pdf}
```

This command can add watermark to the document.

## 3.5  Other customer commands

In order to facilitate input, the following commands are scheduled. You can add others in the `*.cls` file as you like.

| Command | Output | Command | Output | Command | Output |
|---|---|---|---|---|---|
| `\titlelogo{#1}{#2}` | Add emoji with link in text | `\point{#1}` | Add score | `\i` | i |
| `\sokka{#1}` | 故本题选择 #1 项 | `\d` | d | `\e` | e |

# 4.  Environments of LiteSolution

## 4.1  The choice environment

There're two variables in this envrionment. The first one is the answer of the choice problem, the second one is the keywords of this choice problem and it's optional.

```
\begin{choice}{D}[Keywords]
If you want to add choice and keywords.
\begin{tasks}(2) % 2 choices per line
    \task This is choice A  \task This is choice B
    \task This is choice C  \task This is choice D
\end{tasks}
\end{choice}
\begin{choice}{D}
If you want to add choice only.
\begin{tasks}(4) % 4 choices per line
    \task Chc A \task Chc B \task Chc C \task Chc D
\end{tasks}
\end{choice}
```

📝 **题目 1**          🏷 **Keywords**      【   D   】

If you want to add choice and keywords.

A.  This is choice A       B.  This is choice B

C.  This is choice C       D.  This is choice D

📝 **题目 2**                                  【   D   】

If you want to add choice only.

A.  Chc A    B.  Chc B    C.  Chc C    D.  Chc D

📝 **题目 3**          🏷 **Gaussian theory**      【   D   】
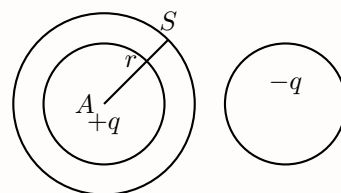
$A$ 和 $B$ 为两个均匀带电球体，$A$ 带电荷 $+q$，$B$ 带电荷 $-q$，作一与 $A$...

A.  通过 $S$ 面的电场强度...       B.  通过 $S$ 面的电场强度...

C.  通过 $S$ 面的电场强度...       D.  通过 $S$ 面的电场强度...

```
\begin{paracol}{2}
\begin{choice}{D}[Gaussian theory]
    $A$和$B$为两个均匀带电球体，$A$带电荷$+q$，$B$带电荷$-q$，作一与$A$...
    \begin{tasks}(2)
        \task 通过$S$面的电场强度...        \task 通过$S$面的电场强度...
        \task 通过$S$面的电场强度...        \task 通过$S$面的电场强度...
    \end{tasks}
\end{choice}
\switchcolumn\centering\vfill\tikz{...}\vfill
\end{paracol}
```

## 4.2  The **problem** environment

Sightly different from the cmdchoice environment: the two variables are points and keywords, and the question number counter is shared with the multiple-choice question number counter.

```
\begin{problem}[Keywords][5]
    If you want to add keywords and points.
\end{problem}
\begin{problem}
    If you want to add none.
\end{problem}
\begin{problem}[Keywords]
    If you want to add keywords only.
\end{problem}
\begin{problem}*[][5]
    If you want to add points only.
\end{problem}
```

✎ 题目 4（本题 5 分）    🏷 **Keywords**

If you want to add keywords and points.

✎ 题目 5

If you want to add none.

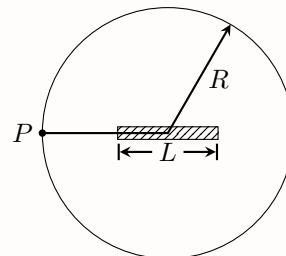✎ 题目 6    🏷 **Keywords**

If you want to add keywords only.

✎ 题目 7（本题 5 分）

If you want to add points only.

---

✎ **题目 8（本题 6 分）**    🏷 **Gaussian theory & Field strength**

一均匀带电直导线长为 $d$，电荷线密度为 $+\lambda$. 过导线中点 $O$ 作一半径为 $R$（$R > \dfrac{d}{2}$）的球面 $S$，$P$ 为带电直导线的延长线与球面 $S$ 的交点. 则通过该球面的电场强度通量 $\Phi_e = \dfrac{\lambda d}{\varepsilon_0}$，带电直线的延长线与球面交点 $P$ 处的电场强度的大小为 $\dfrac{\lambda d}{4\pi\varepsilon_0(R^2 - d^2/4)}$，方向 沿矢径 $\boldsymbol{OP}$.



```
\begin{paracol}{2}
    \begin{problem}[Gaussian theory \& Field strength][6]
        一均匀带电直导线长为$d$，电荷线密度为$+\lambda$，过导线中点$O$...
```

场强大小\ans{$\frac{\lambda d}{4\pi\varepsilon_0(R^2-d^2/4)}$}...

    \end{problem}

\switchcolumn\centering\vfill\tikz{...}\vfill

\end{paracol}

## 4.3 The **note** environment

```
\begin{note}
    Please note that...
\end{note}
```

**❋ 注意**

Please note that...

## 4.4 The **solution** environment

```
\begin{solution}
    This is the answer for the problem.
\end{solution}
```

**☑ 分析与解**

This is the answer for the problem.

If a star (*) is added after the \begin{solution}, then the content will follow the

```
\begin{solution}*
    This is the answer for the problem.
\end{solution}
```

**☑ 分析与解** This is the answer for the problem.

If mode **noans** is enabled, the solution will disappear, leaving only a blank box with the same height as the solution, and the name of the box will change to 🚫 答案隐藏.

## 5.  Version History

This template is used to type the mid-term and final exam solutions of College Physics. Initially, I used the ElegantBook template for layout, however, it's no longer be maintained since January 1st, 2023, so I trun to use the VividBooK instead. But this template is too bloated and some functions & designs need to be redesigned, so I started developing LiteSolution.

**Version 0.1a** was finished developing on 29 June, 2023 and released on  WeChat Public Account: 物理问题作 with the name FreshSolution. This version redesigned the exercise environment and the solution environment in terms of designs and functions, and improvements have been made to the design of the chapterimage part.

**Version 0.1b** was finished developing on 6 July, 2023 and released on LaTeX Studio (Xiaoshan, Hangzhou) and Xiaohongshu, where won the favor of many people. This version has added the global option to make the page number be remaked or continuous between chapters, and command watermark has been added in this version.

**Version 1.0a** was finished developing on 15 November, 2023. This version has redesigned the chapterimage part, choice and replaced the exercise environment with the problem environment.

---

**06/07/2023**  Update: Version 0.1b

- Support page number remaking between chapters.
- Added watermark command.

---

**15/11/2023**  Update: Version 1.0a

- Redesigned the chapterimage part, include the layout and the code.
- Redesigned the choice and solution environment, keywords become optional and supports star (*) key.
- Replaced the exercise environment with the problem environment, supports adding only keywords or points.
- Added the note environment and some customer commands.

### Future Plans

- Plan to integrate the color management of ElegantBook.
- Plan to integrate the chapter design of ElegantBook into the star (*) key value of this template chapter.
- Plan to add the dark mode to this template to make the text color light while make the page color dark to protect eyesight.
- Plan to change the `*.cls` file to a block code design to make it easier for subsequent developers to maintain or modify.
- ......

# A Sample for **LiteSolution** Template 🖋

## 1. 选填题（共 15 分）

### ✅ 题目 1　🏷 波的能量　【　D　】

一平面简谐波在弹性媒介中传播，在媒质质元从最大位移处回到平衡位置的过程中

A. 它的势能转换成动能

B. 它的动能转换成势能

C. 它从相邻的一段质元获得能量，其能量逐渐增加

D. 它把能量传给相邻的一段质元，其能量逐渐减小

☑ **分析与解** 波在传播过程中介质质元振动的动能和势能同时变化. 故本题选择 **C** 项.

### ✅ 题目 2　🏷 双缝干涉　【　D　】

在双缝干涉实验中，两缝间距离为 $d$，双缝与屏幕之间的距离为 $D$（$D \gg d$）. 波长为 $\lambda$ 的平行单色光垂直照射到双缝上，屏幕上干涉条纹中相邻暗纹之间的距离是

A. $\dfrac{2\lambda D}{d}$　　　　B. $\dfrac{\lambda d}{D}$　　　　C. $\dfrac{dD}{\lambda}$　　　　D. $\dfrac{\lambda D}{d}$

☑ **分析与解** 由明纹公式 $x = k\lambda D/d$ 得暗纹间距 $\Delta x = \lambda D/d$. 故本题选择 **D** 项.

### ✅ 题目 3（本题 3 分）　🏷 简谐振动的合成

一个质点同时参与两个在同一直线上的简谐振动：$x_1 = 4\cos\left(2t + \dfrac{\pi}{6}\right)$，$x_2 = 2\cos\left(2t - \dfrac{\pi}{6}\right)$. 该质点合振动的振幅大小为 $\underline{2\sqrt{7}}$.

☑ **分析与解** $A = \sqrt{A_1^2 + A_2^2 + 2A_1 A_2 \cos\Delta\varphi} = 2\sqrt{7}$.

### ✅ 题目 4（本题 6 分）　🏷 多普勒效应

一辆运动的警车发出警铃声音频率为 $f_s = 1400\text{Hz}$，从左向右移动，速度大小为 70m/s. 一个观察者从右向左移动，速度大小为 10m/s，空气中的声速 $u = 340\text{m/s}$. 观察者与警车相遇前后，听到警铃的频率分别为 $\underline{1814.8\text{Hz}，1126.8\text{Hz}}$.

☑ **分析与解** $f_1 = \dfrac{340 + 10}{340 - 70} \times 1400\text{Hz} \approx 1814.8\text{Hz}$，$f_2 = \dfrac{340 - 10}{340 + 70} \times 1400\text{Hz} \approx 1126.8\text{Hz}$.

## 2. 计算题（共 20 分）

### ✏️ 题目 5（本题 10 分）  🏷️ 简谐振动

一个质量为 1kg 的物块沿 $x$ 轴做简谐振动，振幅为 10cm，最大速度 $2 \times 10^{-2}$m/s. 在时间 $t = 4$s 时，物块位于 5cm. 求

1. 简谐运动的周期和最大加速度.
2. 简谐运动的位移方程.

### ☑️ 分析与解

1. 由 $v_{\max} = \omega$, $T = \dfrac{2\pi}{\omega}$ 得 $T = 10\pi$s, $\omega = 0.2$s$^{-1}$, $a_{\max} = \omega^2 A = 4 \times 10^{-3}$m/s$^2$. ························ (4pt)
2. $t = 4$s 时 $x = \dfrac{1}{2}A$, $v < 0$，所以此时相位 $\varphi = \dfrac{\pi}{3}$. 故位移方程为 ························ (2pt)

$$x = 0.1 \cos\left[0.2(t-4)\right] + \frac{\pi}{3} = 0.1\cos\left(0.2t + 0.079\pi\right) \tag{4pt}$$

### ✏️ 题目 6（本题 10 分）  🏷️ 牛顿环

空气中，使用波长为 480nm 平行单色光观察牛顿环. 在反射光中测得某一明环的直径为 4.74mm，在它外面第 10 个明环的直径为 7.24mm. 求

1. 平凸透镜的曲率半径.
2. 直径为 4.74mm 明环的条纹级数 $k$.
3. 假设把整个装置放入水中 ($n = 1.33$)，原直径为 4.74mm 明环的新直径.

### ☑️ 分析与解

1. $R = \left(r_{k+10}^2 - r_k^2\right)/10\lambda = 1.56$m. ························ (4pt)
2. 由 $r_k = \sqrt{\dfrac{2k-1}{2}\lambda R}$ 得 $k = \dfrac{r_k^2}{\lambda R} + \dfrac{1}{2} = 8$. ························ (3pt)
3. 由于光在介质中的波长与折射率成反比，所以此时 $d_k' = \dfrac{d_k}{\sqrt{n}} = 4.11$mm. ························ (3pt)

## 3. 计算题$^\dagger$（共 15 分）

### ✏️ 题目 7（本题 15 分）  🏷️ 弹簧振子

一个质量为 $m = 1$kg 的盘子刚性连接竖直悬挂的轻弹簧下端，弹簧的劲度系数为 $k = 90$N/m. 盘子在竖直方向做简谐运动，振幅 $A = 10.0$cm. 现有一个质量 $m_2 = 1$kg 的物体自由落下掉在盘上，没有反弹. 当**盘子位于向上最大位移处**，盘子与物体发生碰撞，物体从开始自由自由落体发生处，距离为 $h = 20$cm，假设碰撞瞬间完成. 求碰撞后盘子和物体组成的系统，它的振动周期、振幅和振动能量.

### ☑️ 分析与解 Answer omitted.