

This exam scores reasoning, not answers: a selection with the wrong justification earns nothing, and a correct expression with undefined symbols earns nothing either. Everything below is a rule the readers apply. 本科评分看推理: 选项选错则理由不加分, 符号未定义则表达式不加分。

How the readers score a physics free response

✗ Choosing an option and then explaining the other one.

✓ **Make the selection first, and make every sentence support it.**

The guidelines state that reasoning cannot earn credit if the incorrect selection is made – the choice gates the explanation.

选错了, 理由也不加分 SG 3 years

✗ Writing an explanation and leaving the choice blank.

✓ **Answer the question explicitly, then justify.**

The guidelines award no credit for an answer without an explanation, and none for an explanation without the answer.

选项和理由都要写 SG 2 years

✗ Ranking quantities without giving the ranking.

✓ **Write the ranking out, then explain it.**

The guidelines state a ranking must be given for any of the explanation points to be earned.

排序题先写出排序 SG2023

✗ Deriving an expression in part (b) using symbols the diagram never defined.

✓ **Define every variable in the diagram or the procedure of part (a).**

The guidelines require all terms to be indicated in part (a) for full credit in part (b).

变量要在图或步骤中定义 SG 2 years

✗ Writing kx where the question defined the compression as d .

✓ **Use the question’s own symbols.**

The guidelines state that an answer of kx does not earn the point where the quantity was named d .

用题目给定的符号 SG2023

✗ Checking a derived expression only by re-reading the algebra.

✓ **Test a limiting case: does it reduce to g when the mass is zero, or to zero when the angle is?**

The guidelines award credit for a limiting-case argument, and it catches sign and factor errors nothing else will.

用极限情形检验结果 MS

✗ Drawing a graph as a horizontal line along the time axis.

✓ **Read what the physics requires before drawing – a flat line at zero is almost never the**

answer.

The guidelines state that no credit is earned for a horizontal line along the t -axis.

不要画成横轴上的直线 SG2023

✗ Drawing a free-body diagram with forces starting from anywhere.

✓ **Draw each force from the point where it acts, in the right direction – the normal force from the contact point, perpendicular to the surface.**

Mark schemes specify the origin and direction of each arrow, so a correctly named force in the wrong place earns nothing.

受力箭头的起点和方向都要对 MS

■ **Answer in the order asked.** Where a part says JUSTIFY, the justification sentence IS the point; where it says CALCULATE, the substituted equation is.

“ 说明理由 ” 与 “ 计算 ” 要求不同 SG 3 years

1 · Kinematics 运动学

✗ Using a constant-acceleration equation where the acceleration changes.

✓ **Check the graph or the statement first; use the area or the gradient instead.**

The kinematic equations carry a condition, and applying them outside it is a method error, not an arithmetic one.

变加速不能用匀加速公式 CED 1.4

✗ Reading a velocity-time graph’s gradient when the question wants displacement.

✓ **Gradient is acceleration; area under the line is displacement.**

Both are one-step reads, so the wrong one gives a confident wrong answer.

斜率是加速度, 面积是位移 CED 1.3

2 · Force and Translational Dynamics 力与平动动力学

✗ Explaining a tension difference by ‘the rope is heavier there’.

✓ **Say what supports what: there is more rope below the upper point, so the tension there is greater.**

The guidelines print this reasoning as the accepted explanation.

上方绳张力更大 SG2023

✗ Saying a smaller acceleration means a smaller tension.

✓ **Work from the net force: a smaller net force on the block means the tension is CLOSER in magnitude to the weight, so larger.**

The guidelines print this chain; the intuitive answer is the wrong way round.

加速度小 → 张力更接近重力 SG2023

✗ Assuming the static and kinetic coefficients are equal.

✓ **They are usually different, and a question that gives you both is testing that.**

The guidelines make this the correct selection in a question many candidates answer by assumption.

静摩擦与动摩擦系数不同

SG2023

3 · Work, Energy, and Power 功、能与功率

✗ Saying kinetic energy must be greater when the potential energy is the same.

✓ **If the total energy is constant and U is the same at both times, K is the same too.**

The guidelines print this as the valid reason, together with the symmetric-position argument.

总能量守恒推出动能相等

SG2023

✗ Using the distance travelled where the question needs the vertical height.

✓ **Gravitational potential energy depends on the vertical drop alone.**

On a slope or a curved track the two differ, which is exactly when the question asks.

重力势能用竖直高度

CED 3.4

4 · Linear Momentum 线动量

✗ Adding momenta as though they were speeds.

✓ **Choose a positive direction and give the opposing velocity a minus sign.**

Momentum is a vector; without signs a collision gives a plausible wrong number.

动量要带方向

CED 4.2

✗ Assuming kinetic energy is conserved in every collision.

✓ **Only in an elastic one. Momentum is conserved in both.**

The two conservation statements have different conditions, and the question always says which applies.

只有弹性碰撞动能守恒

CED 4.3

5 · Torque and Rotational Dynamics 力矩与转动动力学

✗ Computing a torque without the perpendicular distance.

✓ **$\tau = rF \sin \theta$ – use the component of the force perpendicular to the lever arm.**

Dropping the angle is the standard error and turns a correct force into a wrong torque.

力矩要用垂直分量

CED 5.2

✗ Using the same moment of inertia whatever the axis.

✓ **It depends on the axis; check which one the question uses.**

The value is a property of the body AND the axis together.

转动惯量取决于转轴

CED 5.5

7 · Oscillations 振动

✗ Saying a block at the top of a loop needs zero speed.

✓ **It must be MOVING fast enough for gravity alone to supply the centripetal force, or it leaves the track.**

The guidelines print this as the required reasoning.

环顶必须有最小速度

SG2023

✗ Saying the period of a mass-spring oscillator depends on the amplitude.

✓ **It depends on the mass and the spring constant only.**

This independence is a defining property of simple harmonic motion and a standard discriminator.

周期与振幅无关

CED 7.2

8 · Fluids 流体

✗ Explaining a pressure difference by the weight of the object rather than the fluid.

✓ **Pressure in a fluid depends on depth, density and g , not on the shape of the container.**

The container shape is the usual distractor in these questions.

液体压强只看深度和密度

CED 8.2

✗ Saying an object floats because it is light.

✓ **It floats when the upthrust equals its weight, which happens when its average density is lower than the fluid's.**

The comparison is between densities, not between masses.

浮沉看密度不看质量

CED 8.3

✗ Treating the buoyant force as depending on the object's depth.

✓ **It equals the weight of fluid displaced, so for a fully submerged object it does not change with depth.**

Depth changes the pressure on each face but not the difference between them.

浮力与深度无关

CED 8.3

6 · Energy and Momentum of Rotating Systems 转动系统的能量与动量

✗ Applying conservation of angular momentum to a system with an external torque.

✓ **Check first: angular momentum is conserved only when the net external torque is zero.**

The condition is what makes the conservation statement usable, and the question always supplies it.

无外力矩才守恒

CED 6.3

✗ Saying a skater spins faster because they ‘push harder’.

✓ **Pulling the arms in reduces the moment of inertia, so the angular speed rises to keep L constant.**

The mechanism is the explanation point, and the intuitive answer names no quantity.

转动惯量减小, 角速度增大

CED 6.3

✗ Adding rotational and translational kinetic energy as if one were the other.

✓ **A rolling body has both:** $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$.

Omitting either term makes an energy-conservation answer wrong by a fixed fraction.

滚动有平动和转动两部分动能

CED 6.1

✗ Using $v = \omega r$ for a body that is slipping.

✓ **The relation holds for rolling WITHOUT slipping – check the condition.**

The rolling constraint is an assumption, and the question states whether it applies.

纯滚动才有 $v = \omega r$

CED 5.6

■ Where a question gives a graph and asks for a quantity, say which feature you used – the gradient, the area, or an intercept. The readers score the identification.

说明用的是斜率还是面积

SG 2 years