

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.

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.

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.

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.

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).

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 .

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.

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.

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.

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.

“ ” “ ”

SG 3 years

9 · Thermodynamics

✗ Saying temperature measures the heat in a gas.

✓ **Temperature is proportional to the AVERAGE kinetic energy of the molecules; heat is energy transferred.**

The distinction is the content of the topic, and the wrong word makes the answer wrong.

CED 9.2

✗ Using a Celsius temperature in a gas-law calculation.

✓ **Every gas law takes kelvin.**

A 27 °C substituted as 27 rather than 300 K is out by a factor of eleven.

CED 9.3

✗ Saying entropy ‘is disorder’ and stopping.

✓ **Say what changed: more accessible microstates, so more ways to arrange the energy.**

The explanation point is for the mechanism, and the metaphor names none.

CED 9.6

10 · Electric Force, Field, and Potential

✗ Confusing electric field with electric potential.

✓ **Field is a vector and follows an inverse-square law; potential is a scalar and follows an inverse law.**

The two are computed from the same charge and distance, so the wrong one is easy to write.

CED 10.4

✗ Saying the field inside a charged conductor is zero because there is no charge there.

✓ **It is zero because the charges rearrange until they cancel any internal field.**

The mechanism is the scored part; the potential inside is constant and NOT zero.

CED 10.6

11 · Electric Circuits

✗ Adding parallel resistances directly.

✓ **Reciprocals add, and the result is smaller than the smallest resistance – check it against that.**

The check catches the error instantly and costs one line.

CED 11.4

✗ Saying current is used up as it goes round a circuit.

✓ **Current is the same everywhere in a series loop; it is energy that is transferred.**

A named misconception that contradicts charge conservation.

CED 11.2

12 · Magnetism and Electromagnetism

✗ Using the left hand for induction.

✓ **Left hand is the motor effect; the right hand is the generator effect.**

The rules are mirror images, so the wrong one gives a confident wrong direction.

CED 12.3

✗ Saying a stationary magnet in a coil induces an e.m.f.

✓ **The FLUX must change – by motion, by a changing field, or by a changing area.**

The rate of change is the whole content of Faraday's law.

CED 12.5

13 · Geometric Optics

✗ Guessing the sign convention for a lens or mirror equation.

✓ **State your convention before substituting, and keep it for the whole question.**

The image's nature follows from the signs, so an unstated convention makes the answer unmarkable.

CED 13.3

✗ Describing an image as real without checking which side it forms on.

✓ **A real image forms where the rays actually meet, and can be projected; a virtual one cannot.**

The three properties – real or virtual, upright or inverted, magnified or reduced – are scored separately.

CED 13.2

14 · Waves, Sound, and Physical Optics

✗ Calling two sources coherent because they are equally bright.

✓ **Coherence needs the same frequency and a constant phase difference.**

Amplitude is irrelevant to coherence, and this is a standard discriminator.

✓

CED 14.5

✗ Saying a standing wave transfers energy along the string.

✓ **It does not – that is the defining difference from a progressive wave.**

The property is what the question is testing.

CED 14.3

15 · Modern Physics

✗ Saying brighter light gives photoelectrons more energy.

✓ **Intensity increases the NUMBER emitted; only frequency increases their kinetic energy.**

The distinction is the evidence for the photon model.

✓

CED 15.2

✗ Explaining a nuclear decay as the nucleus ‘getting old’.

✓ **Decay is spontaneous and random, with a constant probability per unit time.**

The randomness is what makes the exponential law follow.

CED 15.5

■ Check that a mass-energy answer uses consistent units: joules with kilograms, or MeV with atomic mass units. Mixing them is the commonest slip in this unit.

CED 15.4

11 · Electric Circuits

✗ Treating e.m.f. and terminal voltage as the same.

✓ **They differ by the potential difference lost across the internal resistance.**

The difference is what the topic is about, and the question always supplies enough to find it.

≠

CED 11.3

✗ Saying a bulb is brighter because it has a larger resistance.

✓ **Brightness follows POWER, and which of I^2R or V^2/R applies depends on whether the current or the voltage is shared.**

Series and parallel give opposite answers, so the circuit has to be read first.

✓

CED 11.4

13 · Geometric Optics

✗ Drawing a ray diagram with only one ray.

✓ **Draw at least two of the standard rays, and let the image form where they meet.**

One ray fixes nothing; the intersection is what locates the image.

CED 13.2

14 · Waves, Sound, and Physical Optics

✗ Confusing the path-difference condition with the phase-difference condition.

✓ **Constructive interference needs a path difference of a whole number of wavelengths, which is a phase difference of $2\pi n$.**

Both are stated in the topic and the question names one of them.

CED 14.6

✗ Saying sound can be polarised.

✓ **Only transverse waves can be polarised; sound is longitudinal.**

The property distinguishes the two wave types and is a standard discriminator.

CED 14.4