

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