AP Physics 2 Practice Ladder

Use this key to check answers and read the explanations.

1. In a classroom model, a fixed amount of monatomic ideal gas keeps the same temperature while its volume changes. What happens to its internal energy?

A. It stays the same.
B. It increases whenever volume increases.
C. It decreases whenever volume increases.
D. It becomes zero when volume changes.

Correct answer: A. It stays the same.

For a fixed amount of monatomic ideal gas, internal energy depends on temperature. A change in volume at constant temperature leaves internal energy unchanged.

2. In an idealized diagram, a uniform electric field points east. Which direction is the electric force on a small negative test charge placed in the field?

A. North
B. East
C. West
D. South

Correct answer: C. West

A field arrow gives the force direction for a positive test charge. A negative test charge has force opposite the electric field, toward the west.

3. A light wave crosses a stationary boundary into a material where its speed is lower. What happens to its frequency and wavelength as it enters?

A. Frequency decreases and wavelength stays the same.
B. Frequency stays the same and wavelength decreases.
C. Frequency stays the same and wavelength increases.
D. Frequency increases and wavelength decreases.

Correct answer: B. Frequency stays the same and wavelength decreases.

The same number of wave crests passes the boundary each second, so the frequency stays fixed. A lower speed at the same frequency means a shorter wavelength.

4. A figure stands 0.60 meter in front of a plane mirror. Where does its virtual image appear?

A. On the surface of the mirror
B. 0.60 meter in front of the mirror
C. 1.20 meters behind the mirror
D. 0.60 meter behind the mirror

Correct answer: D. 0.60 meter behind the mirror
The image of an object in a plane mirror appears as far behind the mirror as the object is in front. Each distance from the mirror is 0.60 meter.

5. Two classical ideal gases are at the same absolute temperature. The particles of gas A have greater mass than those of gas B. How do their average translational kinetic energies compare?

A. Gas A has the greater average energy because its particles are heavier.
B. The two average energies are equal.
C. Gas B has the greater average energy because its particles move faster on average.
D. The average energies cannot be compared without the two container volumes.

Correct answer: B. The two average energies are equal.
The average translational kinetic energy of a gas particle depends on absolute temperature. Lighter particles can move faster at the same temperature while having the same average translational kinetic energy.

6. Two point charges exert an electric force on each other. In a revised model, the magnitude of one charge triples and the distance between them doubles. The other charge stays unchanged. What is the new force magnitude as a fraction of the original?

A. 3/4
B. 3/2
C. 1/4
D. 4/3

Correct answer: A. 3/4
Coulomb’s law makes the force proportional to the product of the charge magnitudes and inversely proportional to the distance squared. The two changes multiply the force by 3 divided by 4.

7. In an ideal low-voltage circuit model, a resistor has 3.0 volts across it and carries 0.015 ampere. What is the resistor’s resistance?

A. 0.005 ohm
B. 45 ohms
C. 0.20 ohm
D. 200 ohms

Correct answer: D. 200 ohms
Resistance equals potential difference divided by current. Dividing 3.0 volts by 0.015 ampere gives 200 ohms.

8. An ideal 0.60-meter string is fixed at both ends. Its third-harmonic standing wave has three loops between the ends. What is the wavelength?

A. 0.60 meter
B. 0.20 meter
C. 0.40 meter
D. 1.20 meters

Correct answer: C. 0.40 meter
Each loop takes up half a wavelength. Three halves of a wavelength fit in 0.60 meter, so the full wavelength is 2 times 0.60 divided by 3.

9. A ray inside a transparent material reaches a boundary with a lower-index material. Its angle of incidence is greater than the critical angle. What does geometric optics predict?

A. The ray is totally internally reflected.
B. The transmitted ray travels along the boundary.
C. The transmitted ray bends closer to the normal.
D. The ray crosses the boundary without changing direction.

Correct answer: A. The ray is totally internally reflected.
At the critical angle, the transmitted ray would run along the boundary. At a greater angle there is no transmitted ray propagating into the lower-index material, so the ray is reflected inside the higher-index material.

10. In a fictional dataset, a fixed amount of ideal gas at constant volume has a pressure of 90 kilopascals at 300 kelvins. What pressure does the ideal-gas model predict at 400 kelvins?

A. 160 kilopascals
B. 67.5 kilopascals
C. 90 kilopascals
D. 120 kilopascals

Correct answer: D. 120 kilopascals
For fixed volume and amount of gas, pressure is proportional to absolute temperature. Multiply 90 kilopascals by 400 divided by 300 to get 120.

11. In a fictional constant-pressure process at 80 kilopascals, a gas expands from 0.50 liter to 0.80 liter and absorbs 40 joules of heat. The only work is expansion work. What is the change in the gas’s internal energy?

A. It decreases by 16 joules.
B. It increases by 64 joules.
C. It increases by 16 joules.
D. It decreases by 24 joules.

Correct answer: C. It increases by 16 joules.
The volume increases by 0.00030 cubic meter. The gas does 80,000 times 0.00030, or 24 joules, of work on its surroundings. It gains 40 joules as heat, so its internal energy rises by 16 joules.

12. In a model, a small charge of negative 2 microcoulombs moves from a point at 5 volts to a point at 1 volt. What happens to its electric potential energy?

A. It decreases by 8 microjoules.
B. It increases by 8 microjoules.
C. It increases by 12 microjoules.
D. It decreases by 4 microjoules.

Correct answer: B. It increases by 8 microjoules.
The potential change is 1 minus 5, or negative 4 volts. The change in potential energy equals the charge times that change. Negative 2 times negative 4 gives positive 8 microjoules.

13. A small object is 30 centimeters from an ideal converging lens with a focal length of 10 centimeters. Which description gives the image distance and orientation?

A. 5 centimeters on the object’s side of the lens, upright
B. 15 centimeters on the object’s side of the lens, upright
C. 30 centimeters on the opposite side of the lens, inverted
D. 15 centimeters on the opposite side of the lens, inverted

Correct answer: D. 15 centimeters on the opposite side of the lens, inverted
The reciprocal of the image distance is one tenth minus one thirtieth, or one fifteenth. The positive image distance puts it on the opposite side from the object. The negative magnification means the image is inverted.

14. Two coherent waves of equal amplitude and wavelength 0.40 meter start in phase. Their path difference is 0.60 meter at point A and 0.80 meter at point B. Which interference occurs at A and at B, in that order?

A. Destructive, then constructive
B. Constructive, then destructive
C. Constructive at both points
D. Destructive at both points

Correct answer: A. Destructive, then constructive
At A the path difference is 1.5 wavelengths, which gives a half-cycle mismatch. At B it is 2 wavelengths, so the waves arrive in phase and add.

15. A fictional ideal circuit has a 6.0-volt source and two series resistors of 100 ohms and 200 ohms. What power is transferred to the 200-ohm resistor?

A. 0.120 watt
B. 0.040 watt
C. 0.080 watt
D. 0.180 watt

Correct answer: C. 0.080 watt

The total resistance is 300 ohms, so the current everywhere in the series circuit is 6.0 divided by 300, or 0.020 ampere. The 200-ohm resistor receives current squared times resistance, which equals 0.080 watt.