Braking on a level track

Suggested time for the entire exam: 35–50 min; adjust to local conditions.

Name _____ **Date** _____

A 2.0 kg cart’s velocity changes uniformly from +8.0 m/s to +2.0 m/s in 3.0 s. Take its original motion as positive.

1. What is the acceleration?

- ○ A −2.0 m/s²
- ○ B +5.0 m/s²
- ○ C +2.0 m/s²
- ○ D −6.0 m/s²

2. What is the net force during braking?

- ○ A −12 N
- ○ B +10 N
- ○ C −4.0 N
- ○ D +4.0 N

3. Determine displacement and change in kinetic energy. Show substitutions and units, and explain the sign of each result.

A circuit on the bench

Use the stimulus and your course knowledge.

Name _____ **Date** _____

An ideal 18 V battery is connected across 9 Ω and 6 Ω resistors in parallel. Ideal wires and steady operation are assumed. Use V = IR and P = VI.

4. What is the current in the 9 Ω branch?

- ○ A 5 A
- ○ B 3 A
- ○ C 0.5 A
- ○ D 2 A

5. If the 6 Ω branch is disconnected, what happens to the current in the 9 Ω branch?

- ○ A It becomes the original total current.
- ○ B It doubles.
- ○ C It stays the same.
- ○ D It drops to zero.

6. For the original circuit calculate total current, equivalent resistance and total power. Show equations and units.

Refraction at a flat surface

Use the stimulus and your course knowledge.

Name _____ **Date** _____

A light ray goes from air (n = 1.00) into a transparent material (n = 1.40). The incident angle is 40° to the normal. Use $n_1 \sin \theta_1 = n_2 \sin \theta_2$ and $c = 3.00 \times 10^8$ m/s.

7. What is the approximate refracted angle to the normal?

- ○ A 40°
- ○ B 27°
- ○ C 64°
- ○ D 13°

8. Which property remains unchanged as the light enters the material?

- ○ A Frequency
- ○ B Wavelength
- ○ C Speed
- ○ D Angle to the normal

9. Calculate speed in the material. Sketch the interface, normal and rays and label both angles so their reference line is unambiguous.

Excited atoms and emitted light

Use the stimulus and your course knowledge.

Name _____ **Date** _____

A model atom has allowed energies −6.0, −3.0 and −1.0 eV. It begins at −1.0 eV and reaches −6.0 eV, either directly or by way of −3.0 eV. Use 1 eV = 1.60×10^{-19} J and h = 6.63×10^{-34} J·s.

10. What photon energy accompanies the direct transition?

- ○ A −5.0 eV
- ○ B 7.0 eV
- ○ C 1.0 eV
- ○ D 5.0 eV

11. Which path yields two photons?

- ○ A Remaining at −6.0 eV
- ○ B −1.0 → −3.0 → −6.0 eV
- ○ C −1.0 → −6.0 eV directly
- ○ D Remaining at −1.0 eV

12. Find the frequency of the directly emitted photon. Compare its energy with the combined energies of the two photons on the other path.