

Heat, work and engines on PV diagrams

AP Physics 2 (algebra-based) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers the first law, PV diagrams, heat engines and entropy for AP Physics 2. Use $\Delta U = Q + W$ with W the work done on the gas, $R = 8.31 \text{ J/(mol}\cdot\text{K)}$ and temperatures in kelvin. Show all working and give a short written reason wherever a question asks you to explain.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 9

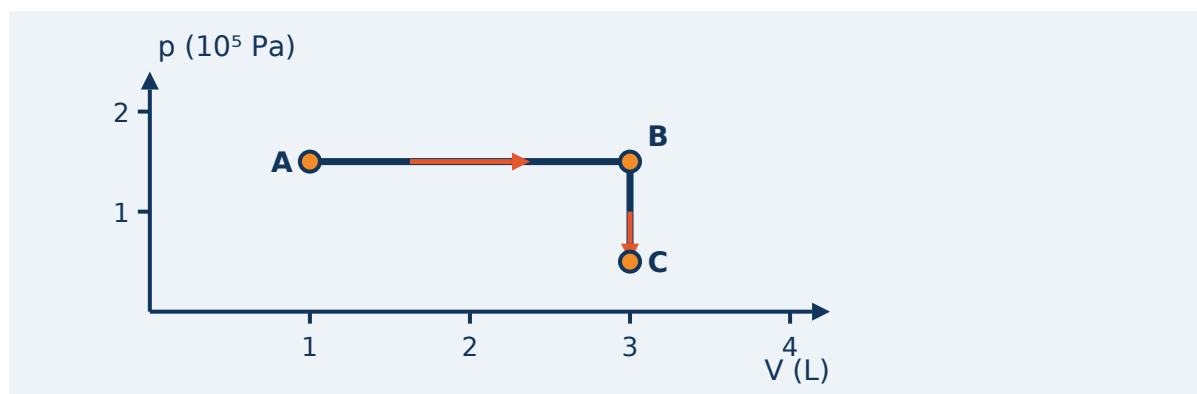
Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 First law with numbers (3 marks)

A gas (0.10 mol, monatomic) absorbs 500 J of heat and expands, doing 200 J of work on its surroundings.

- State the values of Q and W (work done on the gas). (1 mark)
- Calculate ΔU . (1 mark)
- Calculate the temperature change. (1 mark)

Question 2 A two-step path (3 marks)



Path A to B to C.

A gas goes from A to B at constant pressure, then from B to C at constant volume.

- Calculate the work done by the gas from A to B. (1 mark)
- Show that the temperature at C equals the temperature at A. (1 mark)
- Calculate the net heat added from A to C. (1 mark)

Question 3 Process types (2 marks)

- In an isochoric process, state the work done and the relation between Q and ΔU . (1 mark)
- In an isothermal expansion of an ideal gas, explain where the energy for the work comes from. (1 mark)

Question 4 An engine claim (3 marks)

An engine absorbs 1200 J from a hot reservoir at 600 K and rejects 900 J to a cold reservoir at 300 K per cycle.

- Calculate the net work. (1 mark)
- Calculate the efficiency. (1 mark)
- Compare it with the Carnot efficiency and state whether the engine is possible. (1 mark)

Question 5 Maximum efficiency (2 marks)

A steam engine works between 450 K and 300 K.

- Calculate the maximum possible efficiency. (1 mark)
- State the minimum heat rejected for each 900 J absorbed. (1 mark)

Question 6 Entropy and heat flow (3 marks)

A heat flow of 900 J passes from a body at 450 K to a body at 300 K.

- Calculate the entropy change of each body. (2 marks)
- Explain why this process is allowed by the second law. (1 mark)

Question 7 Compressing a gas quickly (2 marks)

A gas in an insulated cylinder is compressed quickly.

- State the value of Q . (1 mark)
- Explain why the temperature of the gas rises. (1 mark)

Question 8 Engine or refrigerator? (2 marks)

A gas follows a closed cycle on a PV diagram.

- State the sign of the net work done on the gas when the loop is traced clockwise. (1 mark)
- State what kind of device the anticlockwise loop represents. (1 mark)