

EPA 608: RECOGNIZE THE PATTERN

Refrigerant families, numbering, blends, ODP/GWP, safety classes and exam shortcuts

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How to use this guide: RULE = reliable convention; PATTERN = useful but not universal; MEMORIZE = learn the specific fact. This is a study supplement, not a substitute for EPA-approved training, manufacturer instructions, or current regulations.

1 | Start with the chemical family

Family	What is in it?	Ozone depletion (ODP)	Examples
CFC	Carbon, chlorine, fluorine	Nonzero; often high	R-11, R-12
HCFC	Hydrogen, chlorine, fluorine, carbon	Nonzero; generally less than CFC	R-22, R-123
HFC	Hydrogen, fluorine, carbon; no chlorine	Zero	R-32, R-134a, R-125
HFO	Unsaturated fluorinated organic compound; many have H, F and C	Typically zero for chlorine-free HFOs	R-1234yf, R-1234ze(E)
Hydrocarbon	Hydrogen and carbon	Zero	R-290, R-600a
Inorganic	Other inorganic molecules	Depends on compound; common examples zero	R-717, R-744

RULE: Chlorine in a CFC/HCFC is the clue for ozone depletion. RULE: HFCs have no chlorine and ODP = 0. TRAP: ODP = 0 does not mean GWP = 0. Some chlorine-containing newer compounds are not ordinary HFOs; identify the actual chemical rather than guessing from a marketing label.

2 | Decode refrigerant number families

Designation	Recognition rule	Example / caveat
R-4xx	Zeotropic blend series	R-407C, R-410A, R-454B; glide may be tiny
R-5xx	Azeotropic blend series	R-502, R-507A
R-4xxx	Additional zeotropic blend series	Used as the classic 4xx assignments fill up
R-5xxx	Additional azeotropic blend series	Do not confuse with R-500 itself
R-7xx	Inorganic; generally 700 + rounded molecular mass	R-717 ammonia; R-718 water; R-744 CO ₂
R-6xx	Selected organic compounds; not a single safety family	R-600a isobutane; do not generalize
R-1xxx	Often unsaturated compounds, not all necessarily HFO	R-1234yf, R-1270 (propylene)

MEMORIZE: R-11 and R-12 = CFC; R-22 and R-123 = HCFC; R-134a and R-32 = HFC. A number by itself does not tell you the ODP, GWP, or safety class of an arbitrary refrigerant.

3 | Decode a pure saturated halocarbon

For many common saturated halocarbons, write the number as three digits (pad with leading zeros). Read digits as (carbon - 1), (hydrogen + 1), fluorine. Then complete the carbon valences with chlorine, where applicable. This does NOT apply to blends, inorganic compounds or unsaturated compounds.

Refrigerant	Digits	Carbon	Hydrogen	Fluorine	Chlorine / family
R-12	012	$0 + 1 = 1$	$1 - 1 = 0$	2	2 Cl = CFC
R-22	022	$0 + 1 = 1$	$2 - 1 = 1$	2	1 Cl = HCFC
R-134a	134	$1 + 1 = 2$	$3 - 1 = 2$	4	0 Cl = HFC

Letter trick: lowercase a/b after a pure-compound number denotes an isomer (R-134a); uppercase A/B/C after a blend number distinguishes compositions made from the same constituent refrigerants (R-407A vs R-407C). Uppercase A in R-410A does NOT mean safety group A.

4 | 700-series memory trick

RULE: Common inorganic numbers approximate 700 + molecular mass: $\text{NH}_3 = 17 \rightarrow \text{R-717}$; $\text{H}_2\text{O} = 18 \rightarrow \text{R-718}$; $\text{CO}_2 = 44 \rightarrow \text{R-744}$. Use this as a recognition rule, not a substitute for a refrigerant listing.

BLENDS: WHAT THE EXAM IS TESTING

5 | Zeotropic vs azeotropic

Zeotropic (400 / 4000)	Azeotropic (500 / 5000)
Liquid and vapor can have different compositions during boiling/condensing.	At a particular condition, vapor and liquid compositions are the same.
Usually exhibits temperature glide; amount varies greatly.	Essentially zero glide at the azeotropic condition.
Composition can shift through fractionation.	Can still segregate away from azeotropic conditions; not magic.
Examples: R-407C, R-410A, R-454B.	Examples: R-502, R-507A.

TRAP: R-410A is a zeotropic blend despite having very small glide. Do not call it azeotropic simply because its glide is negligible in many service situations.

6 | Bubble, dew and temperature glide

Bubble point: the saturated-liquid temperature at a specified pressure. Dew point: the saturated-vapor temperature at that pressure. Glide: difference between dew and bubble temperatures at the same pressure (for the applicable PT chart).

Calculation	Use on a glide-aware PT chart	Memory phrase
Subcooling	Bubble temperature minus actual liquid-line temperature	Bubble = liquid = subcooling
Superheat	Actual vapor/suction temperature minus dew temperature	Dew = vapor = superheat

Worked example (illustrative, not actual refrigerant data): At a measured pressure, PT chart says bubble 95°F and dew 105°F. Liquid line = 88°F → subcooling = 95 - 88 = 7°F. Suction line = 117°F → superheat = 117 - 105 = 12°F. Glide = 105 - 95 = 10°F.

7 | Fractionation and charging blends

Fractionation: blend components separate disproportionately, potentially changing mixture composition. RULE for classroom/exam: Withdraw zeotropic blend refrigerant from the cylinder as liquid to maintain intended composition. When adding through a suction service connection, meter/throttle it appropriately to avoid sending liquid to the compressor. Follow the specific manufacturer and refrigerant instructions.

TRAP: “Charge as liquid” does NOT mean pour unrestricted liquid into a running compressor. It refers to the state withdrawn from the cylinder. Do not assume every blend requires exactly the same charging procedure.

8 | Common blends to recognize

Refrigerant	Blend constituents	Family / useful exam clue
R-410A	R-32 / R-125 (50/50)	HFC zeotrope; very low glide; A1
R-407C	R-32 / R-125 / R-134a (23/25/52)	HFC zeotrope; noticeable glide; A1
R-404A	R-125 / R-143a / R-134a (44/52/4)	HFC zeotrope; high GWP; A1
R-507A	R-125 / R-143a (50/50)	HFC azeotrope; A1
R-454B	R-32 / R-1234yf	HFC/HFO blend; zeotrope; A2L

Refrigerant	Blend constituents	Family / useful exam clue
R-32	Single HFC, NOT a blend	A2L
R-290	Propane, NOT a blend	A3

Pattern: A blend may mix HFC and HFO ingredients; do not assume every 400-series blend is all-HFC or all-A1. Confirm the assigned safety class.

ODP, GWP AND SAFETY

9 | ODP versus GWP

Term	Reference	What it measures	Exam trap
ODP	R-11 = 1	Relative ozone-depleting impact	Zero ODP does not mean safe or climate-neutral
GWP	CO ₂ = 1	Relative warming effect over a chosen time horizon, commonly 100 years	Same family does not guarantee same GWP

MEMORIZE the relative picture: CFCs often have high ODP; HCFCs have lower but nonzero ODP; HFCs have zero ODP but some have high GWP; many HFOs have zero ODP and low GWP; CO₂ has GWP 1 by definition. GWP values vary by scientific assessment and time horizon: the exact number must come from a specified table.

10 | Approximate 100-year GWP reference examples

The following are rounded teaching reference values using commonly cited IPCC AR4 100-year values, not a universal/current regulatory lookup table. Different IPCC assessment editions can report different numbers. Learn comparisons unless your exam material specifies a dataset.

Refrigerant	Approx. GWP (AR4)	What to remember
R-744 (CO ₂)	1	Reference gas
R-32	675	Lower than R-410A, not zero
R-134a	1,430	Zero ODP; meaningful GWP
R-22	1,810	Nonzero ODP and substantial GWP
R-410A	2,088	Higher than R-32
R-404A	3,922	Very high GWP
R-1234yf	Very low (single digits)	HFO; source-dependent exact value

RULE: There is no dependable shortcut that calculates GWP from the refrigerant number. Memorize a few comparisons, and look up exact values.

11 | ASHRAE safety classifications

First character = toxicity group: A lower toxicity, B higher toxicity (under the standard criteria). Second character = flammability class: 1 no flame propagation in specified tests; 2L lower flammability with low burning velocity; 2 lower flammability; 3 higher flammability.

Class	Meaning / example	Important caution
A1	Lower toxicity, no flame propagation; e.g., R-410A	Can still displace oxygen or cause injury
A2L	Lower toxicity, lower burning velocity; e.g., R-32, R-454B	Ignition and ventilation requirements matter
A3	Lower toxicity, higher flammability; e.g., R-290	Flammable hydrocarbon; special equipment/procedures
B2L / B2	Higher toxicity with applicable flammability category	Do not equate “B” with flammability

TRAP: “A” does not mean non-toxic in all circumstances. “1” does not mean zero hazard. Safety group is independent of GWP, ODP, and refrigerant series.

12 | Recover, recycle, reclaim

Word	Meaning	Quick cue
Recover	Remove refrigerant from a system and store in an external container	Take it OUT
Recycle	Reduce contaminants using oil separation/filtering/drying processes	Clean it UP
Reclaim	Reprocess to the specified purity standard, verified by analysis	Restore to SPEC

EXAM TRAP: Recycling in the field is not the same as reclaiming to industry purity standards. Do not infer that recovered refrigerant can be freely sold or transferred to another owner without meeting applicable requirements.

EXAM DECISION RULES + PRACTICE

13 | Five-step method for unfamiliar questions

1. Look at the number: pure refrigerant, 400/500 blend, 700 inorganic, or another family?
2. Look for chlorine: ozone-depleting family or not?
3. Ask whether the question is about ozone (ODP), climate (GWP), glide, or safety. These are different properties.
4. For a blend question, think composition, liquid withdrawal, and bubble/dew.
5. If the question asks an exact GWP, pressure, safety class, or legal threshold, do not invent it from the number. Use the studied reference.

14 | Rules vs patterns vs memorize

RULE: usually dependable	PATTERN: useful but check	MEMORIZE / look up
400/4000 zeotropic; 500/5000 azeotropic	400-series blends can have little or much glide	Actual glide for a particular refrigerant
700-series inorganic convention	Many HFOs have low GWP	Exact GWP and assessment basis
Chlorine-containing CFC/HCFC have nonzero ODP	CFC generally worse ODP than HCFC	Exact ODP and chemical identity
Bubble for subcool; dew for superheat	Common HFCs often have zero ODP, substantial GWP	Safety class and composition of each blend
Uppercase blend suffix = composition variation	Liquid charging prevents composition shift	Exact service instructions and regulatory rules

15 | Ten quick practice questions

1. R-407C is what kind of refrigerant?
Answer: A zeotropic blend (400 series).
2. Does the 400 series guarantee a large temperature glide?
Answer: No. R-410A has very small glide.
3. Which saturation point is used for subcooling on a zeotropic blend PT chart?
Answer: Bubble point.
4. Which saturation point is used for superheat?
Answer: Dew point.
5. Does zero ODP mean zero GWP?
Answer: No. R-134a and R-410A are counterexamples.
6. What does the A in R-410A identify?
Answer: A blend composition suffix, not ASHRAE safety group.
7. What does the lowercase a in R-134a identify?
Answer: An isomer.
8. What refrigerant is R-744?
Answer: Carbon dioxide; 700 + approximately 44.
9. How should a zeotropic blend be withdrawn from the charging cylinder?
Answer: As liquid, with safe metering into the system as required.
10. Can you calculate the exact GWP of R-454B from its number?
Answer: No. Use a published reference value.

16 | Final one-minute memory sheet

400 = zeotrope. 500 = azeotrope. 700 = inorganic.
Bubble = liquid/subcool. Dew = vapor/superheat.
Chlorine = ozone concern. No chlorine does NOT mean no climate concern.
ODP: R-11 baseline. GWP: CO2 baseline.
Liquid out of blend cylinder; meter safely into equipment.
A/B after blend = formulation; lowercase a after pure compound = isomer.
Safety group, GWP, ODP and refrigerant number are different pieces of information.

References and currency

ASHRAE Standard 34 refrigerant designations and safety classifications:

<https://www.ashrae.org/technical-resources/standards-and-guidelines/ashrae-refrigerant-designations>

UNEP/ASHRAE Refrigerant Factsheet (2023), numbering and blend designation conventions:

<https://www.ashrae.org/file%20library/technical%20resources/refrigeration/unep---ashrae-factsheet--english----august2023.pdf>

EPA Section 608 certification: <https://www.epa.gov/section608/section-608-technician-certification-requirements>

EPA Section 608 program overview: <https://www.epa.gov/section608/section-608-clean-air-act>

Classroom note: Regulations, accepted refrigerants, safety requirements and GWP reporting conventions change. Check current EPA/ASHRAE and equipment documentation before field work. This supplement focuses on pattern recognition rather than complete Section 608 regulatory coverage.