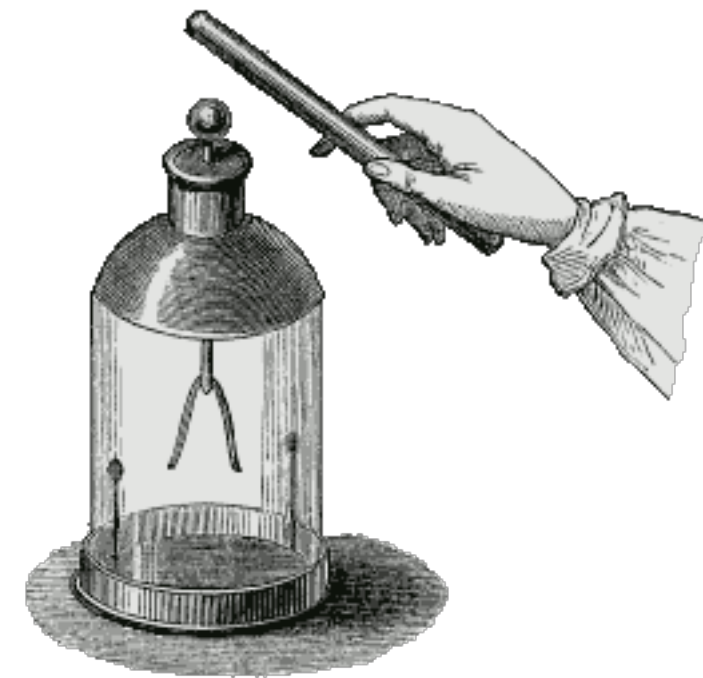


Phys121 Review

- Final Exam Thursday, August 15, 8:30 am
- Location: WMC 3520
- Same rules at midterms: 1 letter-sized formula sheet, basic scientific calculator, ruler

An electroscope is positively charged by touching it with a positive glass rod. The electroscope leaves spread apart and the glass rod is removed. Then a negatively charged plastic rod is brought close to the top of the electroscope, but it doesn't touch. What happens to the leaves?

- (a) The leaves get closer together.
- (b) The leaves spread further apart.
- (c) One leaf moves higher, the other lower.
- (d) The leaves don't move.



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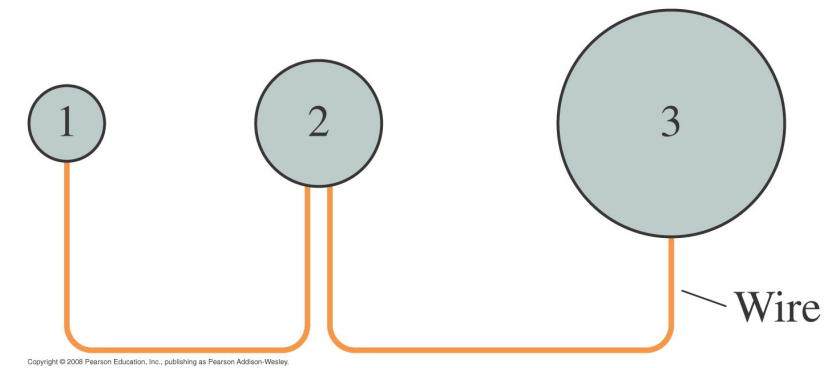
- (a) The leaves get closer together.
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- (c) One leaf moves higher, the other lower.
- (d) The leaves don't move.



(4 points) Three charged metal spheres of different radii are connected by a thin metal wire. Which describes the potential and electric field at the surface of each sphere?

- (a) $V_1 = V_2 = V_3$ and $E_1 = E_2 = E_3$
- (b) $V_1 = V_2 = V_3$ and $E_1 > E_2 > E_3$
- (c) $V_1 > V_2 > V_3$ and $E_1 = E_2 = E_3$
- (d) $V_1 > V_2 > V_3$ and $E_1 > E_2 > E_3$
- (e) $V_3 > V_2 > V_1$ and $E_3 = E_2 = E_1$

$$R_1 < R_2 < R_3$$



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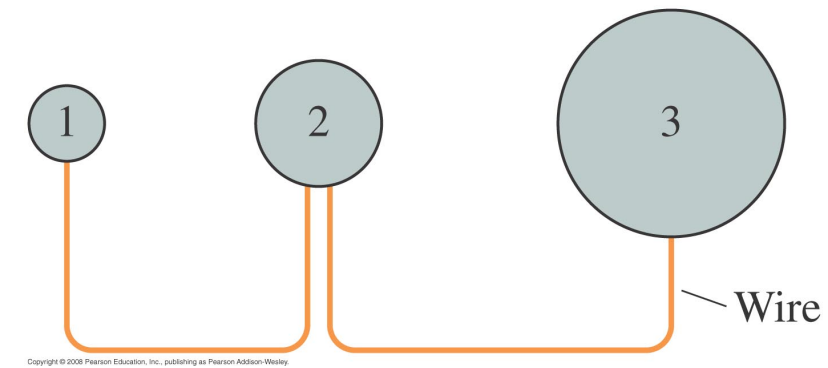
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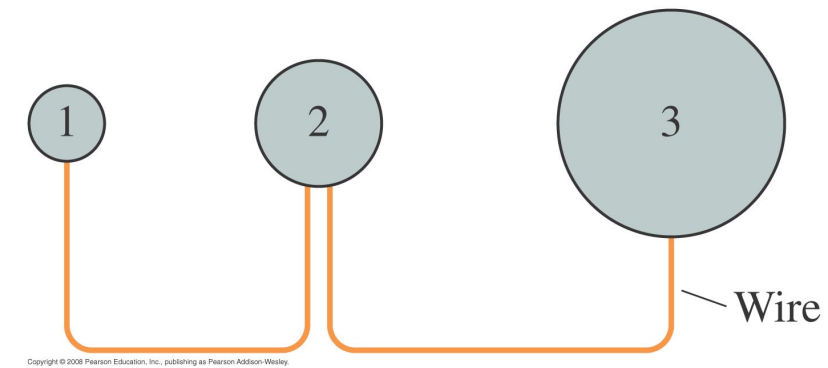
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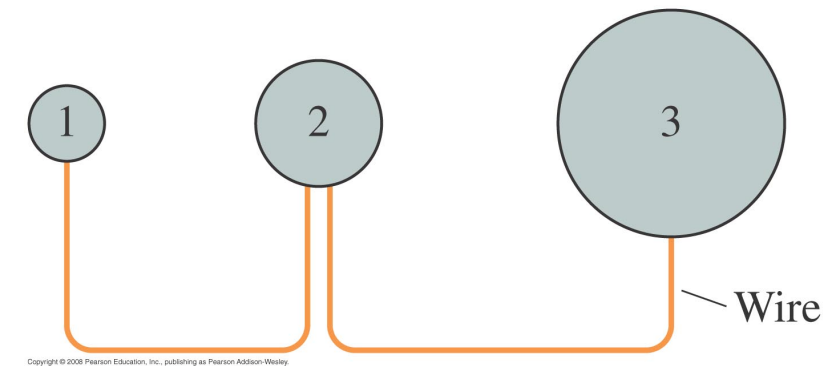
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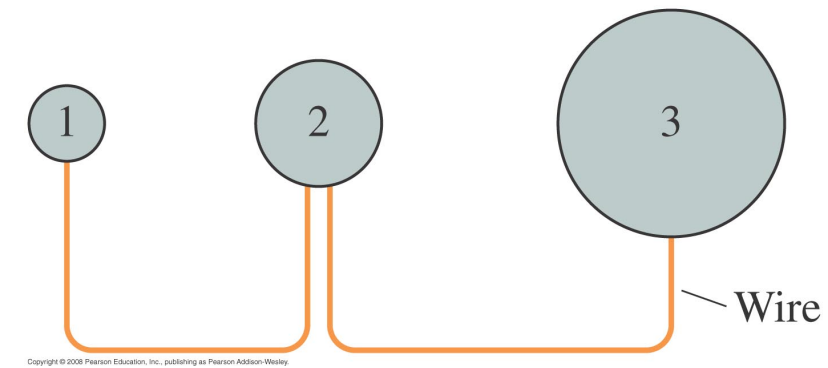
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$$\sigma_i = Q_i/4\pi R_i^2$$

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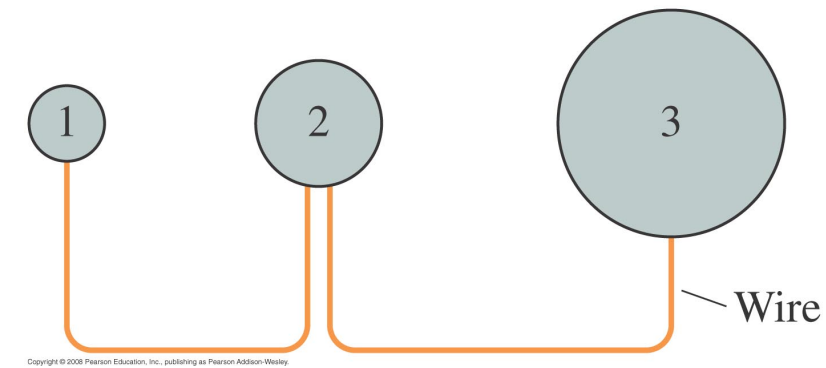
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$$R_1 < R_2 < R_3$$



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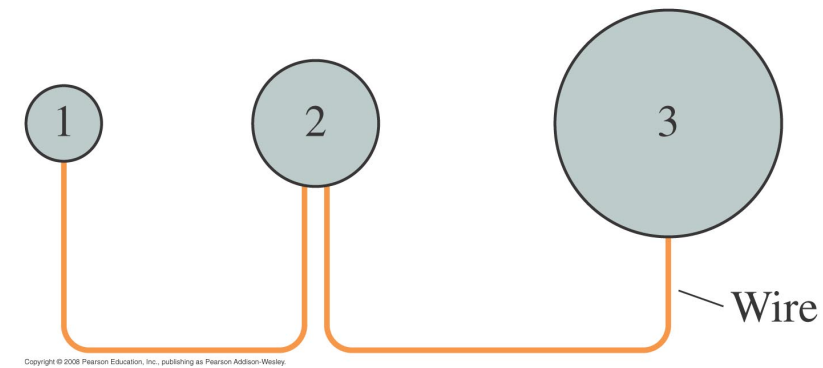
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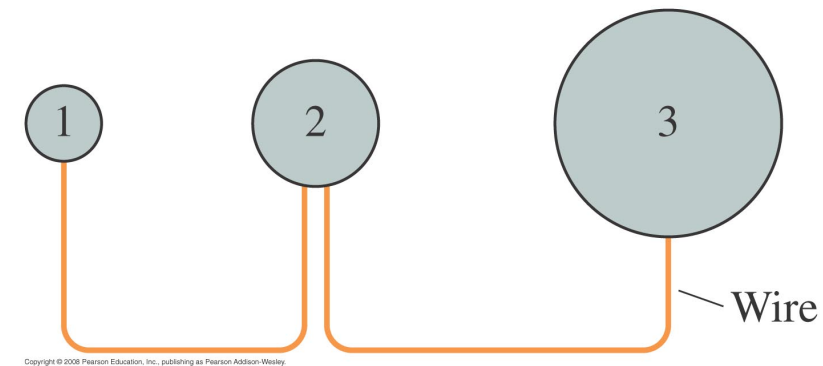
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$$V_1 = V_2 = V_3$$

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$$\sigma_i = Q_i/4\pi R_i^2$$

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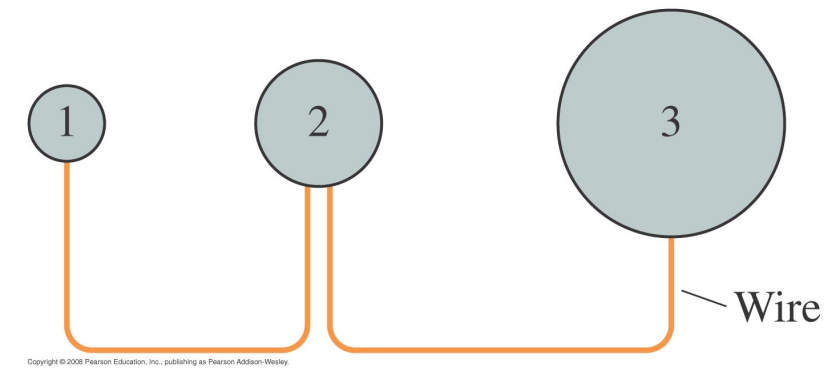
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$$V_1 = V_2 = V_3$$

$$Q_1/R_1 = Q_2/R_2 = Q_3/R_3$$

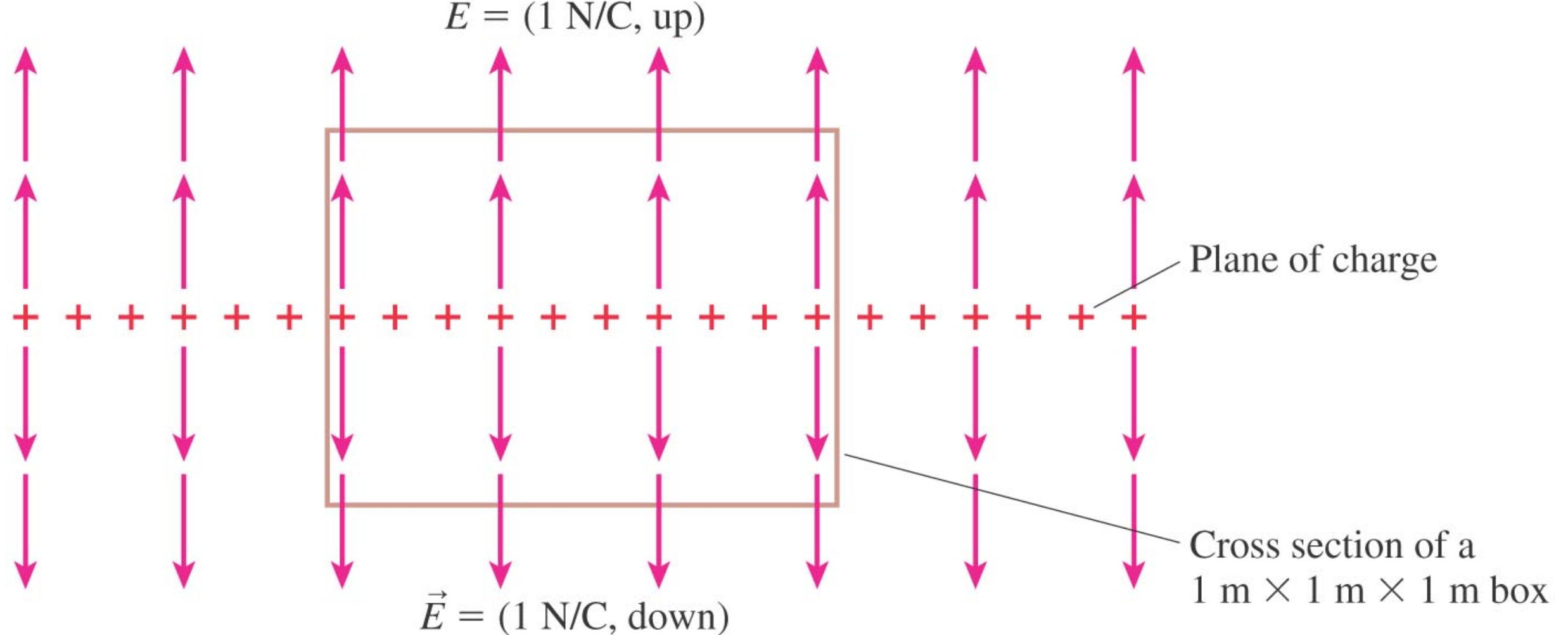
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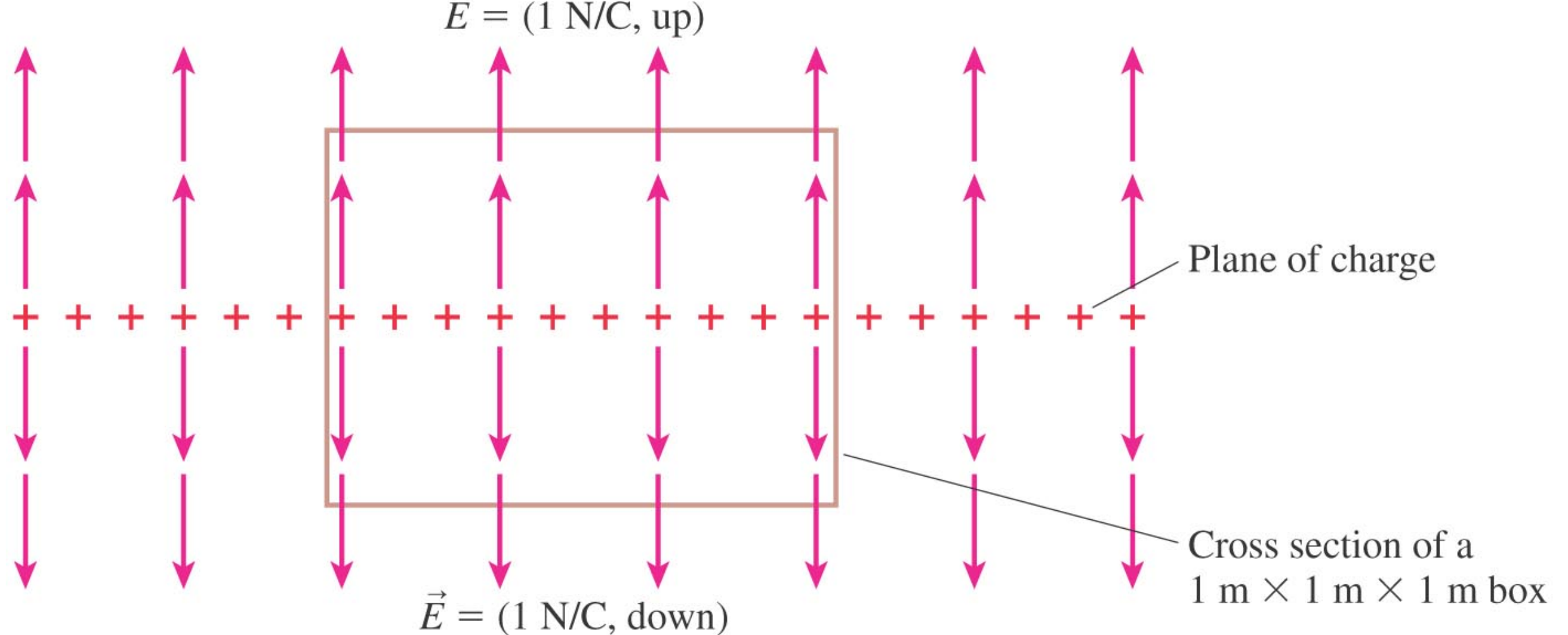
$$E_1 > E_2 > E_3$$



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The total electric flux through this box is

(a) $0 \text{ N}\cdot\text{m}^2/\text{C}$ (b) $1 \text{ N}\cdot\text{m}^2/\text{C}$ (c) $2 \text{ N}\cdot\text{m}^2/\text{C}$ (d) $3 \text{ N}\cdot\text{m}^2/\text{C}$ (e) $4 \text{ N}\cdot\text{m}^2/\text{C}$



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A conductor with total charge Q on it has a cavity inside it with an arbitrary shape. What is the electric potential inside the cavity?

- A. kQ/r where r is the distance from origin.
- B. kQ/r where r is the distance from the surface of the conductor.
- C. constant and equals the potential on the surface of the conductor.
- D. zero
- E. none of the above

A conductor with total charge Q on it has a cavity inside it with an arbitrary shape. What is the electric potential inside the cavity?

A. kQ/r where r is the distance from origin.

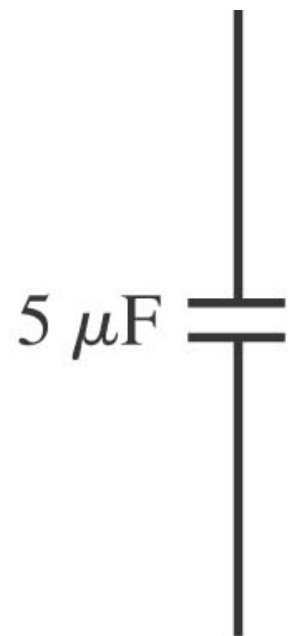
B. kQ/r where r is the distance from the surface of the conductor.

C. constant and equals the potential on the surface of the conductor.

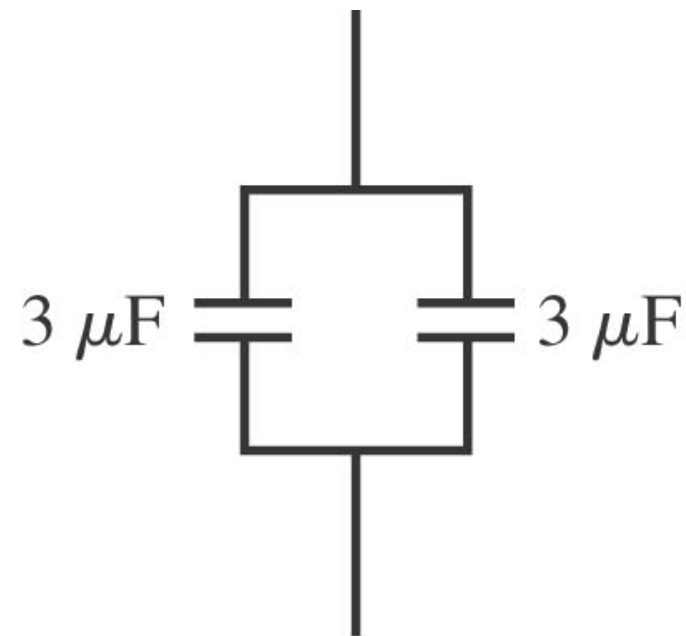
D. zero

E. none of the above

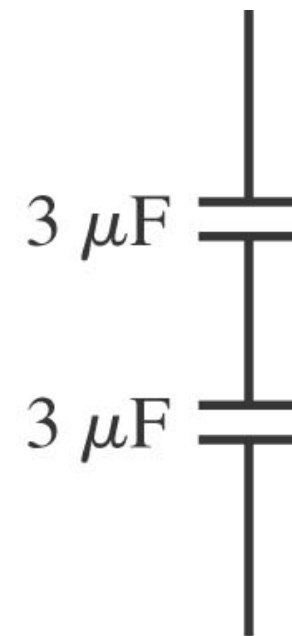
Which network of capacitors has the smallest C?



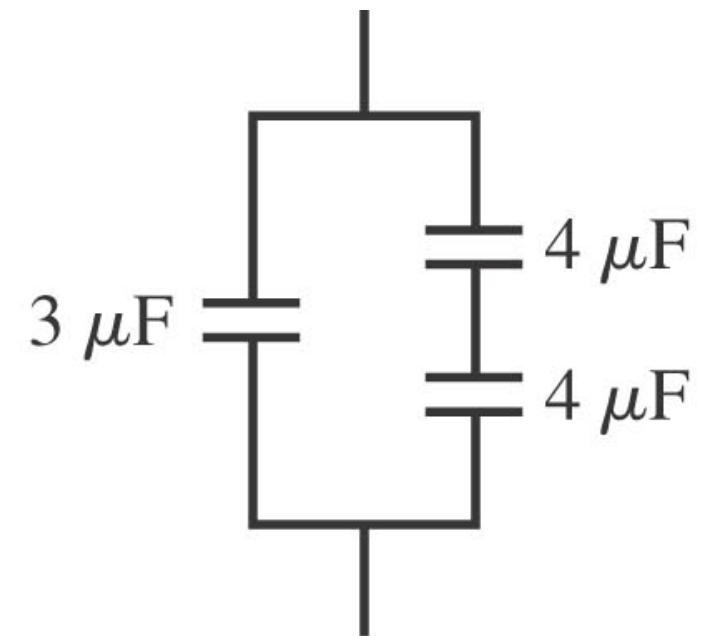
(a)



(b)

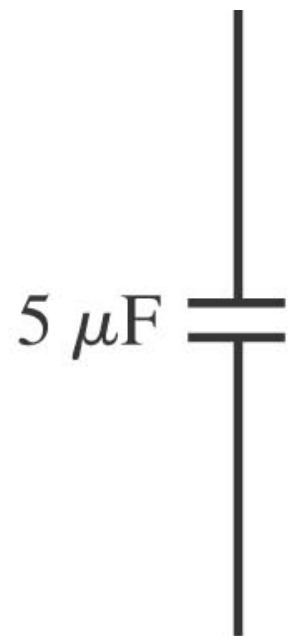


(c)

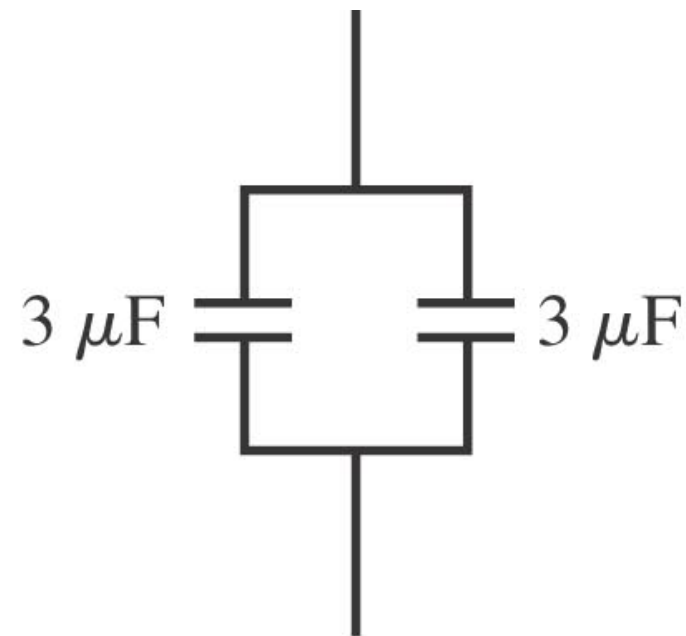


(d)

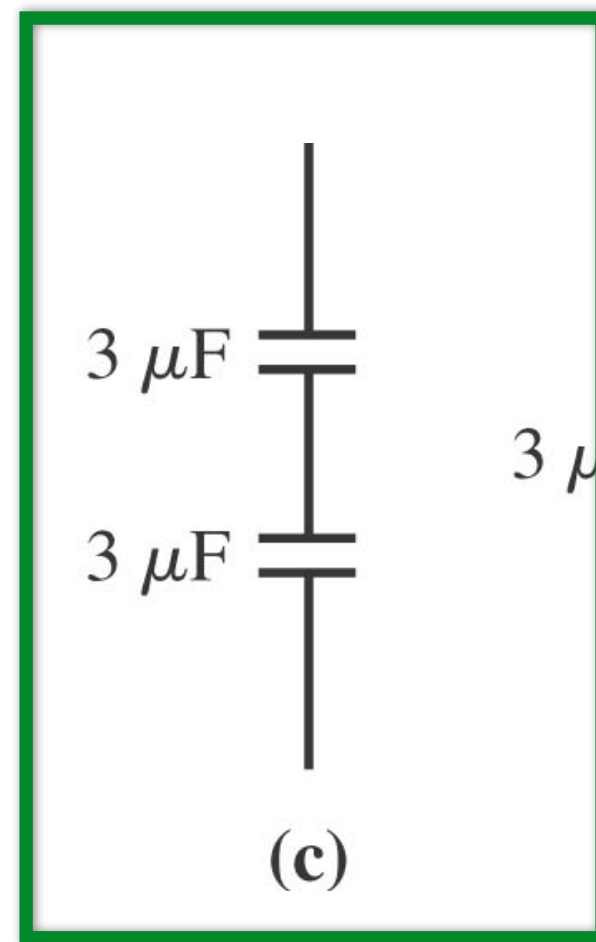
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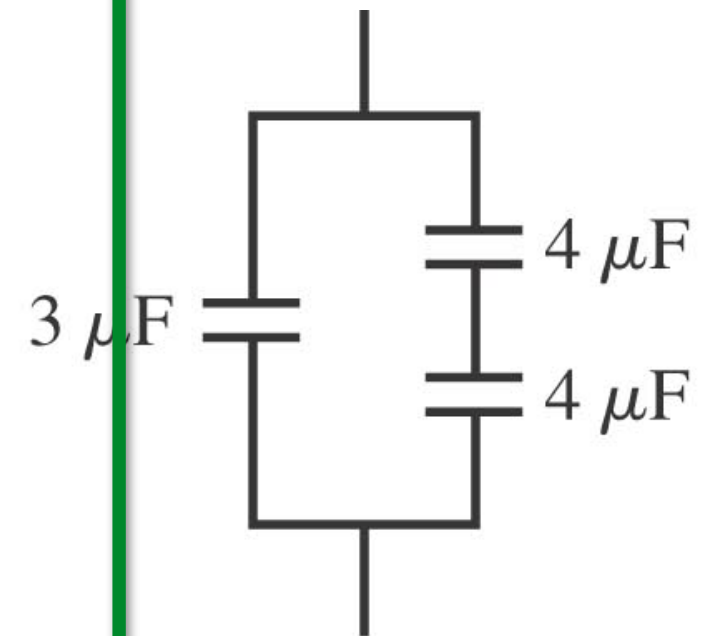
(a)



(b)

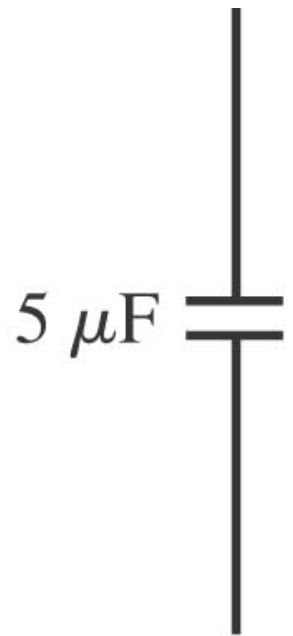


(c)

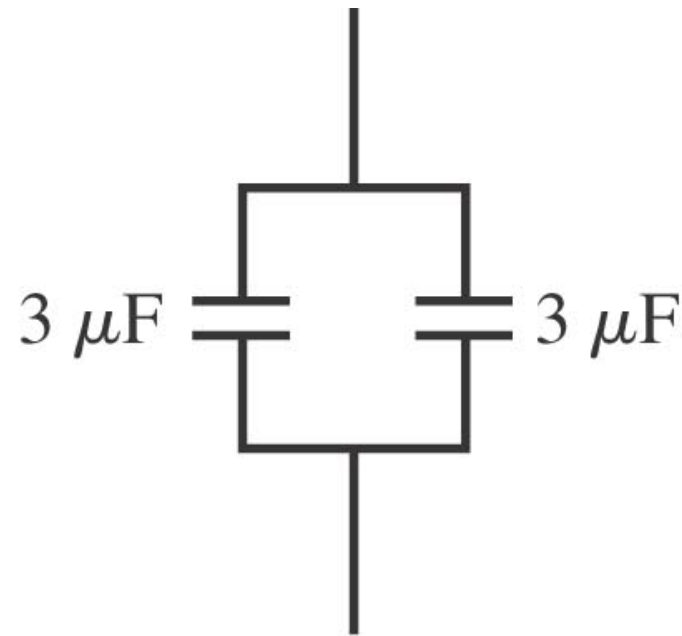


(d)

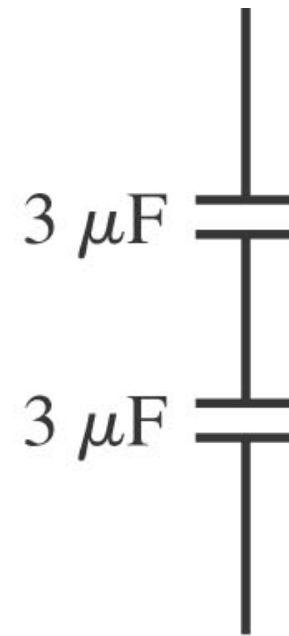
Which network of capacitors has the **largest** C?



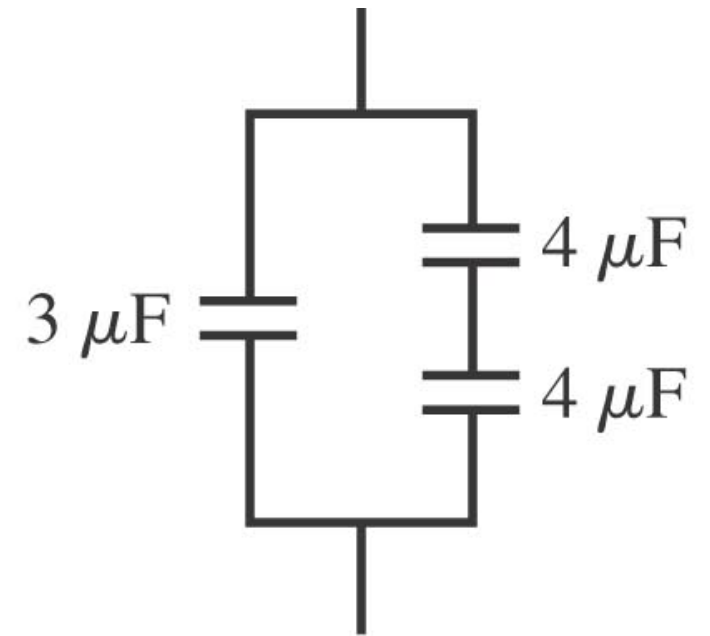
(a)



(b)

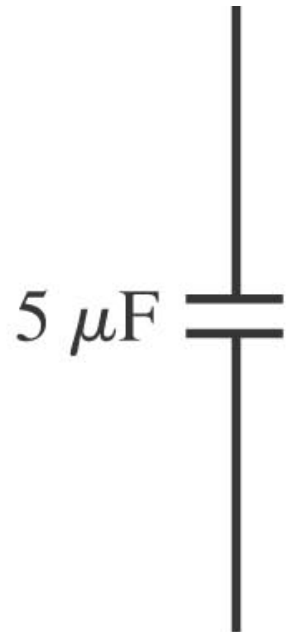


(c)

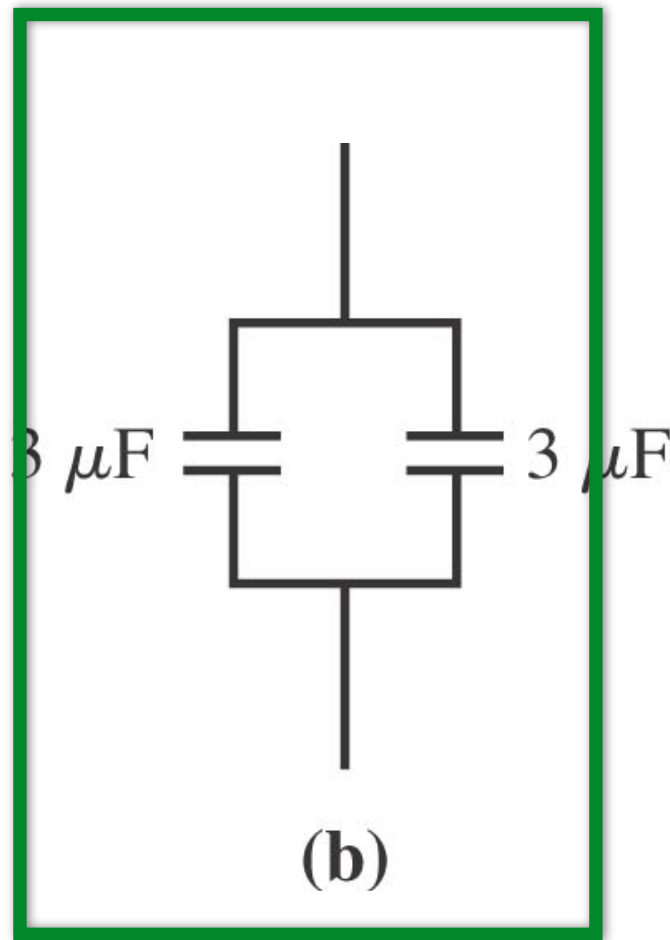


(d)

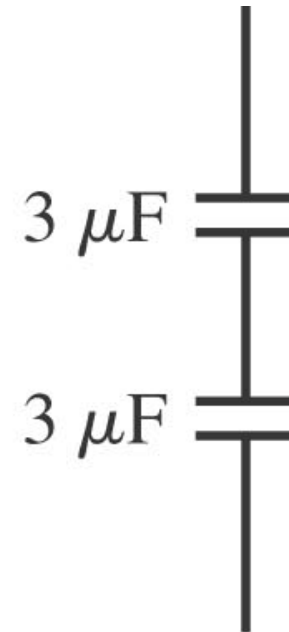
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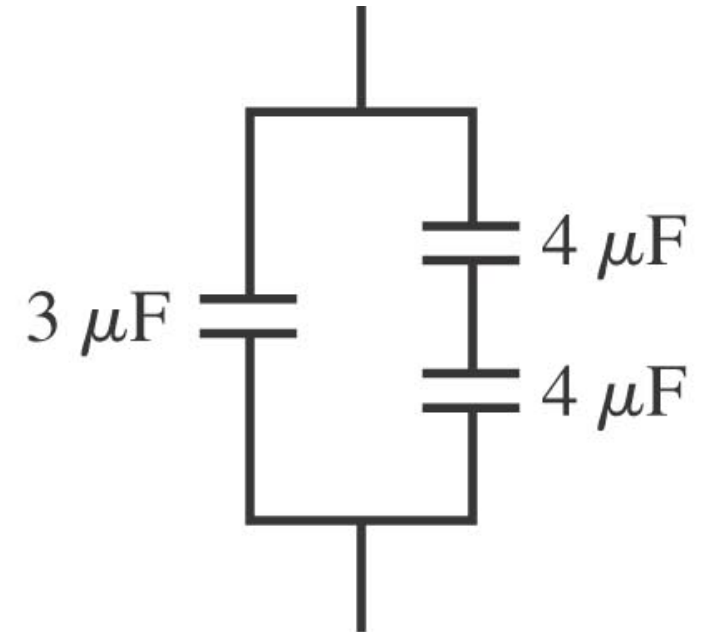
(a)



(b)

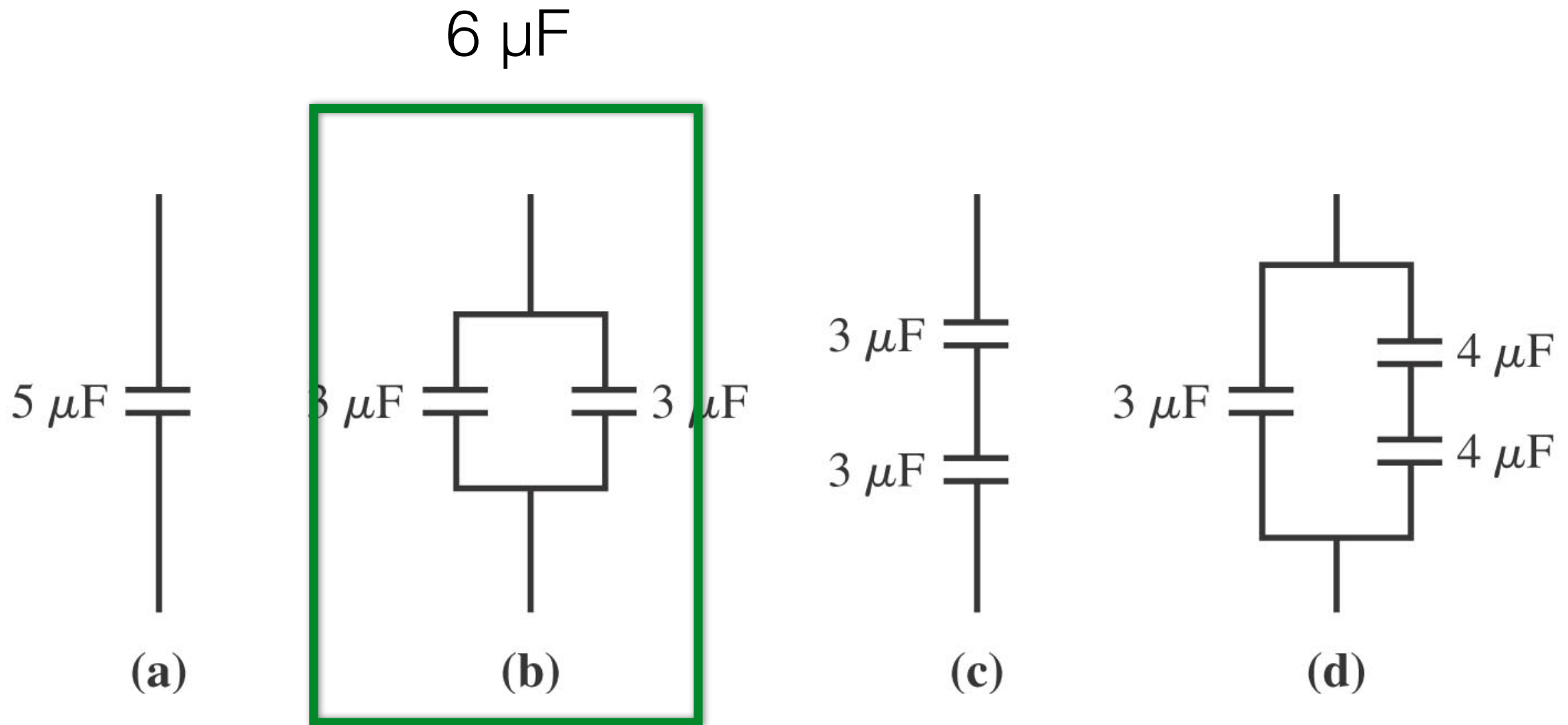


(c)

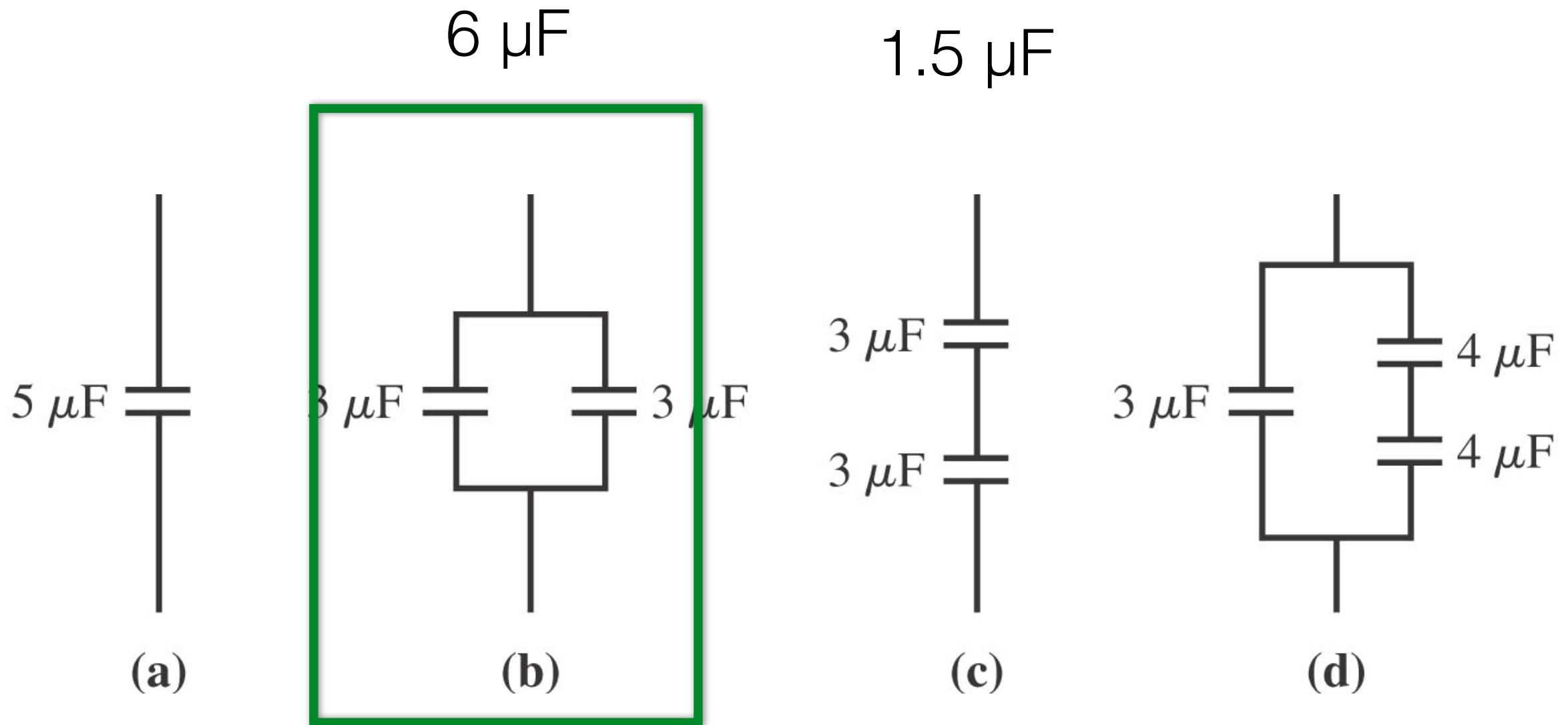


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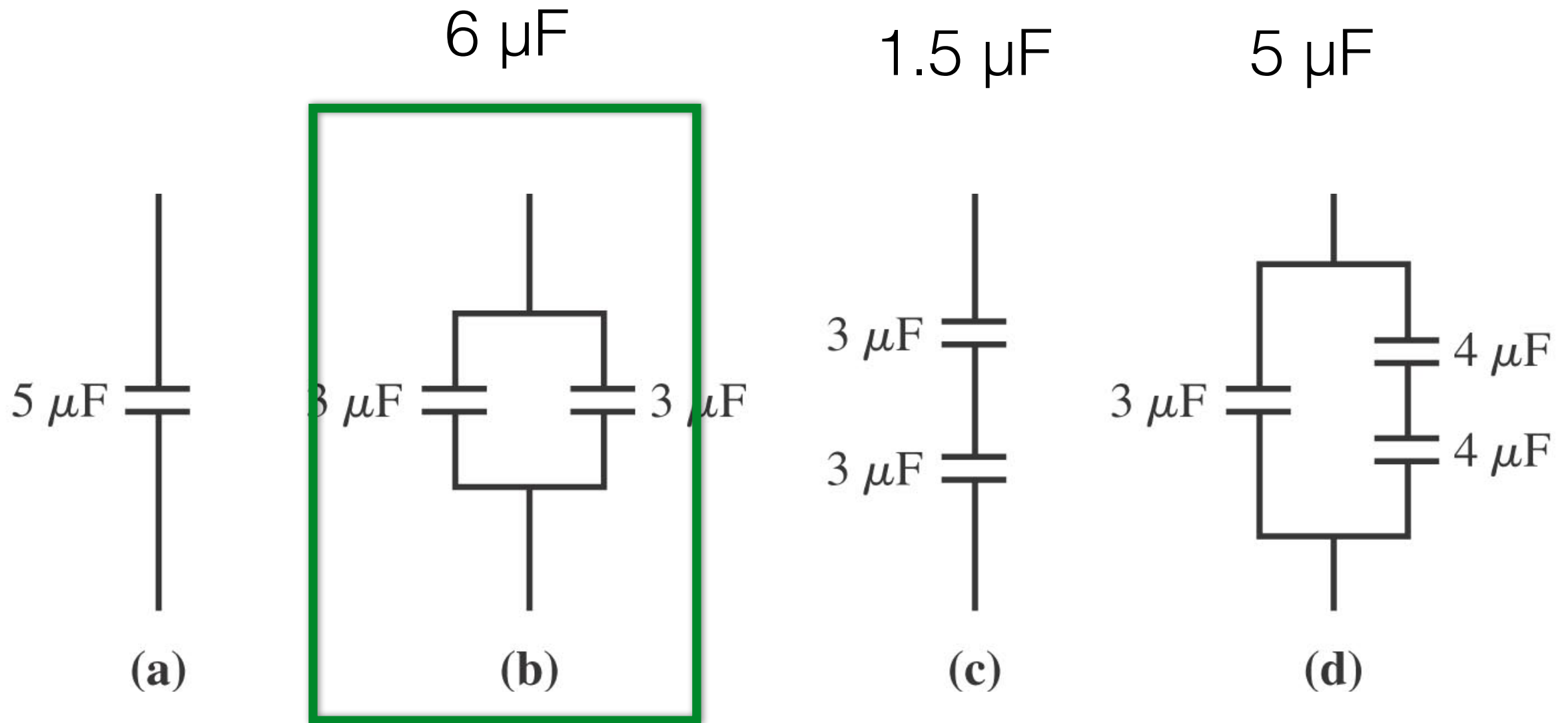
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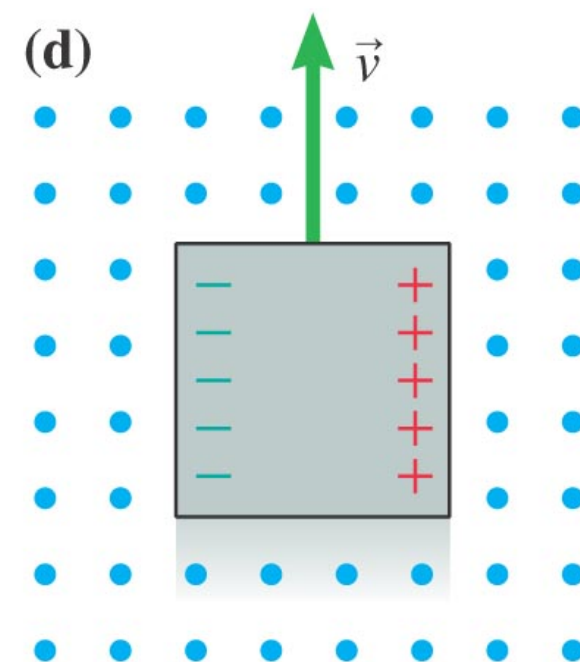
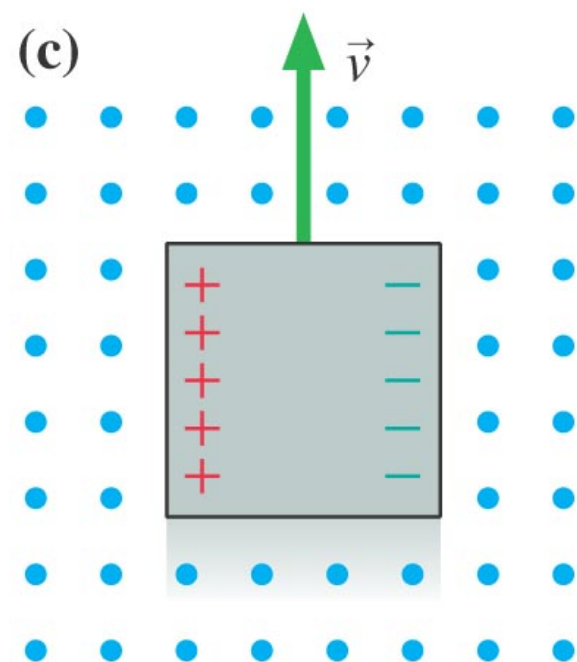
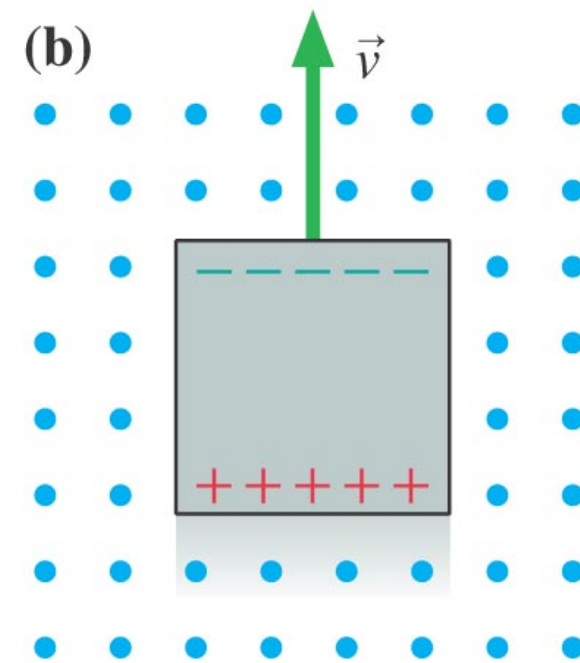
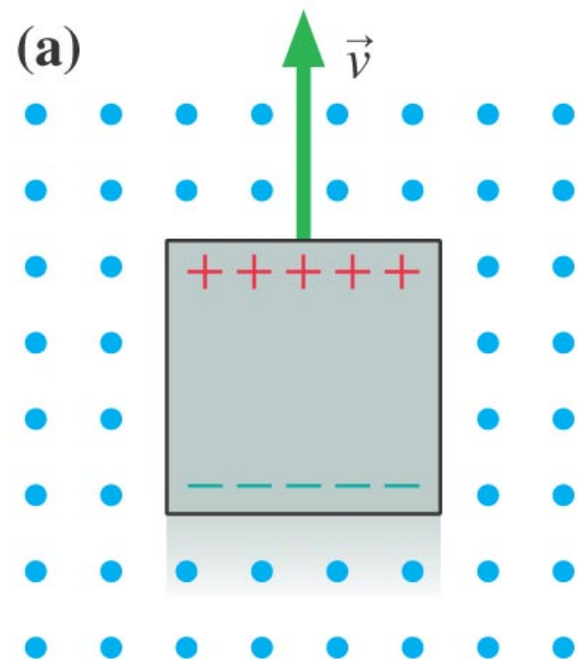
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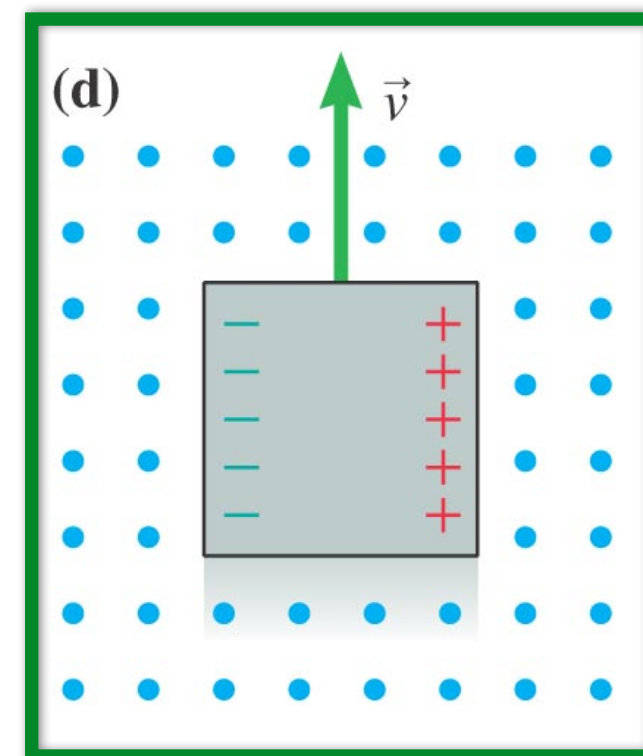
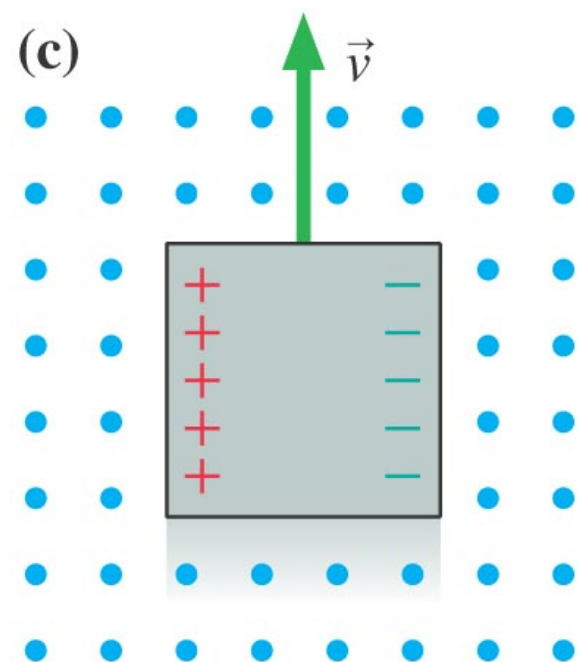
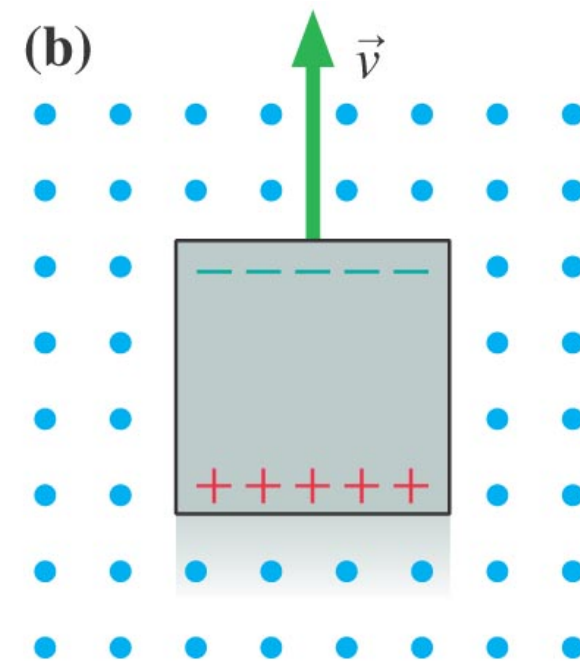
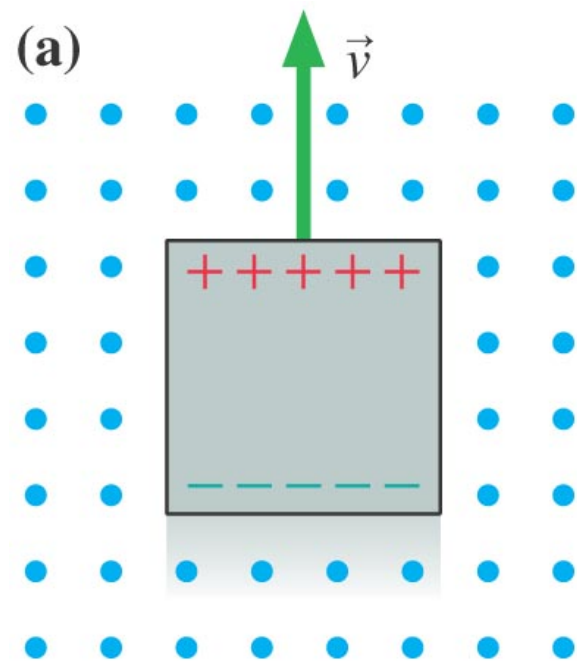


A square conductor moves through a uniform magnetic field. Which of the figures below show the correct charge distribution on the conductor?

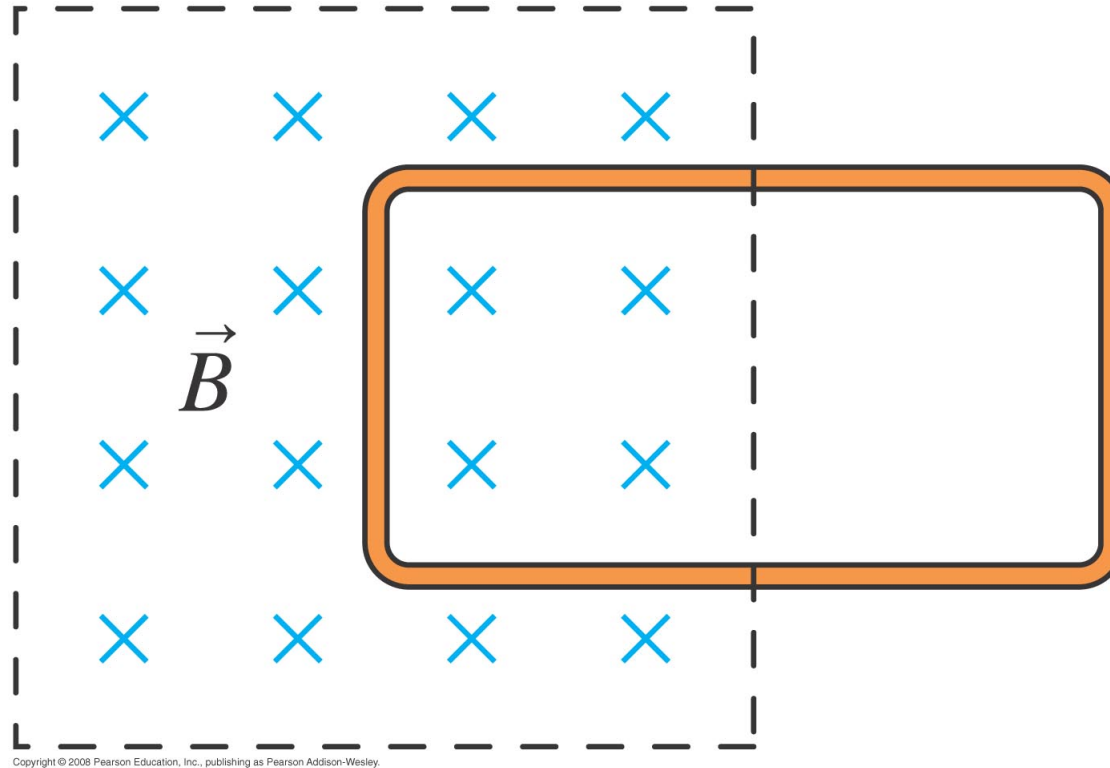


\vec{B} out of page

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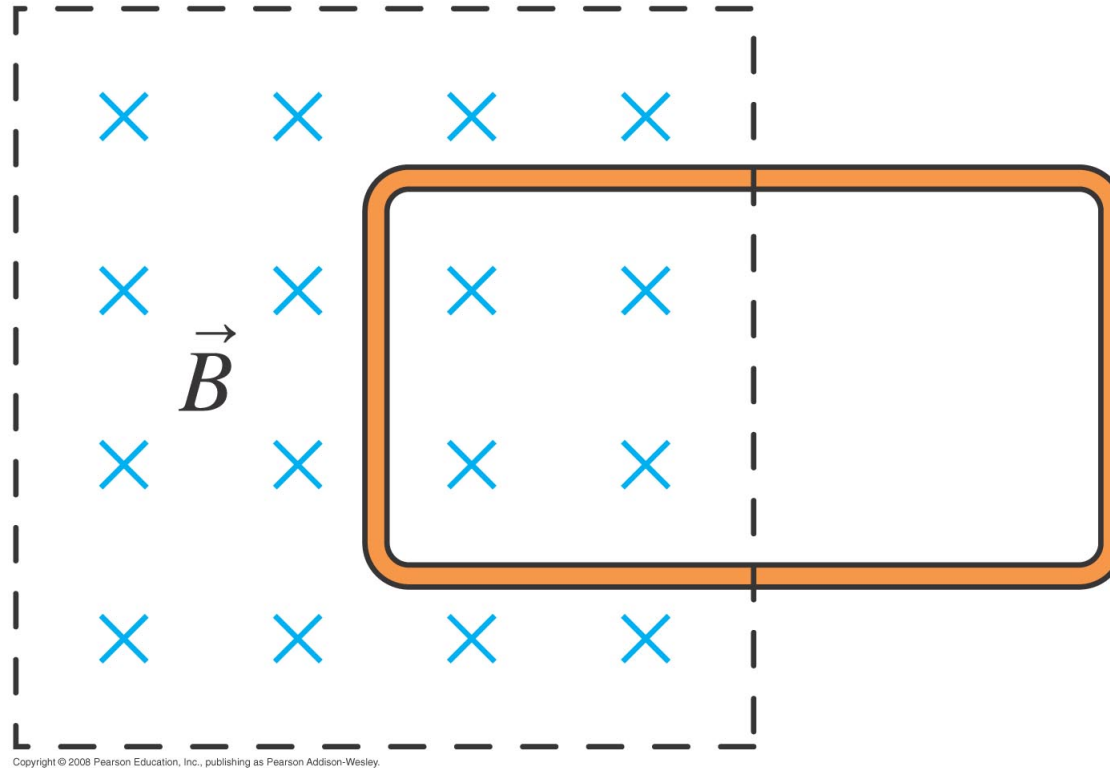


\vec{B} out of page



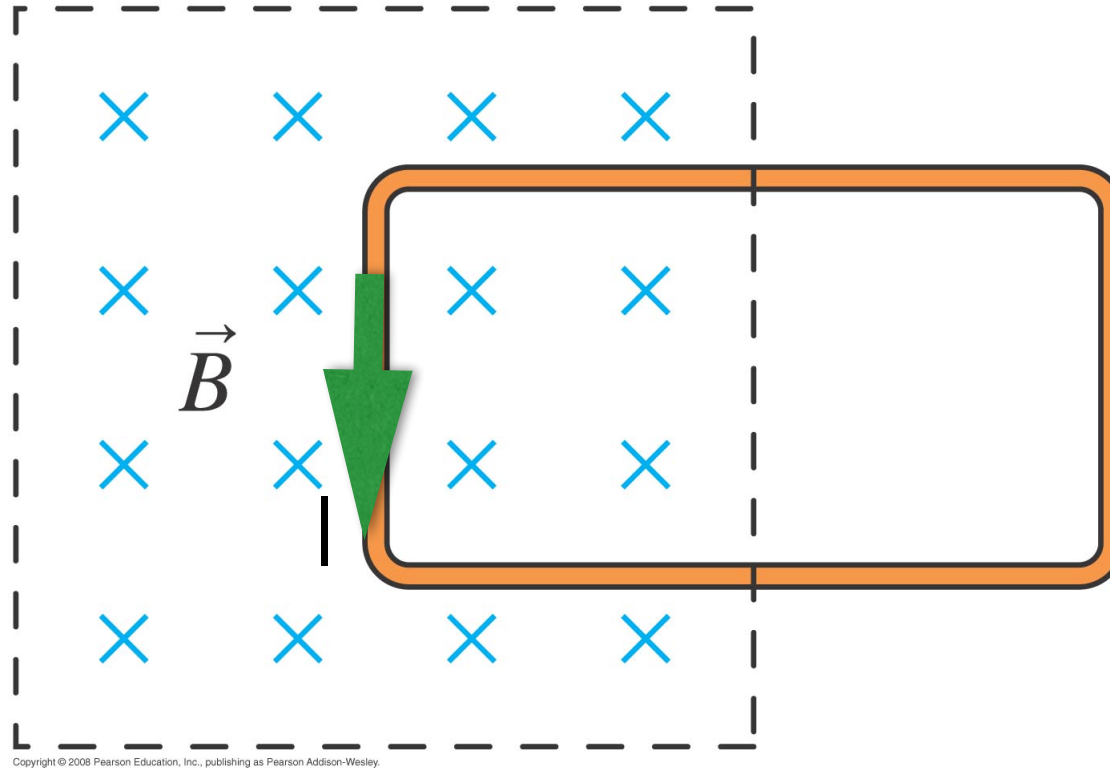
A conducting loop is halfway into a magnetic field. Suppose the magnetic field begins to increase rapidly in strength. What happens to the loop?

- (a) The loop is pushed upwards, toward the top of the page
- (b) The loop is pushed downwards, towards the bottom of the page
- (c) The loop is pulled to the left.
- (d) The loop is pushed to the right.
- (e) The tension in the wires increases but the loop does not move.



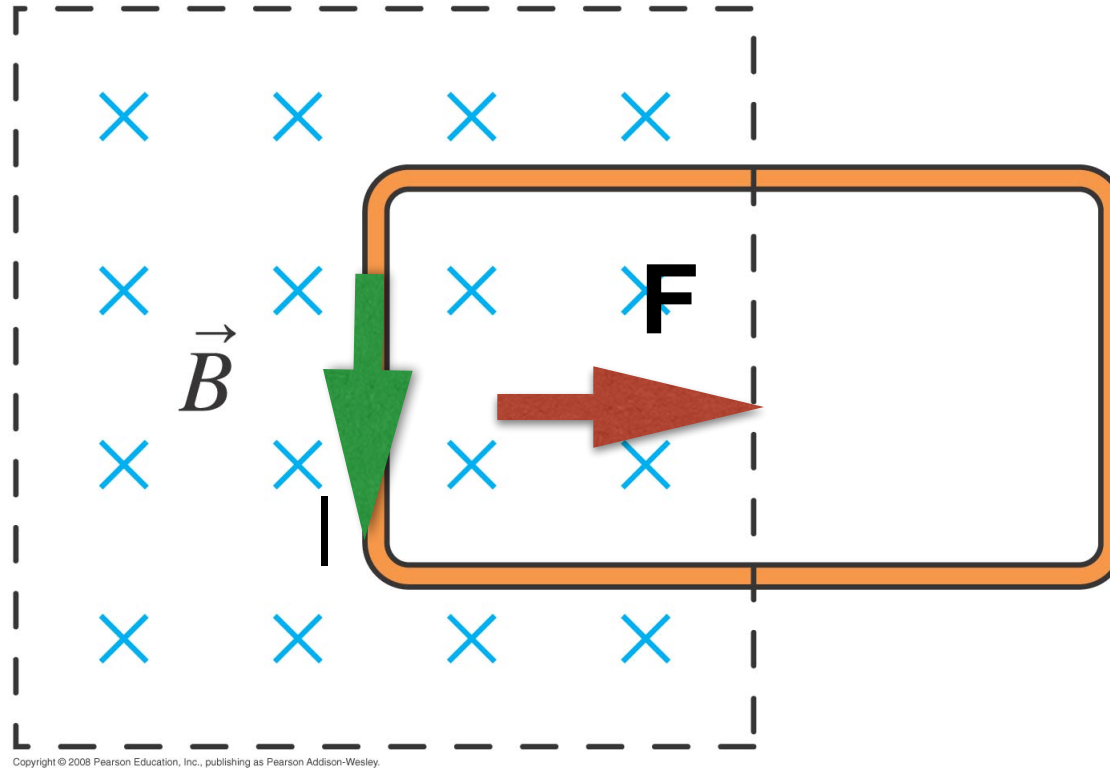
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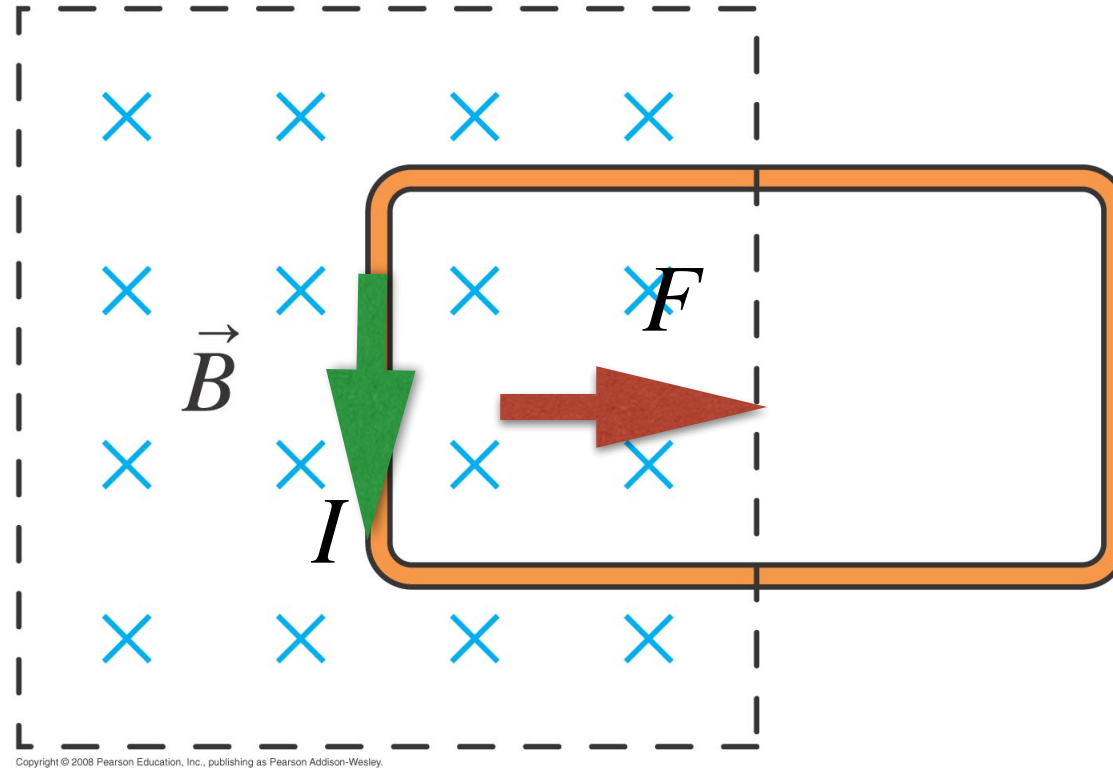
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The loop current goes CCW creating an out-of-page B field that counters the increasing into-page B. The Lorentz force due to the downward current in the B field points right.

What is the phase difference between the crest of a wave and the adjacent trough?

- (a) -2π rad
- (b) 2π rad
- (c) $\pi/4$ rad
- (d) $\pi/2$ rad
- (e) π rad

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- What are the units of capacitive reactance X_c ?

A. farad

B. farad⁻¹

C. ohm

D. ohm⁻¹

E. none

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B. farad⁻¹

C. ohm

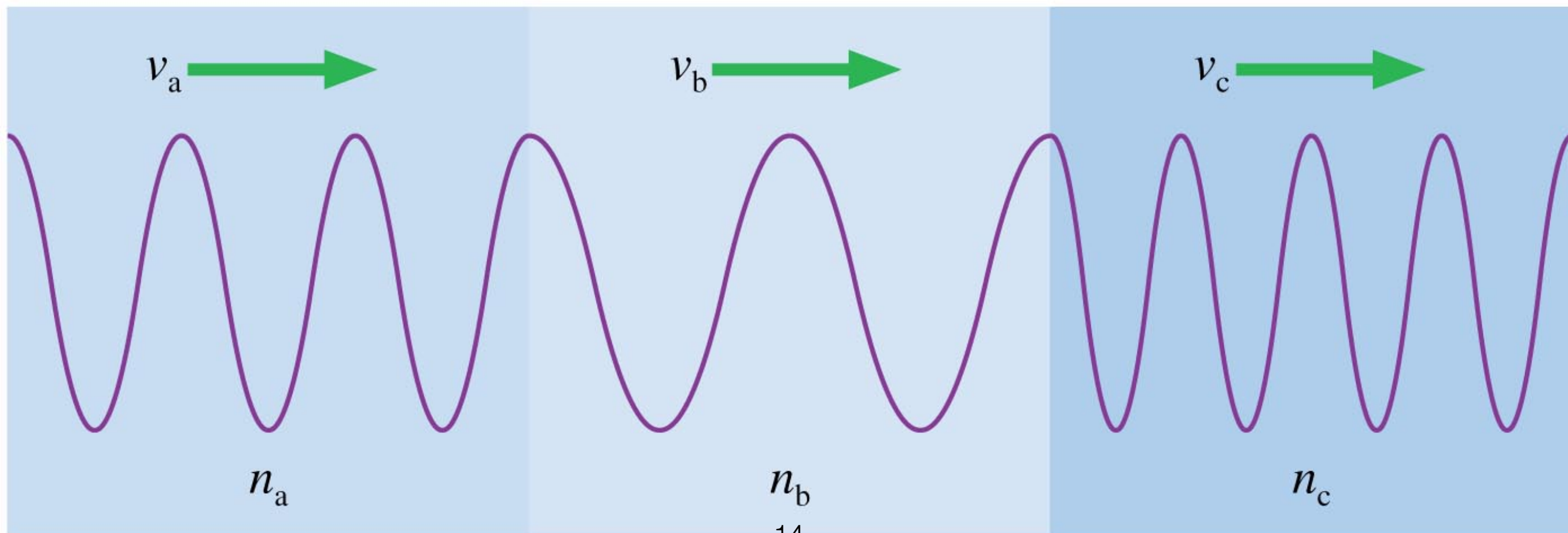
D. ohm⁻¹

E. none

Light waves from the same source travel in 3 media as shown.

Which has the highest Index of Refraction?

- A
- B
- C
- D All the same.



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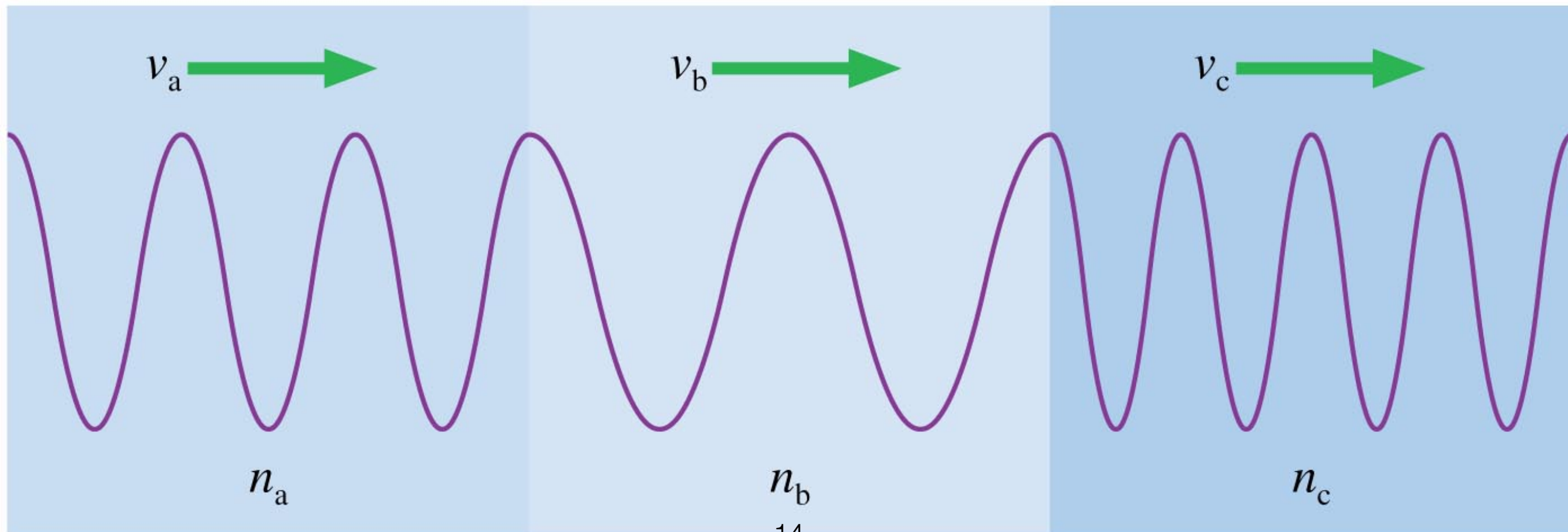
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☒ C

D All the same.



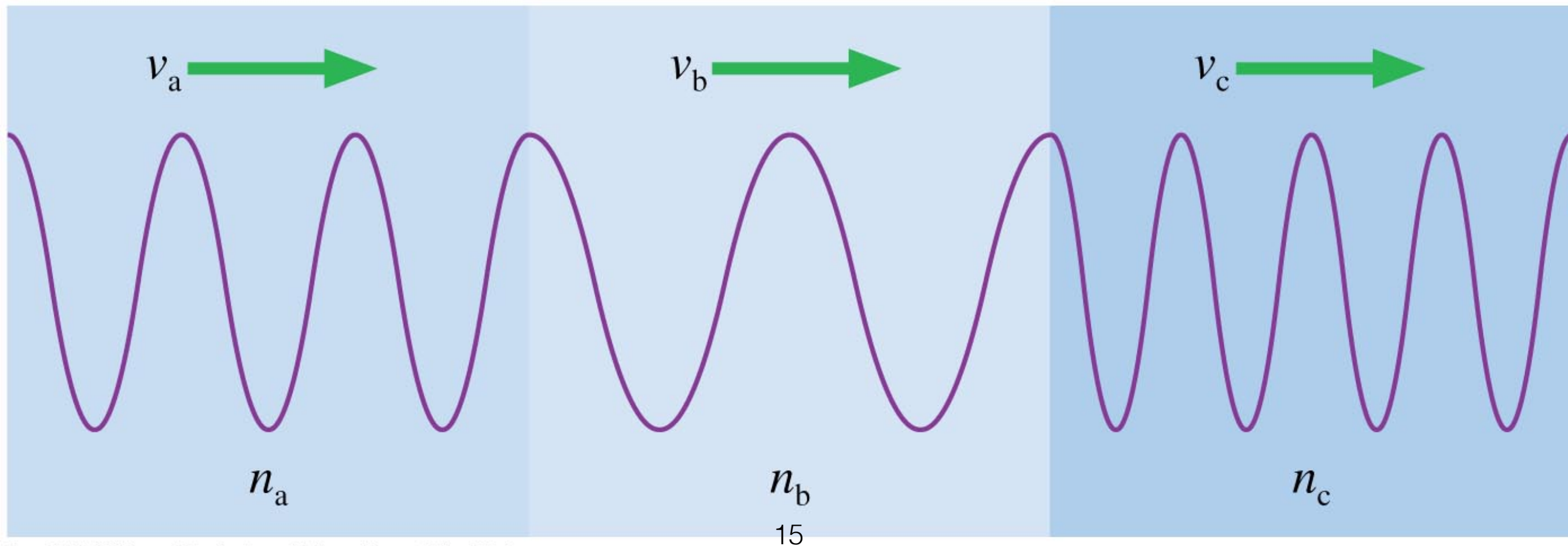
Light waves from the same source travel in 3 media as shown. Which has the highest speed of light?

A

B

C

D All the same.

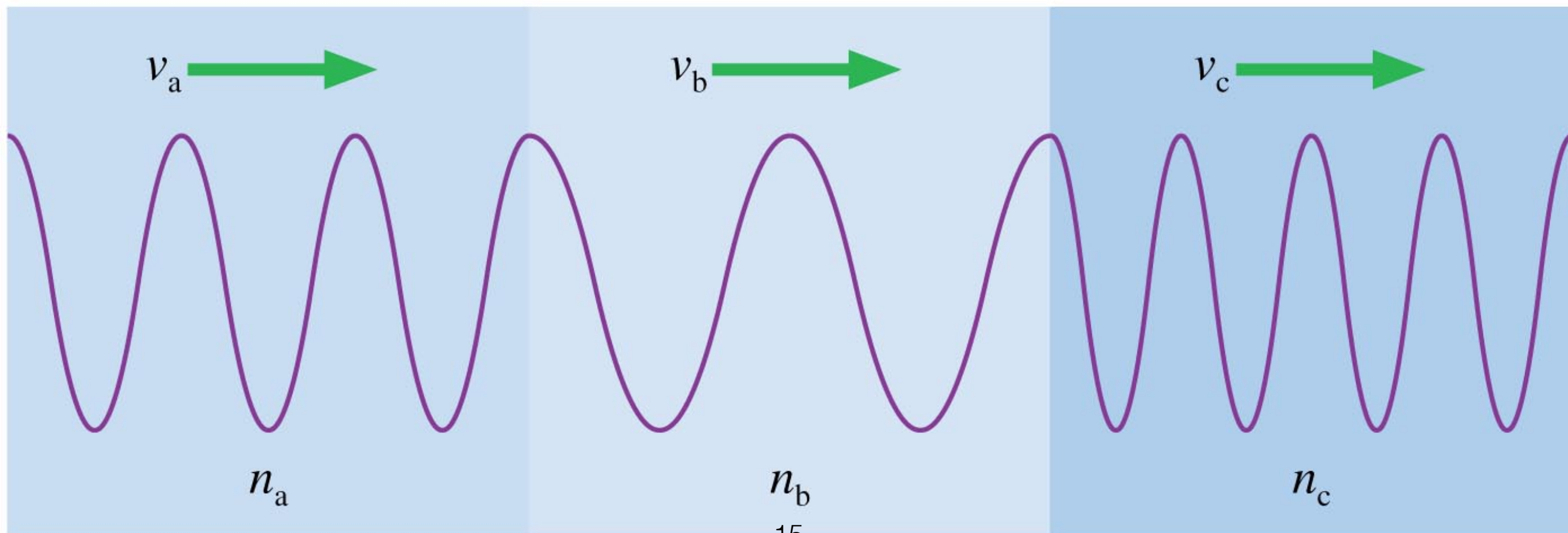


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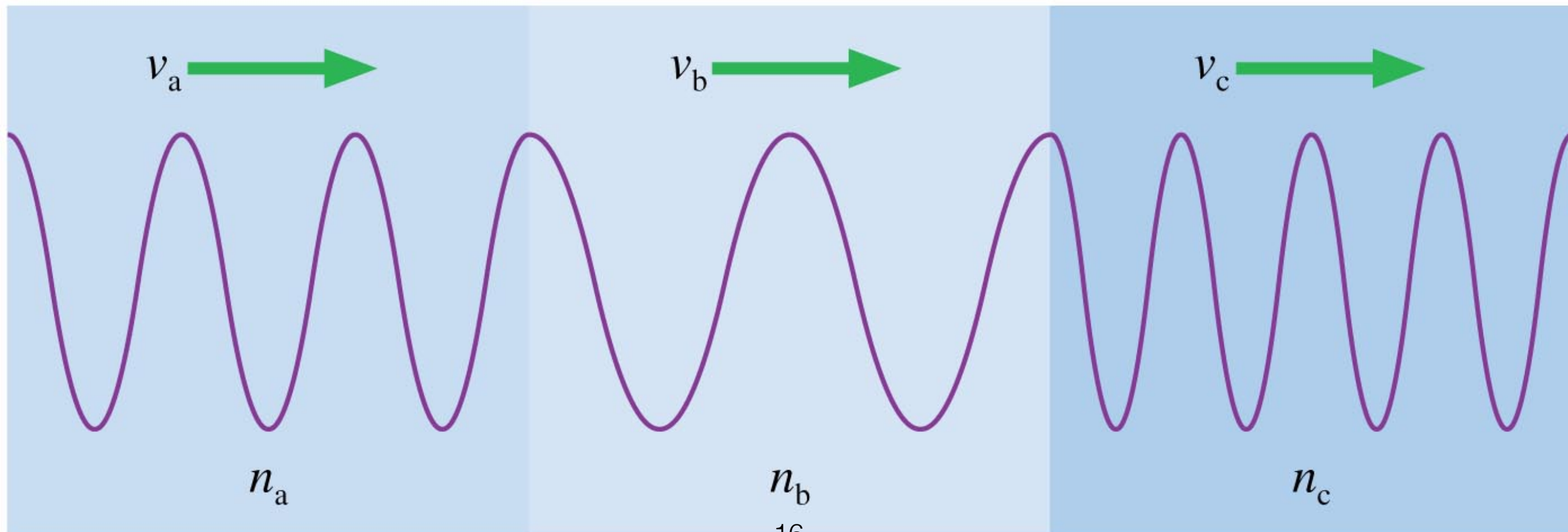
Light waves from the same source travel in 3 media as shown. Which has the highest frequency?

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C

D All the same.



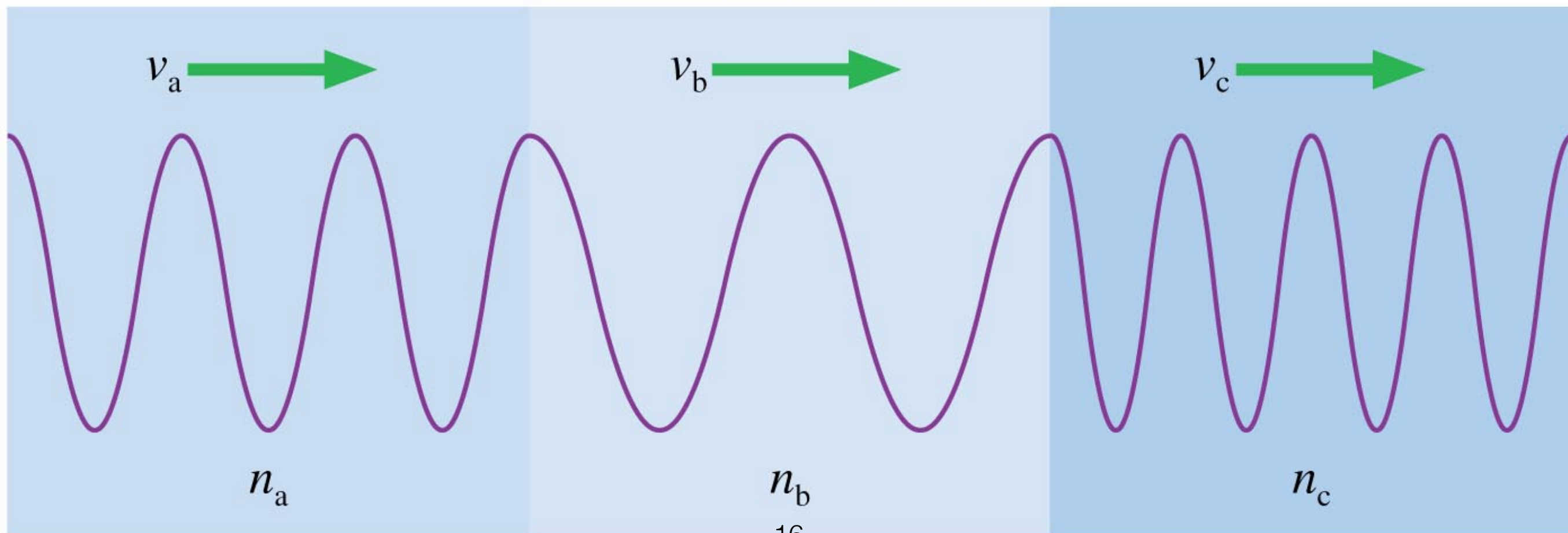
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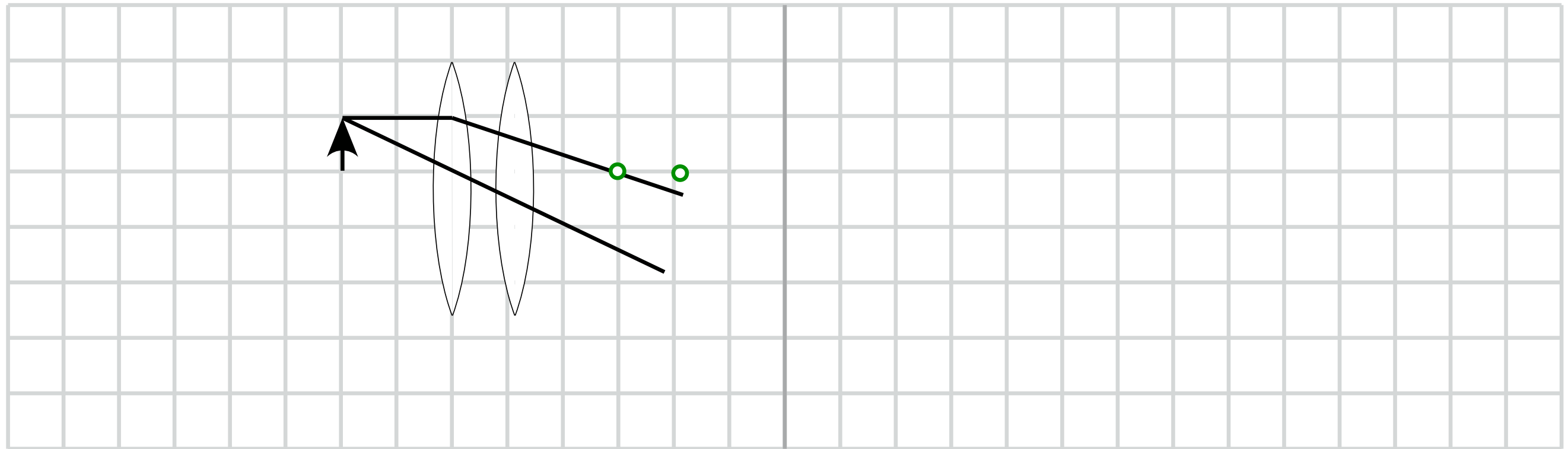


Two identical converging lenses of focal lengths $f = f' = 15\text{cm}$ are separated by a distance $d = 6\text{cm}$. A luminous source is placed a distance $s_1 = 10\text{cm}$ from the first lens.

- (a) Draw a ray-tracing diagram of this situation
- (b) Calculate the position of the final image.

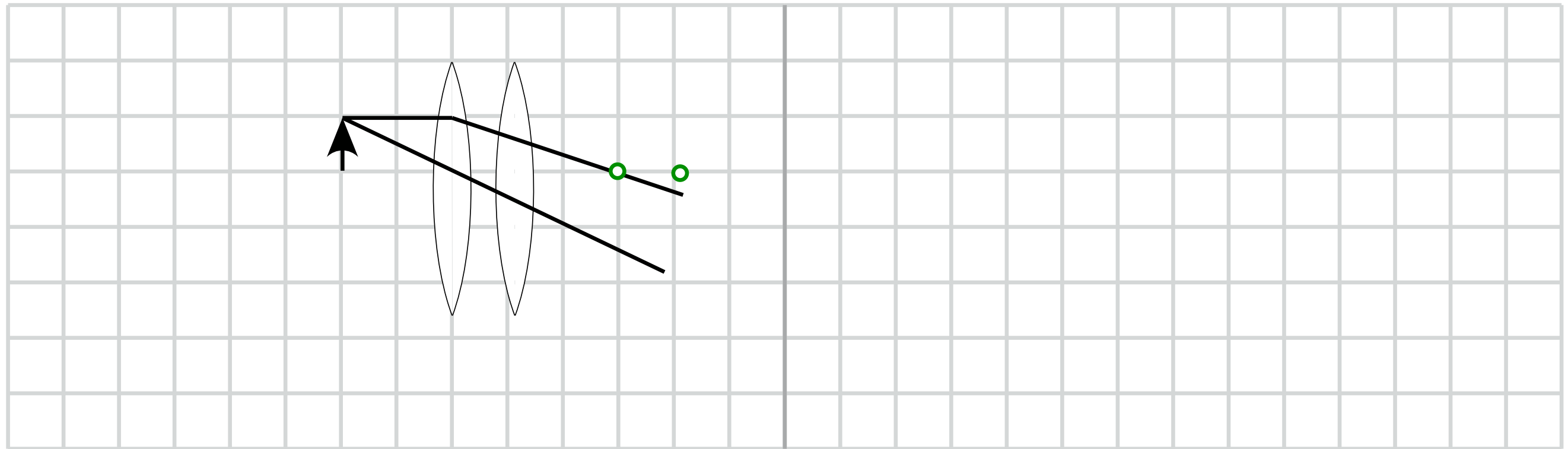
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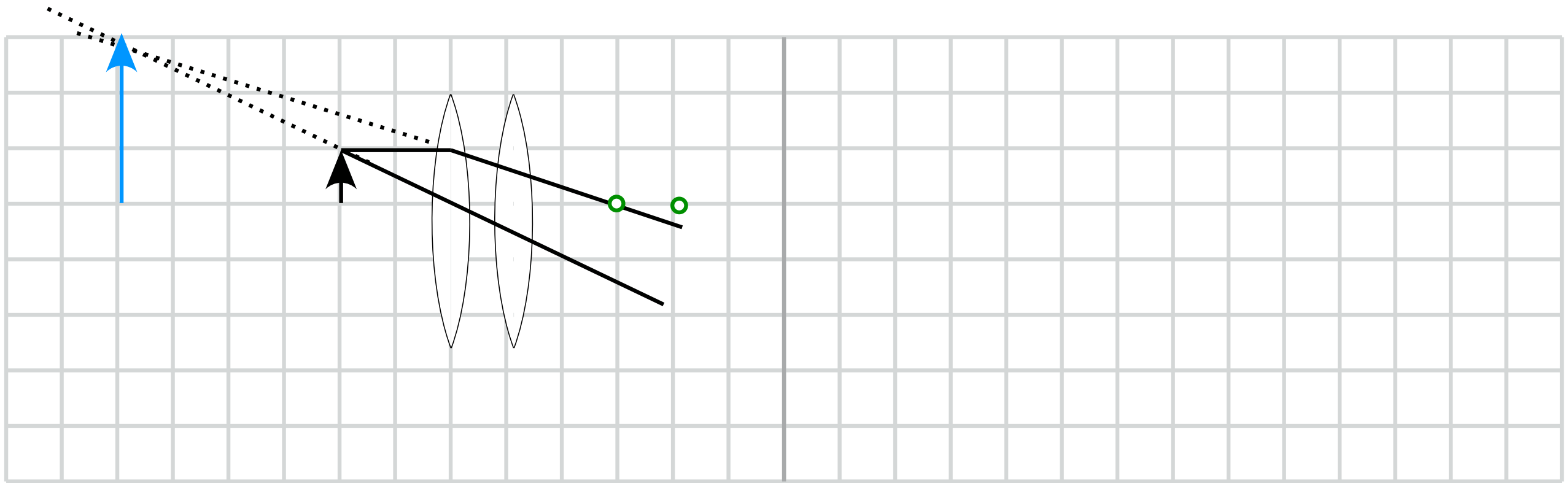


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5 cm grid

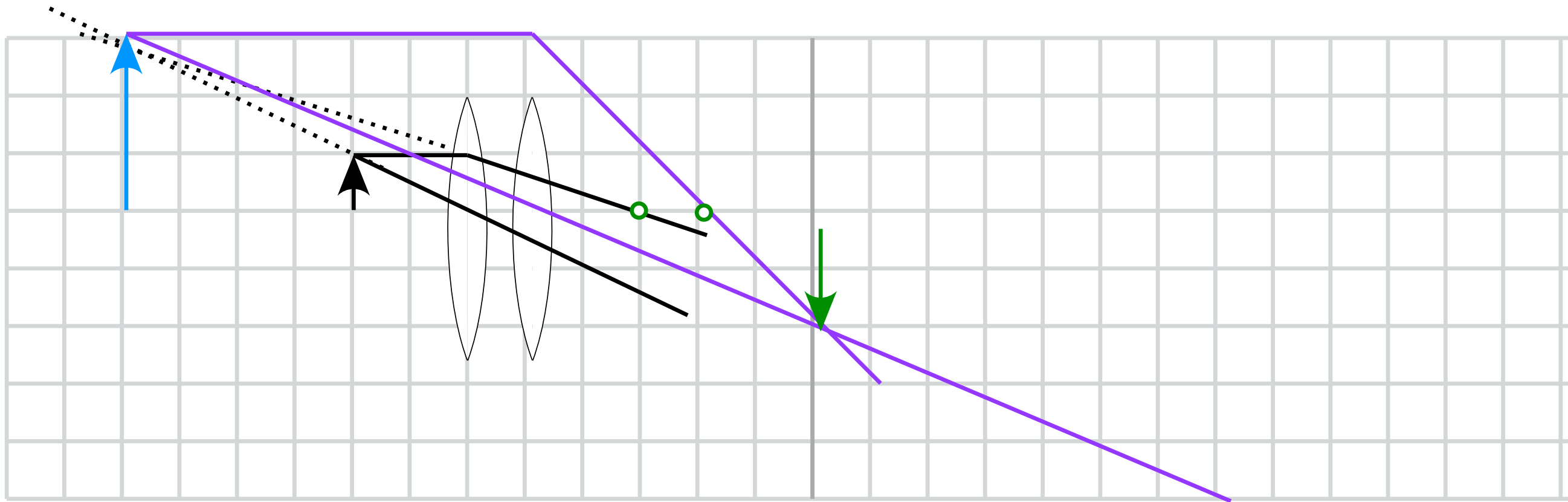


$$\frac{1}{s_1} + \frac{1}{s'_1} = \frac{1}{f}$$

$$\frac{1}{10} + \frac{1}{s'_1} = \frac{1}{15}$$

$$s'_1 = -30 \text{ cm}$$

virtual image, 30 cm behind 1st lens



$$\frac{1}{s_1} + \frac{1}{s'_1} = \frac{1}{f}$$

$$\frac{1}{10} + \frac{1}{s'_1} = \frac{1}{15}$$

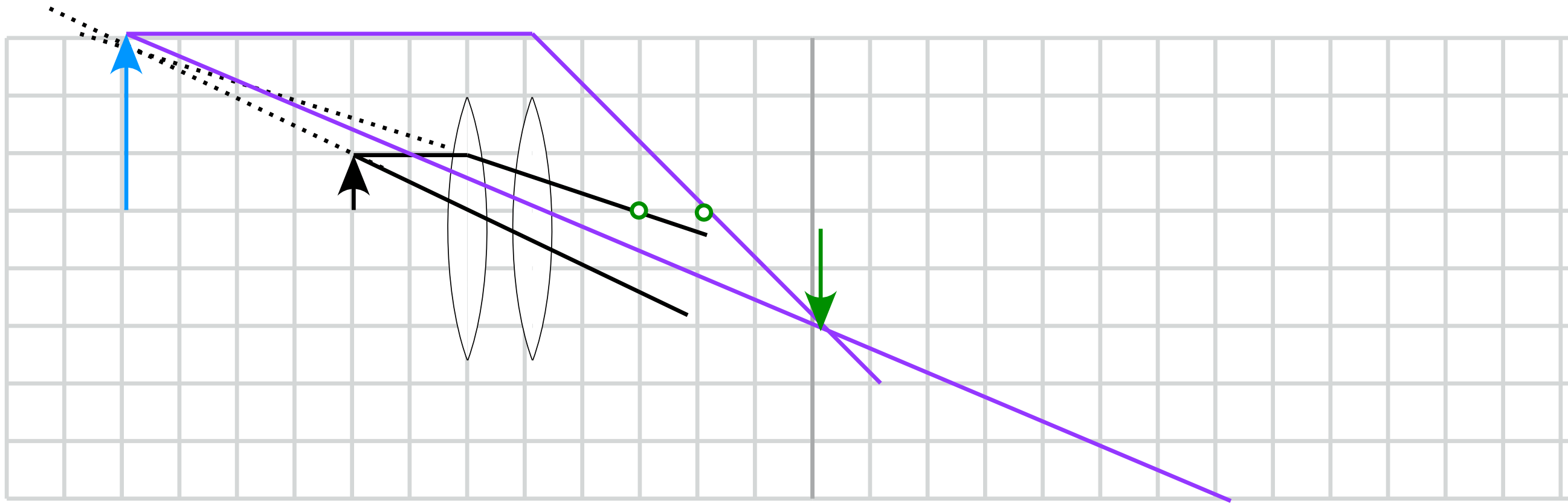
$$s'_1 = -30 \text{ cm}$$

$$\frac{1}{s_2} + \frac{1}{s'_2} = \frac{1}{f}$$

$$\frac{1}{36} + \frac{1}{s'_2} = \frac{1}{15}$$

$$s'_2 = +26 \text{ cm}$$

real₁image 26 cm from the 2nd lens



magnification: $(30/10) \times (-26/36) = -2.17$

$$\frac{1}{s_1} + \frac{1}{s'_1} = \frac{1}{f}$$

$$\frac{1}{10} + \frac{1}{s'_1} = \frac{1}{15}$$

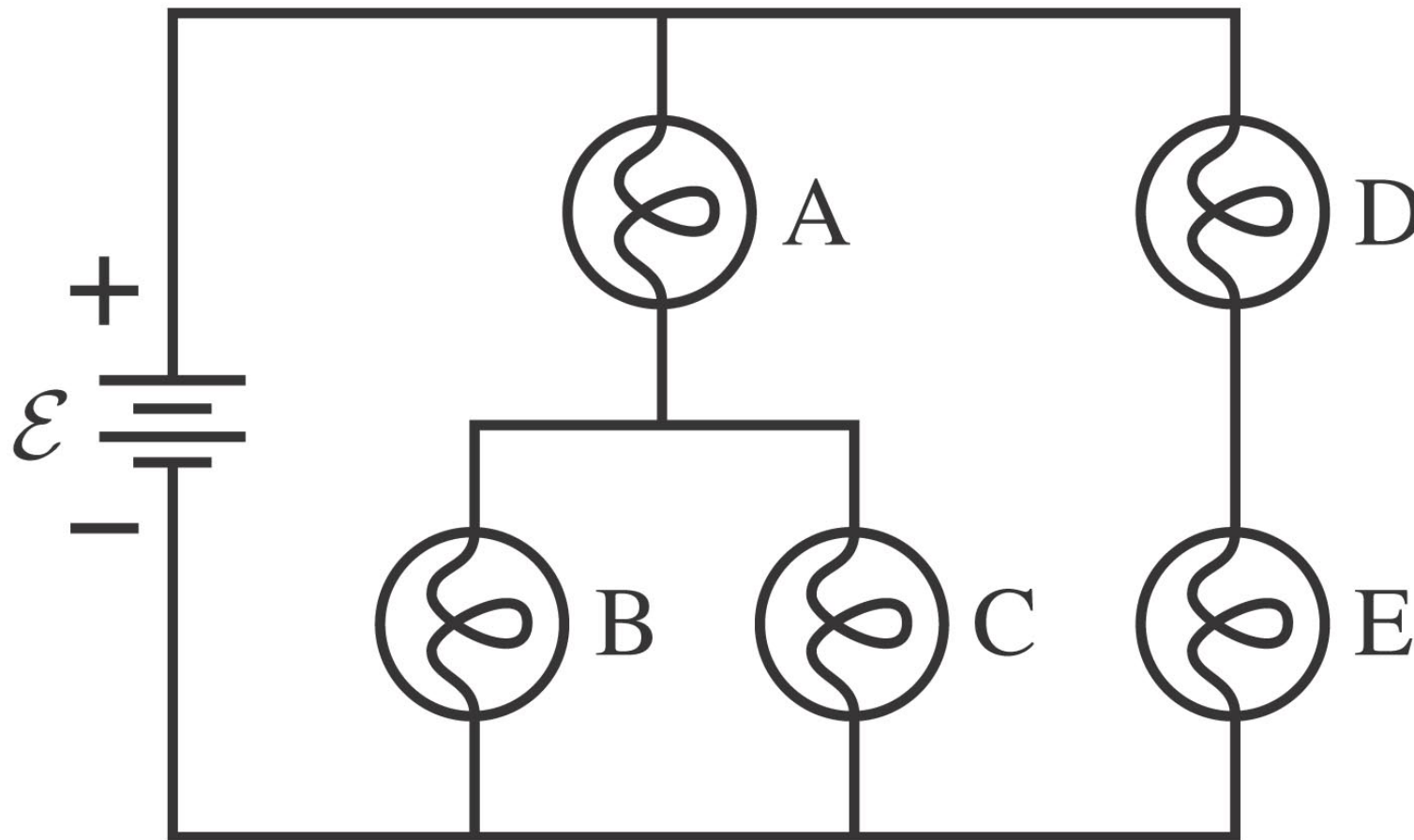
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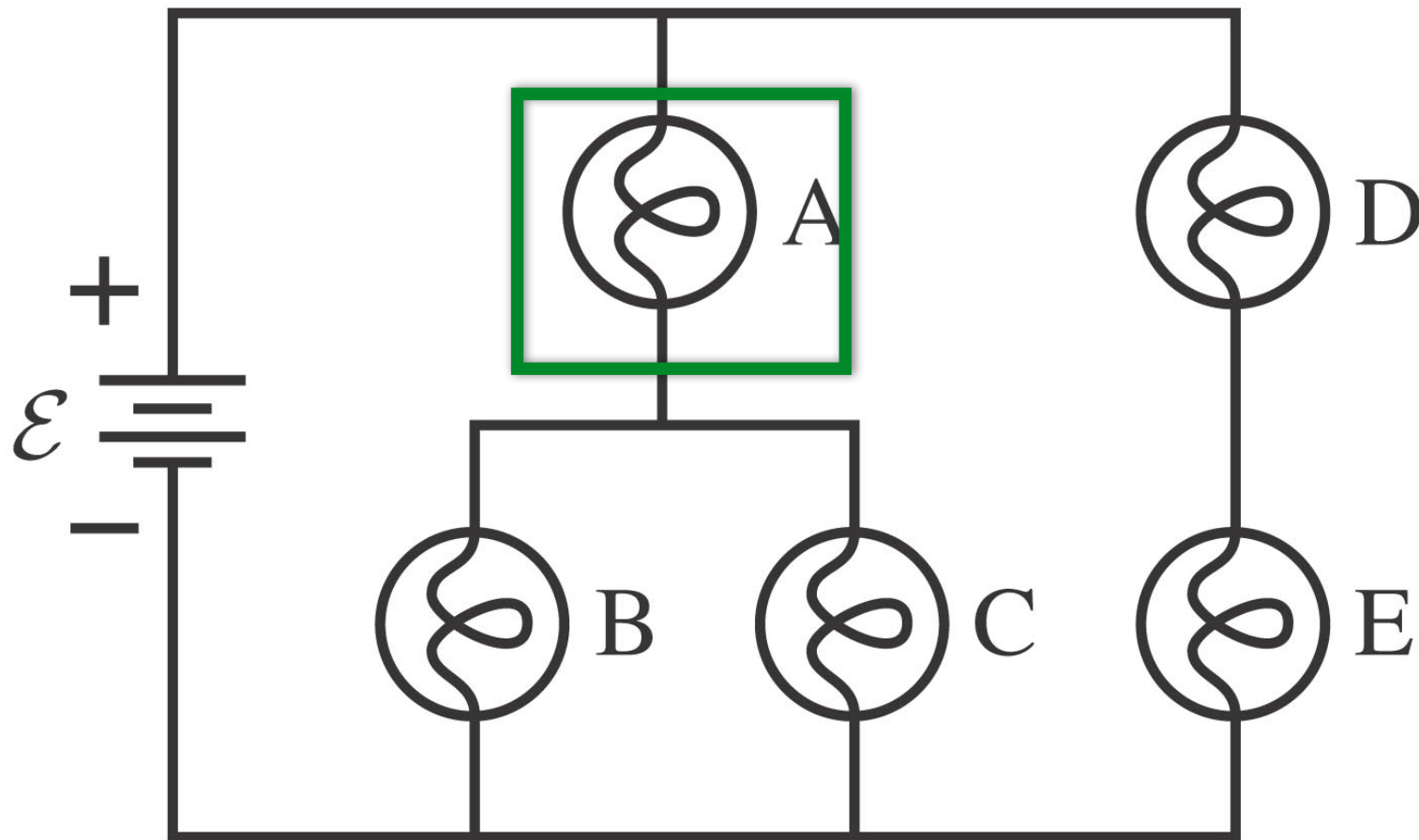
$$s'_2 = +26 \text{ cm}$$

Which of the bulbs is the brightest?

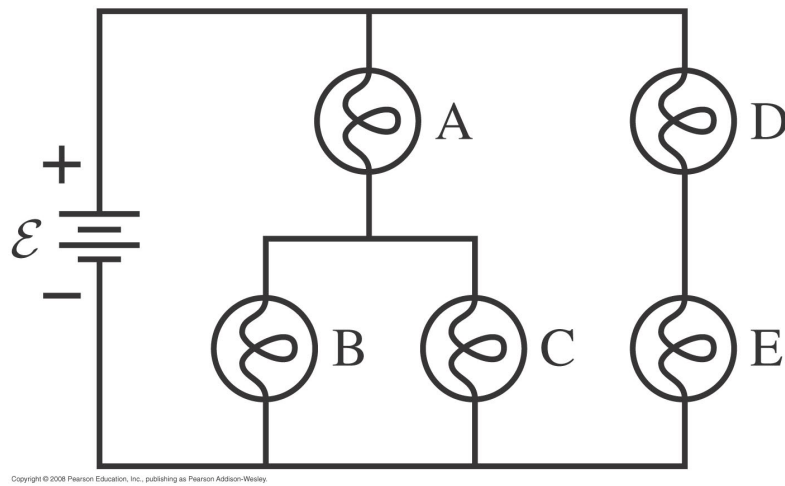


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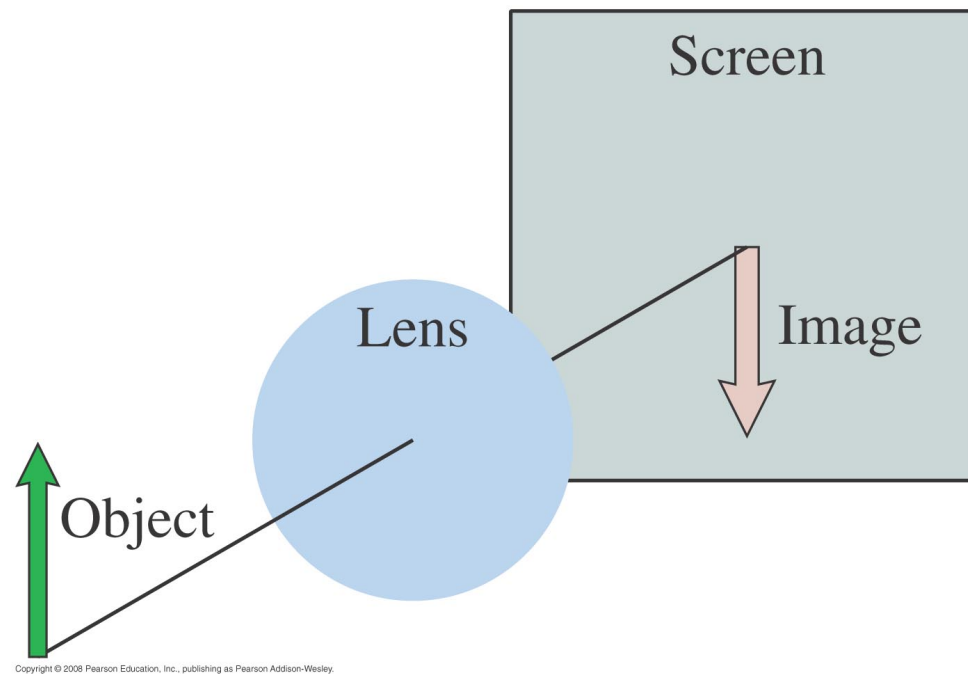


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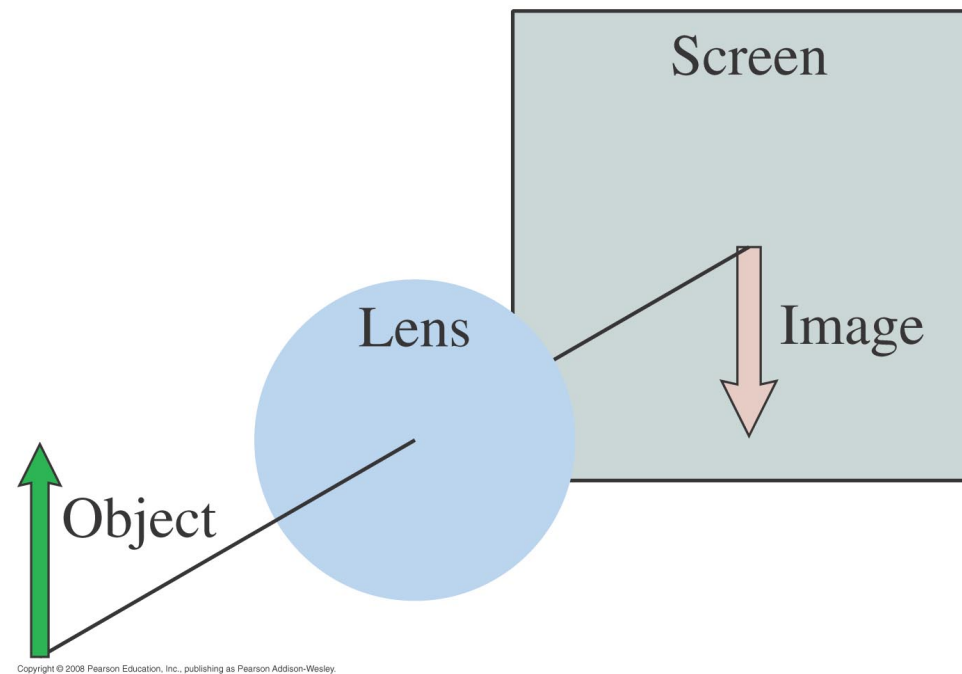
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- One way to do this is to assign $1\ \Omega$ to each bulb and $1\ \text{V}$ to the battery: in terms of power
- A) $V_A = 1/1.5 = 0.67\ \text{V}$, $I_A = 1/1.5 = 0.67\ \text{A}$, $P = 0.44\ \text{W}$
- B) $V_B = 0.5/1.5 = 0.33\ \text{V}$, $I_B = 0.67/3 = .33\ \text{A}$, $P_B = 0.11\ \text{W}$
- D) $V_D = 0.5\ \text{V}$, $I_D = 0.5\ \text{A}$, $P_D = 0.25\ \text{W}$
- Notice that I^2R , V^2/R and VI give same power.



A lens produces a sharply focused, inverted image on a screen. What will you see on the screen if the lens is removed?

- (a) The image will be inverted and blurry.
- (b) The image will be upright and sharp.
- (c) The image will be upright and blurry
- (d) The image will be dimmer but otherwise unchanged.
- (e) There will be no image at all.

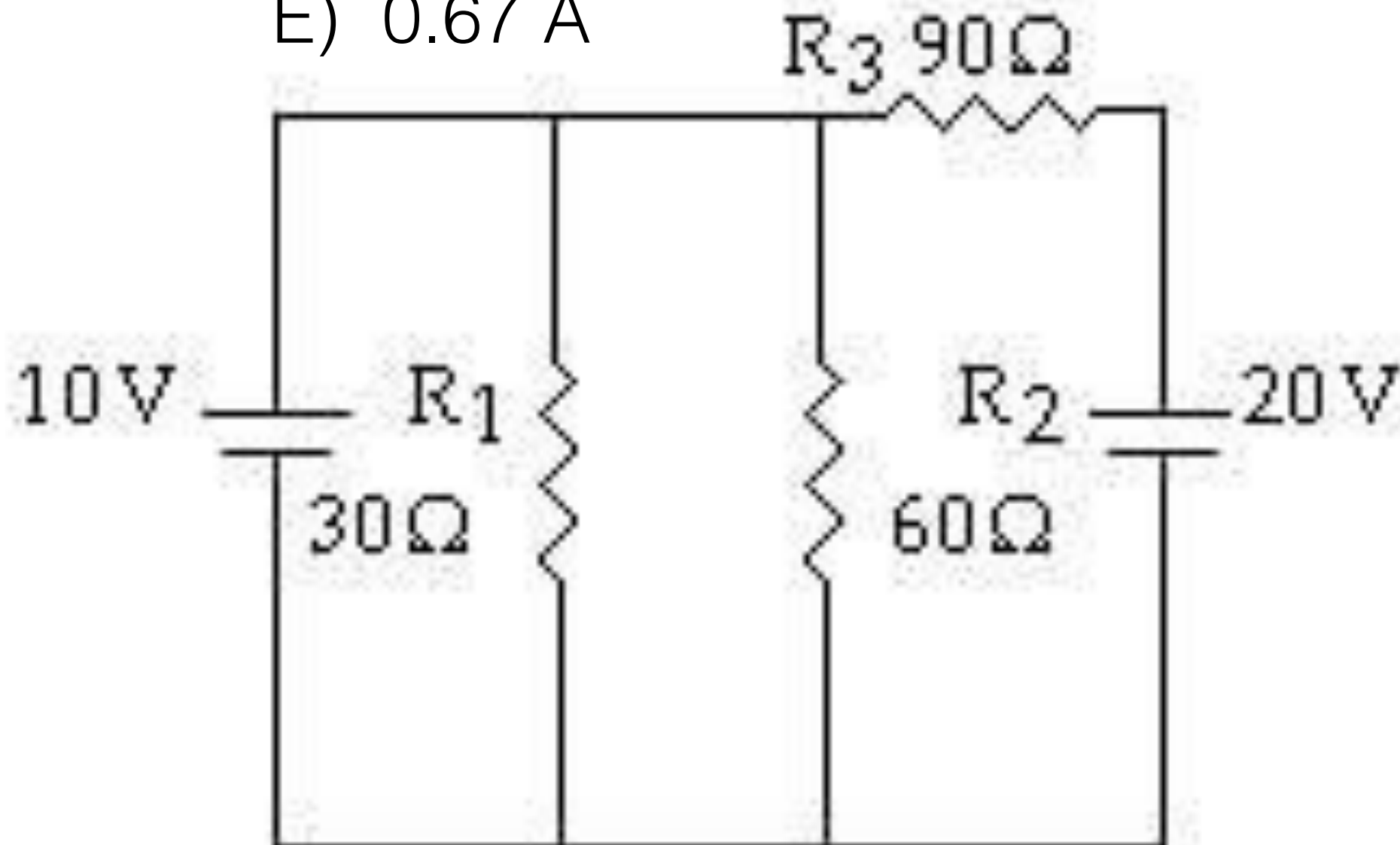


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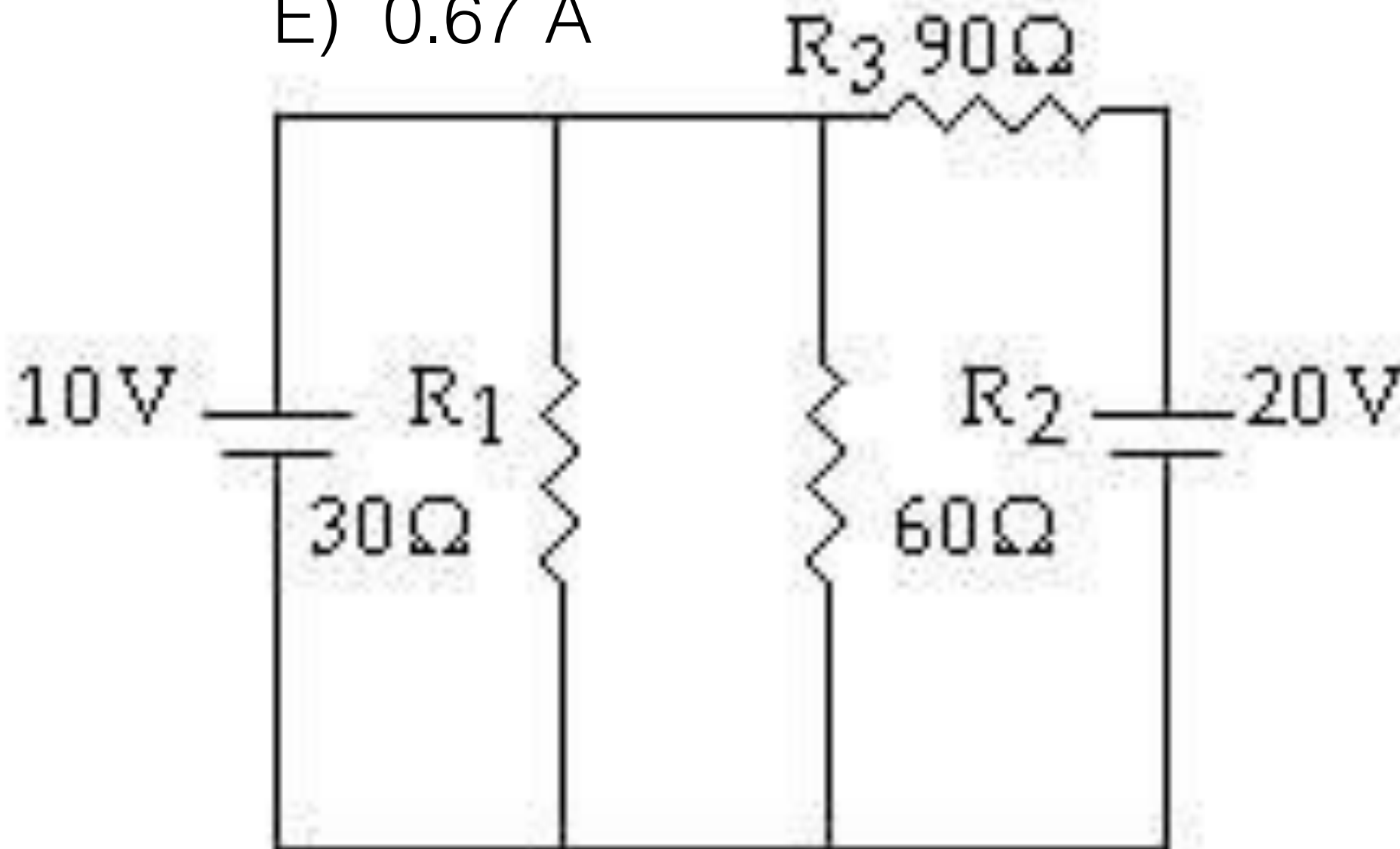
What is the current through R_1 ?

- A) 0.11 A
- B) 0.25 A
- C) 0.33 A
- D) 0.50 A
- E) 0.67 A

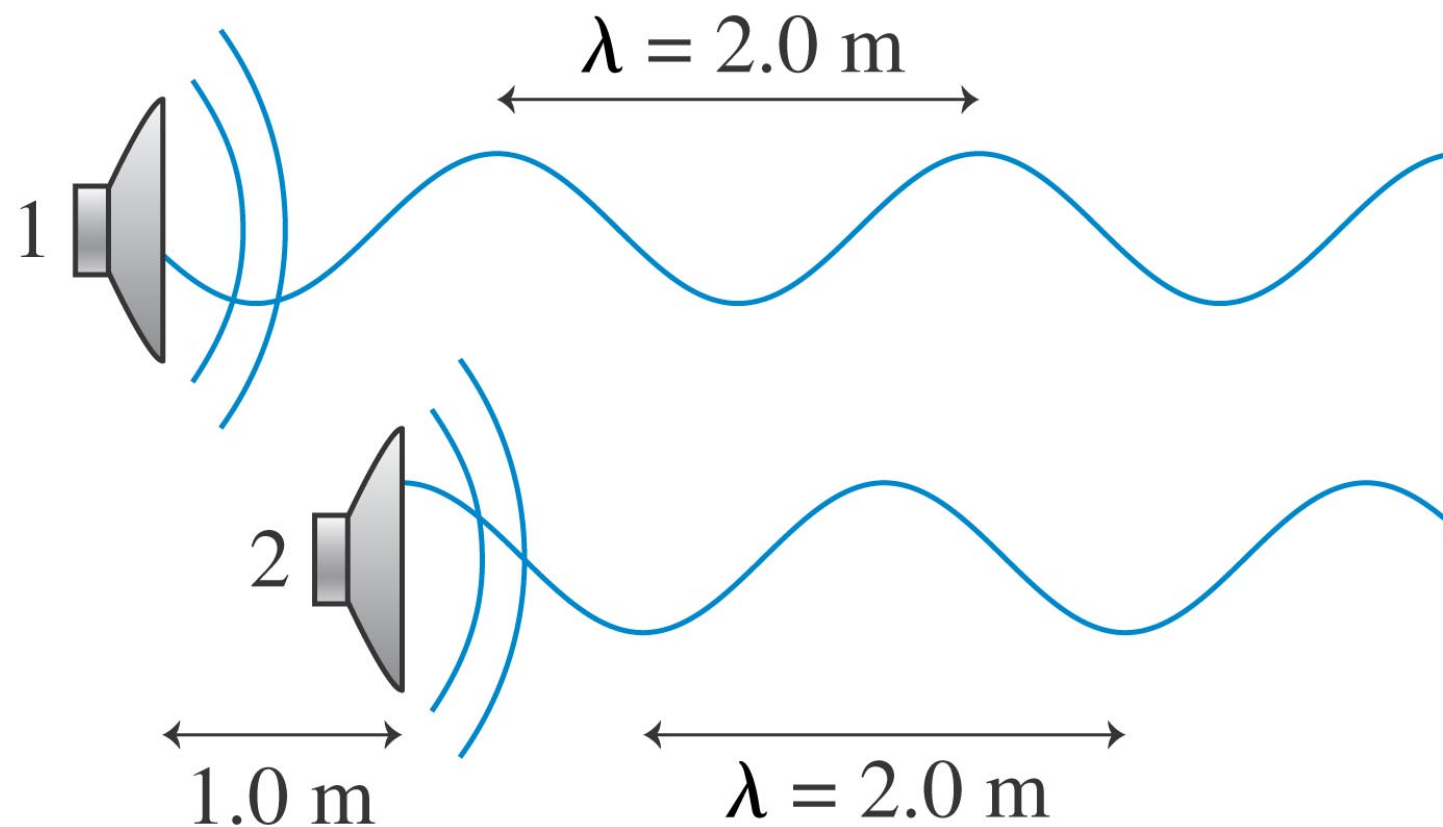


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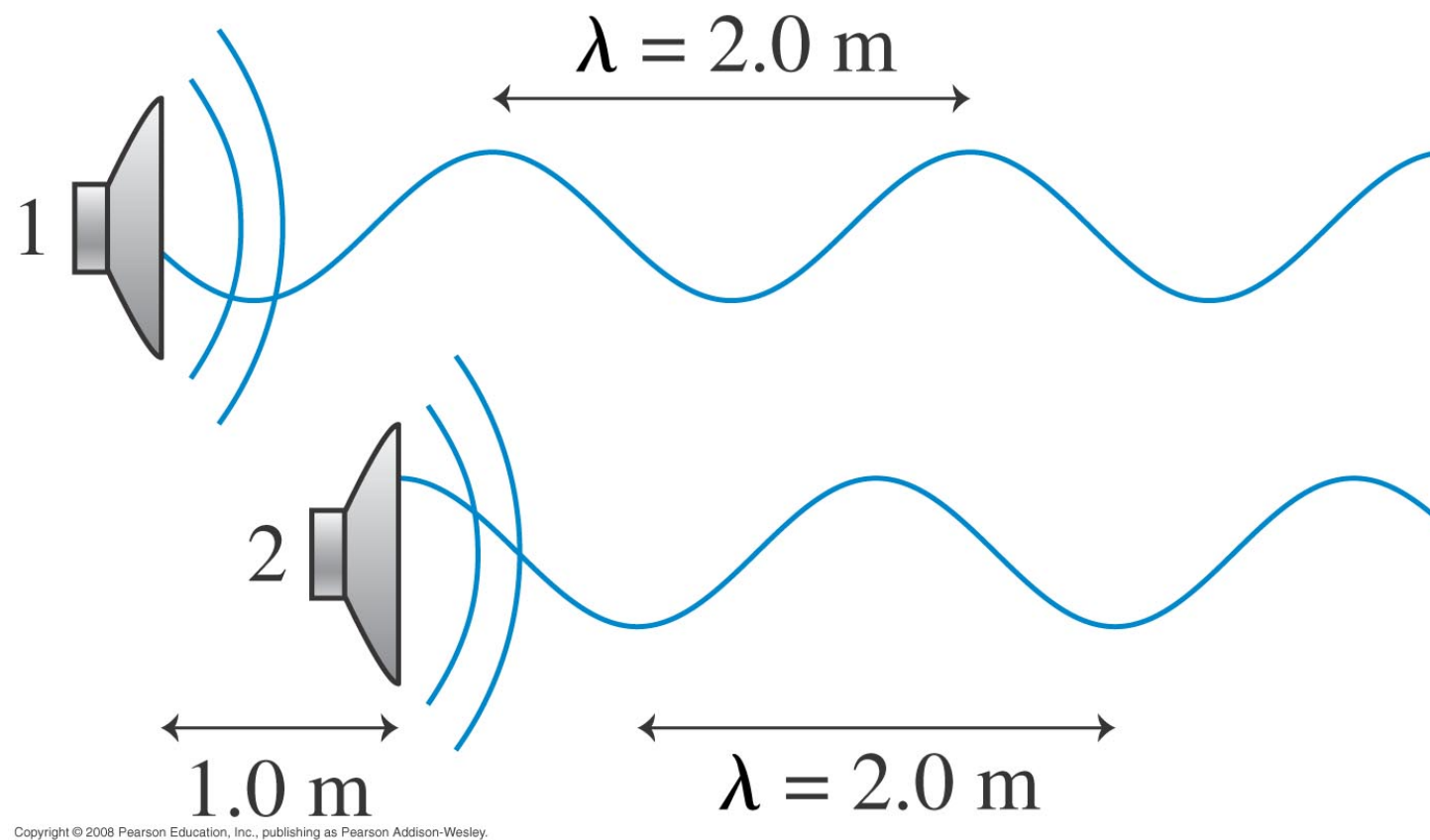


$$I_1 = 10V/30\Omega = 0.33 \text{ A}$$



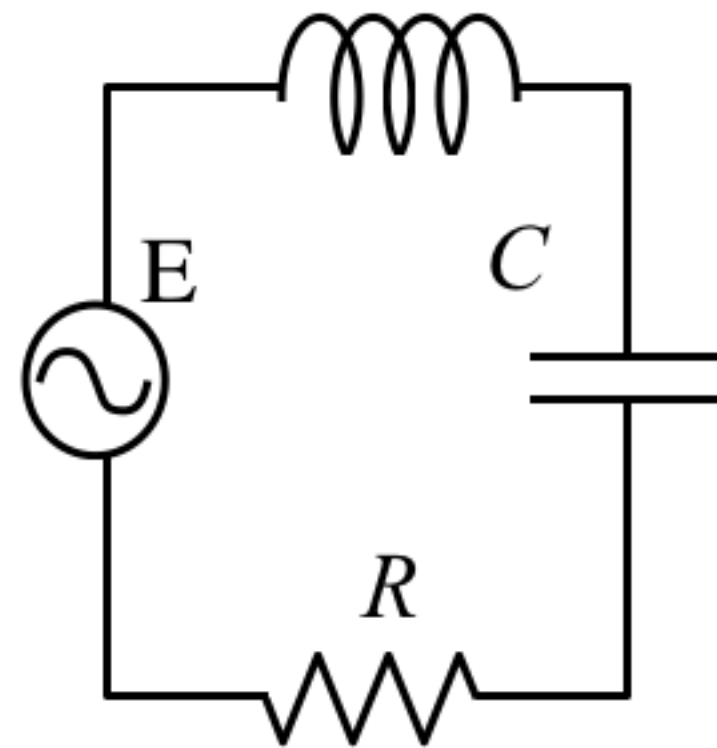
Two loudspeakers emit waves with $\lambda = 2.0\text{m}$. Speaker 2 is 1.0m in front of speaker 1. What, if anything, can be done to cause constructive interference between the two waves?

- (a) Move speaker 1 to the right 1.0m
- (b) Move speaker 1 to the right 0.5m
- (c) Move speaker 1 to the left 0.5m
- (d) Move speaker 1 to the left 1.0m
- (e) Nothing. This situation already causes constructive interference..



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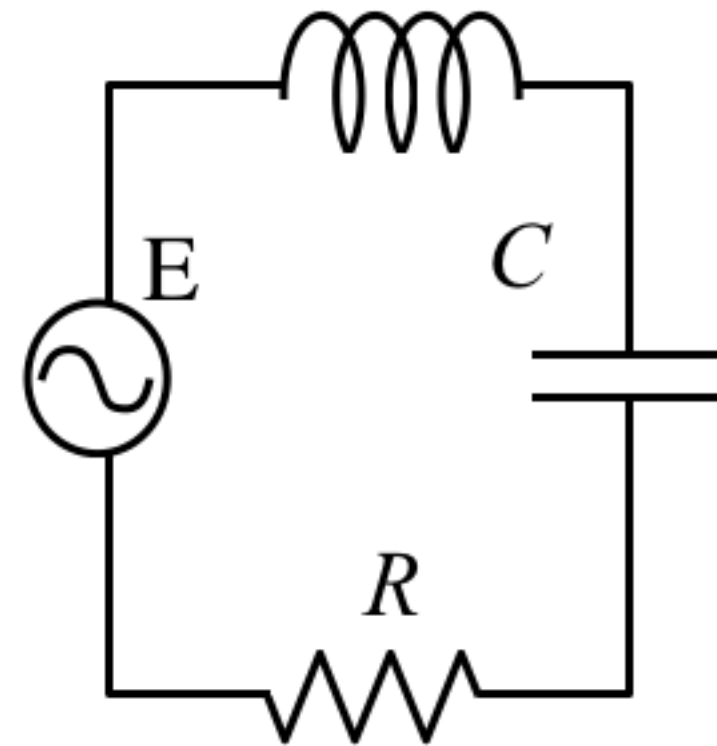
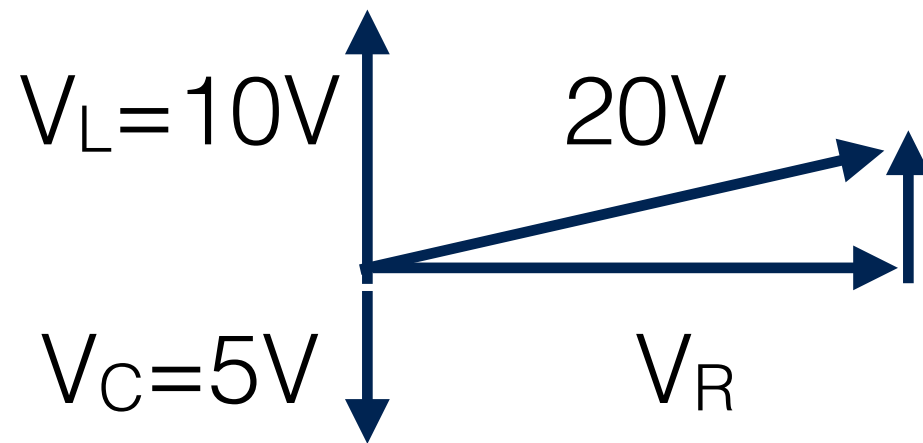


$$\begin{aligned}
 L &= 0.05 \text{ H} \\
 C &= 1 \times 10^{-6} \text{ F} \\
 R &= ? \\
 \underline{E_{\max}} &= 20 \text{ V} \\
 V_{L,\max} &= 10 \text{ V} \\
 V_{C,\max} &= 5 \text{ V}
 \end{aligned}$$

An AC generator of unknown angular frequency ω produces an amplitude of $E_{\max} = 20 \text{ V}$. The inductance and the capacitance values appear on the figure. The maximum voltage drop across the inductor is $V_{L,\max} = 10 \text{ V}$ and the maximum voltage drop across the capacitor is $V_{C,\max} = 5 \text{ V}$. *Note: This problem is much easier if you draw phasor diagrams throughout.*

The max voltage drop across R is

- a. 5.0 V b. 20.0 V c. 19.4 V₂₆ d. 15.0 V e. 16.8 V



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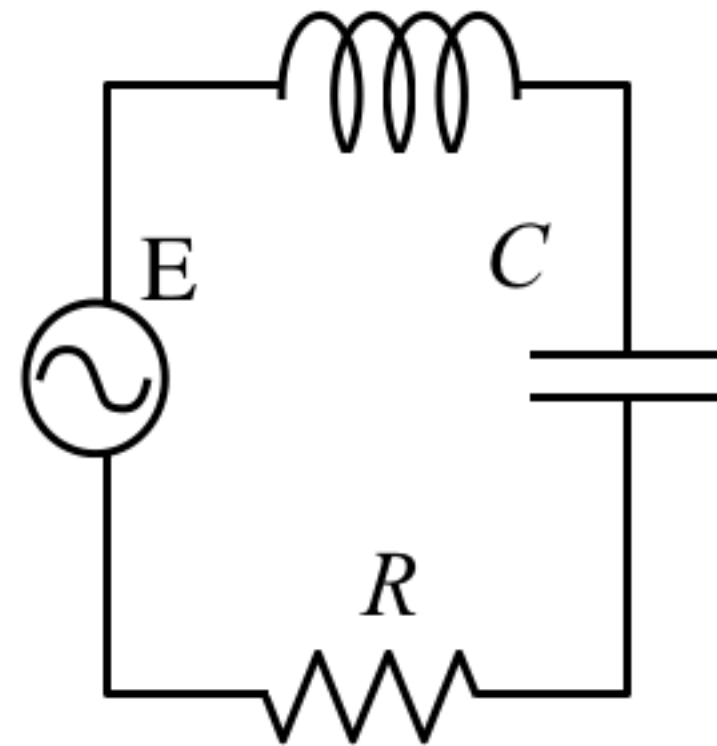
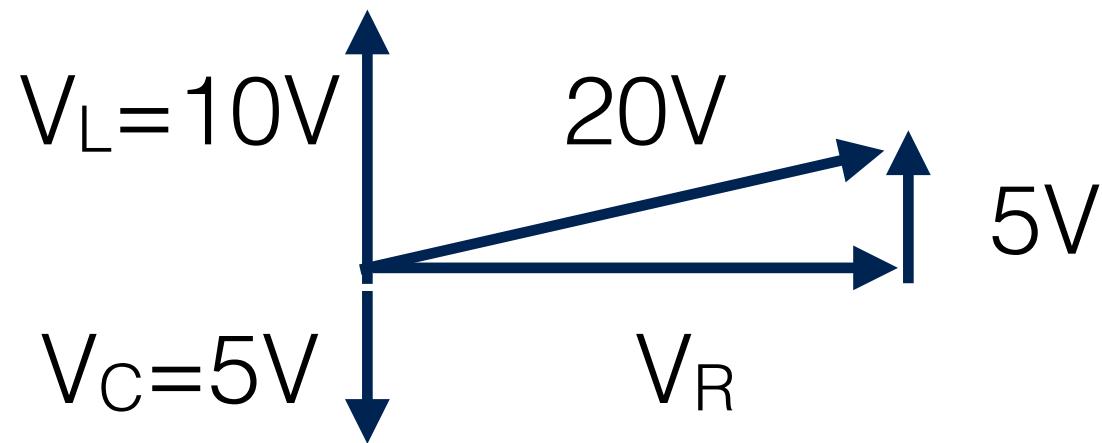
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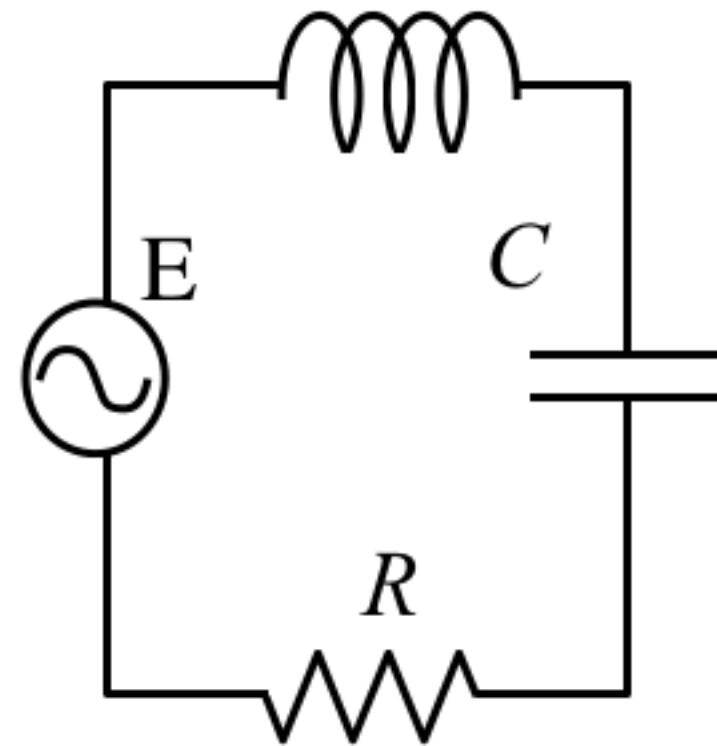
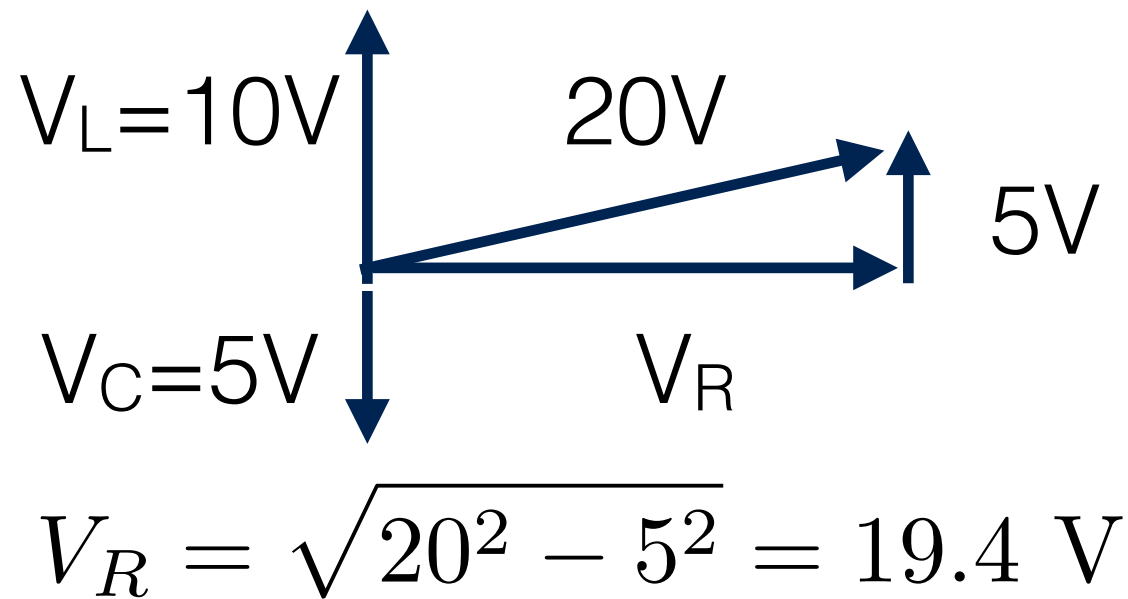
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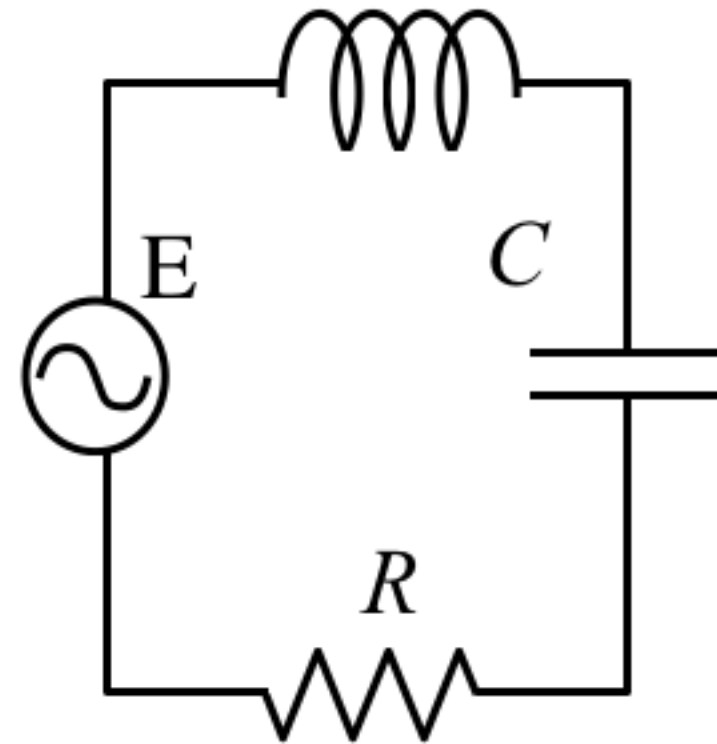
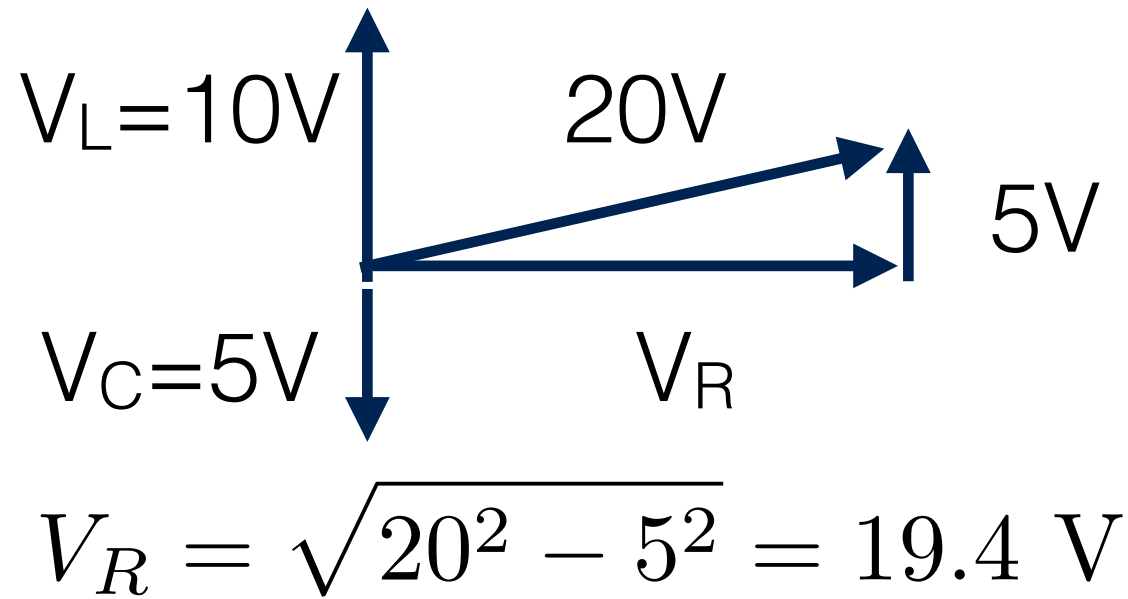


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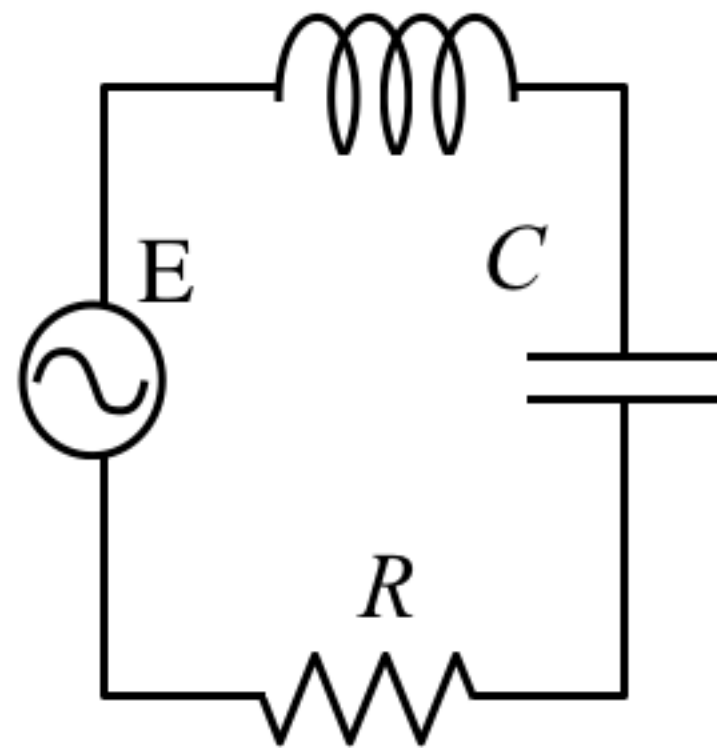
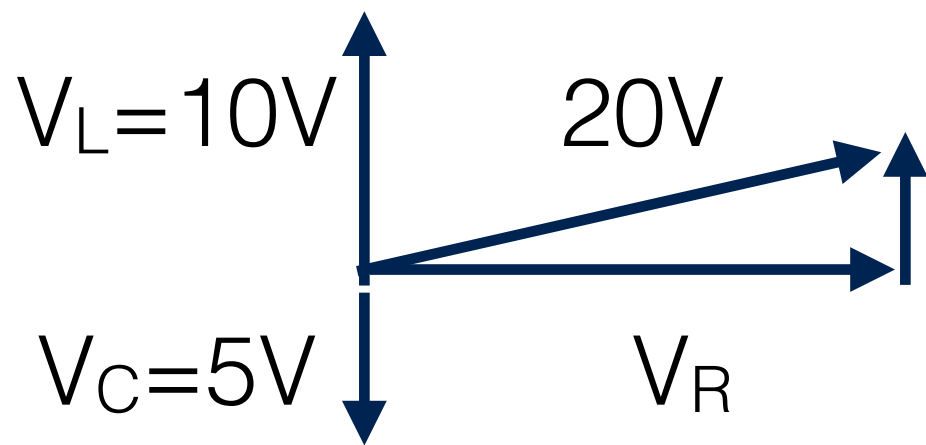


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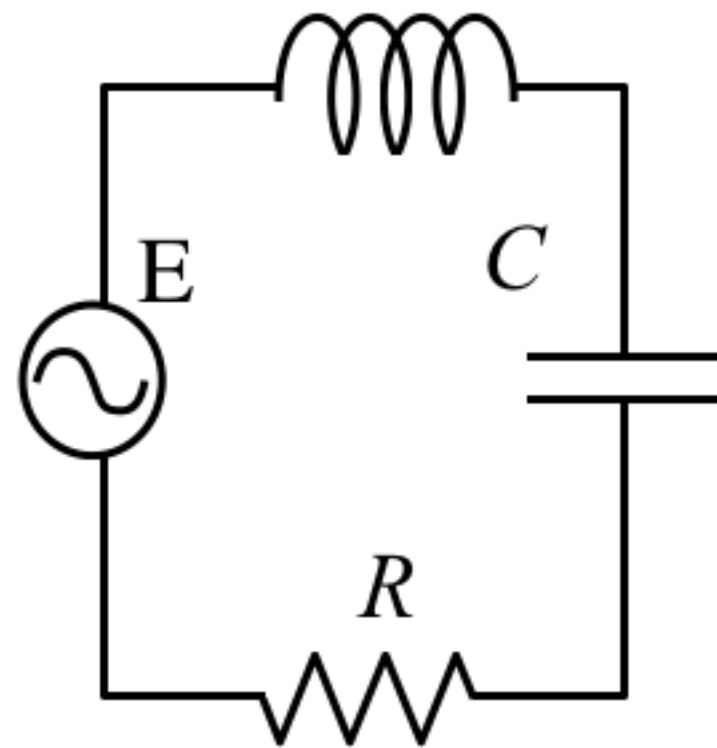
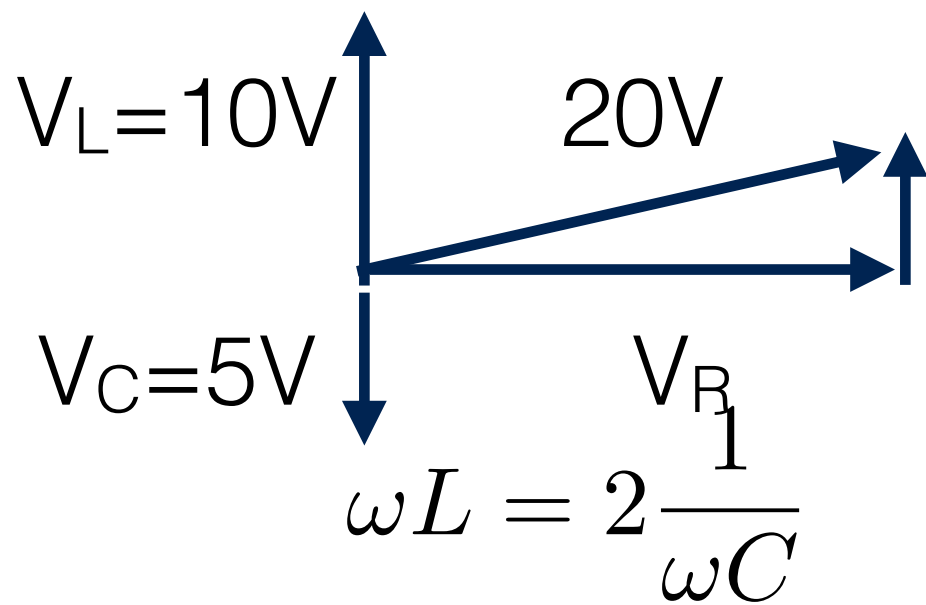
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What is the angular frequency ω of the generator?

- a. 2236 rad/s b. 3162 rad/s c. 4472 rad/s d. 6325 rad/s



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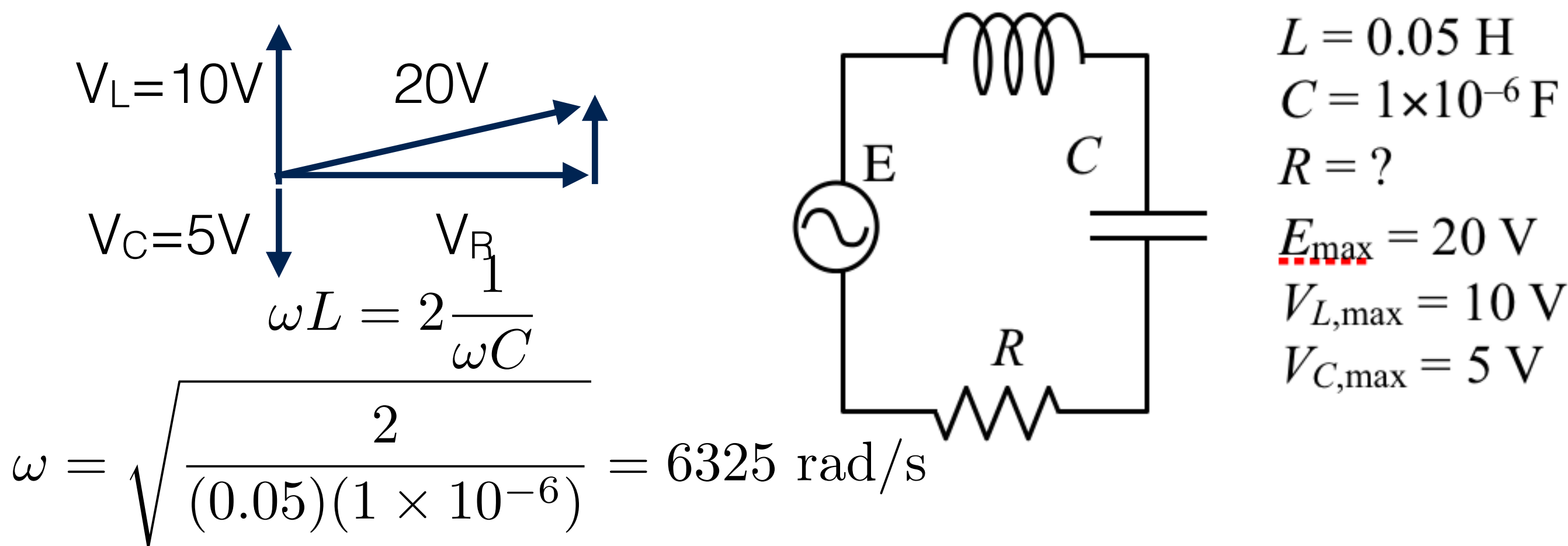
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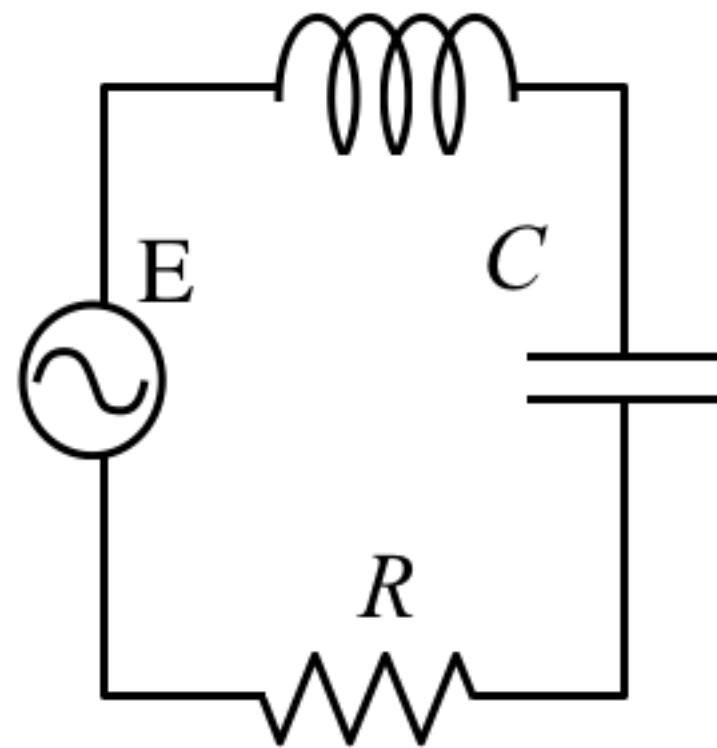
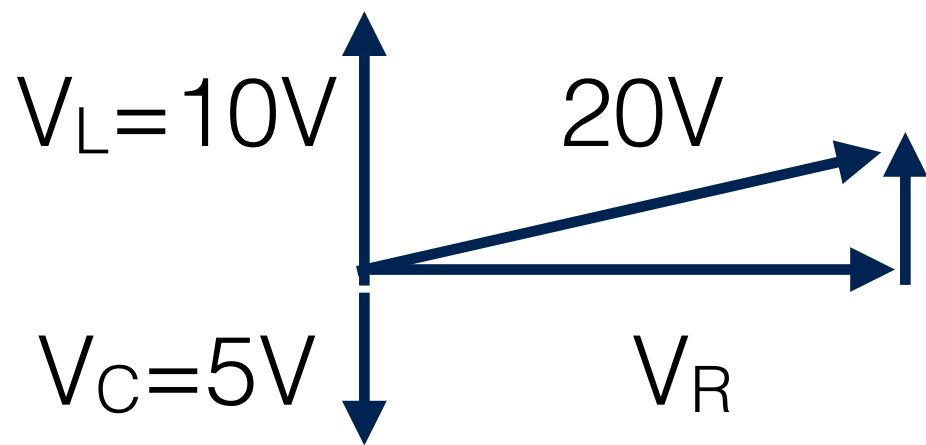
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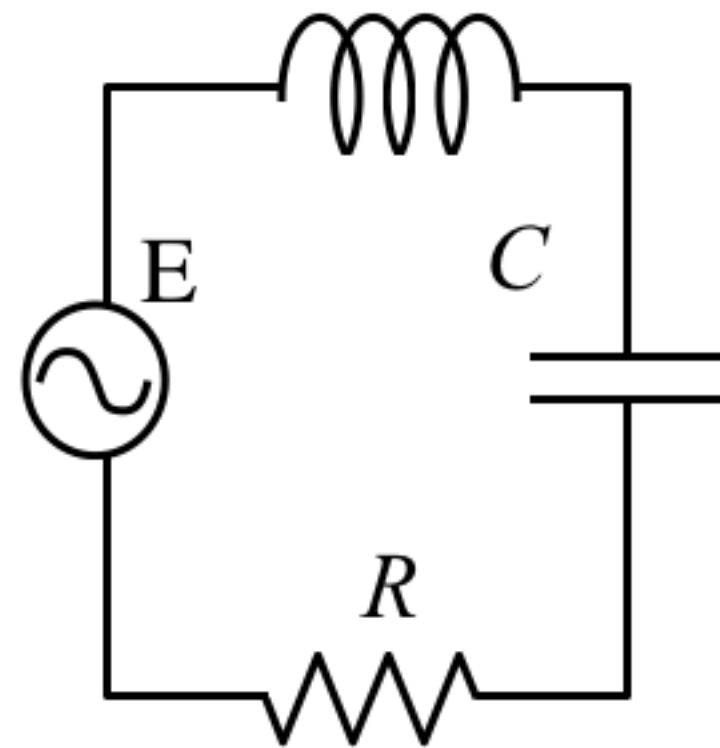
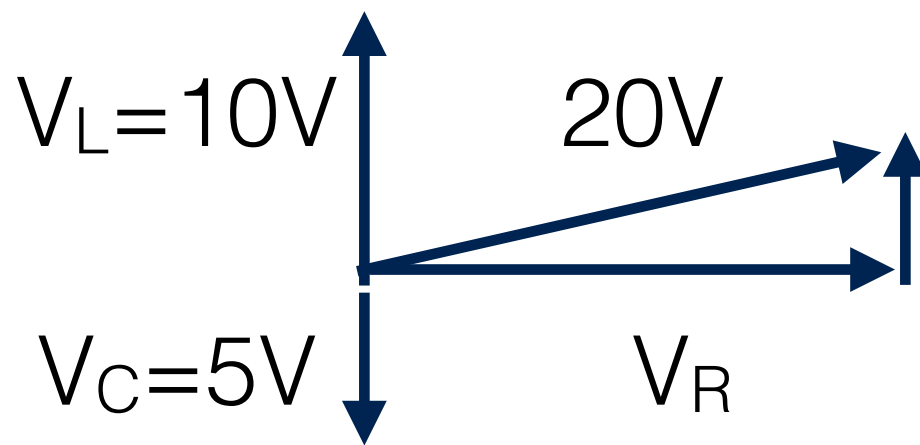
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By what phase φ does the generator voltage lead the current?

- a. $\varphi = 14.5^\circ$ b. $\varphi = 30.0^\circ$ c. $\varphi = 63.4^\circ$



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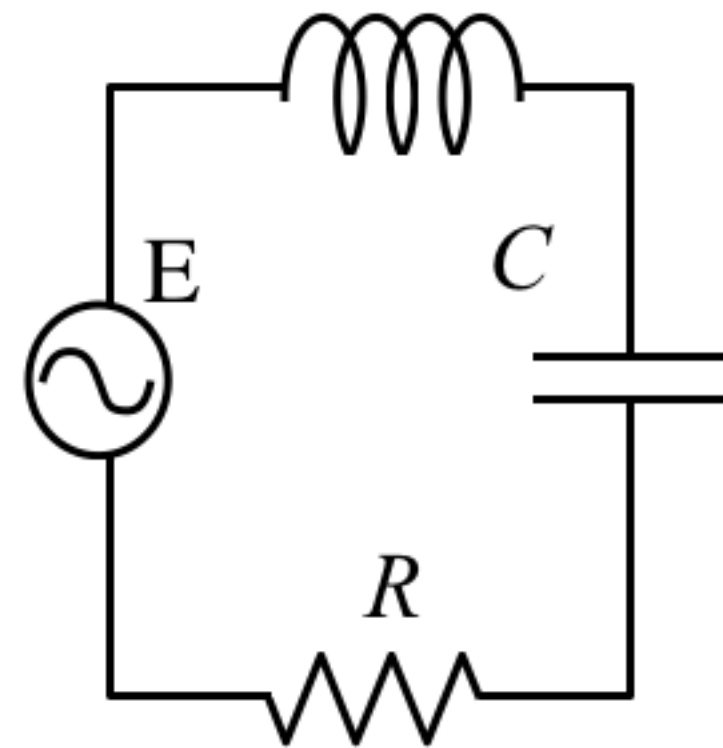
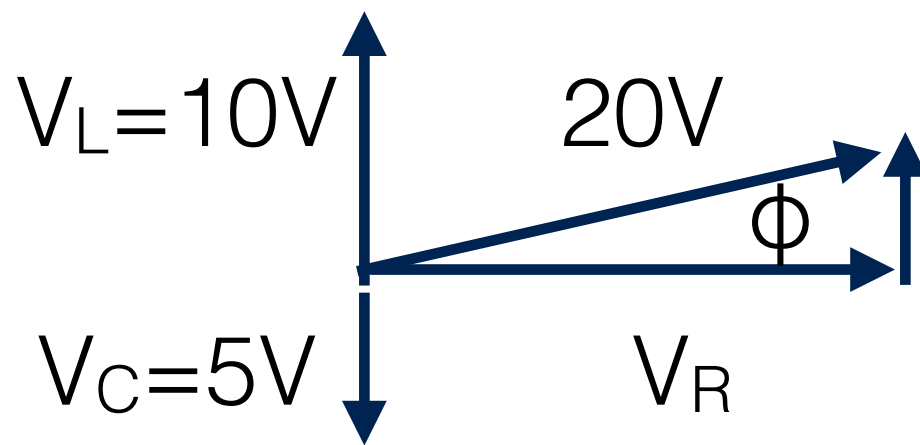
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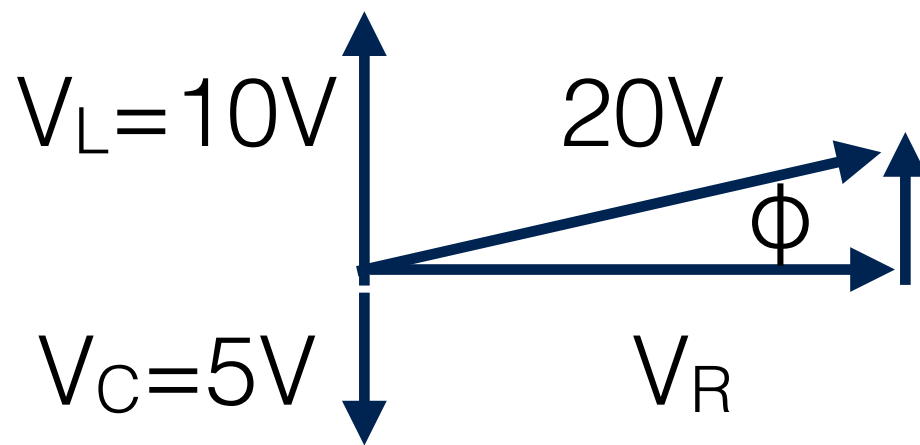
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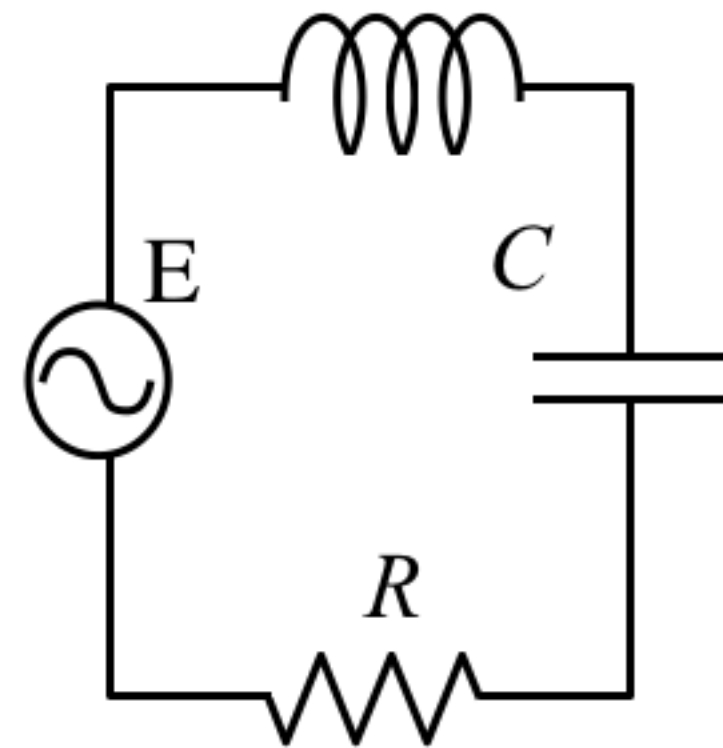
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$$\phi = \arcsin(5/20) = 14.5^\circ$$



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- Final Exam Thursday, August 15, 8:30 am
- Location: WMC 3520
- Same rules at midterms: 1 letter-sized formula sheet, basic scientific calculator, ruler