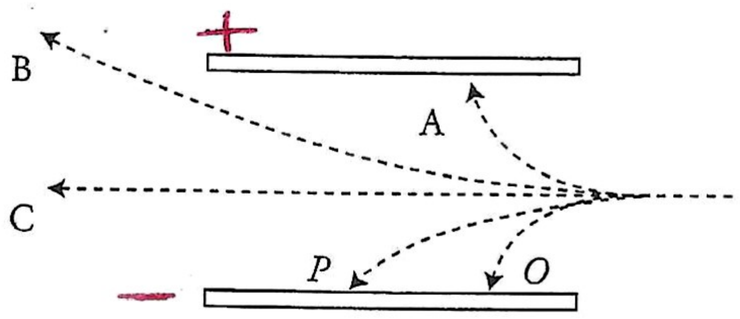
AP Physics 2: Practice Exam 1

Section 1 (Multiple Choice)

Directions: The multiple-choice section consists of 50 questions to be answered in 90 minutes. You may write scratch work in the test booklet itself, but only the answers on the answer sheet will be scored. You may use a calculator, the equation sheet, and the table of information. These can be found in the appendix or you can download the official ones from College Board at: https://secure-media.collegeboard.org/digitalServices/pdf/ap/ap-physics-2-equations-table.pdf.

Questions 1–45: Single-Choice Items

Choose the single best answer from the choices provided, and mark the answer with a pencil on the answer sheet.

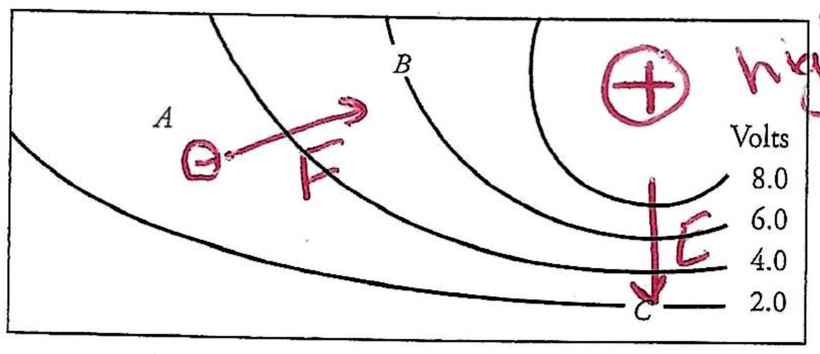


1. A beam of various particles is launched into the space between two oppositely charged parallel plates as shown in the figure. It is known that the particles are all traveling at the same initial velocity as they enter the region, and that particle *P* is a proton. What else can be inferred?

   (A) Particle A could be a β-particle.
   (B) Particle B could be an α-particle.
   (C) Particle C has too much mass to be affected by the external force field.
   (D) Particle D could be an electron.

Questions 2 and 3 refer to the following material.

The figure shows an electric potential field created by charges that are not shown.

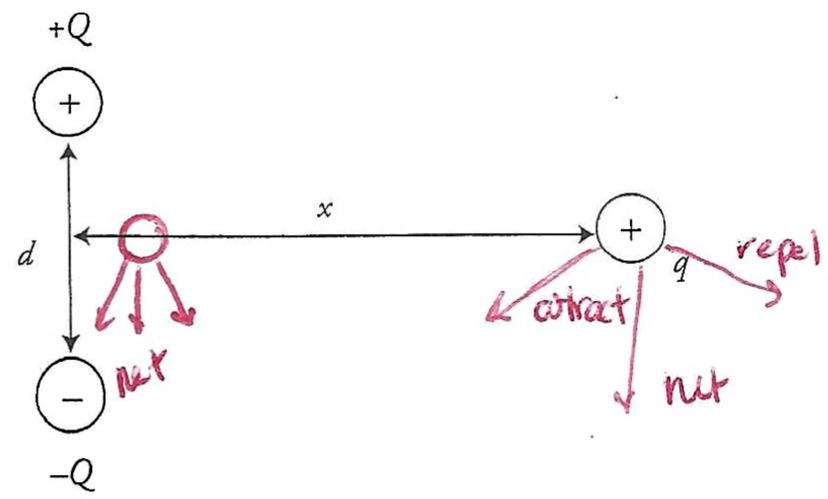


2. A small negative charge is placed at the location labeled *A*. Which one of the following vectors most closely depicts the direction of the electric force on the charge?

   (A)
   (B)
   (C)
   (D)

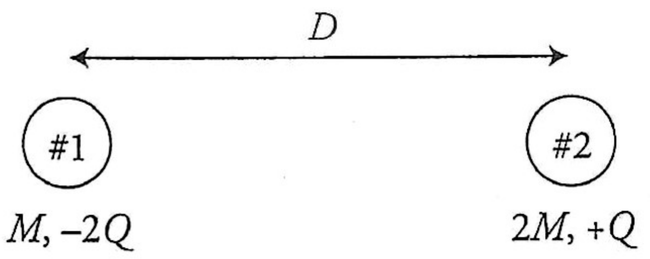
3. At which location is the electric field strongest, and which direction is the electric field?

   (A) *A*
   (B) *B*
   (C) *C*
   (D) *C*



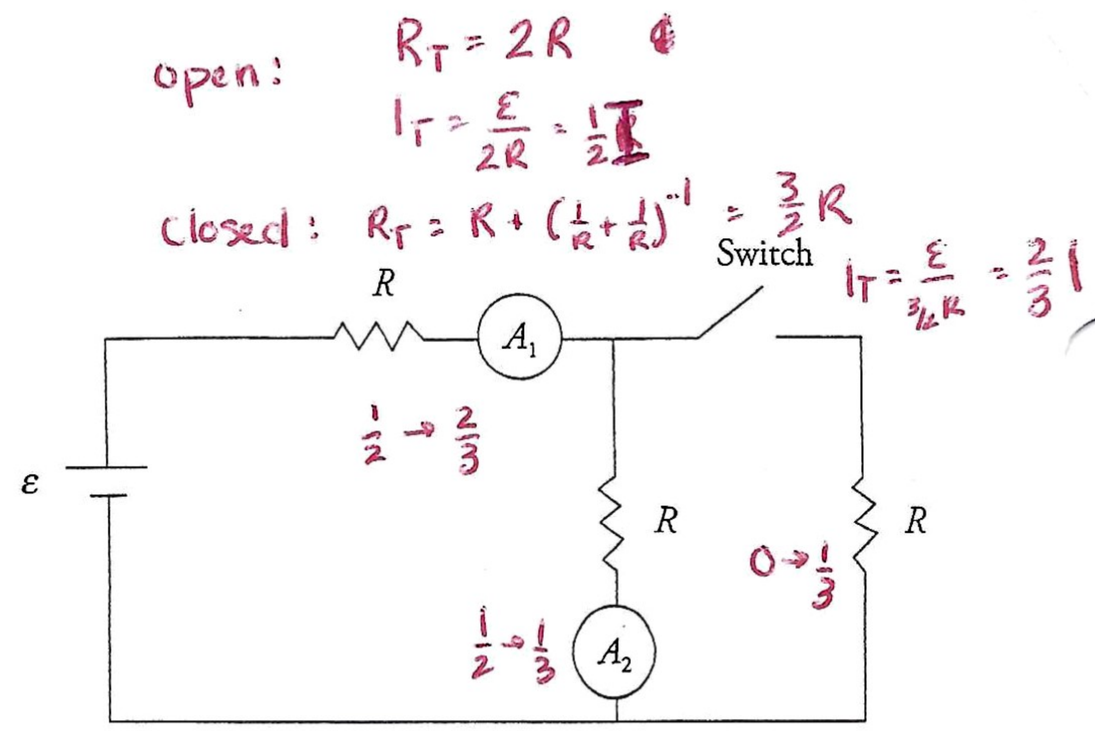
4. Two spheres with charges $+Q$ and $-Q$ of equal magnitude are placed a vertical distance d apart on the y-axis as shown in the figure. A third charge $+q$ is brought from a distance x, where $x >> d$, horizontally toward the midpoint between $+Q$ and $-Q$. The net force on $+q$ as it is moved to the left along the x-axis:

(A) increases and remains in the same direction
(B) increases and changes direction
(C) remains the same magnitude and in the same direction
(D) remains in the same direction but decreases to zero



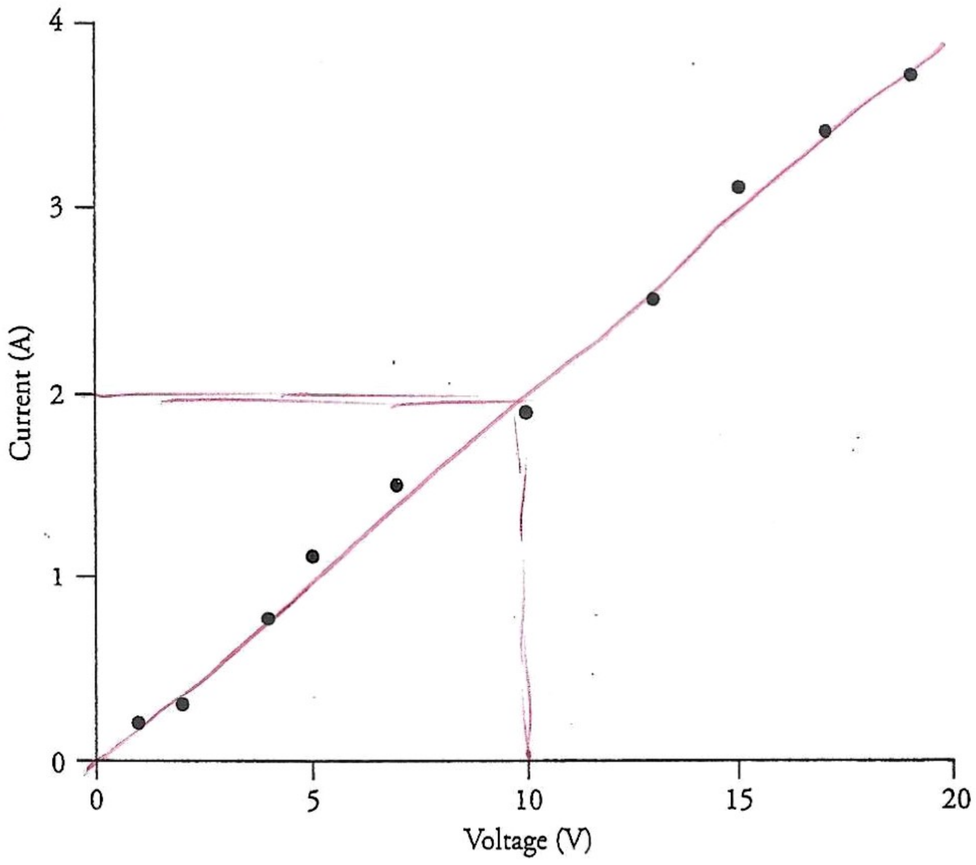
5. Two charges are separated by a distance D as shown in the figure. Charge #1, on the left, has a mass of M and a charge of $-2Q$. Charge #2, on the right, has a mass of $2M$ and a charge of $+Q$. The two charges are released. Where will the charges collide and why?

(A) The charges will collide closer to charge #1 because charge #1 has a larger magnitude charge and will exert a larger force on charge #2 giving charge #2 a larger acceleration.
(B) The charges will collide in the middle because the larger charge of #1 cancels the larger mass of #2.
(C) The charges will collide in the middle because the force between the charges will be equal and opposite in direction.
(D) The charges will collide closer to charge #2 because the center of mass is closer to charge #2 and there are no other forces on the system.



6. The circuit shown has a battery of emf $\mathcal{E}$; three identical resistors, R; two ammeters, A_1 and A_2; and a switch that is initially in the open position as shown in the figure. When the switch is closed, what happens to the current reading in the two ammeters?

	A_1	A_2
(A)	increases	increases
(B)	increases	stays the same
(C)	increases	decreases
(D)	decreases	stays the same



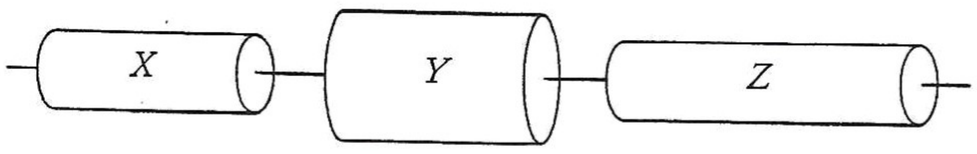
7. A kitchen toaster is connected to a variable power supply. The voltage difference across and current through the toaster are measured for various settings of the power supply. The figure shows the graph of the data. The resistance of the toaster:

(A) varies up and down with voltage
(B) increases linearly with input voltage
(C) is constant at 0.2 Ω
(D) is constant at 5.0 Ω

Questions 8 and 9 refer to the following material.

The figure shows three resistors, X, Y, and Z, which have different shapes but are made of the same material. The resistors as shown are connected to a voltage source.

Series connection



8. Which of the following correctly ranks the current in the resistors?

$R = \rho \frac{L}{A}$

Y: ↑A ↓R

Series → equal current

(A) ~~$I_X = I_Y = I_Z$~~
(B) $I_X > I_Y > I_Z$
(C) $I_Y > I_X > I_Z$
(D) $I_Z > I_X > I_Y$

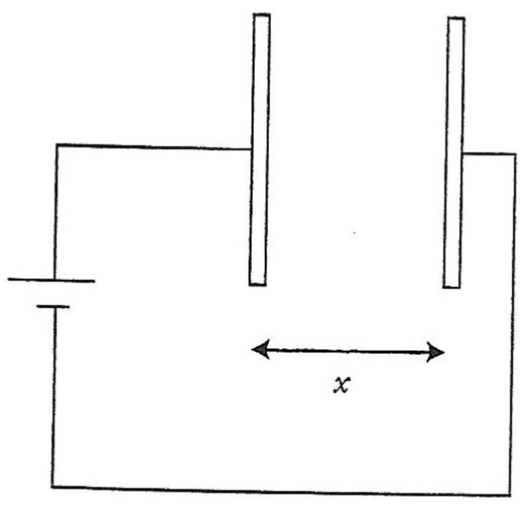
9. Which of the following correctly ranks the potential difference across the resistors?

↑R ↑V in series

Y ↓R ↓V

Z ↑L ↑R ↑V

(A) ~~$V_X = V_Y = V_Z$~~
(B) $V_X > V_Y > V_Z$
(C) $V_Y > V_X > V_Z$
(D) $V_Z > V_X > V_Y$



10. A capacitor with movable parallel plates is connected to a battery. The plates of the capacitor are originally a distance x apart as shown in the figure. With the battery still connected, what happens to the energy stored in the capacitor and the electric field between the capacitor plates, if the plates are moved to a new distance $x/2$?

	Energy	Electric Field
(A)	increases	increases
(B)	increases	~~decreases~~
(C)	~~decreases~~	increases
(D)	~~decreases~~	~~decreases~~

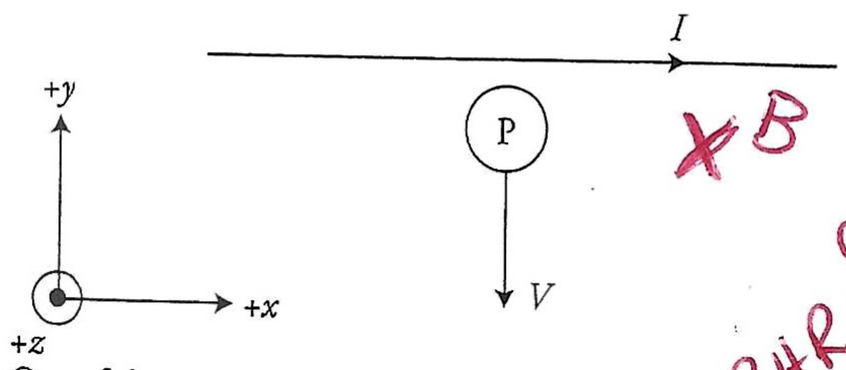
$U_C = \frac{1}{2} C \Delta V^2$

$C = k\varepsilon \frac{A}{d}$

↓d ↑C ↑U_C

$V = Ed$

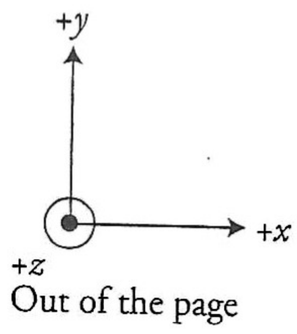
$E = \frac{V}{d}$ ↓d ↑E

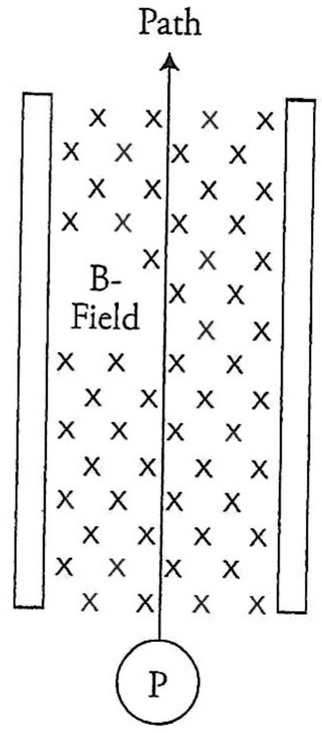


RHR: ① current wire ② B in to pg ③ B in v

11. A proton with a velocity v is moving directly away from a wire carrying a current I directed to the right in the $+x$ direction as shown in the figure. The proton will experience a force in which direction?

(A) $-x$
(B) $-z$
(C) $+x$
(D) $+z$





B makes it go left & C and out

12. A magnetic field directed into the page in the $-z$ direction is placed between the plates of a charged capacitor as shown in the figure. The magnetic and electric fields are adjusted so that a particle of charge $+1\ e$ moving at a velocity of v will pass straight through the fields in the $+y$ direction. Which of the following changes will cause the particle to deflect to the left as it passes through the fields?

$V = \frac{E}{B}$

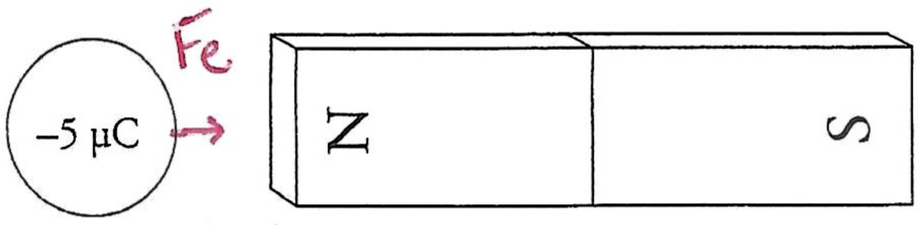
$F_e = F_B$

$Eq = qvB$

(A) increasing the electric field strength
(B) changing the sign of the charge to $-1\ e$
(C) increasing the velocity v of the particle
(D) ~~decreasing~~ the magnetic field strength

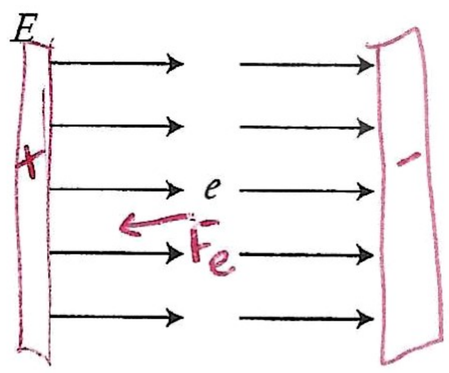
↑v F_B ↑

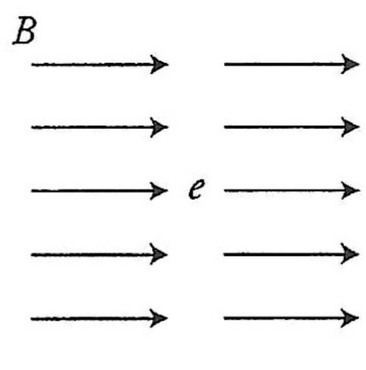
you could: ↑B ↓E ↑V



13. A stationary charge is placed a small distance from an iron bar magnet as shown in the figure. Which of the following correctly indicates the cause and direction of the force on the charge?

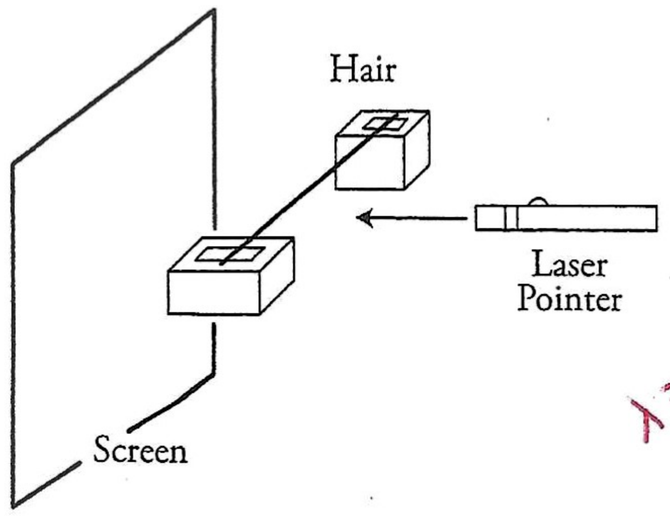
(A) The charge experiences an ~~electric force~~ to the right.
(B) The charge experiences a magnetic force to the right.
(C) The charge experiences a magnetic force to the left.
(D) The charge experiences no force.





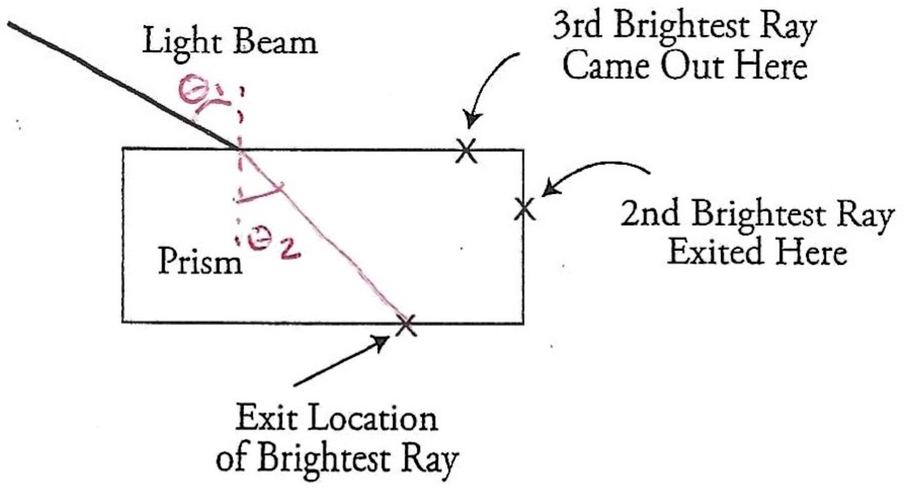
14. An electron *e* is placed in an electric field and a second electron is placed in a magnetic field as shown in the figure. Both are released from rest at the same time. How do the forces on the charges compare?

(A) Both electrons experience a constant force in the ~~same direction.~~
(B) Both electrons experience a constant force but in different directions.
(C) One electron experiences a constant force in a constant direction, while the other experiences a constant force that changes direction.
(D) One electron experiences a constant force, while the other experiences no force.



15. A technician sets up a red laser pointer and directs light at a strand of hair suspended between two blocks in such a way that the light falls on a screen behind the hair as shown in the figure. This produces a pattern of alternating light and dark fringes on the screen. The technician makes one change to the setup and repeats the procedure. This change produces a similar pattern, but the light and dark fringes are spaced farther apart. Which of the following could account for this different pattern?

(A) The hair was replaced with one of ~~larger~~ diameter.
(B) The screen was moved farther away from the hair.
(C) The red laser was replaced with a blue laser.
(D) The red laser was moved farther away from the hair.



16. Your lab group has been asked to determine the index of refraction of a plastic rectangular prism. Your partner places the prism on a sheet of paper, traces its shape, shines a beam of light through the prism, and traces the incoming ray. The light exits the prism at multiple locations. Your partner marks the exit locations of the three brightest rays on the side of the prism as

shown in the figure. Is this enough information to determine the index of refraction of the prism and why?

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

(A) Yes, by measuring ray angles with a protractor and using the concepts of refraction

(B) Yes, by measuring the internal reflected angles with a protractor and using the concepts of total internal reflection

(C) No, the exit rays from the prism should have been traced. It is impossible to utilize the concepts of refraction without having the exit ray directions.

(D) No, without knowing the velocity of the beam inside the prism, you cannot use the index of refraction equation.

17. A very slow-moving positron interacts with a stationary electron. Which of the following statements correctly describes a possible outcome of this reaction and why it would occur?

+le m=me

(A) Conservation of mass indicates that if a single new particle were created in the reaction, it must have a total mass equal to the combined masses of the electron and positron.

(B) Conservation of charge indicates that all new particles created in the reaction would have no electric charge.

(C) Conservation of momentum indicates that two identical gamma rays moving off in opposite directions could be created.

(D) Conservation of energy indicates that the antimatter positron could annihilate into energy, leaving the stationary electron behind.

matter converts to energy

could have opposite charges

18. $^{14}_{6}C$ decays into $^{14}_{7}N$ and an electron. The half-life of carbon-14 is 5730 years. Which of the following statements is correct?

(A) Carbon-14 has the same number of protons as carbon-11.

(B) Carbon-14 is used to determine the age of 120-million-year-old dinosaur bones.

(C) The combined mass of nitrogen-14 and an electron equals the mass of carbon-14.

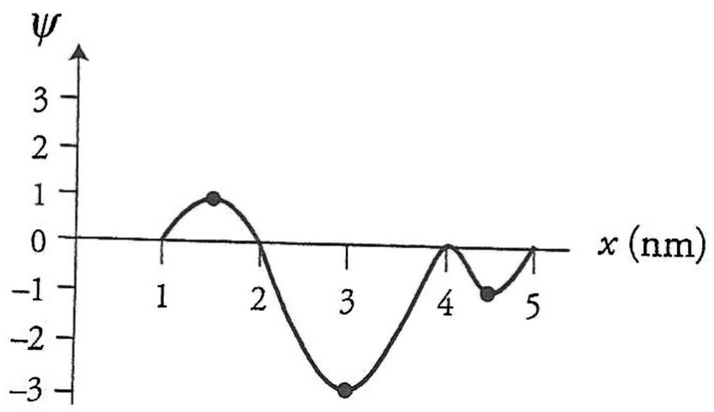
(D) Carbon-14 and carbon-11 will have different chemical properties.

5730 too short

energy lost

→same electron config

$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$



19. The figure shows the wave functions $\Psi(x)$ of a particle moving along the x-axis. Which of the following statements correctly interprets this graph?

(A) The particle is oscillating in charge from positive to negative.

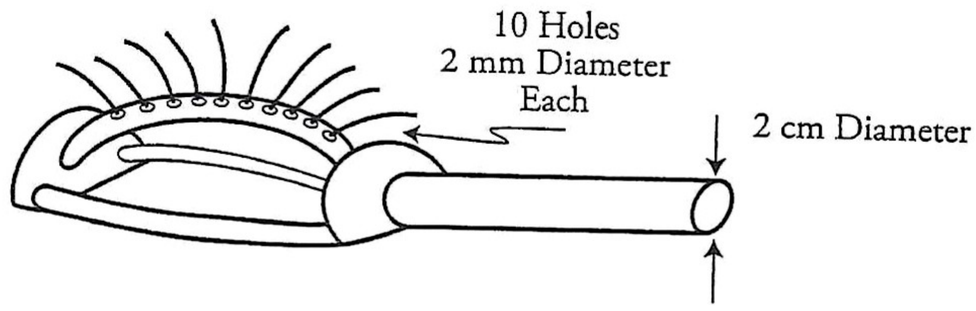
(B) The lowest probability of finding the particle is at 3.0 nm.

highest

(C) There is an equal probability of finding the particle at 1.5 nm as at 4.5 nm.

(D) The length of the particle is 4 nm.

same displacement
same prob



20. A 2-cm diameter hose leads to a lawn sprinkler with ten 2-mm exit holes as shown in the figure. The velocity of the water in the hose is v_1. What is the velocity of the water exiting the holes?

(A) $0.1\ v_1$

(B) v_1

(C) $2.5\ v_1$

(D) $10\ v_1$

$A_1 v_1 = A_2 v_2$

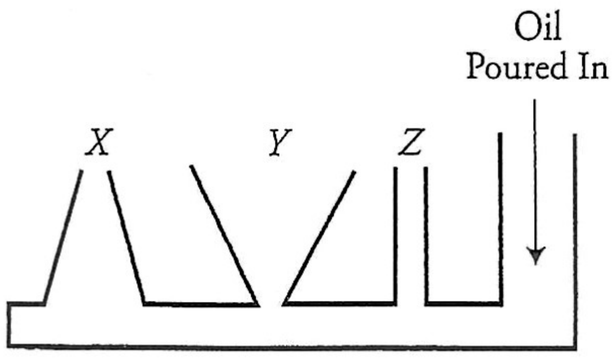
$\pi r_1^2 v_1 = \pi r_1^2 v_2$

$V_2 = \dfrac{r_1^2 V_1}{r_1^2}$

$\dfrac{(2)^2 V_1}{(10)(.2)^2}$

$\dfrac{2^2}{(10)(\frac{2}{10})^2}$

$\frac{1}{10^2/100}$ $\frac{100}{10} = 10$

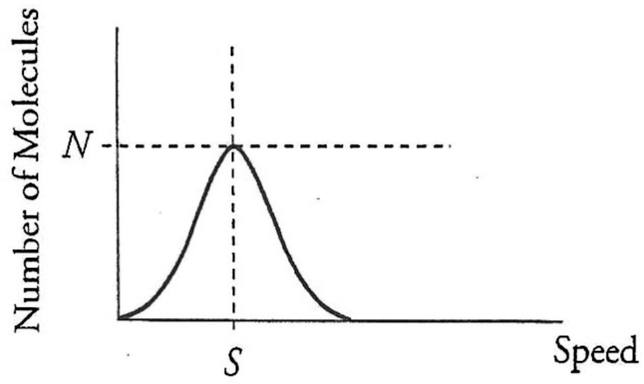


21. Oil is very slowly poured into the container shown in the figure until the fluid enters the three open tubes *X*, *Y*, and *Z*. The oil does not overflow any of the tubes. Which of the following correctly ranks the height of the oil in each of the three tubes?

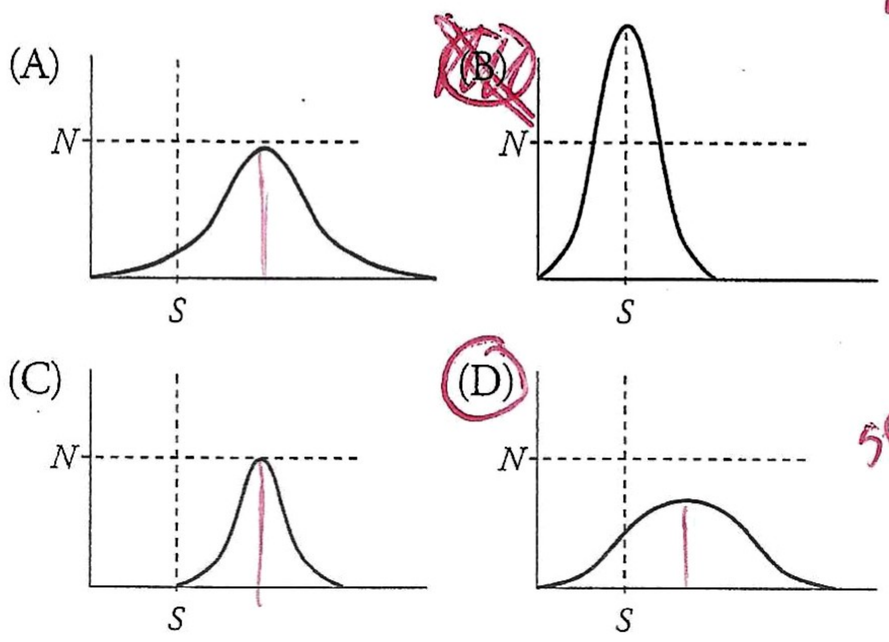
(A) $Z > Y > X$
(B) $Z > X > Y$
(C) $X > Z > Y$
(D) $X = Y = Z$

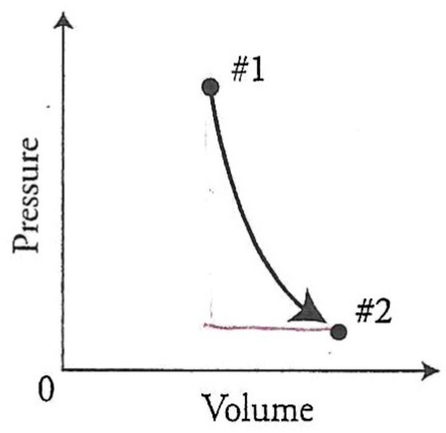
22. Two identical containers are filled with different gases. Container 1 is filled with hydrogen and container 2 is filled with nitrogen. Each container is set on a lab table and allowed to come to thermal equilibrium with the room. Which of the following correctly compares the properties of the two gases?

(A) The average kinetic energy of the hydrogen gas is greater than the nitrogen gas.
(B) The average force exerted on the container by the hydrogen gas is greater than the nitrogen gas.
(C) The density of the hydrogen gas is less than the nitrogen gas.
(D) The pressures of the gases cannot be compared without knowing the number of molecules in each container.



23. The graph shows the distribution of speeds for a gas sample at temperature *T*. The gas is heated to a higher temperature. Which of the following depicts a possible distribution after the gas has been heated? (Horizontal line *N* and vertical line *S* are shown for reference.)





24. The graph shows the pressure and volume of a gas being taken from state #1 to state #2, in a very quick process, where there is not enough time for heat to either leave or enter the gas. Which of the following correctly indicates the sign of the work done on the gas, and the change in temperature of the gas?

	Work Done	Δ Temperature
(A)	+	+
(B)	+	−
(C)	−	+
(D)	−	−