SAT Physics Practice Paper 13

1. If a particle of charge –0.2 mC were placed at a certain location within an electric field, the magnitude of the electric force it would feel is 1 N. What is the magnitude of the electric field at this location? (1 mC = 10^{-3} C)

A. 2,000 N/C

B. 5,000 N/C

C. 20,000 N/C

D. 50,000 N/C

E. 500,000 N/C

2. Traveling at an initial speed of 1.5×10^6 m/s, a proton enters a region of constant magnetic field, B, of magnitude 1.0 tesla. If the proton's initial velocity vector makes an angle of 30° with the direction of B, compute the proton's speed 4 seconds after entering the magnetic field.

A. 5.0×10^5 m/s

B. 7.5×10^5 m/s

C. 1.5×10^6 m/s

D. 3.0×10^6 m/s

E. 6.0×10^6 m/s

3. An object of mass 2 kg increases in speed from 2 m/s to 4 m/s in 3 s. What was the total work performed on the object during this time interval?

A. 4 J

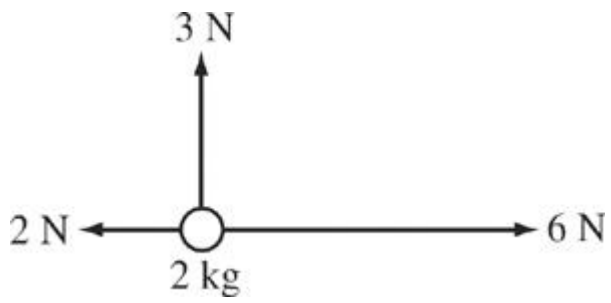
B. 6 J

C. 12 J

D. 24 J

E. 36 J

4.



The figure above shows the forces acting on an object of mass 2 kg. What is the object's acceleration?

A. 2 m/s^2

B. 2.5 m/s^2

C. 3 m/s^2

D. 3.5 m/s^2

E. 4 m/s^2

5. Two traveling waves of equal frequency, one of amplitude 4 cm and the other of amplitude 6 cm, superimpose in a single medium. Which of the following best describes the amplitude, *A*, of the resultant wave?

A. 2 cm ≤ *A* ≤ 10 cm

B. *A* = 5 cm

C. *A* = 10 cm

D. 10 cm ≤ *A* ≤ 12 cm

E. 12 cm ≤ *A* ≤ 24 cm

6. A uniform bar is lying on a flat table. Besides the gravitational and normal forces (which cancel), the bar is acted upon by exactly two other forces, $\mathbf{F}_1$ and $\mathbf{F}_2$, which are parallel to the surface of the table. If the net force on the rod is zero, then which one of the following is true?

A. The net torque on the bar must also be zero.

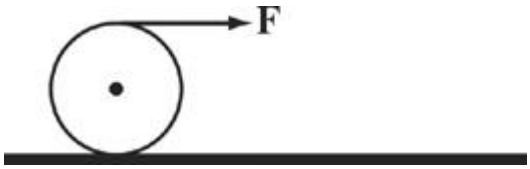
B. The bar can accelerate translationally if $\mathbf{F}_1$ and $\mathbf{F}_2$ are not applied at the same point.

C. The net torque will be zero if $\mathbf{F}_1$ and $\mathbf{F}_2$ are applied at the same point.

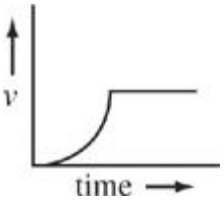
D. The bar cannot accelerate translationally or rotationally.

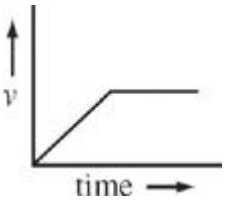
E. None of the above

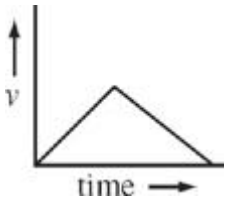
7.

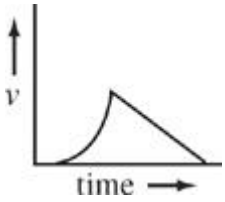


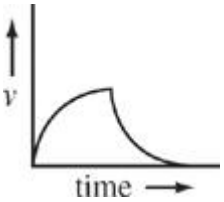
A uniform cylinder, initially at rest on a frictionless, horizontal surface, is pulled by a constant force **F** from time *t* = 0 to time *t* = *T*. From time *t* = *T* on, this force is removed. Which of the following graphs best illustrates the speed, *v*, of the cylinder's center of mass from *t* = 0 to *t* = 2*T*?

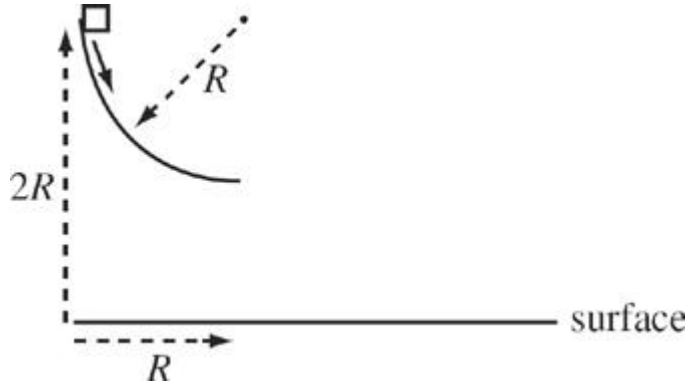
A. 

B. 

C. 

D. 

E. 

8. 

A small box slides down a frictionless track in the shape of a quarter-circle of radius *R*. The box starts from rest at the top of the track, a height equal to 2*R* above a horizontal surface. At the moment the box leaves the bottom of the track, a ball of the same mass as the box is dropped from the same height at the bottom of the track.

How fast is the box moving when it reaches the end of the track?

A. $v = \sqrt{gR}$

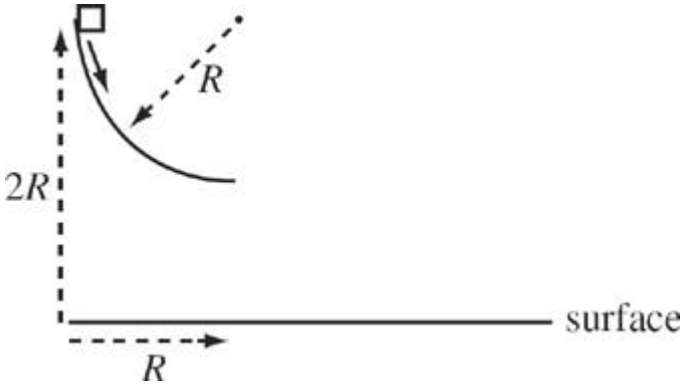
B. $v = \sqrt{2gR}$

C. $v = \sqrt{\pi gR}$

D. $v = \sqrt{2\pi gR}$

E. $v = \pi\sqrt{2gR}$

9.



A small box slides down a frictionless track in the shape of a quarter-circle of radius *R*. The box starts from rest at the top of the track, a height equal to 2*R* above a horizontal surface. At the moment the box leaves the bottom of the track, a ball of the same mass as the box is dropped from the same height at the bottom of the track.

Which of the following quantities must decrease as the box slides down the track?

A. The normal force on the box

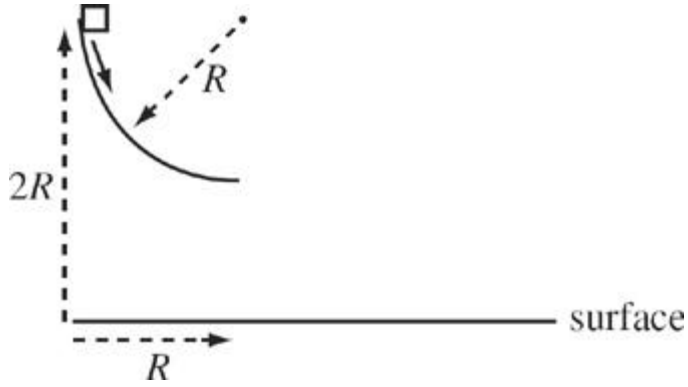
B. The net force on the box

C. The kinetic energy of the box

D. The potential energy of the box

E. The total mechanical energy (kinetic + potential) of the box

10.



A small box slides down a frictionless track in the shape of a quarter-circle of radius *R*. The box starts from rest at the top of the track, a height equal to 2*R* above a horizontal surface. At the moment the box leaves the bottom of the track, a ball of the same mass as the box is dropped from the same height at the bottom of the track.

Once the box leaves the bottom of the slide, which of the following statements best describes the motions of the box and the ball?

A. The ball hits the floor at the same time as the box.

B. The ball hits the floor before the box does.

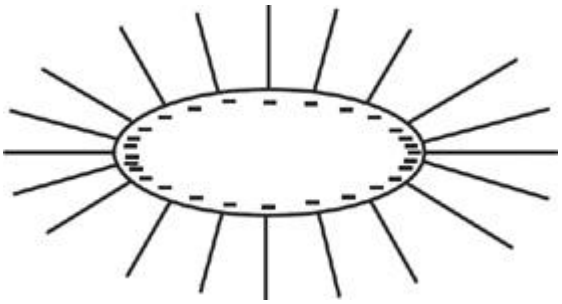
C. The ball hits the floor after the box does.

D. The acceleration of the box is greater than the acceleration of the ball.

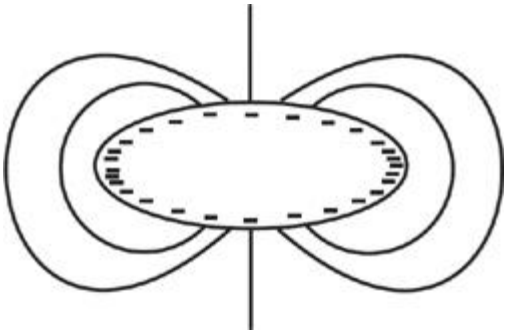
E. The acceleration of the ball is greater than the acceleration of the box.

11. An ellipsoid-shaped conductor is negatively charged. Which one of the following diagrams best illustrates the charge distribution and electric field lines?

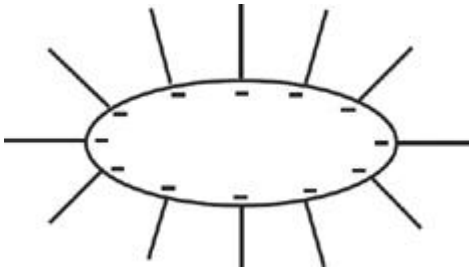
A.



B.



C.



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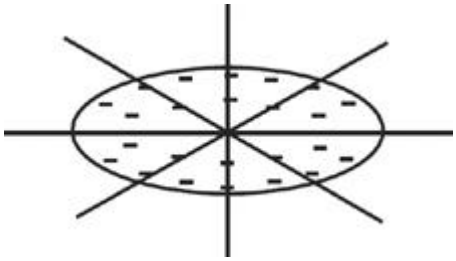
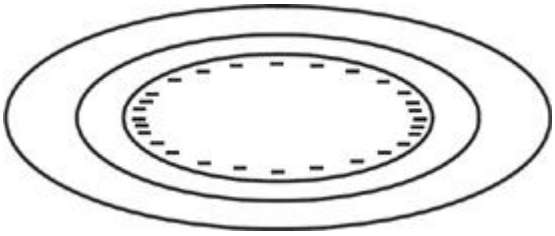


E.



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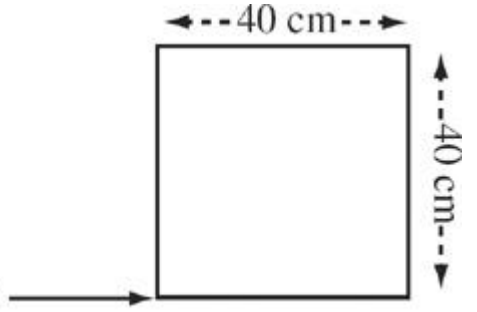


The figure above shows a square metal plate of side length 40 cm and uniform density, lying flat on a table. A force **F** of magnitude 10 N is applied at one of the corners, parallel to one of the sides, as shown. What's the torque produced by **F** relative to the center of the square?

A. 0 N-m

B. 1.0 N-m

C. 1.4 N-m

D. 2.0 N-m

E. 4.0 N-m

13. A mover, exerting a steady force of 200 N, pushes a box of mass 50 kg across a flat wooden floor. If the velocity of the box does not change while he pushes, what is the coefficient of kinetic friction between the box and the floor?

A. 0.2

B. 0.4

C. 0.5

D. 0.6

E. 0.8

14. What principle is the basis for the transmission of light through glass (fiber optic) cables, allowing the signal to be sent even if the cable is bent?

A. Photoelectric effect

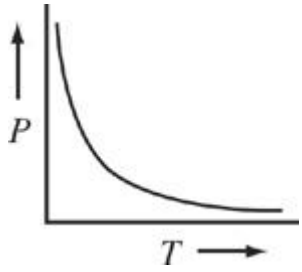
B. Uncertainty principle

C. Light diffraction

D. Light polarization

E. Total internal reflection

15. A student is monitoring the pressure and absolute temperature in a container of fixed volume filled with an ideal gas as the gas is heated. Which of the following graphs best illustrates the relationship between the pressure (*P*) and absolute temperature (*T*) of the gas, assuming that none of the gas escapes from the container?

A. 

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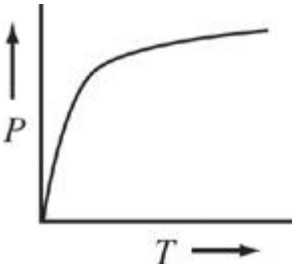
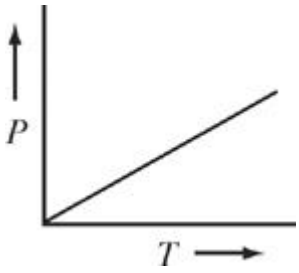
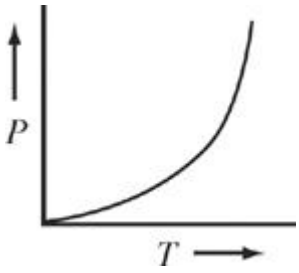


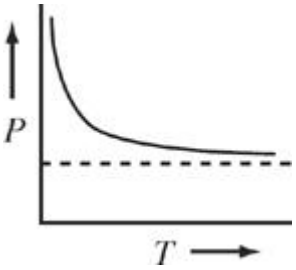
C.



D.



E.



16. Of the following types of waves, which type travels at the greatest speed through vacuum?

A. Radio waves

B. Microwaves

C. Ultraviolet light

D. X-rays

E. None of the above; all these waves would travel at the same speed.

17. What would happen to the electrostatic force between a pair of charged particles if both charges were doubled and the distance between them were also doubled?

A. It would decrease by a factor of 4.

B. It would decrease by a factor of 2.

C. It would remain unchanged.

D. It would increase by a factor of 2.

E. It would increase by a factor of 4.

18. As a bat flies at a constant speed of 0.04 *V* toward a large tree trunk (where *V* denotes the speed of sound), the bat emits an ultrasonic pulse. The pulse is reflected off the tree and returns to the bat, which can detect and analyze the returning signal. If the returning signal has a frequency of 61 kHz, at approximately what frequency did the bat emit the original ultrasonic pulse?

A. 56 kHz

B. 62 kHz

C. 68 kHz

D. 74 kHz

E. 78 kHz

19. During practice, an athlete runs in a straight line from point X to point Y, and then back along the same path from Y to X. If she runs at a constant speed of 3 m/s from X to Y, and then at a constant speed of 6 m/s from Y to X, what is her average speed for the entire run?

A. 3.5 m/s

B. 4 m/s

C. 4.5 m/s

D. 5 m/s

E. 5.5 m/s

20. A sky diver jumps from an airplane. After "free falling" for a while, she opens her parachute and her descent speed begins to decrease. While her descent speed decreases, let *F* denote the magnitude of the gravitational force on the sky diver and let *D* denote the magnitude of the upward force of air resistance (drag). Which of the following is then true?

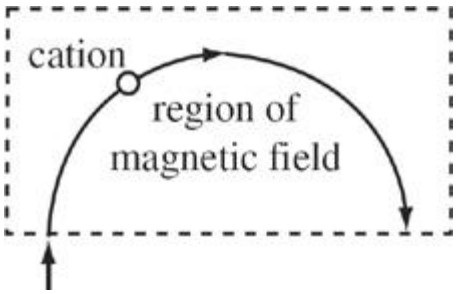
A. $F > D$

B. $F < D$

C. $F + D <$ weight of the sky diver

D. $F - D >$ weight of the sky diver

E. $F - D > 0$



21.

The figure above shows a cation (a positive ion—that is, an atom that has lost one or more electrons) entering a mass spectrometer, which contains a region with a uniform magnetic field, **B**. Once in the magnetic field, the cation moves in a semicircular path in the direction indicated. What is the direction of **B**?

A. Upward in the plane of the page

B. To the left in the plane of the page

C. To the right in the plane of the page

D. Out of the plane of the page

E. Into the plane of the page

22. A traveling wave has a frequency of 6.0 Hz, an amplitude of 0.2 m, and a wavelength of 0.5 m. What is its wave speed?

A. 0.1 m/s

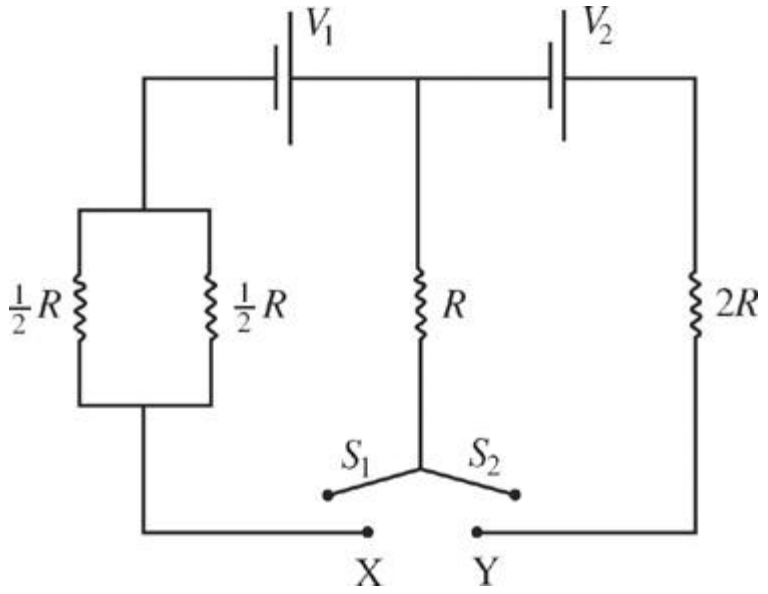
B. 0.6 m/s

C. 1.2 m/s

D. 2.4 m/s

E. 3.0 m/s

23.



The circuit shown contains two switches: S_1, which can connect to point X, and S_2, which can connect to point Y.

If switch S_1 is left in the position shown in the figure but switch S_2 is connected to point Y, what is the current through the resistor R?

A. $\frac{V_2}{3R}$

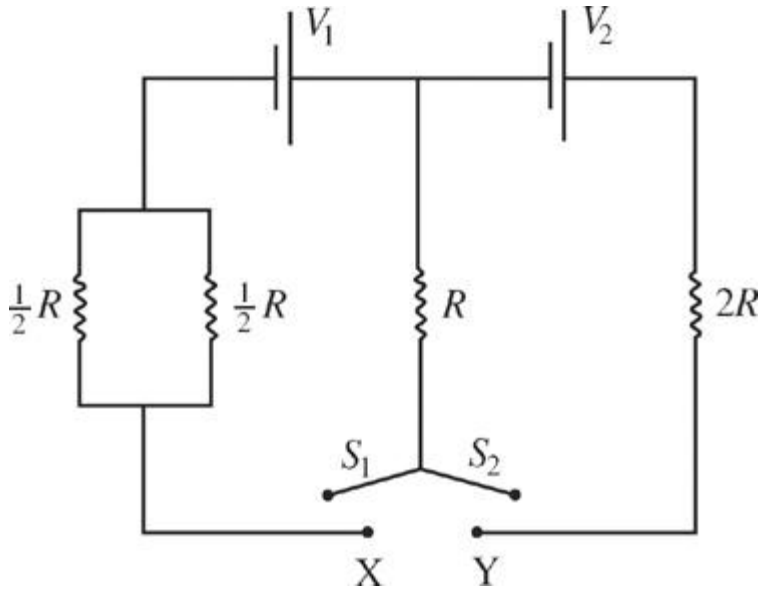
B. $\frac{V_2}{R}$

C. $\frac{3V_2}{2R}$

D. $\frac{V_1 + V_2}{3R}$

E. $\frac{V_1 - V_2}{R}$

24.



The circuit shown contains two switches: S_1, which can connect to point X, and S_2, which can connect to point Y.

If switch S_2 is left in the position shown in the diagram, but switch S_1 is connected to point X, what is the current through the resistor R?

A. $\frac{V_1}{4R}$

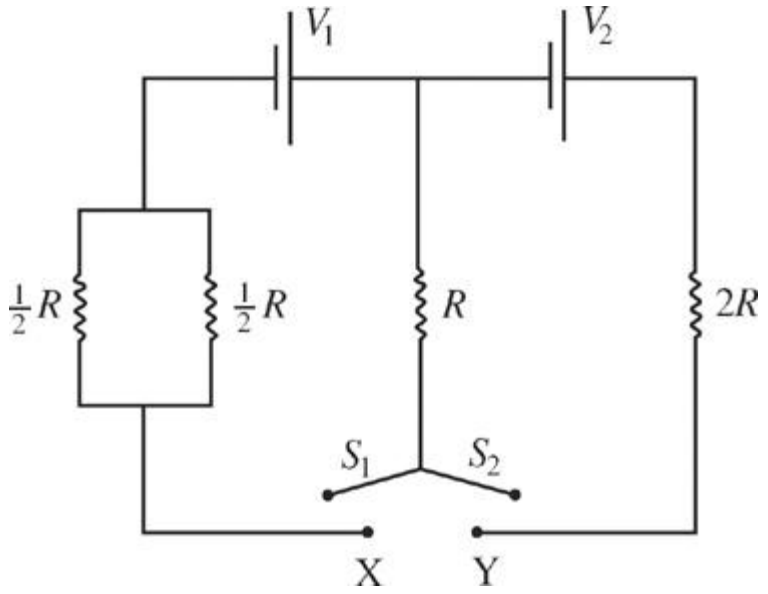
B. $\frac{V_1}{2R}$

C. $\frac{4V_1}{5R}$

D. $\frac{5V_1}{4R}$

E. $\frac{(V_1+V_2)}{2R}$

25.



The circuit shown contains two switches: S_1, which can connect to point X, and S_2, which can connect to point Y.

If both switches are left in the positions shown in the diagram, what is the current through the resistor *R*?

A. 0

B. $\frac{2(V_1+V_2)}{11R}$

C. $\frac{4(V_1+V_2)}{13R}$

D. $\frac{2(V_1+V_2)}{5R}$

E. $\frac{6(V_1+V_2)}{7R}$

26. What does the second law of thermodynamics say should happen to an isolated, ordered system?

A. Heat will flow into the system.

B. Heat will flow out of the system.

C. Work will be done by the system.

D. Work will be done on the system.

E. The entropy within the system will increase.

27. The potential difference between the plates of a charged, parallel-plate capacitor is equal to *X* volts. If the amount of charge on the POSITIVE plate is equal to *Y* coulombs, what is the capacitance (in farads)?

A. $\frac{X}{2Y}$

B. $\frac{Y}{2X}$

C. $\frac{Y}{X}$

D. $\frac{2Y}{X}$

E. $\frac{2X}{Y}$

28. A car, starting from rest, accelerates uniformly at 4 m/s^2 along a straight track. How far will it travel in 6 s ?

A. 24 m

B. 48 m

C. 64 m

D. 72 m

E. 144 m

29. An object is executing uniform circular motion. Which of the following quantities remain(s) constant during the object's motion?

A. Velocity and acceleration

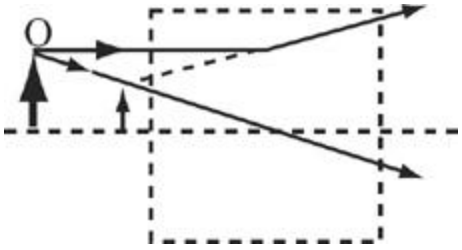
B. Speed and velocity

C. Speed and acceleration

D. Acceleration only

E. Speed only

30. In the diagram accompanying each question, representative light rays from an illuminated object (labeled "O" in the diagrams) interact with an optical device (or devices): a mirror, a lens, or a combination of both. In each case, identify the optical device(s)—from among the choices below—that is/are most likely in the dotted box.



A. Plane mirror

B. Converging lens

C. Diverging lens

D. Plane mirror and a converging lens

E. Plane mirror and a diverging lens