## Physics B Sample Multiple-Choice Questions

Most of the following sample questions, illustrative of the Physics B Exam, have appeared in past exams. The answers are on page 52. Additional questions can be found in the 2009 *AP Physics B and Physics C Released Exams* book.

Note: Units associated with numerical quantities are abbreviated, using the abbreviations listed in the table of information included with the exams (see insert in this book.) To simplify calculations, you may use $g = 10$ m/s^2 in all problems.

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case.

1. An object is thrown with a horizontal velocity of 20 m/s from a cliff that is 125 m above level ground. If air resistance is negligible, the time that it takes the object to fall to the ground from the cliff is most nearly

   (A)   3 s
   (B)   5 s
   (C)   6 s
   (D)   12 s
   (E)   25 s
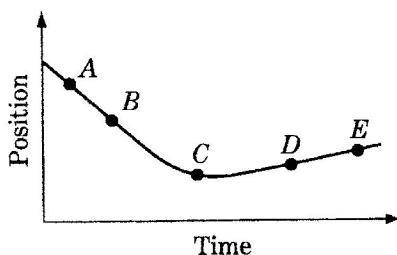
2. The motion of a particle along a straight line is represented by the position versus time graph above. At which of the labeled points on the graph is the magnitude of the acceleration of the particle greatest?

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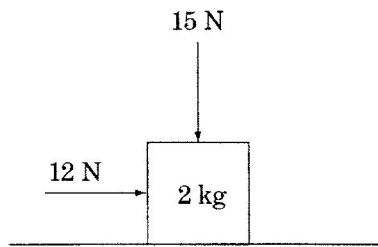   (C) *C*
   (D) *D*
   (E) *E*

Questions 3–4
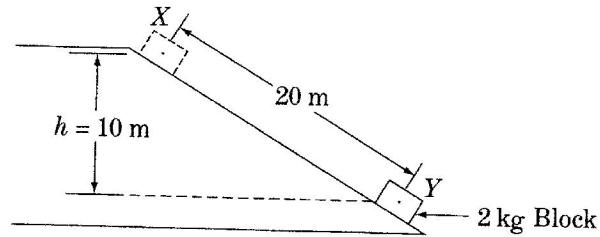
A 2 kg block, starting from rest, slides 20 m down a frictionless inclined plane from X to Y, dropping a vertical distance of 10 m as shown above.

3. The magnitude of the net force on the block while it is sliding is most nearly

   (A)   0.1 N
   (B)   0.4 N
   (C)   2.5 N
   (D)   5.0 N
   (E)   10.0 N

4. The speed of the block at point Y is most nearly

   (A)   7 m/s
   (B)   10 m/s
   (C)   14 m/s
   (D)   20 m/s
   (E)   100 m/s

15 N

12 N

2 kg

5. A block of mass 2 kg slides along a horizontal tabletop. A horizontal applied force of 12 N and a vertical applied force of 15 N act on the block, as shown above. If the coefficient of kinetic friction between the block and the table is 0.2, the frictional force exerted on the block is most nearly

    (A) 1 N
    (B) 3 N
    (C) 4 N
    (D) 5 N
   (E) 7 N

M v $\dfrac{v}{2}$ $2M$
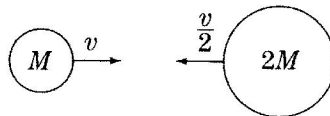
6. A ball of mass M and speed v collides head-on with a ball of mass $2M$ and speed $\dfrac{v}{2}$, as shown above. If the two balls stick together, their speed after the collision is

    (A) 0

    (B) $\dfrac{v}{2}$

    (C) $\dfrac{\sqrt{2}v}{2}$

    (D) $\dfrac{\sqrt{3}v}{2}$

    (E) $\dfrac{3v}{2}$
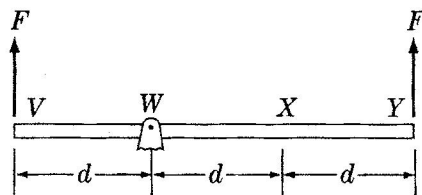
7. A massless rigid rod of length $3d$ is pivoted at a fixed point W, and two forces each of magnitude F are applied vertically upward as shown above. A third vertical force of magnitude F may be applied, either upward or downward, at one of the labeled points. With the proper choice of direction at each point, the rod can be in equilibrium if the third force of magnitude F is applied at point

   (A) W only
   (B) Y only
   (C) V or X only
   (D) V or Y only
   (E) V, W, or X

8. An ideal monatomic gas is compressed while its temperature is held constant. What happens to the internal energy of the gas during this process, and why?

   (A) It decreases because the gas does work on its surroundings.
   (B) It decreases because the molecules of an ideal gas collide.
   (C) It does not change because the internal energy of an ideal gas depends only on its temperature.
   (D) It increases because work is done on the gas.
   (E) It increases because the molecules travel a shorter path between collisions.
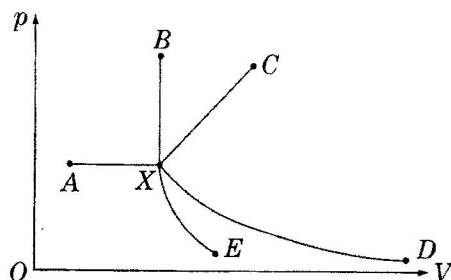
9. In the pV diagram above, the initial state of a gas is shown at point X. Which of the curves represents a process in which no work is done on or by the gas?

    (A) XA
    (B) XB
    (C) XC
    (D) XD
    (E) XE

$P.$ $\bullet q$

$T.$
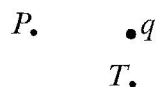
10. An isolated positive charge q is in the plane of the page, as shown above. The directions of the electric field vectors at points P and T, which are also in the plane of the page, are given by which of the following?

 | | Point P | Point T |
    | --- | --- | --- |
    | (A) | Left | Right |
    | (B) | Right | Left |
    | (C) | Left | Toward the top of the page |
    | (D) | Right | Toward the top of the page |
    | (E) | Left | Toward the bottom of the page |

Questions 11–12 relate to the following circuit in which the battery has zero internal resistance.
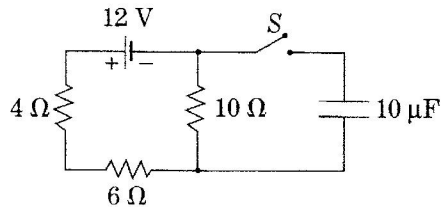
11. What is the current in the 4 Ω resistor while the switch *S* is open?

    (A) 0 A
    (B) 0.6 A
    (C) 1.2 A
    (D) 2.0 A
    (E) 3.0 A

12. When the switch *S* is closed and the 10 µF capacitor is fully charged, what is the voltage across the capacitor?

    (A)   0 V
    (B)   6 V
    (C)   12 V
    (D)   60 V
    (E) 120 V
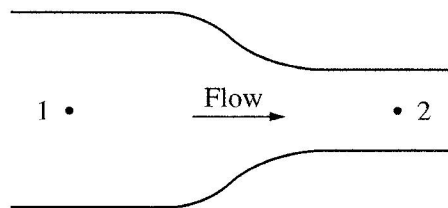
13. A fluid flows steadily from left to right in the pipe shown above. The diameter of the pipe is less at point 2 than at point 1, and the fluid density is constant throughout the pipe. How do the velocity of flow and the pressure at points 1 and 2 compare?

 | | Velocity | Pressure |
    |---|---|---|
    | (A) | $v_1 < v_2$ | $p_1 = p_2$ |
    | (B) | $v_1 < v_2$ | $p_1 > p_2$ |
    | (C) | $v_1 = v_2$ | $p_1 < p_2$ |
    | (D) | $v_1 > v_2$ | $p_1 = p_2$ |
    | (E) | $v_1 > v_2$ | $p_1 > p_2$ |
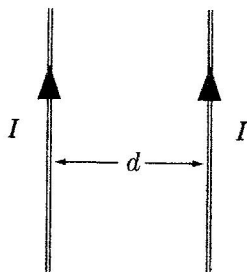
14. Two long parallel wires, separated by a distance d, carry equal currents I toward the top of the page, as shown above. The magnetic field due to the wires at a point halfway between them is

   (A) zero in magnitude
   (B) directed into the page
   (C) directed out of the page
   (D) directed to the right
   (E) directed to the left

15. A source S of sound and a listener L each can be at rest or can move directly toward or away from each other with speed v_0. In which of the following situations will the observer hear the lowest frequency of sound from the source?

   (A) $\quad$ S $\quad\quad\quad$ L
   $\quad\quad$ • $\quad\quad\quad\quad$ •
   $\quad\quad$ $v=0$ $\quad\quad\quad$ $v=0$

   (B) $\quad$ S $\quad\quad\quad$ L
   $\quad\quad$ • $\quad\quad\quad\quad$ • $\longrightarrow$
   $\quad\quad$ $v=0$ $\quad\quad\quad\quad$ $v=v_0$

   (C) $\longleftarrow$ S $\quad\quad\quad$ L
   $\quad\quad\quad$ • $\quad\quad\quad\quad$ •
   $\quad\quad$ $v=v_0$ $\quad\quad\quad$ $v=0$

   (D) $\quad$ S $\quad\quad\quad$ L
   $\quad$ $\longleftarrow$ • $\quad\quad\quad$ • $\longrightarrow$
   $\quad\quad$ $v=v_0$ $\quad\quad\quad\quad$ $v=v_0$

   (E) $\quad$ S $\longrightarrow$ $\quad$ L
   $\quad\quad$ • $\quad\quad$ $\longleftarrow$ •
   $\quad\quad$ $v=v_0$ $\quad$ $v=v_0$

16. The wavelength of yellow sodium light in vacuum is 5.89×10^{-7} m. The speed of this light in glass with an index of refraction of 1.5 is most nearly

   (A) 4×10^{-7} m/s
   (B) 9×10^{-7} m/s
   (C) 2×10^{8} m/s
   (D) 3×10^{8} m/s
   (E) 4×10^{8} m/s

17. An object O is in front of a convex mirror. The focal point of the mirror is labeled F and the center of curvature is labeled C. The direction of the reflected ray is correctly illustrated in all of the following EXCEPT which diagram?

(A)

(B)

(C)

(D)

(E)
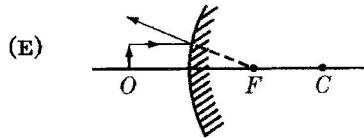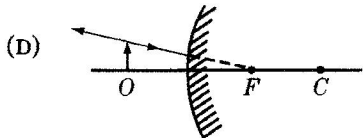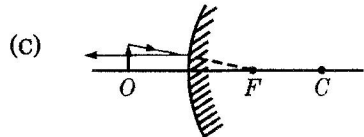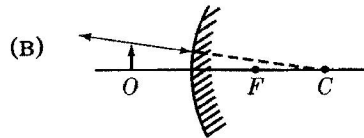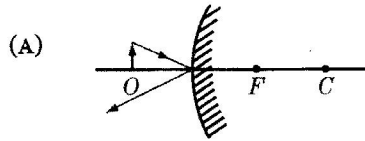
18. A system initially consists of an electron and an incident photon. The electron and the photon collide, and afterward the system consists of the electron and a scattered photon. The electron gains kinetic energy as a result of this collision. Compared with the incident photon, the scattered photon has

   (A) the same energy
   (B) a smaller speed
   (C) a larger speed
   (D) a smaller frequency
   (E) a larger frequency

19. In an experiment, light of a particular wavelength is incident on a metal surface, and electrons are emitted from the surface as a result. To produce more electrons per unit time but with less kinetic energy per electron, the experimenter should do which of the following?

    (A) Increase the intensity and decrease the wavelength of the light.
    (B) Increase the intensity and the wavelength of the light.
    (C) Decrease the intensity and the wavelength of the light.
    (D) Decrease the intensity and increase the wavelength of the light.
    (E) None of the above would produce the desired result.

20. When ^{10}B is bombarded by neutrons, a neutron can be absorbed and an alpha particle (^{4}He) emitted. The kinetic energy of the reaction products is equal to the

    (A) kinetic energy of the incident neutron
    (B) total energy of the incident neutron
    (C) energy equivalent of the mass decrease in the reaction
    (D) energy equivalent of the mass decrease in the reaction, minus the kinetic energy of the incident neutron
    (E) energy equivalent of the mass decrease in the reaction, plus the kinetic energy of the incident neutron

Answers to Physics B Multiple-Choice Questions				
1 – B	5 – E	9 – B	13 – B	17 – D
2 – C	6 – A	10 – E	14 – A	18 – D
3 – E	7 – C	11 – B	15 – D	19 – B
4 – C	8 – C	12 – B	16 – C	20 – E