Practice Test 1

Physics B
Section I

Time—90 minutes
70 Questions

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 and then fill in the corresponding oval on the answer sheet.

Reference sheets: You may use the "Table of Information" on page 198 for Section I. However, you are NOT allowed to use the "Advanced Placement Physics B Equations" on page 210–211 for Section I.

Calculators: You may NOT use a calculator for Section I.

1. The velocity of an object constantly accelerating at 0.30 m/s^2 from 8.0 m/s after 60.0 meters is
   (A) 8.0 m/s
   (B) 8.3 m/s
   (C) 9.1 m/s
   (D) 10 m/s
   (E) 13 m/s

2. What is the maximum height above the ground for a projectile fired straight up at 98 m/s from a building that is 210 m tall?
   (A) 240 m
   (B) 330 m
   (C) 490 m
   (D) 550 m
   (E) 700 m

3. How far north will a person who walks 150 meters 30° north of east and then walks 20 meters due north find herself?
   (A) 71 m
   (B) 95 m
   (C) 126 m
   (D) 150 m
   (E) 180 m

4. An object thrown horizontally at 4.5 m/s from the window of a 500.0 m building will land how far from the base of the building?
   (A) 11 m
   (B) 29 m
   (C) 36 m
   (D) 45 m
   (E) 56 m

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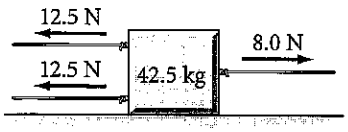
5. At which of the following pairs of angles will the y component of a 36 meter vector be 34 meters?
   (A) 71° and 109°
   (B) 71° and 289°
   (C) 19° and 161°
   (D) 19° and 341°
   (E) 71° and 341°

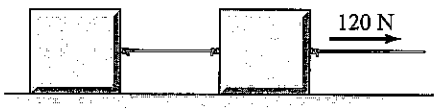
6. If two ropes each pulling a 42.5 kg box across a frictionless surface with a tension of 12.5 N are opposed by a single rope with a 8.0 N tension, as shown, what is the magnitude of the resulting acceleration?



   (A) 0.40 m/s^2
   (B) 1.2 m/s^2
   (C) 8 m/s^2
   (D) 17 m/s^2
   (E) 22 m/s^2

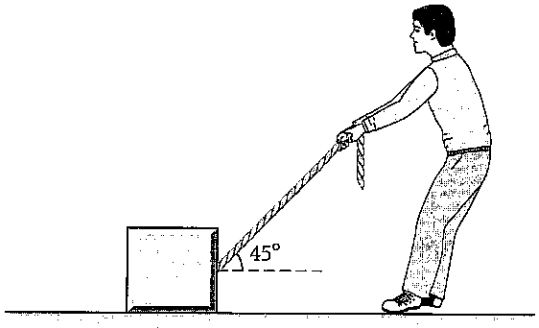
7. What is the minimum coefficient of friction necessary to prevent a 20 kg object from being dragged across a horizontal surface when a 49 N force is applied parallel to the plane of the surface?
   (A) 0.015
   (B) 0.064
   (C) 0.13
   (D) 0.25
   (E) 0.38

8. Two 15,000-gram objects are pulled along a frictionless surface by a 120 N force with an acceleration of 4 m/s^2. The tension of the string that joins the boxes is



   (A) 4 N
   (B) 8 N
   (C) 60 N
   (D) 120 N
   (E) 240 N

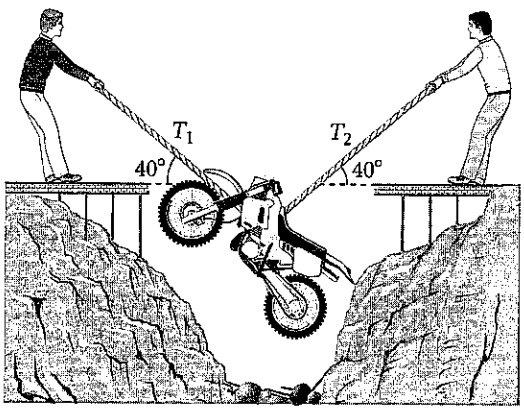
Questions 9 & 10 refer to the following diagram and situation, in which a person pulls a 35 kg box along a frictionless surface with a 100.0 N force at a 45° angle from the surface.



9. The normal force for the box is
   (A) 71 N
   (B) 100 N
   (C) 180 N
   (D) 220 N
   (E) 270 N

10. Assuming it is on a frictionless surface, what is the acceleration of the object?
   (A) 1.1 m/s^2
   (B) 2.0 m/s^2
   (C) 4.9 m/s^2
   (D) 7.8 m/s^2
   (E) 9.0 m/s^2

11. Two people are careful to pull an object of mass m up a chasm (as shown below), so all motion is strictly vertical. The values presented represent a single instant in time. Which of the following equations can be derived from this situation?



I. $\Sigma F_y = T_1 \sin 40° + T_2 \sin 40° - mg$
II. $\Sigma F_x = T_1 \cos 40° - T_2 \cos 40°$
III. $\Sigma F_x = 0$.
(A) I only
(B) I and II
(C) II and III
(D) I and III
(E) I, II, and III

12. What is the ratio of work required to move a 45 kg object 1000 meters along the frictionless surface of a 30° and a 45° incline?
(A) 0.57
(B) 0.71
(C) 1.0
(D) 1.4
(E) 1.7

13. At what average velocity will a 10 kg object move up a 60° frictionless incline if an average power of 120 watts is used and the applied force is parallel to the incline?
(A) $240/(98\sqrt{3})$
(B) $120/98$
(C) $120(\sqrt{3})/98$
(D) $98(\sqrt{3})/120$
(E) $120\sqrt{3}$

14. A ball of mass M compresses a spring with a constant k 30 cm and is released. What is its speed the instant after the ball passes the equilibrium point?
(A) $0.3\sqrt{(k/M)}$
(B) $0.3k\sqrt{M}$
(C) $0.3M\sqrt{k}$
(D) $0.3(\sqrt{k})/M$
(E) Not enough information is presented to determine its speed.

15. What is the mass of an object if it takes 4500 J to uniformly increase the speed from 40 m/s to 60 m/s across a frictionless surface?
(A) 2.0 kg
(B) 4.5 kg
(C) 9.8 kg
(D) 14 kg
(E) 22 kg

16. An object of mass 4 kg traveling at 5 m/s strikes an 8 kg object initially at rest in a perfectly inelastic collision. The resulting velocity is
(A) 0.75 m/s
(B) 1.7 m/s
(C) 2.4 m/s
(D) 5.0 m/s
(E) 7.6 m/s

17. Kinetic energy is most often conserved in collisions
(A) where thermal energy is produced
(B) where the objects stick together
(C) where the objects are soft
(D) that occur on a microscopic level
(E) where the total energy is conserved

18. The units of the product of momentum and kinetic energy can be expressed as
(A) $J^2 \cdot m/s^2$
(B) $J \cdot m/s$
(C) $J^2 \cdot s/m$
(D) m/s
(E) J^2

19. The gravitational force between two bodies
(A) is directly proportional to their distance of separation
(B) is directly proportional to the sum of their masses
(C) is inversely proportional to their distance of separation
(D) is inversely proportional to the sum of their masses
(E) None of the above

20. Two 7.0×10^5 kg bodies separated by 25 cm have a gravitational force between them of
(A) 52 N
(B) 104 N
(C) 520 N
(D) 1100 N
(E) 1300 N

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21. After two 225 kg weights shift 40 cm further from the axis of rotation along a massless barbell, the angular velocity changes from 15 rad/s to 10 rad/s. What was the original distance of each from the axis of rotation.
(A) $(\sqrt{[0.8 + 0.96]})$ m
(B) $(-0.96 - \sqrt{0.8})$ m
(C) $(0.8 - \sqrt{0.96})$ m
(D) $(-0.8 + \sqrt{0.96})$ m
(E) $(0.8 + \sqrt{0.96})$ m

22. The period is measured for a simple pendulum to be 0.780 seconds. If the mass of a pendulum bob doubles and the length of the string is quadrupled, the period of a pendulum would be
(A) 0.390 s
(B) 0.780 s
(C) 1.56 s
(D) 3.12 s
(E) 6.24 s

23. A mass that oscillates with a period of 2π seconds when attached to a spring of constant 2.15 N/m would be most nearly
(A) 0.342 kg
(B) 2.15 kg
(C) 3.67 kg
(D) 2π kg
(E) 4.3π kg

24. The acceleration due to gravity as measured on the surface of a planet of mass M and radius $R/2$ is given by
(A) $4GM/R^2$
(B) $2GM/R$
(C) $2GM^2/R$
(D) $4GM^2/R^2$
(E) $GM/4R^2$

25. The period for an object of mass 0.00001 M orbiting around a planet of mass M with an orbital radius R is
(A) $\sqrt{(GM/R^3)}$
(B) $\sqrt{(R^3/GM)}$
(C) $2\pi\sqrt{(R^3/GM)}$
(D) $2\pi\sqrt{(GM/R^3)}$
(E) None of the above is correct.

26. Find the minimum mass needed for a ball with a radius of 40 cm to sink in a liquid of density 1.4×10^3 kg/m^3.
(A) 37.5 kg
(B) 375 kg
(C) 3750 kg
(D) 37500 kg
(E) 375000 kg

27. What vertical percentage of a 0.25 m deep sheet of ice, whose density $\rho = 0.95 \times 10^3$ kg/m^3, will be visible in an ocean whose density is $\rho = 1.1 \times 10^3$ kg/m^3? Assume that there is no thermal exchange.
(A) 14%
(B) 34%
(C) 58%
(D) 71%
(E) 87%

28. The idea that the velocity of a fluid is high when pressure is low and that the velocity of a fluid is low when pressure is high embodies a principle attributed to
(A) Torricelli
(B) Pascal
(C) Galileo
(D) Archimedes
(E) Bernoulli

29. The mass of an 1.3 m^3 object with a specific gravity of 0.82 is
(A) 630 kg
(B) 730 kg
(C) 820 kg
(D) 1100 kg
(E) 1600 kg

30. If 4.0×10^4 moles of a monatomic gas are at 0.80 atmospheres at −23 °C, what will its volume be in terms of the gas constant, R (using standard SI units)?
(A) 125 R
(B) 250 R
(C) 320 R
(D) 1.25×10^7 R
(E) 2.50×10^7 R

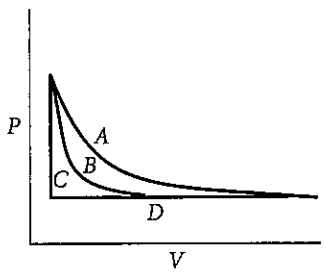
31. As the temperature of a molecule quadruples, the root-mean-square velocity
(A) quadruples
(B) doubles
(C) stays the same
(D) is halved
(E) is quartered

32. If it takes 12040 J to raise 400 grams of a uniform substance 70C° (without a phase change), the specific heat constant for the substance is
(A) 0.015 °C/J·kg
(B) 69 J·kg/ °C
(C) 2000000 J·°C/kg
(D) 430 J/kg·°C
(E) 340000 J·kg °C

33. Given that silver has a melting point of 961 °C, a boiling point of 2193 °C, a specific heat of 230 J/kg·°C, a heat of fusion of 0.88×10^5 J/kg, and a heat of vaporization of 23×10^5 J/kg, how much energy is required to convert 550 grams of solid silver at 61°C entirely into liquid?
(A) 48 kJ
(B) 110 kJ
(C) 160 kJ
(D) 320 kJ
(E) 1600 kJ

34. What is the change in internal energy of a system if 1125 J of heat are lost, 705 J of work are done on a system, and 460 J are done by the system?
(A) −1370 J
(B) −880 J
(C) 40 J
(D) 880 J
(E) 1370 J

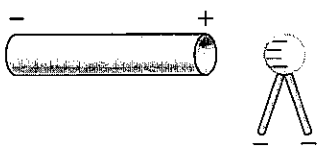
35. In this PV diagram, which of the following lines represents an isobaric process?

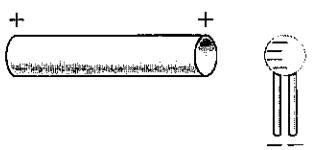


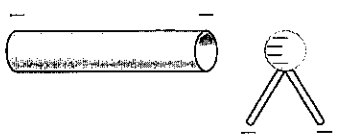
(A) Curve *A*
(B) Curve *B*
(C) Curve *C*
(D) Curve *D*
(E) None of the above is correct.

36. The initial position of a negatively charged electroscope is shown below.

A neutral metal rod, initially grounded, is charged by induction with a negatively charged rod. After the ground is removed, the rod is brought near the knob of a negatively charged electroscope. For the rod and the gold leaves of the electroscope, the resulting situation will look like

(A)


(B)


(C)


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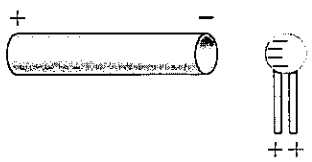
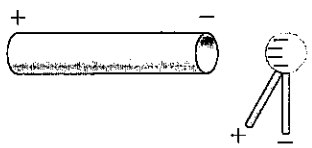


(E)


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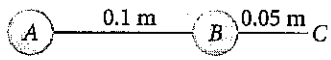
37. If the force between two point charges is equal to F, what would the new force be in a similar situation where the separation distance was tripled and each object had twice the original charge?
(A) $2F/3$
(B) $4F/3$
(C) $4F/9$
(D) $2F/9$
(E) $F/18$

38. Four collinear 3.0 μC point charges are evenly spaced 20.0 cm apart. The magnitude of force on an endpoint charge is
(A) 0.23 N
(B) 0.51 N
(C) 1.3 N
(D) 2.0 N
(E) 2.7 N

39. At point C shown below, find the magnitude of the electric field that is created by charges A and B, where $A = 8.0\ \mu C$ and $B = -3.0\ \mu C$.



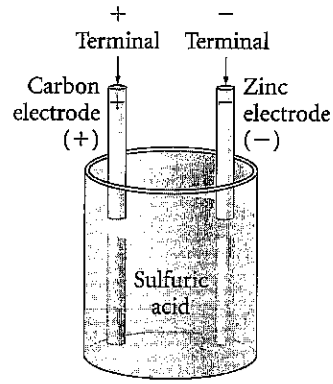
(A) 1.4×10^6 N/C
(B) 1.4×10^7 N/C
(C) 4.3×10^6 N/C
(D) 7.6×10^6 N/C
(E) 9.8×10^6 N/C

40. The ratio between the potential energy of two charges (Q_1 and Q_2) r meters apart and the force between them is
(A) k
(B) r
(C) $(Q_1Q_2)^2$
(D) Q_1Q_2/r
(E) k/r

41. With respect to electric field lines, the lines representing electric potential lines are drawn
(A) parallel but not collinear
(B) antiparallel
(C) perpendicular
(D) collinear
(E) None of the above is correct.

42. For two identical charges (4.0×10^{-5} C) separated by 10 cm, the work required to decrease their separation distance by half is
(A) –72 J
(B) –432 J
(C) –144 J
(D) 144 J
(E) 432 J

43. Inside a simple electric cell in a circuit (shown below), all of the following occur EXCEPT

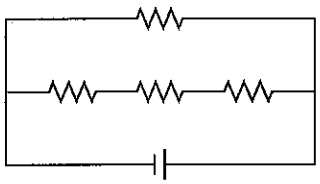


(A) atoms of the electrode attached to the negative terminal enter the electrolyte as positive ions
(B) electrons leave the electrode attached to the positive terminal and enter the electrolyte
(C) the electrolyte dissolves the electrode attached to the negative terminal
(D) the electrode attached to the negative terminal acquires a negative charge
(E) the atoms of electrode attached to the positive terminal enter the electrolyte as negative ions

44. A wire with a cross sectional area of 0.04 cm^2 functions as a resistor when attached to a 9 V battery. If a current of 6 A travels through it and the resistivity of the wire's material at this temperature is $10^{-6}\ \Omega\cdot$m, what is the length of the wire?
(A) 0.06 cm
(B) 0.6 cm
(C) 6 cm
(D) 60 cm
(E) 600 cm

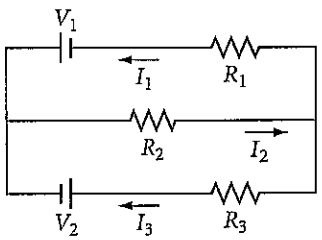
45. The quantity of power used by a 12 V appliance that has a resistance of 4.5 Ω is
(A) 0.031 W
(B) 5.9 W
(C) 32 W
(D) 54 W
(E) 240 W

46.



In the diagram above, each of the resistors is rated at 12 Ω attached as shown to a 18 V battery. The current flowing out of the battery is
(A) 0.5 A
(B) 2 A
(C) 6 A
(D) 12 A
(E) 18 A

47.

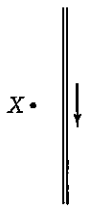


Based on the DC circuit shown above, which of the following equations CANNOT be derived?
(A) $I_2 = I_1 + I_3$
(B) $-R_2I_2 - R_1I_1 + V_1 = 0$
(C) $R_3I_3 - R_1I_1 + V_1 + V_2 = 0$
(D) $V_1 - R_1I_1 - R_2I_2 + V_2 - R_3I_3 = 0$
(E) $-R_2I_2 - R_3I_3 = V_2$

48. The force on a length of current-carrying wire oriented at 60° from the direction of a magnetic field is 34 N. The maximum force an identical wire could attain in the same magnetic field is
(A) 34 N
(B) 39 N
(C) 55 N
(D) 68 N
(E) Not enough information is provided to determine the maximum force.

49. As the perpendicular distance from a long straight wire quadruples, the strength of its magnetic field decreases by a factor of
(A) 2
(B) 4
(C) 16
(D) 4π
(E) 16π

50.



A point, X, is a distance away from a current-carrying wire whose direction is indicated in the diagram shown above. The direction of the magnetic field at point X is
(A) to the left in the plane of the page
(B) to the right in the plane of the page
(C) upward in the plane of the page
(D) out of the page
(E) into the page

51. A step-up transformer has 780 turns in the primary coil and 1200 turns in the secondary coil. If 16 V DC is applied to the primary coil, the voltage in the secondary coil is
(A) 0 V
(B) 10.4 V
(C) 16 V
(D) 25 V
(E) 32 V

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52. What is the induced emf produced when the radius of 400 loops perpendicular to a 4.2 T magnetic field changes from 15 cm to 25 cm over 12 seconds?
(A) 5.6 V
(B) 5.6π V
(C) -5.6 V
(D) -5.6π V
(E) None of the above

53. Lenz's law defines
(A) the direction of induced emf
(B) the relationship between number of loops and induced emf
(C) the transformer equation
(D) the relationship between angular orientation and induced emf
(E) the magnitude of output of an electrical generator

54. Constructive interference will maximize the amplitude of two waves of identical wavelength if they are offset by
(A) $\lambda/4$
(B) $\lambda/2$
(C) λ/π
(D) $\lambda/2\pi$
(E) λ

55. The second overtone of a fundamental frequency of a string fixed at two ends has
(A) 4 nodes and 3 antinodes
(B) 3 nodes and 3 antinodes
(C) 3 nodes and 4 antinodes
(D) 5 nodes and 3 antinodes
(E) 3 nodes and 5 antinodes

56. What is the length of a string along which a sinusoidal wave of wavelength λ and frequency F travels if the string has mass M and tension T at frequency F? Assume the wave has a small amplitude relative to the length of the string.
(A) $M/T\sqrt{(F^2\lambda^2)}$
(B) $MF^2\lambda^2/T$
(C) $MT\sqrt{(F^2\lambda^2)}$
(D) $\sqrt{(F^2\lambda^2)}/MT$
(E) $M^2T^2/F\lambda$

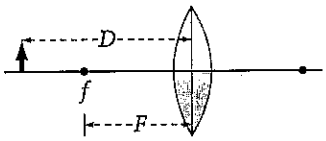
57. A mechanical wave traveling at 14 m/s strikes a boundary at 45° from the perpendicular, and it propagates through the new medium at 30° from the perpendicular. The velocity of the wave within the new medium would be
(A) 9.3 m/s
(B) 9.9 m/s
(C) 14 m/s
(D) 20 m/s
(E) 21 m/s

58. The frequency of violet light with a 4.0×10^{-7} m wavelength is
(A) 1.3×10^{-15} Hz
(B) 12×10^{-1} Hz
(C) 4.0×10^{7} Hz
(D) 7.5×10^{14} Hz
(E) none of the above

59. The minimum number of Polaroid sheets necessary to stop light entirely from an unpolarized light source is
(A) 1
(B) 2
(C) 3
(D) 4
(E) 8

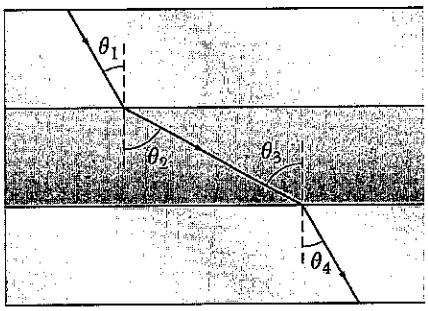
60. To increase the accuracy of wavelength measurements in a diffraction grating,
(A) the number of lines per unit length must be increased
(B) the number of lines per unit length must be decreased
(C) a single slit must be used
(D) multichromatic light must be used
(E) monochromatic light must be used

61. The image distance of a double-sided convex lens, in terms of its object distance D and its focal length F is



(A) $(F - D)/FD$
(B) $(D - F)/FD$
(C) $FD/(D - F)$
(D) $FD/(F - D)$
(E) $F(D - 1)/FD$

62.



A ray of light in a type of glass with an index of refraction of 1.2 enters a diamond with an index of refraction of 2.4 and exits back into the glass, as shown above (not to scale). What is the θ_4 if $\theta_1 = 30°$?
(A) 15°
(B) 30°
(C) 45°
(D) 60°
(E) 75°

63. At what minimum angle to the normal will a light ray entering a medium with an index of refraction of $n = 1.3$ from a medium with an index of refraction of $n = 1.5$ experience total internal reflection?
(A) 0°
(B) 30°
(C) 45°
(D) 60°
(E) 90°

64. What is the radius of curvature for a concave spherical mirror such that the object distance is twice the image distance, which is given by D?
(A) $3D/4$
(B) $4D/3$
(C) $2D/3$
(D) $3/2D$
(E) $3/4D$

65. For any molecular vibration, Planck's quantum hypothesis posits
(A) that each energy state is at most equal to a quantum of energy
(B) that each energy state is a whole number multiple of a quantum of energy
(C) that energy cannot exist in discrete quantities
(D) that all amplitudes of vibration are possible
(E) none of the above

66. The wavelength of a photon of light that has an energy of 10^{-20} J would be most nearly
(A) 2×10^{-5} m
(B) 4×10^{-6} m
(C) 7×10^{-7} m
(D) 1×10^{-8} m
(E) 3×10^{-9} m

67. $$n + {}^{A}_{B}\mathrm{X} \rightarrow {}^{C}_{D}\mathrm{Y} + {}^{E}_{F}\mathrm{Z} + 4n$$

In a typical fission reaction, as shown above, the value for C is
(A) $(A + 1) - (E + 4)$
(B) $(B + 1) - (F + 4)/D$
(C) $(A - B + 1) - (E - F + 4) - D$
(D) $(B + 1) - (F + 4)/D$
(E) $A - E$

GO ON TO THE NEXT PAGE

68. In which of the following decay types does transmutation occur?
   I. Alpha decay
   II. Beta decay
   III. Gamma decay
   (A) I only
   (B) II only
   (C) III only
   (D) I and II only
   (E) I and III only

69. According to the Bohr model, which of the following is not an orbital electron energy for an excited state of hydrogen?
   (A) −13.6 eV
   (B) −3.40 eV
   (C) −1.51 eV
   (D) −.85 eV
   (E) −.544 eV

70. If the principle quantum number of an excited state hydrogen atom is X, a possible value for the magnetic quantum number is
   (A) $X + 1$
   (B) $2X$
   (C) $2(X + 1)$
   (D) X
   (E) 0

STOP

END OF SECTION I

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION.

DO NOT GO ON TO SECTION II UNTIL YOU ARE TOLD TO DO SO.