

Physics

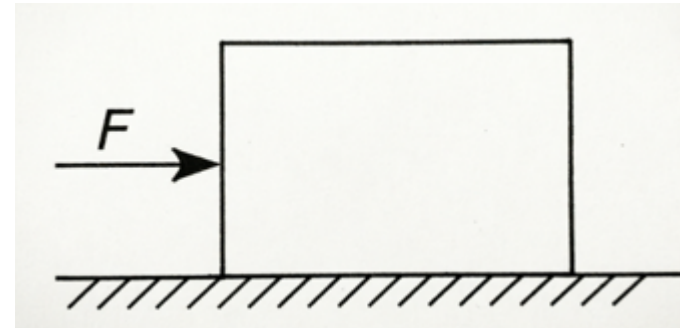
1. A block of 3 kg is stopped against a wall by applying a force F perpendicular to the wall. If $\mu = 0.6$ then minimum value of F will be (take $g = 10 \text{ m/s}^2$)

- A) 300 N B) 50 N
C) 5 N D) 18 N

2. A block of 8 kg is initially at rest on a rough horizontal surface. The coefficient of static friction between the block and the surface is $\mu_s = 0.75$ and the coefficient of kinetic friction is $\mu_k = 0.50$. Taking $g = 10 \text{ m/s}^2$, the horizontal force required to just set the block in motion is

- A) 40 N B) 80 N
C) 60 N D) 20 N

3. A block of mass 4 kg is kept on a rough floor. The coefficient of static friction between the block and the floor is 0.6. If a horizontal force F of 6 N is applied on the block as shown in the new diagram above, the frictional force between the block and the floor will be (take $g = 10 \text{ m/s}^2$)

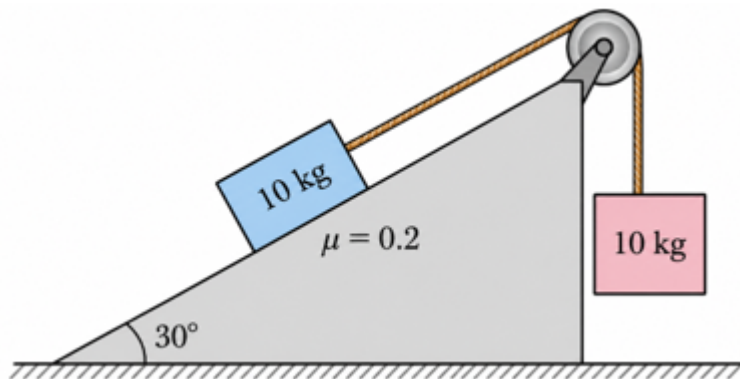


- A) 24 N B) 12 N
C) 40 N D) 6 N

4. If a ladder weighing 300 N is placed against a smooth vertical wall having coefficient of friction between it and floor is 0.4, then what is the maximum force of friction available at the point of contact between the ladder and the floor

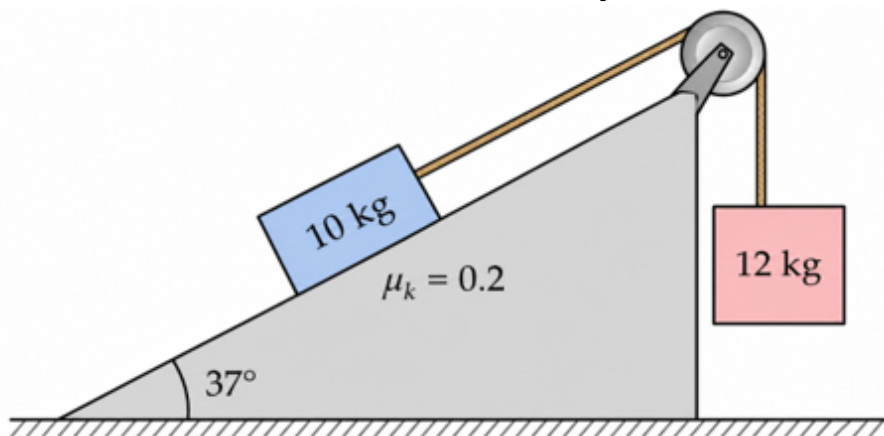
- A) 75 N B) 300 N
C) 120 N D) 30 N

12. A 10kg block is placed on a rough inclined plane of angle 30° and is connected by a light string passing over a smooth pulley to a hanging 10kg block. The coefficient of kinetic friction between the block and the incline is $\mu = 0.2$. Take $g = 10\text{m/s}^2$. Find the acceleration of the system and the frictional force on the block.



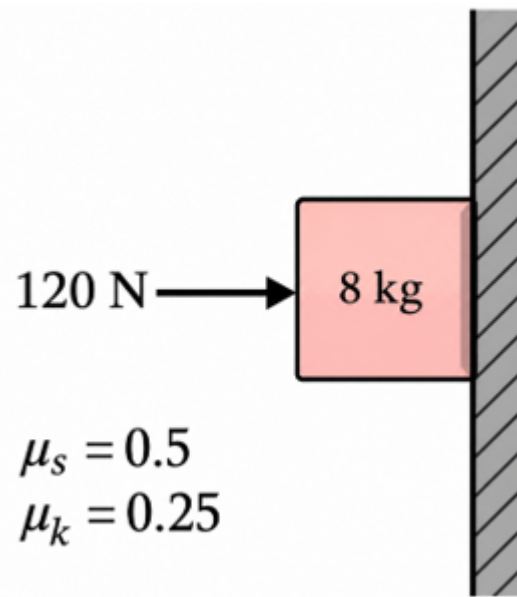
- A) $a = 1.63\text{m/s}^2$, $f = 17.3\text{N}$ B) $a = 2.0\text{m/s}^2$, $f = 20\text{N}$
 C) $a = 1.0\text{m/s}^2$, $f = 10\text{N}$ D) $a = 2.5\text{m/s}^2$, $f = 17.3\text{N}$

13. A 10kg block is placed on a rough inclined plane of angle 37° and is connected by a light string over a smooth pulley to a hanging 12kg block. The coefficient of kinetic friction between the block and the inclined plane is $\mu_k = 0.2$. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$. Find the acceleration a of the system.



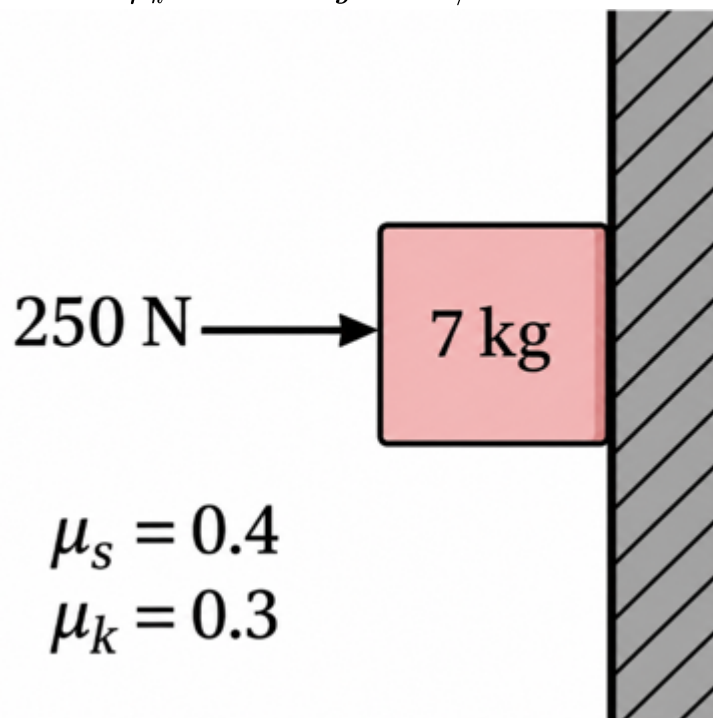
- A) 1m/s^2 B) 2m/s^2
 C) 3m/s^2 D) 4m/s^2

14. Determine the magnitude of the frictional force and acceleration of a block of mass 8kg pushed against a vertical wall with a normal force of 120N. The coefficients of static and kinetic friction are $\mu_s = 0.5$ and $\mu_k = 0.25$. Take $g = 10\text{m/s}^2$.



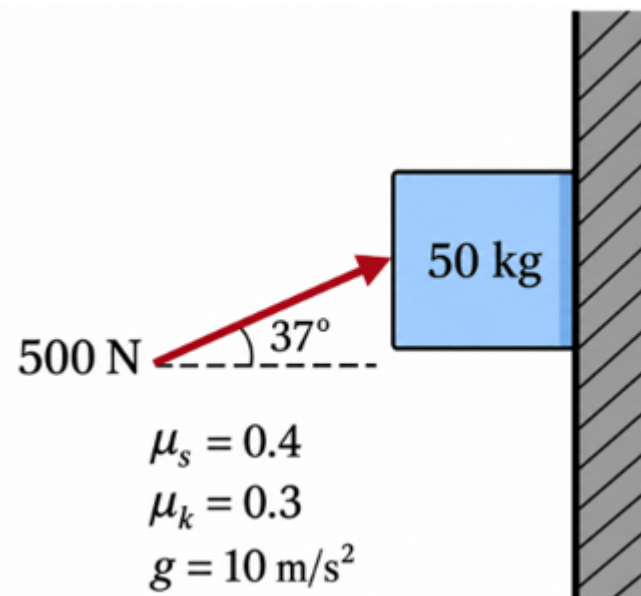
- A) $f = 30\text{N}$, $a = 6.25\text{m/s}^2$ B) $f = 60\text{N}$, $a = 2.5\text{m/s}^2$
 C) $f = 30\text{N}$, $a = 0\text{m/s}^2$ D) $f = 120\text{N}$, $a = 5\text{m/s}^2$

15. Determine the magnitude of the frictional force and acceleration of a block of mass 7kg pushed against a vertical wall with a normal force of 250N. The coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$.



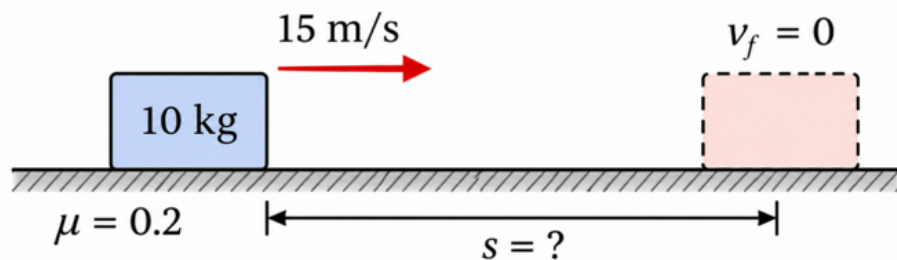
- A) $f = 70\text{N}$, $a = 0\text{m/s}^2$
 B) $f = 75\text{N}$, $a = 0\text{m/s}^2$
 C) $f = 70\text{N}$, $a = 2\text{m/s}^2$
 D) $f = 100\text{N}$, $a = 0\text{m/s}^2$

16. A block of mass 50kg is pushed against a vertical wall by a force of 500N inclined at an angle of 37° above the horizontal. The coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$. Determine the magnitude of the frictional force and acceleration of the block.



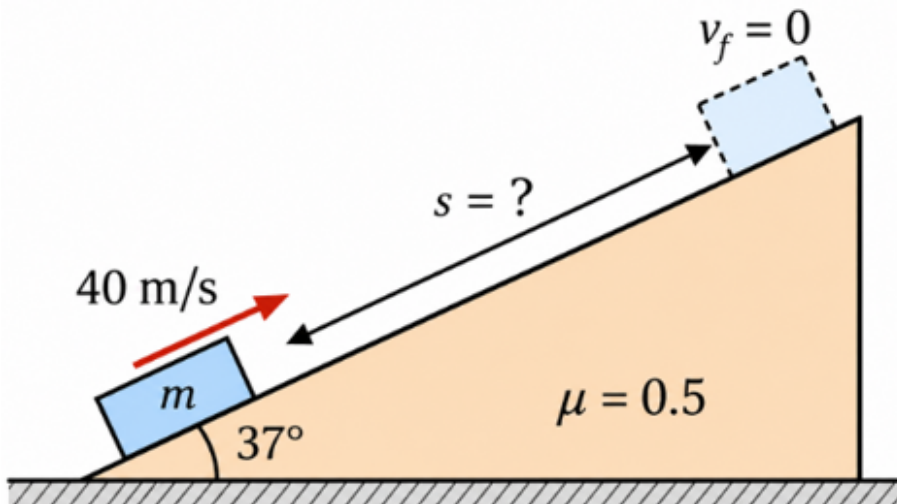
- A) $f = 120\text{N}$, $a = 1.6\text{m/s}^2$
 B) $f = 160\text{N}$, $a = 0\text{m/s}^2$
 C) $f = 150\text{N}$, $a = 1\text{m/s}^2$
 D) $f = 100\text{N}$, $a = 2\text{m/s}^2$

17. A block of mass 10kg is moving on a rough horizontal surface with an initial speed of 15m/s. The coefficient of friction between the block and the surface is $\mu = 0.2$. Find the distance travelled by the block before coming to rest. Take $g = 10\text{m/s}^2$.



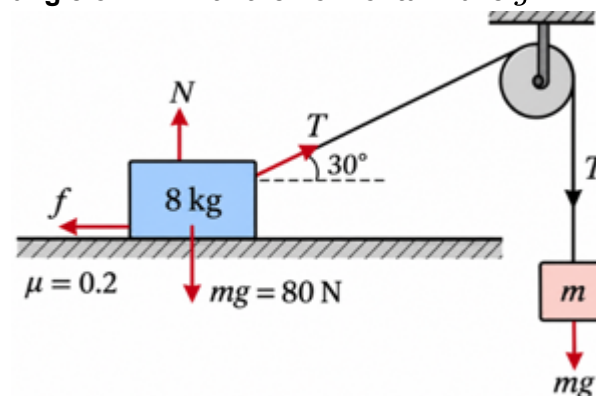
- A) 40m
B) 50m
C) 56.25m
D) 60m

18. A block is projected upward along a rough incline of angle 37° with an initial speed of 40m/s. The coefficient of friction between the block and the incline is $\mu = 0.5$. Find the distance travelled by the block before coming to rest. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



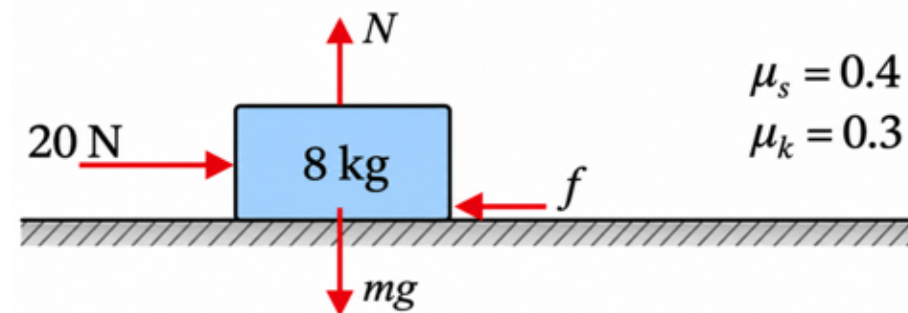
- A) 60m
B) 80m
C) 100m
D) 120m

19. Find the minimum value of m so that the 8kg block just starts moving toward the right. The coefficient of friction between the block and the horizontal surface is $\mu = 0.2$. The string makes an angle of 30° with the horizontal. Take $g = 10\text{m/s}^2$.



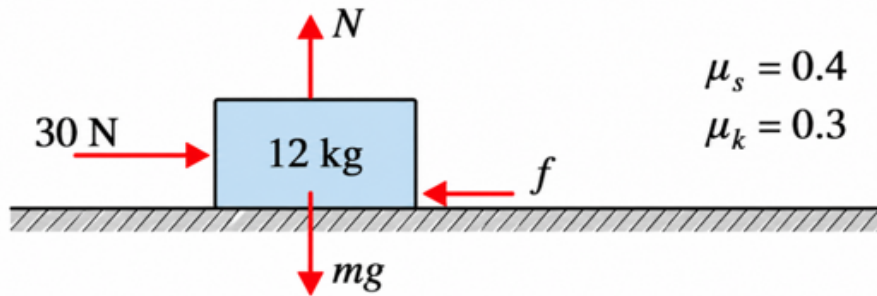
- A) 1.66kg
B) 2.50kg
C) 3.20kg
D) 4.00kg

20. A block of mass 8kg is placed on a rough horizontal surface. A horizontal force of 20N is applied to the block. The coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$. Find the acceleration and frictional force.



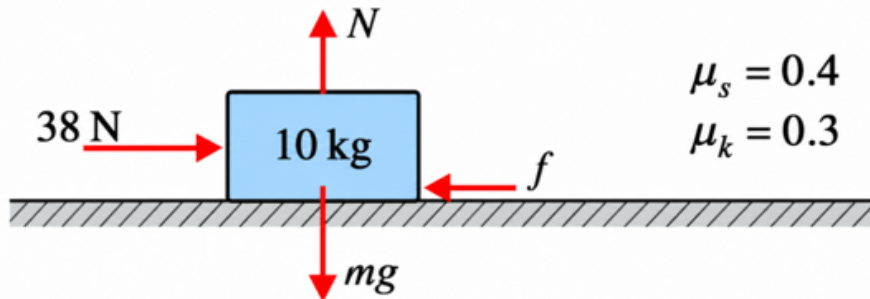
- A) $a = 0$, $f = 20\text{N}$
B) $a = 2.5\text{m/s}^2$, $f = 20\text{N}$
C) $a = 0$, $f = 32\text{N}$
D) $a = 1\text{m/s}^2$, $f = 24\text{N}$

21. A block of mass 12kg is placed on a rough horizontal surface. A horizontal force of 30N is applied to the block. The coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$. Find the acceleration and frictional force.



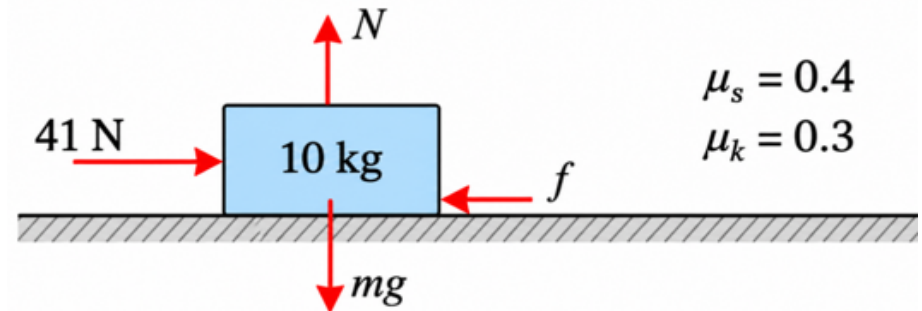
- A) $a = 0$, $f = 30\text{N}$ B) $a = 0.5\text{m/s}^2$, $f = 30\text{N}$
 C) $a = 0$, $f = 48\text{N}$ D) $a = 2\text{m/s}^2$, $f = 36\text{N}$

22. A block of mass 10kg is placed on a rough horizontal surface. A horizontal force of 38N is applied to the block. The coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$. Find the acceleration and frictional force.



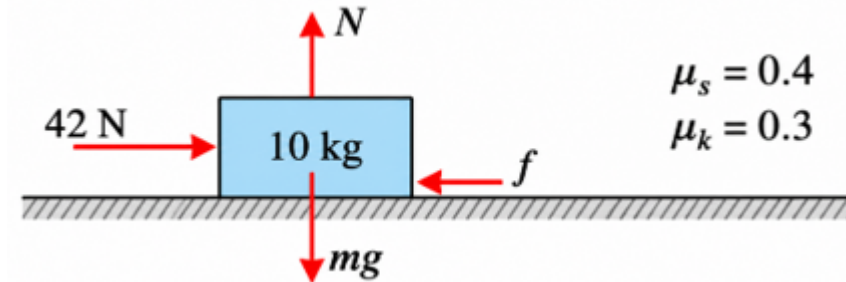
- A) $a = 0$, $f = 38\text{N}$ B) $a = 0.8\text{m/s}^2$, $f = 30\text{N}$
 C) $a = 0$, $f = 40\text{N}$ D) $a = 1\text{m/s}^2$, $f = 30\text{N}$

23. In the given figure, a block of mass 10kg is placed on a rough horizontal surface. A horizontal force of 41N is applied to the block. The coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$. Find the acceleration and frictional force.



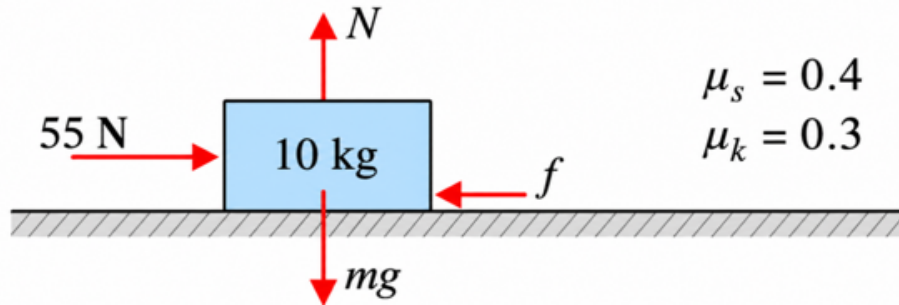
- A) $a = 1.1\text{m/s}^2$, $f = 30\text{N}$ B) $a = 0$, $f = 40\text{N}$
 C) $a = 1.1\text{m/s}^2$, $f = 41\text{N}$ D) $a = 0.5\text{m/s}^2$, $f = 30\text{N}$

24. In the given figure, find the value of acceleration if $F = 42\text{N}$, given the mass of the block is 10kg, $\mu_s = 0.4$, and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$.

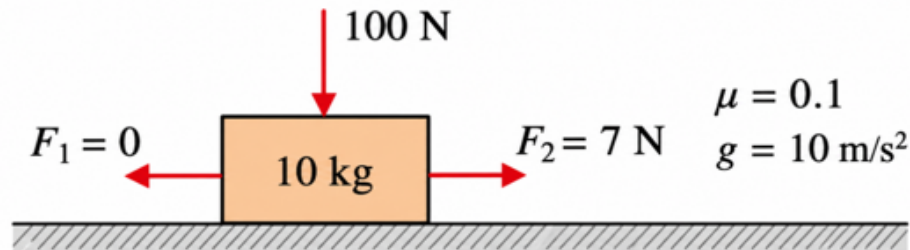


- A) $a = 1.2\text{m/s}^2$ B) $a = 2\text{m/s}^2$
 C) $a = 0.5\text{m/s}^2$ D) $a = 0\text{m/s}^2$

25. In the given figure, find the value of acceleration if $F = 55\text{N}$, given the mass of the block is 10kg , $\mu_s = 0.4$, and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$.

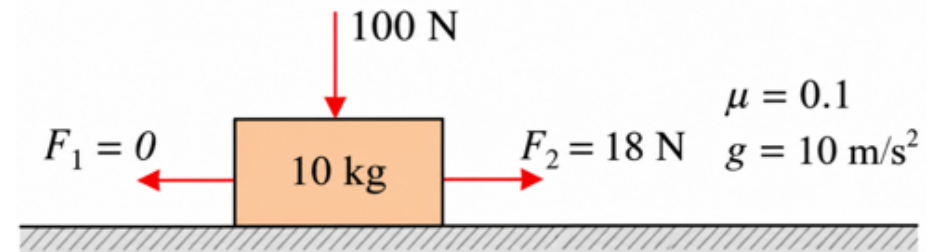


- A) $a = 1.5\text{m/s}^2$
 B) $a = 2.5\text{m/s}^2$
 C) $a = 2\text{m/s}^2$
 D) $a = 0$
26. Find the frictional force acting on the block for Case-I when $F_1 = 0$ and $F_2 = 7\text{N}$, given the mass of the block is 10kg , $\mu = 0.1$, and $g = 10\text{m/s}^2$.



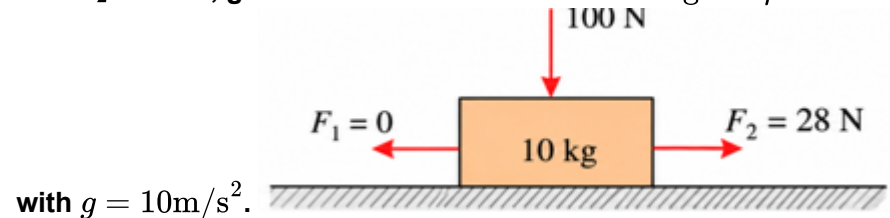
- A) $f = 7\text{N}$ towards left
 B) $f = 10\text{N}$ towards right
 C) $f = 3\text{N}$ towards left
 D) $f = 0$

27. Find the frictional force acting on the block for Case-I when $F_1 = 0$ and $F_2 = 18\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.



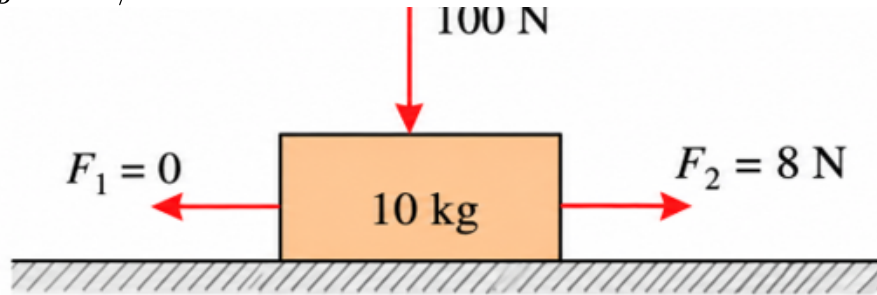
- A) $f = 10\text{N}$ towards left
 B) $f = 18\text{N}$ towards left
 C) $f = 8\text{N}$ towards right
 D) $f = 0$

28. Find the frictional force acting on the block for Case-I when $F_1 = 0$ and $F_2 = 28\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$

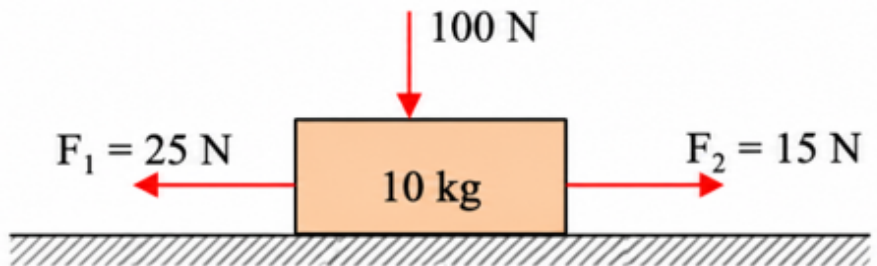


- A) $f = 10\text{N}$ towards left
 B) $f = 28\text{N}$ towards left
 C) $f = 18\text{N}$ towards right
 D) $f = 0$

29. Find the frictional force acting on the block for Case-I when $F_1 = 0$ and $F_2 = 8\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.

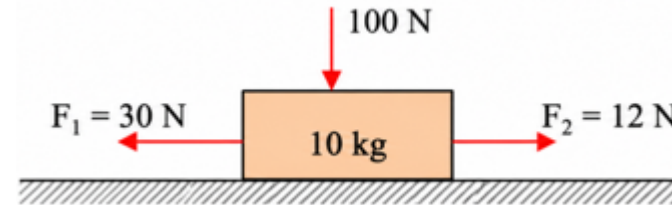


- A) $f = 10\text{N}$ towards left
 B) $f = 8\text{N}$ towards left
 C) $f = 2\text{N}$ towards right
 D) $f = 0$
30. Find the frictional force acting on the block for Case-II when $F_1 = 25\text{N}$ and $F_2 = 15\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.



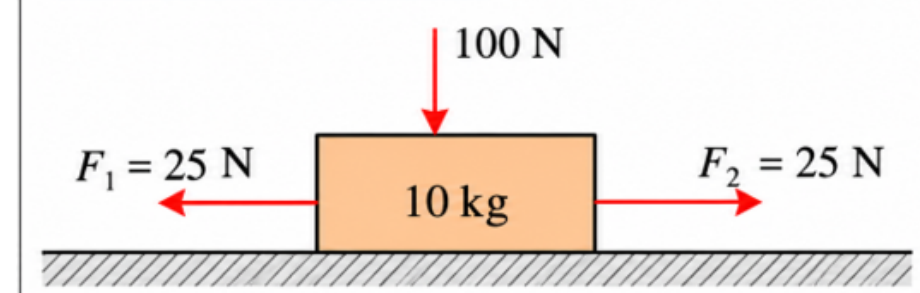
- A) $f = 10\text{N}$ towards right
 B) $f = 10\text{N}$ towards left
 C) $f = 5\text{N}$ towards right
 D) $f = 0$

31. Find the frictional force acting on the block for Case-II when $F_1 = 30\text{N}$ and $F_2 = 12\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.



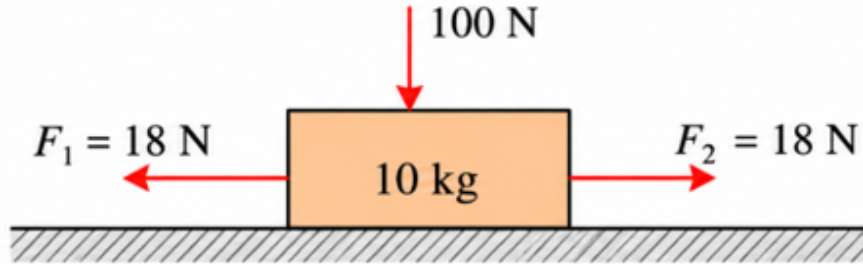
- A) $f = 10\text{N}$ towards right
 B) $f = 10\text{N}$ towards left
 C) $f = 8\text{N}$ towards right
 D) $f = 18\text{N}$ towards right

32. Find the frictional force acting on the block for Case-II when $F_1 = 25\text{N}$ and $F_2 = 25\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.



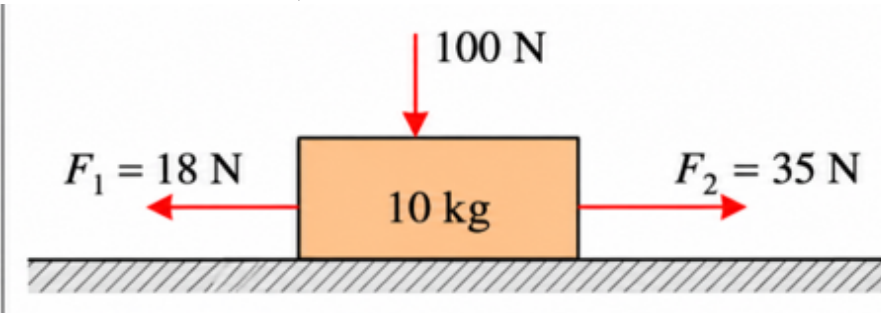
- A) $f = 25\text{N}$
 B) $f = 10\text{N}$
 C) $f = 0$
 D) $f = 50\text{N}$

33. Find the frictional force acting on the block for Case-II when $F_1 = 18\text{N}$ and $F_2 = 18\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.



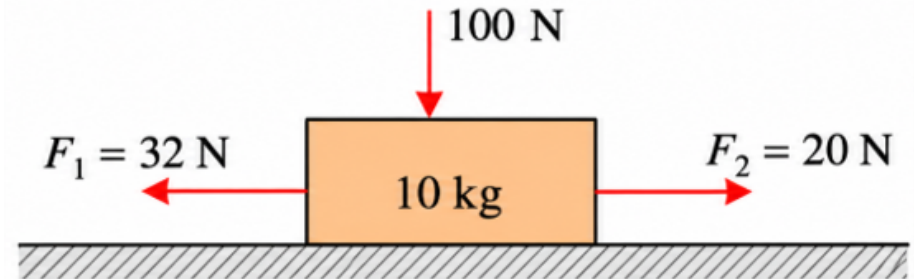
- A) $f = 18\text{N}$
 B) $f = 10\text{N}$
 C) $f = 0$
 D) $f = 36\text{N}$

34. Find the frictional force acting on the block for Case-II when $F_1 = 18\text{N}$ and $F_2 = 35\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.



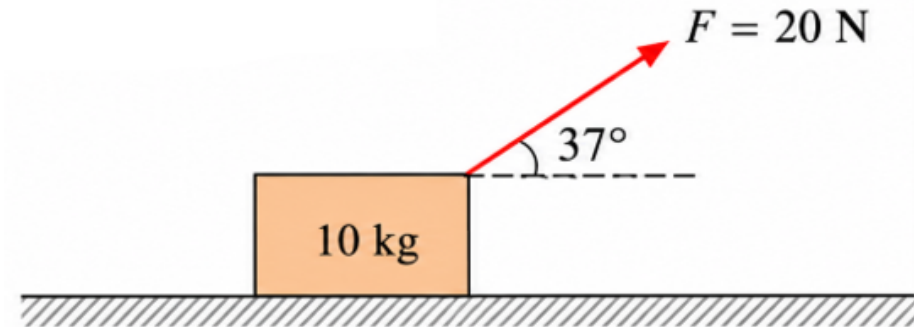
- A) $f = 10\text{N}$ towards left
 B) $f = 10\text{N}$ towards right
 C) $f = 17\text{N}$ towards left
 D) $f = 0$

35. Find the frictional force acting on the block for Case-II when $F_1 = 32\text{N}$ and $F_2 = 20\text{N}$, given the mass of the block is 10kg and $\mu = 0.1$ with $g = 10\text{m/s}^2$.



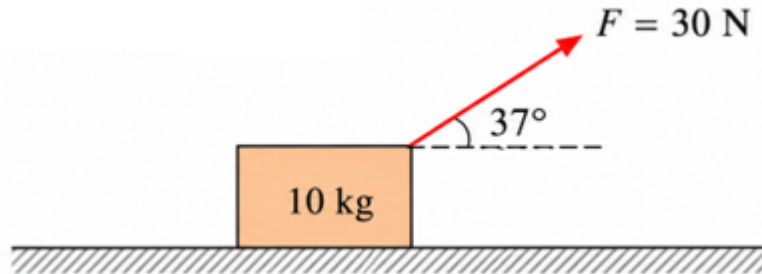
- A) $f = 10\text{N}$ towards left
 B) $f = 10\text{N}$ towards right
 C) $f = 12\text{N}$ towards right
 D) $f = 0$

36. Find the frictional force and acceleration of the block when a force $F = 20\text{N}$ is applied at an angle of 37° above the horizontal to a block of mass 10kg . The coefficients of static and kinetic friction are $\mu_s = 0.3$ and $\mu_k = 0.2$. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



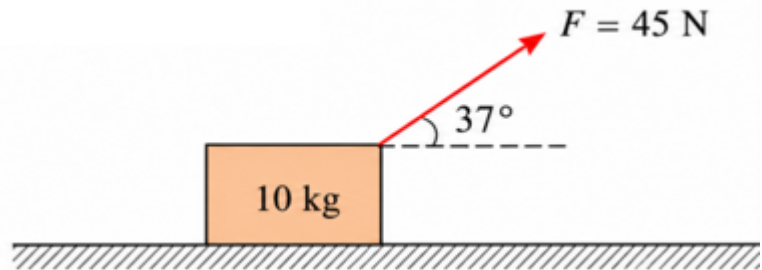
- A) $a = 7.04\text{m/s}^2$, $f = 17.6\text{N}$
 B) $a = 5\text{m/s}^2$, $f = 20\text{N}$
 C) $a = 0$, $f = 26.4\text{N}$
 D) $a = 6\text{m/s}^2$, $f = 12\text{N}$

37. Find the frictional force and acceleration of the block when a force $F = 30\text{N}$ is applied at an angle of 37° above the horizontal to a block of mass 10kg . The coefficients of static and kinetic friction are $\mu_s = 0.3$ and $\mu_k = 0.2$. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



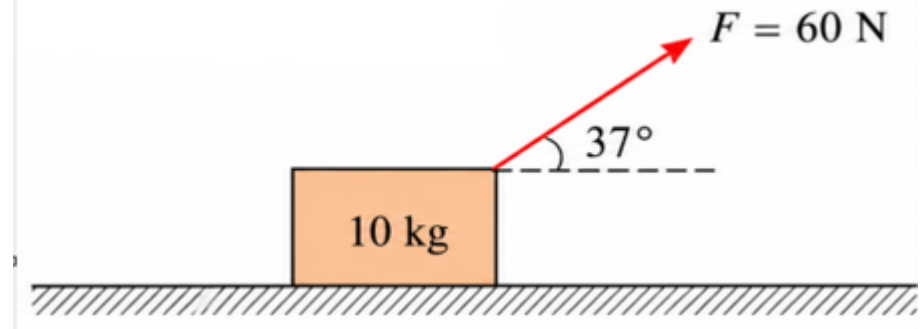
- A) $a = 6.56\text{m/s}^2$, $f = 16.4\text{N}$ B) $a = 5\text{m/s}^2$, $f = 18\text{N}$
 C) $a = 0$, $f = 24.6\text{N}$ D) $a = 7\text{m/s}^2$, $f = 20\text{N}$

38. Find the frictional force and acceleration of the block when $F = 45\text{N}$ is applied at an angle of 37° above the horizontal. The mass of the block is 10kg , $\mu_s = 0.3$, and $\mu_k = 0.2$. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



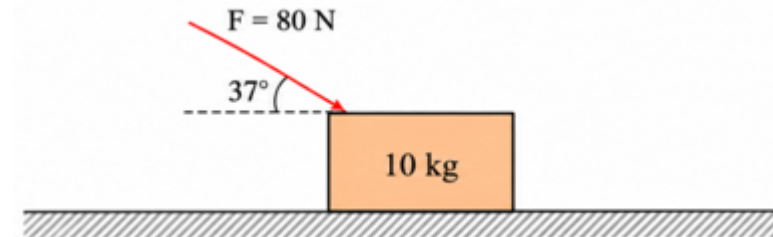
- A) $a = 2.14\text{m/s}^2$, $f = 14.6\text{N}$ B) $a = 1.8\text{m/s}^2$, $f = 18\text{N}$
 C) $a = 0$, $f = 21.9\text{N}$ D) $a = 2.5\text{m/s}^2$, $f = 15\text{N}$

39. Find the frictional force and acceleration of the block when $F = 60\text{N}$ is applied at an angle of 37° above the horizontal. The mass of the block is 10kg , $\mu_s = 0.3$, and $\mu_k = 0.2$. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



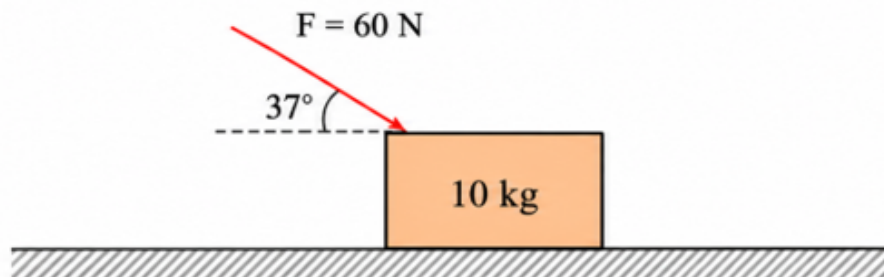
- A) $a = 3.52\text{m/s}^2$, $f = 12.8\text{N}$ B) $a = 3\text{m/s}^2$, $f = 18\text{N}$
 C) $a = 0$, $f = 19.2\text{N}$ D) $a = 4\text{m/s}^2$, $f = 15\text{N}$

40. Find the acceleration of the block if $F = 80\text{N}$, given the mass of the block is 10kg , $\mu = 0.2$, and the force acts at an angle of 37° downward. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



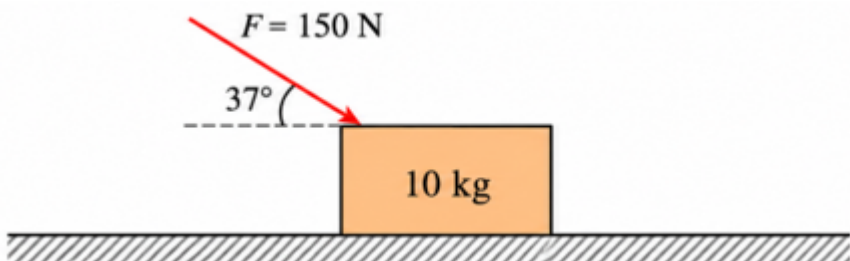
- A) $a = 3.44\text{m/s}^2$ B) $a = 4.8\text{m/s}^2$
 C) $a = 2.4\text{m/s}^2$ D) $a = 5.6\text{m/s}^2$

41. Find the acceleration of the block if $F = 60\text{N}$, given the mass of the block is 10kg , $\mu = 0.2$, and the force acts at an angle of 37° downward. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



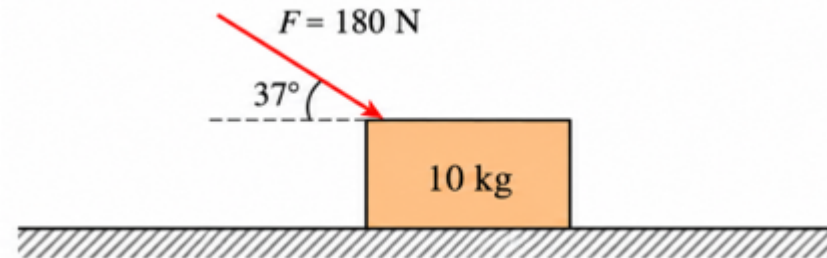
- A) $a = 2.08\text{m/s}^2$ B) $a = 3.2\text{m/s}^2$
 C) $a = 1.6\text{m/s}^2$ D) $a = 4.0\text{m/s}^2$

42. Find the acceleration of the block if $F = 150\text{N}$, given the mass of the block is 10kg , $\mu = 0.2$, and the force acts at an angle of 37° downwards. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



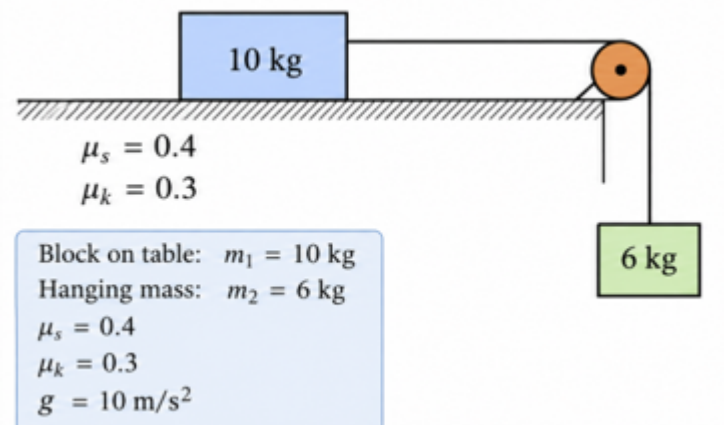
- A) $a = 8.2\text{m/s}^2$ B) $a = 7.2\text{m/s}^2$
 C) $a = 9.6\text{m/s}^2$ D) $a = 6.8\text{m/s}^2$

43. Find the acceleration of the block if $F = 180\text{N}$, given the mass of the block is 10kg , $\mu = 0.2$, and the force acts at an angle of 37° downwards. Take $g = 10\text{m/s}^2$, $\sin 37^\circ = 0.6$, and $\cos 37^\circ = 0.8$.



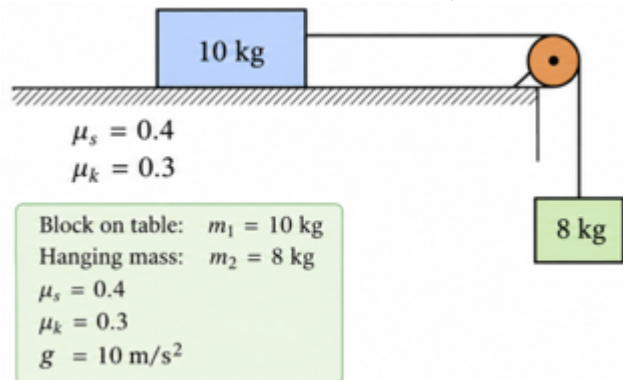
- A) $a = 10.24\text{m/s}^2$ B) $a = 9.6\text{m/s}^2$
 C) $a = 11.2\text{m/s}^2$ D) $a = 8.8\text{m/s}^2$

44. Find the acceleration of the 10kg block and the tension in the string for the system shown, where a 6kg mass hangs vertically. Given $\mu_s = 0.4$, $\mu_k = 0.3$, and $g = 10\text{m/s}^2$.



- A) $a = 1.875\text{m/s}^2$, $T = 48.75\text{N}$ B) $a = 2\text{m/s}^2$, $T = 48\text{N}$
 C) $a = 1.5\text{m/s}^2$, $T = 50\text{N}$ D) $a = 2.5\text{m/s}^2$, $T = 45\text{N}$

45. Find the acceleration of the 10kg block and the tension in the string for the system shown, where an 8kg mass hangs vertically. Given $\mu_s = 0.4$, $\mu_k = 0.3$, and $g = 10\text{m/s}^2$.



- A) $a = \frac{25}{9}\text{m/s}^2$, $T = \frac{520}{9}\text{N}$ B) $a = 3\text{m/s}^2$, $T = 50\text{N}$
 C) $a = 2.5\text{m/s}^2$, $T = 55\text{N}$ D) $a = 4\text{m/s}^2$, $T = 48\text{N}$

Chemistry

46. The number of atoms present in 16 g of oxygen is

- A) $6.02 \times 10^{11.5}$ B) 3.01×10^{23}
 C) $3.01 \times 10^{11.5}$ D) 6.02×10^{23}

47. The number of atoms in 4.25 g of NH_3 is approx:-

- A) 1×10^{23} B) 1.5×10^{23}
 C) 2×10^{23} D) 6×10^{23}

48. Which of the following contains maximum number of oxygen atoms ?

- A) 1 g of O B) 1 g of O_2
 C) 1 g of O_3 D) all have the same number of atoms

49. The number of atoms present in 0.5 g atom of nitrogen is same as the atoms in –

- A) 12 g of C B) 32 g of S
 C) 8 g of oxygen D) 24 g of Mg

50. Which of the following contains maximum number of atoms ?

- A) 4 g of H_2 B) 16 g of O_2
 C) 28 g of N_2 D) 18 g of H_2O

51. Number of neutrons present in 1.7 g of ammonia is -

- A) N_A B) $N_A/10 \times 4$
 C) $(N_A/10) \times 7$ D) $N_A \times 10 \times 7$

52. 5.6 L of oxygen at STP contains -

- A) 6.02×10^{23} atoms B) 3.01×10^{23} atoms
 C) 1.505×10^{23} atoms D) 0.7525×10^{23} atoms

53. Number of oxygen atoms in 8 g of ozone is -

- A) 6.02×10^{23} B) $\frac{6.02 \times 10^{23}}{2}$
 C) $\frac{6.02 \times 10^{23}}{3}$ D) $\frac{6.02 \times 10^{23}}{6}$

54. Sum of number of protons, electrons and neutrons in 12 g of $^{12}_6\text{C}$ is :-

- A) 1.8 B) 12.044×10^{23}
 C) 1.084×10^{25} D) 10.84×10^{23}

55. The weight of one atom of Uranium is 238 amu. Its actual weight is g.

- A) 1.43×10^{26} B) 3.94×10^{-22}
 C) 6.99×10^{-23} D) 1.53×10^{-22}

56. The actual weight of a molecule of water is -

- A) 18 g
B) 2.99×10^{-23} g
C) both (A) & (B) are correct
D) 1.66×10^{-24} g

57. What is the mass of a molecule of CH_4 :-

- A) 16 g
B) 26.6×10^{22} g
C) 2.66×10^{-23} g
D) $16N_A$ g

58. Which of the following has the highest mass ?

- A) 1 g atom of C
B) 1/2 mole of CH_4
C) 10 mL of water
D) 3.011×10^{23} atoms of oxygen

59. Which of the following contains the least number of molecules ?

- A) 4.4 g CO_2
B) 3.4 g NH_3
C) 1.6 g CH_4
D) 3.2 g SO_2

60. The number of molecule in 4.25 g of NH_3 is -

- A) 1.505×10^{23}
B) 3.01×10^{23}
C) 6.02×10^{23}
D) None of these

61. Elements A and B form two compounds B_2A_3 and B_2A . 0.05 moles of B_2A_3 weight 9.0 g and 0.10 mole of B_2A weight 10 g. Calculate the atomic weight of A and B :-

- A) 20 and 30
B) 30 and 40
C) 40 and 30
D) 30 and 20

62. 5.6 L of oxygen at NTP is equivalent to -

- A) 1 mol
B) 1/2 mol
C) 1/4 mol
D) 1/8 mol

63. 4.4 g of an unknown gas occupies 2.24 L of volume at STP. The gas may be :-

- A) N_2O
B) CO
C) CO_2
D) A and C both

64. Which contains least number of molecules :-

- A) 1 g CO_2
B) 1 g N_2
C) 1 g O_2
D) 1 g H_2

65. If V mL of the vapours of substance at NTP weight W g. Then molecular weight of substance is:-

- A) $(W/V) \times 22400$
B) $\frac{V}{W} \times 22.4$
C) $(W - V) \times 22400$
D) $\frac{W \times 1}{V \times 22400}$

66. If 3.01×10^{20} molecules are removed from 98 mg of H_2SO_4 , then the number of moles of H_2SO_4 left are :-

- A) 0.1×10^{-3}
B) 0.5×10^{-3}
C) 1.66×10^{-3}
D) 9.95×10^{-2}

67. Equal masses of H_2 , O_2 and methane have been taken in a container of volume V at temperature $27^\circ C$ at identical conditions. The ratio of the volumes of gases $H_2 : O_2 : CH_4$ would be :

- A) 8 : 16 : 1
B) 16 : 8 : 1
C) 16 : 1 : 2
D) 8 : 1 : 2

68. When 22.4 L of $H_2(g)$ is mixed with 11.2 L of $Cl_2(g)$ at S.T.P., the moles of $HCl(g)$ formed is equal to:-

- A) 1 mol of $HCl(g)$
B) 2 mol of $HCl(g)$
C) 0.5 mol of $HCl(g)$
D) 1.5 mol of $HCl(g)$

69. 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and by how much ? (At. wt. Mg = 24 ; O = 16)

- A) Mg, 0.16 g
B) O_2 , 0.16 g
C) Mg, 0.44 g
D) O_2 , 0.28 g

A) 4 : 1

B) 16 : 1

C) 2 : 1

D) 1 : 4

A) 18 g of water **B) 18 mol of water**
C) 18 molecules of water **D) 1.8 g of water**

A) The ratio of chemical species to each other in a balanced equation

B) The ratio of elements to each other in a compound

C) The definition of mass in units of grams

D) The mass of one mole of carbon

A) 60 **B) 84**
C) 75 **D) 96**

A) 20, 30

B) 30, 20

C) 40, 30

D) 60, 40

A) 18 mL of water
B) 0.18 g of water
C) 0.00224 L of water vapours at 1 atm and 273K
D) 10^{-3} mol of water

A) 1 g of Li(s) [Atomic mass of Li = 7]
B) 1 g of Ag(s) [Atomic mass of Ag = 108]
C) 1 g of Mg(s) [Atomic mass of Mg = 24]
D) 1 g of $\text{O}_2(\text{g})$ [Atomic mass of O = 16]

A) 1.2×10^{23}

B) 6.022×10^{22}

C) 12×10^{22}

D) 6.022×10^{23}

A) 5375×10^{-3} g **B)** 5.4 g
C) 5.38 g **D)** 53.75 g

A) 4 mol of helium **B) 4 u of helium**
C) 4 g of helium **D) 2.271098 L of helium at STP**

A) 750 mg

B) 250 mg

C) Zero mg

D) 200 mg

A) 14 g of N_2
B) 18 g of H_2O
C) 16 g of CO
D) 28 g of N_2

82. 100 ml aqueous solution (density = $\frac{5}{3}$ g/ml) contains 40% by weight NaOH. The number of molecules of NaOH dissolved in the above solution is: (Use $N_A = 6 \times 10^{23}$)

- A) 2×10^{22} B) 3.33×10^{22}
C) 10^{24} D) 3.33×10^{23}

83. Calculate molality of the solution obtained by dissolving 11.7 g NaCl in 500 g water:

- A) 0.1 m B) 0.3 m
C) 0.2 m D) 0.4 m

84. The normality of 0.3 M phosphorous acid (H_3PO_3) is:

- A) 0.1 B) 0.9
C) 0.3 D) 0.6

85. The mole fraction of oxygen in a mixture of 7 g of nitrogen and 8 g of oxygen is:

- A) $\frac{8}{15}$ B) 0.5
C) 0.25 D) 1.0

86. Density of a solution containing 13% by mass of sulphuric acid is 0.98 g/ml. Then molarity of solution will be:

- A) 1.1 M B) 1.5 M
C) 1.3 M D) 1.7 M

87. Molality of 20% (w/w) aq. glucose solution is :

- A) $\frac{25}{18}$ m B) $\frac{10}{9}$ m
C) $\frac{25}{9}$ m D) $\frac{5}{18}$ m

88. Molarity and Molality of a solute (Molar weight = 50 g) in aqueous solution is 9 and 18 respectively. What is the density of solution.

- A) 1 g/cc B) 0.95 g/cc
C) 1.05 g/cc D) 2 g/cc

89. 3.0 molal NaOH solution has a density of 1.12 g/mL.

The molarity of the solution is-

- A) 18 B) 3
C) 44 D) 24

90. The molarity of 98% by wt. H_2SO_4 (Density=1.8g/ml) is

- A) 18 B) 89
C) 44 D) 24

Botany

91. When stamens are attached to the petals, the condition is termed as:

- A) Epiphyllous B) Epipetalous
C) Monadelphous D) Syngenesious

92. Epiphyllous stamens, where stamens are attached to the perianth, are characteristically found in:

- A) China rose B) Brinjal
C) Lily D) Pea

93. Stamens united into more than two bundles (polyadelphous condition) are found in:

- A) Pea B) China rose
C) Citrus D) Mustard

94. Variation in the length of filaments within a single flower is observed in:

- A) Salvia and Mustard B) China rose and Citrus
C) Pea and Tomato D) Brinjal and Lily

95. Tetradynamous condition (4 long and 2 short stamens) is typically found in:

- A) Salvia B) Mustard (Brassica)
C) Sunflower D) Onion

96. Which of the following groups of plants possess superior ovaries?

- A) Mustard, China rose, Brinjal B) Plum, Rose, Peach
C) Guava, Cucumber, Ray florets of sunflower D) Pea, Bean, Aloe

97. In epigynous flowers, the margin of the thalamus grows upward enclosing the ovary completely. This is seen in:

- A) Brinjal B) Cucumber and Guava
C) Peach D) Mustard

98. When more than one carpel is present and they are free from each other, the condition is called:

- A) Syncarpous B) Apocarpous
C) Monocarpellary D) Polyadelphous

99. Apocarpous gynoecium is found in:

- A) Lotus and Rose B) Mustard and Tomato
C) Brinjal and China rose D) Onion and Garlic

100.

When carpels are fused together, the condition is termed syncarpous. Examples include:

- A) Lotus and Rose B) Mustard and Tomato
C) Michelia and Lily D) Pea and Bean

101.

Axile placentation is observed in:

- A) China rose, Tomato, and Lemon B) Mustard and Argemone
C) Dianthus and Primrose D) Sunflower and Marigold

102.

In parietal placentation, ovules develop on the inner wall of the ovary. A false septum (replum) develops in:

- A) Pea B) Lemon
C) Mustard and Argemone D) Dianthus

103.

When the ovules are borne on the central axis and septa are absent, the placentation is called:

- A) Axile B) Parietal placentation
C) Free central D) Basal

104.

Free central placentation occurs in:

- A) Dianthus and Primrose B) Sunflower and Marigold
C) Mustard and Lemon D) Tomato and Pea

105.

A fruit developed without fertilization of the ovary is called a:

- A) True fruit B) False fruit
C) Parthenocarpic fruit D) Apomictic fruit

106.

In Mango and Coconut, the fruit is known as a:

- A) Berry B) Drupe
C) Pepo D) Pome

107.

Drupe fruits develop from:

- A) Monocarpellary, superior ovaries B) Multicarpellary, inferior ovaries
C) Monocarpellary, inferior ovaries D) Multicarpellary, superior ovaries

108.

In Mango, the edible fleshy part is the:

- A) Epicarp B) Mesocarp
C) Endocarp D) Perisperm

109.

In Coconut, the mesocarp is:

- A) Fleshy and edible B) Stony and hard
C) Fibrous D) Thin and leathery

110.

The outermost layer of the fruit wall (pericarp) is called the:

- A) Mesocarp
- B) Endocarp
- C) Epicarp
- D) Tegmen

111.

The outermost covering of a seed is the seed coat. It has two layers: the outer _____ and inner _____.

- A) Tegmen, Testa
- B) Testa, Tegmen
- C) Hilum, Micropyle
- D) Coleoptile, Coleorhiza

112.

The scar on the seed coat through which the developing seeds were attached to the fruit is the:

- A) Micropyle
- B) Hilum
- C) Chalaza
- D) Raphe

113.

Which of the following is a non-endospermic (exalbuminous) dicotyledonous seed?

- A) Castor
- B) Pea, Gram, and Bean
- C) Maize
- D) Barley

114.

Generally, monocotyledonous seeds are endospermic, but which of the following is an exception (non-endospermic)?

- A) Maize
- B) Rice
- C) Orchids
- D) Wheat

115.

In the seeds of cereals like maize, the seed coat is fused with the:

- A) Fruit wall (pericarp)
- B) Endosperm
- C) Aleurone layer
- D) Scutellum

116.

The outer proteinaceous layer that separates the endosperm from the embryo in a maize seed is the:

- A) Scutellum
- B) Aleurone layer
- C) Coleoptile
- D) Perisperm

117.

The diadelphous condition (9+1 arrangement of stamens) is a hallmark feature of which family?

- A) Solanaceae
- B) Fabaceae
- C) Liliaceae
- D) Brassicaceae

118.

The large, shield-shaped single cotyledon of a monocotyledonous seed is called:

- A) Coleoptile
- B) Coleorhiza
- C) Scutellum
- D) Epiblast

119.

Read the following statements and select the correct option:

Statement 1: In a marginal placentation, the ovary is unilocular.

Statement 2: In axile placentation, the ovary is multilocular.

- A) Both statements are incorrect
- B) Both statements are correct
- C) Statement 1 is correct, Statement 2 is incorrect
- D) Statement 1 is incorrect, Statement 2 is correct

120.

Identify the mismatch among the following pairs:

- A) Epipetalous — Brinjal
- B) Polyadelphous — Citrus
- C) Diadelphous — Pea
- D) Epiphyllous — China rose

121.

Match Column I (Placentation) with Column II (Examples) and select the correct option:

Column I (Placentation)	Column II (Examples)
A. Basal	i. Mustard
B. Free Central	ii. China rose
C. Parietal	iii. Marigold
D. Axile	iv. Dianthus

A) A-iii, B-iv, C-i, D-ii

B) A-iv, B-iii, C-i, D-ii

C) A-iii, B-i, C-iv, D-ii

D) A-i, B-iv, C-iii, D-ii

122.

Which of the following structural parts protects the plumule during monocot seed germination?

A) Coleorhiza

B) Coleoptile

C) Scutellum

D) Radicle

123.

An ovary which is one-chambered but becomes two-chambered due to the formation of a false septum is seen in:

A) Argemone

B) Pea

C) Lemon

D) Dianthus

124.

Select the correct statement regarding the seed structure:

A) Non-endospermic seeds store food material inside the endosperm.

B) Micropyle is a small pore present below the hilum.

C) Coleoptile is an undifferentiated sheath enclosing the root cap.

D) Castor is a non-endospermic dicot seed.

125.

The plumule and radicle in a dicot seed embryo are attached to the:

A) Seed coat

B) Embryonal axis

C) Hilum

D) Endosperm

126.

Assertion (A): In Mustard and Argemone, the ovary is initially unilocular but later becomes bilocular. Reason (R): A false septum called replum develops within the ovary in parietal placentation.

A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C) If Assertion is true but Reason is false.

D) If Assertion is false but Reason is true or both are false.

127.

Assertion (A): Banana is a classic example of a parthenocarpic fruit. Reason (R): Parthenocarpic fruits develop from the ovary without undergoing fertilization.

A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C) If Assertion is true but Reason is false.

D) If Assertion is false but Reason is true or both are false.

128.

Assertion (A): Castor seed is a non-endospermic dicotyledonous seed. Reason (R): Castor retains a food-storing tissue called endosperm which results from double fertilization.

A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C) If Assertion is true but Reason is false.

D) If Assertion is false but Reason is true or both are false

129.

Assertion (A): The scar left on the seed coat of a dicot seed is called the hilum. **Reason (R):** Hilum is a small micro-pore through which oxygen enters during seed germination.

- A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion. B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C) If Assertion is true but Reason is false. D) If Assertion is false but Reason is true or both are false.

130.

Consider the following statements about a monocotyledonous seed grain (e.g., Maize): I. The seed coat is membranous and generally fused with the fruit wall. II. The endosperm is bulky and stores food. III. The outer proteinaceous layer of the endosperm is called the aleurone layer. IV. The single large shield-shaped cotyledon is known as the epiblast. **Select the correct statements:**

- A) I, II and III B) II, III and IV
C) I, III and IV D) All statements are correct

131.

Read carefully: I. In Apple, the thalamus contributes to fruit formation, making it a false fruit. II. Drupes are characterized by a stony endocarp. III. Coconut fruit is structurally a nut, not a drupe. IV. The edible part of almond is the mesocarp. **Which statements are false?**

- A) I and II B) III and IV
C) II and III D) I and IV

132.

In a monocot seed embryo, the plumule and radicle are enclosed in sheaths called _____ and _____ respectively.

- A) Coleorhiza, Coleoptile B) Coleoptile, Coleorhiza
C) Scutellum, Aleurone D) Testa, Tegmen

133.

The layer of cells rich in protein in a maize grain is the:

- A) Scutellum B) Pericarp
C) Aleurone layer D) Endosperm core

134.

Assertion (A): Mango and Coconut fruits are morphologically classified as drupes. **Reason (R):** They develop from monocarpellary superior ovaries and are single-seeded.

- A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion. B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C) If Assertion is true but Reason is false. D) If Assertion is false but Reason is true or both are false.

135.

Assertion (A): In Mango, the middle layer of the fruit wall is hard and stony. **Reason (R):** The pericarp of Mango is well differentiated into a thin epicarp, fleshy edible mesocarp, and stony hard endocarp.

- A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion. B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C) If Assertion is true but Reason is false. D) If Assertion is false but Reason is true or both are false.

Zoology.

136.

The interaction in which both species are benefited is:

- A) Competition B) Predation
C) Mutualism D) Parasitism

137.

In the interaction represented as (+,+), the relationship is most appropriately called:

- A) Competition
- B) Mutualism
- C) Amensalism
- D) Predation

138.

Which interaction is represented by (+,-)?

- A) Mutualism
- B) Competition
- C) Predation
- D) Commensalism

139.

Which interaction is represented by (-,-)?

- A) Competition
- B) Mutualism
- C) Predation
- D) Commensalism

140.

Which interaction is represented by (+,0)?

- A) Parasitism
- B) Predation
- C) Commensalism
- D) Competition

141.

Lichens represent an association between:

- A) Algae and fungi
- B) Bacteria and fungi
- C) Algae and bryophytes
- D) Fungi and mosses

142.

The algal partner in a lichen primarily provides:

- A) Shelter
- B) Food
- C) Nitrogen fixation in every lichen
- D) Mineral absorption

143.

Mycorrhiza is an association between:

- A) Alga and fungus
- B) Fungus and roots of higher plants
- C) Bacteria and roots only
- D) Two fungal species

144.

In mycorrhiza, the fungal partner helps the plant mainly in:

- A) Pollination
- B) Absorption of phosphorus and water/minerals
- C) Seed dispersal
- D) Fruit formation

145.

Which is an example of mutualism involving an animal and a plant?

- A) Fig and fig wasp
- B) Cuscuta and host
- C) Plasmodium and human
- D) Tiger and deer

146.

The interaction between cattle egret and grazing cattle is generally cited as:

- A) Parasitism
- B) Commensalism
- C) Competition
- D) Predation

147.

In commensalism:

- A) Both species are harmed
- B) One benefits and the other is unaffected
- C) Both species benefit
- D) One benefits and the other is harmed

148.

An orchid growing as an epiphyte on a mango tree is an example of:

- A) Parasitism
- B) Mutualism
- C) Commensalism
- D) Competition

149.

A tick feeding on a dog is an example of:

- A) Predation
- B) Parasitism
- C) Mutualism
- D) Commensalism

150.

Which statement best distinguishes parasitism from predation?

- | | |
|--|---|
| A) Parasite always kills the host immediately | B) Parasite generally derives nourishment from a host without immediately killing it |
| C) Predator never consumes another organism | D) Parasite always lives independently of the host |

151.

Cuscuta is best described as:

- | | |
|--------------------------------|-------------------------------|
| A) A predator | B) A parasitic plant |
| C) A commensal epiphyte | D) A mutualistic plant |

152.

The relationship between Plasmodium and humans is:

- | | |
|----------------------|------------------------|
| A) Mutualism | B) Commensalism |
| C) Parasitism | D) Competition |

153.

Brood parasitism is illustrated by:

- | | |
|--|---|
| A) Cuckoo laying eggs in the nest of a crow | B) Lion killing a deer |
| C) Lichen formation | D) Cattle egret following cattle |

154.

Which adaptation is commonly associated with parasites?

- | | |
|---|--|
| A) High dependence on host resources | B) Complete independence from hosts |
| C) Absence of reproductive adaptations | D) Always possessing chlorophyll |

155.

In host–parasite relationships, the host is generally:

- | | |
|---------------------------------------|--|
| A) Unaffected in all cases | B) The organism that provides resources/environment to the parasite |
| C) Always the smaller organism | D) Always a plant |

156.

Predators play an important ecological role by:

- | | |
|--|--|
| A) Eliminating all prey species | B) Maintaining prey populations and contributing to community stability |
| C) Preventing all competition | D) Increasing parasitism in every ecosystem |

157.

Which is a classic example of predation?

- | | |
|----------------------------|---------------------------------|
| A) Tiger and deer | B) Lichen |
| C) Cuscuta and host | D) Orchid and mango tree |

158.

Predation may also occur when:

- | | |
|--|---|
| A) An organism consumes another organism or its tissues | B) Both organisms exchange nutrients equally |
| C) Neither organism is affected | D) One organism only provides shelter |

159.

Competition occurs when two organisms:

- | | |
|---|---|
| A) Require the same limited resource | B) Always belong to the same species |
| C) Always benefit one another | D) Never share a habitat |

160.

Which statement about competition is correct?

- A)** It can occur between closely related as well as unrelated species
B) It occurs only among carnivores
C) It always produces mutual benefit
D) It is restricted to plants

161.

Gause's competitive exclusion principle states that:

- A)** Two species with identical niches can coexist indefinitely
B) Two closely related species competing for the same resources cannot coexist indefinitely if other ecological factors remain constant
C) Predators always eliminate competitors
D) Mutualists always occupy identical niches

162.

The principle of competitive exclusion is associated with the experiments of:

- A)** G. F. Gause
B) Charles Darwin
C) Watson and Crick
D) Mendel

163.

When two species use exactly the same limiting resource, the likely outcome is:

- A)** Competitive interaction
B) Mutualism
C) Commensalism
D) Parasitism

164.

Which pair illustrates interspecific competition?

- A)** Two species of Paramecium using the same resources
B) Cuscuta and its host
C) Tiger and deer
D) Lichen partners

165.

Which pair correctly represents the interaction and its effect?

- A)** Mutualism — (+, +)
B) Predation — (+, +)
C) Parasitism — (0, 0)
D) Competition — (+, 0)

166.

Consider the following: 1. Lichen 2. Mycorrhiza 3. Cattle egret and cattle 4. Cuscuta and host Which are mutualistic interactions?

- A)** 1 and 2 only
B) 1, 2 and 3 only
C) 2 and 4 only
D) 1, 2, 3 and 4

167.

Consider the following statements about parasitism: 1. Parasite obtains nourishment from the host. 2. Parasite is generally smaller than its host. 3. Parasite usually kills the host immediately. 4. Parasites may have special adaptations for living on or in hosts. Choose the correct option.

- A)** 1, 2 and 4 only
B) 1 and 3 only
C) 2 and 3 only
D) 1, 2, 3 and 4

168.

Which set contains only examples of commensalism?

- A)** Orchid on mango tree; cattle egret with cattle
B) Cuscuta on host; Plasmodium in human
C) Lichen; mycorrhiza
D) Tiger and deer; lion and antelope

169.

Which set contains only examples of parasitism?

- A)** Cuscuta and host; Plasmodium and human
B) Lichen; mycorrhiza
C) Tiger and deer; cattle egret and cattle
D) Orchid and mango; lichen

170.

Which statement is NOT correct about mutualism?

- | | |
|---------------------------------|--|
| A) Both partners derive benefit | B) It may involve nutritional exchange |
| C) It is represented by (+,+) | D) One partner must always be harmed |

171.

Assertion (A): Competition can occur even between unrelated species. Reason (R): Competition arises when organisms require the same limited resources.

- | | |
|--|--|
| A) Both A and R are true and R is the correct explanation of A | B) Both A and R are true but R is not the correct explanation of A |
| C) A is true but R is false | D) A is false but R is true |

172.

Assertion (A): Predation can help maintain species diversity in a community. Reason (R): Predators may prevent one species from becoming excessively dominant.

- | | |
|--|--|
| A) Both A and R are true and R is the correct explanation of A | B) Both A and R are true but R is not the correct explanation of A |
| C) A is true but R is false | D) A is false but R is true |

173.

Assertion (A): In commensalism, the commensal benefits while the other species is not significantly affected. Reason (R): The interaction is represented as (+,0).

- | | |
|--|--|
| A) Both A and R are true and R is the correct explanation of A | B) Both A and R are true but R is not the correct explanation of A |
| C) A is true but R is false | D) A is false but R is true |

174.

An organism obtains food from another organism while causing it harm but normally not killing it immediately. This interaction is:

- | | |
|--------------|-----------------|
| A) Predation | B) Parasitism |
| C) Mutualism | D) Commensalism |

175.

A student classifies interactions as follows: I. (+,+) II. (+,-) III. (-,-) IV. (+,0) Which sequence is correct?

- | | |
|---|---|
| A) Mutualism, predation/parasitism, competition, commensalism | B) Competition, mutualism, predation, parasitism |
| C) Commensalism, competition, mutualism, predation | D) Parasitism, commensalism, competition, mutualism |

176.

If a predator is removed from a community and its prey population increases sharply, this observation most directly demonstrates:

- | | |
|---|--|
| A) Predation as a population-regulating interaction | B) Mutualism between predator and prey |
| C) Commensalism | D) Competitive exclusion |

177.

Which interaction can be described as beneficial to one species while having no significant effect on the other?

- | | |
|----------------|-----------------|
| A) Competition | B) Commensalism |
| C) Parasitism | D) Predation |

178.

Which one of the following is correctly matched?

- | | |
|----------------------------|---------------------------|
| A) Lichen — mutualism | B) Cuscuta — commensalism |
| C) Tiger—deer — parasitism | D) Tick—dog — mutualism |

179.

Which of the following represents the most appropriate sequence of interaction types from (+,+) to (+,-) to (-,-) to (+,0)?

- | | |
|--|--|
| A) Mutualism → predation/parasitism → competition → commensalism | B) Competition → mutualism → commensalism → parasitism |
| C) Commensalism → competition → mutualism → predation | D) Parasitism → commensalism → competition → mutualism |

180.

A plant species and a fungal species both gain an advantage from their association, particularly through improved mineral uptake by the plant. This is:

A) Mycorrhiza — mutualism

B) Cuscuta — parasitism

C) Orchid — parasitism

D) Cattle egret — predation

ANSWER KEY

Physics

1.	2	13.	2	25.	2	37.	1
2.	3	14.	1	26.	1	38.	1
3.	4	15.	1	27.	1	39.	1
4.	3	16.	1	28.	1	40.	1
5.	3	17.	3	29.	2	41.	1
6.	2	18.	2	30.	1	42.	1
7.	4	19.	1	31.	1	43.	1
8.	2	20.	1	32.	3	44.	1
9.	1	21.	1	33.	3	45.	1
10.	1	22.	1	34.	1		
11.	2	23.	1	35.	2		
12.	1	24.	1	36.	1		

Chemistry

46.	4	57.	3	68.	1	79.	1
47.	4	58.	1	69.	1	80.	2
48.	4	59.	4	70.	1	81.	1
49.	3	60.	1	71.	2	82.	3
50.	1	61.	3	72.	4	83.	4
51.	3	62.	3	73.	2	84.	4
52.	2	63.	4	74.	3	85.	2
53.	2	64.	1	75.	1	86.	3
54.	3	65.	1	76.	1	87.	1
55.	2	66.	2	77.	4	88.	2
56.	2	67.	3	78.	2	89.	2

90. 1

Botany

91.	2	103.	3	115.	1	127.	1
92.	3	104.	1	116.	2	128.	4
93.	3	105.	3	117.	2	129.	3
94.	1	106.	2	118.	3	130.	1
95.	2	107.	1	119.	2	131.	2
96.	1	108.	2	120.	4	132.	2
97.	2	109.	3	121.	1	133.	3
98.	2	110.	3	122.	2	134.	1
99.	1	111.	2	123.	1	135.	4
100.	2	112.	2	124.	2		
101.	1	113.	2	125.	2		
102.	3	114.	3	126.	1		

Zoology

136.	3	147.	2	158.	1	169.	1
137.	2	148.	3	159.	1	170.	4
138.	3	149.	2	160.	1	171.	1
139.	1	150.	2	161.	2	172.	1
140.	3	151.	2	162.	1	173.	1
141.	1	152.	3	163.	1	174.	2
142.	2	153.	1	164.	1	175.	1
143.	2	154.	1	165.	1	176.	1
144.	2	155.	2	166.	1	177.	2
145.	1	156.	2	167.	1	178.	1
146.	2	157.	1	168.	1	179.	1

SOLUTIONS

Q1.

Answer: B

Explanation:

For the block to remain stopped, the upward friction force must balance the weight of the block. Since friction is $f = \mu N$ and the normal reaction equals the applied force ($N = F$), the condition $\mu F = mg$ gives $F = \frac{mg}{\mu} = \frac{3 \times 10}{0.6} = 50 \text{ N}$.

Q2.

Answer: C

Explanation:

To just start the block moving, the applied force must overcome the limiting static friction. On a horizontal surface the normal reaction is $N = mg$, so the required force is $F = \mu_s N = \mu_s mg = 0.75 \times 8 \times 10 = 60 \text{ N}$.

Q3.

Answer: D

Explanation:

Static friction is self-adjusting: it matches the applied force until the limiting value $f_{max} = \mu_s mg$ is reached. Here $f_{max} = 0.6 \times 4 \times 10 = 24 \text{ N}$, which is greater than the applied force of 6 N, so the block stays at rest and the friction force simply equals the applied force, $f = 6 \text{ N}$.

Q4.

Answer: C

Explanation:

Since the wall is smooth, it exerts only a horizontal normal force on the ladder and no vertical frictional force. Therefore vertical equilibrium of the ladder gives the floor normal reaction $N = W = 300 \text{ N}$, and the maximum (limiting) friction at the floor is $f_{max} = \mu N = 0.4 \times 300 = 120 \text{ N}$.

Q5.

Answer: C

Explanation:

The pressing force provides the normal reaction $N = 200 \text{ N}$, so the limiting friction is $f_{max} = \mu N = 0.4 \times 200 = 80 \text{ N}$. The weight of the body is only $mg = 3 \times 10 = 30 \text{ N}$, which is less than f_{max} , so the body stays at rest and static friction simply balances the weight: $f = mg = 30 \text{ N}$.

Q6.

Answer: B

Explanation:

Once the block slides, the opposing kinetic friction is $f = \mu mg = 0.3 \times 5 \times 10 = 15 \text{ N}$. The net driving force is $F - f = 35 - 15 = 20 \text{ N}$, so the acceleration is $a = \frac{F - \mu mg}{m} = \frac{20}{5} = 4 \text{ m/s}^2$.

Q7.

Answer: D

Explanation:

Uniform velocity means the applied force exactly balances friction, so $f = \mu mg = 0.2 \times 3 \times 9.8 = 5.88 \text{ N}$. The distance covered in 5 s is $d = vt = 2 \times 5 = 10 \text{ m}$, so the work done against friction is $W = fd = 58.8 \text{ J}$, and the heat generated is $H = \frac{W}{J} = \frac{58.8}{4.2} = 14 \text{ cal}$.

Q8.

Answer: B

Explanation:

The applied force has horizontal and vertical components. The vertical component reduces the normal force, which in turn reduces the friction force. The net horizontal force is the horizontal component of the applied force minus the friction force. Using Newton's second law, we can find the acceleration.

Q9.

Answer: A

Explanation:

The net force acting on the body down the plane is the component of gravity ($mg \sin \theta$) minus the frictional force ($\mu mg \cos \theta$). Dividing this net force by the mass m gives the acceleration $a = g(\sin \theta - \mu \cos \theta)$.

Q10.

Answer: A

Explanation:

For the block to be just stationary, friction balances its weight: $f = W$ At limiting friction, $f = \mu N$ Since the applied horizontal force provides the normal reaction, $N = 16\text{N}$ Therefore, $W = \mu N = 0.25 \times 16 = 4\text{N}$ Hence, the correct answer is A) 4N.

Q11.

Answer: B

Explanation:

The 12kg block moves downward, the 8kg block moves upward, and the 10kg block moves toward the 12kg side. Net driving force:
 $F_{\text{net}} = (12 - 8)g = 4(10) = 40\text{N}$ Total mass: $M = 8 + 10 + 12 = 30\text{kg}$
Therefore, $a = \frac{40}{30} = 1.33\text{m/s}^2$ Correction: Since the central 10kg block is connected to two separate strings, its acceleration is the same magnitude as the hanging blocks only when the string constraints are satisfied. Thus the correct equations must be solved individually. For the left block: $8g - T_1 = 8a$ For the right block: $12g - T_2 = 12a$ For the central block: $T_2 - T_1 = 10a$ Solving these equations gives: $a = 1.67\text{m/s}^2$

Q12.

Answer: A

Explanation:

For the 10kg block on the incline, $N = mg \cos 30^\circ$ $f = \mu N$ The hanging block pulls the inclined block upward. Therefore, friction acts down the incline. Using the equations of motion for both blocks: $100 - T = 10a$ $T - 50 - f = 10a$ Adding, $100 - 50 - f = 20a$ With $f = 0.2(10)(10) \cos 30^\circ = 17.3\text{N}$ we get
 $a = \frac{100-50-17.3}{20} = 1.63\text{m/s}^2$ Hence, A.

Q13.

Answer: B

Explanation:

For the 10kg block: $mg \sin 37^\circ = 10(10)(0.6) = 60\text{N}$
 $N = mg \cos 37^\circ = 10(10)(0.8) = 80\text{N}$ $f = \mu_k N = 0.2(80) = 16\text{N}$ The 12kg block moves downward, so the 10kg block moves upward and friction acts down the incline. For the complete system: $12g - 10g \sin 37^\circ - f = (12 + 10)a$
 $120 - 60 - 16 = 22a$ $44 = 22a$ $a = 2\text{m/s}^2$

Q14.

Answer: A

Explanation:

Weight of the block: $W = mg = 8(10) = 80\text{N}$ Maximum static friction:
 $f_{s,\text{max}} = \mu_s N = 0.5(120) = 60\text{N}$ Since $80 > 60$, static friction cannot prevent the block from sliding downward. Therefore, kinetic friction acts upward:
 $f_k = \mu_k N = 0.25(120) = 30\text{N}$ Net downward force: $F_{\text{net}} = 80 - 30 = 50\text{N}$
Thus, $a = \frac{50}{8} = 6.25\text{m/s}^2$

Q15.

Answer: A

Explanation:

Weight of the block: $W = mg = 7(10) = 70\text{N}$ Maximum static friction:
 $f_{s,\text{max}} = \mu_s N = 0.4(250) = 100\text{N}$ Since $f_{s,\text{max}} > W$, static friction can balance the weight. Therefore, $f = 70\text{N}$ and the block remains stationary: $a = 0\text{m/s}^2$

Q16.

Answer: A

Explanation:

The horizontal component of the applied force gives the normal reaction:
 $N = 500 \cos 37^\circ = 400\text{N}$ Maximum static friction:
 $f_{s,\text{max}} = \mu_s N = 0.4(400) = 160\text{N}$ The upward component of the applied force is: $500 \sin 37^\circ = 300\text{N}$ The weight is: $mg = 50(10) = 500\text{N}$ The block tends to move downward. Since the required static friction would be $500 - 300 = 200\text{N}$ but $200 > 160$, the block slides downward. Therefore, kinetic friction acts upward:
 $f_k = \mu_k N = 0.3(400) = 120\text{N}$ Net downward force: $500 - 300 - 120 = 80\text{N}$
Thus, $a = \frac{80}{50} = 1.6\text{m/s}^2$

Q17.

Answer: C

Explanation:

Friction produces retardation: $a = \mu g = 0.2(10) = 2\text{m/s}^2$ Using $v_f^2 = v_i^2 + 2as$
 $0 = 15^2 + 2(-2)s$ $4s = 225$ $s = 56.25\text{m}$

Q18.

Answer: B

Explanation:

While the block moves upward, both gravity and friction act down the incline.
Acceleration down the incline: $a = g \sin 37^\circ + \mu g \cos 37^\circ$
 $= 10(0.6) + 0.5(10)(0.8) = 6 + 4 = 10\text{m/s}^2$ Using $v_f^2 = v_i^2 + 2as$
 $0 = 40^2 - 2(10)s$ Therefore, $s = 80\text{m}$

Q19.

Answer: A

Explanation:

At the limiting condition, tension is equal to the weight of the hanging mass:
 $T = mg$ The vertical component of tension reduces the normal reaction:
 $N = 80 - T \sin 30^\circ$ At impending motion, $T \cos 30^\circ = \mu N$ Therefore,
 $10m \cos 30^\circ = 0.2(80 - 10m \sin 30^\circ)$ Solving gives: $m \approx 1.66\text{kg}$

Q20.

Answer: A

Explanation:

The normal reaction is $N = mg = 8(10) = 80\text{N}$ Maximum static friction is
 $f_{s,\max} = \mu_s N = 0.4(80) = 32\text{N}$ Since the applied force is only 20N and
 $20 < 32$ the block does not move. Static friction adjusts to balance the applied
force: $f = 20\text{N}$ Hence, $a = 0$.

Q21.

Answer: A

Explanation:

The normal reaction is $N = mg = 12(10) = 120\text{N}$ Maximum static friction is
 $f_{s,\max} = \mu_s N = 0.4(120) = 48\text{N}$ Since the applied force is only 30N, $30 < 48$
the block remains stationary. Therefore, static friction adjusts to balance the applied
force: $f = 30\text{N}$ Hence, $a = 0$, $f = 30\text{N}$

Q22.

Answer: A

Explanation:

The normal reaction is $N = mg = 10(10) = 100\text{N}$ Maximum static friction is
 $f_{s,\max} = \mu_s N = 0.4(100) = 40\text{N}$ Since $38 < 40$ the block remains at rest. Static
friction adjusts to the applied force: $f = 38\text{N}$ Therefore, $a = 0$, $f = 38\text{N}$

Q23.

Answer: A

Explanation:

The maximum static friction is $f_{s,\max} = \mu_s N = 0.4(100) = 40\text{N}$ Since $41 > 40$
the block starts moving. Therefore, kinetic friction acts:
 $f_k = \mu_k N = 0.3(100) = 30\text{N}$ Net force: $F_{\text{net}} = 41 - 30 = 11\text{N}$ Hence,
 $a = \frac{11}{10} = 1.1\text{m/s}^2$

Q24.

Answer: A

Explanation:

The normal reaction is $N = mg = 10(10) = 100\text{N}$ Maximum static friction:
 $f_{s,\max} = \mu_s N = 0.4(100) = 40\text{N}$ Since $42 > 40$ the block starts moving.
Therefore, kinetic friction acts: $f_k = \mu_k N = 0.3(100) = 30\text{N}$ Net force:
 $F_{\text{net}} = 42 - 30 = 12\text{N}$ Hence, $a = \frac{12}{10} = 1.2\text{m/s}^2$

Q25.

Answer: B

Explanation:

Normal reaction: $N = mg = 10(10) = 100\text{N}$ Maximum static friction:
 $f_{s,\max} = \mu_s N = 0.4(100) = 40\text{N}$ Since $55 > 40$, the block moves. Kinetic
friction: $f_k = \mu_k N = 0.3(100) = 30\text{N}$ Net force: $F_{\text{net}} = 55 - 30 = 25\text{N}$
Therefore, $a = \frac{25}{10} = 2.5\text{m/s}^2$

Q26.

Answer: A

Explanation:

Normal reaction: $N = mg = 10(10) = 100\text{N}$ Maximum static friction:
 $f_{\max} = \mu N = 0.1(100) = 10\text{N}$ Since the applied force is 7N and $7 < 10$ the block remains at rest. Static friction balances the applied force: $f = 7\text{N}$ The friction acts towards the left.

Q27.

Answer: A

Explanation:

The normal reaction is $N = mg = 10(10) = 100\text{N}$ Maximum friction is
 $f_{\max} = \mu N = 0.1(100) = 10\text{N}$ Since $18 > 10$ the block moves toward the right. Therefore, friction acts toward the left with magnitude $f = 10\text{N}$

Q28.

Answer: A

Explanation:

Normal reaction: $N = mg = 10(10) = 100\text{N}$ Maximum friction:
 $f_{\max} = \mu N = 0.1(100) = 10\text{N}$ Since $28 > 10$ the block moves towards the right, so friction acts towards the left with magnitude $f = 10\text{N}$

Q29.

Answer: B

Explanation:

Normal reaction: $N = mg = 10(10) = 100\text{N}$ Maximum static friction:
 $f_{s,\max} = \mu N = 0.1(100) = 10\text{N}$ Since $8 < 10$ the block remains at rest. Static friction adjusts to balance the applied force: $f = 8\text{N}$ Therefore, friction acts towards the left.

Q30.

Answer: A

Explanation:

Net applied force: $F_{\text{net}} = 25 - 15 = 10\text{N}$ towards left. Normal reaction:
 $N = mg = 10(10) = 100\text{N}$ Maximum friction: $f_{\max} = \mu N = 0.1(100) = 10\text{N}$
Since the required friction is exactly 10N , the block remains at the limiting condition. Therefore, $f = 10\text{N}$ towards right

Q31.

Answer: A

Explanation:

Normal reaction: $N = mg = 10(10) = 100\text{N}$ Maximum friction:
 $f_{\max} = \mu N = 0.1(100) = 10\text{N}$ Net applied force: $F_1 - F_2 = 30 - 12 = 18\text{N}$ towards left. Since $18 > 10$, the block moves towards the left, so kinetic friction acts towards the right: $f = 10\text{N}$

Q32.

Answer: C

Explanation:

The two horizontal forces are equal and opposite: $F_1 - F_2 = 25 - 25 = 0$
Therefore, there is no tendency for horizontal motion, so no friction is required.
 $f = 0$

Q33.

Answer: C

Explanation:

The forces F_1 and F_2 are equal and opposite: $F_1 = F_2 = 18\text{N}$ Thus,
 $F_{\text{net}} = 18 - 18 = 0$ There is no tendency for the block to move, so friction is zero.
 $f = 0$

Q34.

Answer: A

Explanation:

Normal reaction: $N = mg = 10(10) = 100\text{N}$ Maximum friction:
 $f_{\max} = \mu N = 0.1(100) = 10\text{N}$ Net applied force: $F_2 - F_1 = 35 - 18 = 17\text{N}$ towards right. Since $17 > 10$, the block moves right, so friction acts left:
 $f = 10\text{N}$ towards left

Q35.

Answer: B

Explanation:

Normal reaction: $N = mg = 10(10) = 100\text{N}$ Maximum friction:
 $f_{\max} = \mu N = 0.1(100) = 10\text{N}$ Net applied force: $F_2 - F_1 = 20 - 32 = -12\text{N}$
Thus, the block tends to move towards the left. Since $12 > 10$, it moves left and friction acts towards the right: $f = 10\text{N}$ towards right

Q36.

Answer: A

Explanation:

Vertical component of force: $F_y = 20 \sin 37^\circ = 12\text{N}$ Normal reaction: $N = 100 - 12 = 88\text{N}$ Maximum static friction: $f_{s,\max} = 0.3(88) = 26.4\text{N}$ Since the block tends to slide downward, the required friction is 88N , which is greater than 26.4N . Therefore, the block slides downward. Kinetic friction: $f_k = 0.2(88) = 17.6\text{N}$ Hence, $a = \frac{100-12-17.6}{10} = 7.04\text{m/s}^2$

Q37.

Answer: A

Explanation:

Vertical component: $F_y = 30 \sin 37^\circ = 18\text{N}$ Normal reaction: $N = 100 - 18 = 82\text{N}$ Maximum static friction: $f_{s,\max} = 0.3(82) = 24.6\text{N}$ The block tends to slide downward, and the required friction is 82N , so it slides. Kinetic friction: $f_k = 0.2(82) = 16.4\text{N}$ Therefore, $a = \frac{100-18-16.4}{10} = 6.56\text{m/s}^2$

Q38.

Answer: A

Explanation:

Resolve the applied force: $F_x = 45 \cos 37^\circ = 36\text{N}$ $F_y = 45 \sin 37^\circ = 27\text{N}$ Normal reaction: $N = 100 - 27 = 73\text{N}$ Maximum static friction: $f_{s,\max} = 0.3(73) = 21.9\text{N}$ Since $36 > 21.9$, the block moves. Kinetic friction: $f_k = 0.2(73) = 14.6\text{N}$ Therefore, $a = \frac{36-14.6}{10} = 2.14\text{m/s}^2$

Q39.

Answer: A

Explanation:

Horizontal component: $F_x = 60(0.8) = 48\text{N}$ Vertical component: $F_y = 60(0.6) = 36\text{N}$ Normal reaction: $N = 100 - 36 = 64\text{N}$ Maximum static friction: $f_{s,\max} = 0.3(64) = 19.2\text{N}$ Since $48 > 19.2$, the block moves. Kinetic friction: $f_k = 0.2(64) = 12.8\text{N}$ Thus, $a = \frac{48-12.8}{10} = 3.52\text{m/s}^2$

Q40.

Answer: A

Explanation:

Horizontal component: $F_x = 80 \cos 37^\circ = 64\text{N}$ Vertical downward component: $F_y = 80 \sin 37^\circ = 48\text{N}$ Normal reaction: $N = 100 + 48 = 148\text{N}$ Friction: $f = \mu N = 0.2(148) = 29.6\text{N}$ Therefore, $a = \frac{64-29.6}{10} = 3.44\text{m/s}^2$

Q41.

Answer: A

Explanation:

Horizontal component: $F_x = 60 \cos 37^\circ = 48\text{N}$ Downward component: $F_y = 60 \sin 37^\circ = 36\text{N}$ Normal reaction: $N = 100 + 36 = 136\text{N}$ Friction: $f = 0.2(136) = 27.2\text{N}$ Hence, $a = \frac{48-27.2}{10} = 2.08\text{m/s}^2$

Q42.

Answer: A

Explanation:

Horizontal component: $F_x = 150(0.8) = 120\text{N}$ Downward component: $F_y = 150(0.6) = 90\text{N}$ Normal reaction: $N = 100 + 90 = 190\text{N}$ Friction: $f = 0.2(190) = 38\text{N}$ Therefore, $a = \frac{120-38}{10} = 8.2\text{m/s}^2$

Q43.

Answer: A

Explanation:

Horizontal component: $F_x = 180(0.8) = 144\text{N}$ Downward component: $F_y = 180(0.6) = 108\text{N}$ Normal reaction: $N = 100 + 108 = 208\text{N}$ Friction: $f = 0.2(208) = 41.6\text{N}$ Therefore, $a = \frac{144-41.6}{10} = 10.24\text{m/s}^2$

Q44.

Answer: A

Explanation:

For the 10kg block: $f_k = \mu_k N = 0.3(10)(10) = 30\text{N}$ For the 6kg hanging mass: $W = 6(10) = 60\text{N}$ Since $60 > 30$, the system moves. Net driving force: $60 - 30 = 30\text{N}$ Total mass: $10 + 6 = 16\text{kg}$ Therefore, $a = \frac{30}{16} = 1.875\text{m/s}^2$ Tension: $T = 60 - 6(1.875) = 48.75\text{N}$

Q45.

Answer: A

Explanation:

Kinetic friction on the 10kg block: $f_k = 0.3(10)(10) = 30\text{N}$ Weight of the hanging mass: $W = 8(10) = 80\text{N}$ Net driving force: $80 - 30 = 50\text{N}$ Total mass: $10 + 8 = 18\text{kg}$ Therefore, $a = \frac{50}{18} = \frac{25}{9}\text{m/s}^2$ Tension: $T = 80 - 8\left(\frac{25}{9}\right)$
 $T = \frac{520}{9}\text{N}$

Q46.

Answer: D

Explanation:

Atomic mass of oxygen is 16 g mol^{-1} . Therefore, 16 g of oxygen atoms corresponds to 1 mole of oxygen atoms, which contains Avogadro's number (6.022×10^{23}) of atoms.

Q47.

Answer: D

Explanation:

4.25 g of NH_3 equals 0.25 moles of molecules. Since each NH_3 molecule contains 4 atoms (1 N + 3 H), total atoms equal $0.25 \times 4 \times N_A = 1N_A = 6 \times 10^{23}$.

Q48.

Answer: D

Explanation:

Since all three samples contain 1 g of pure elemental oxygen, the mass of oxygen atoms is identical in each case, resulting in an equal number of oxygen atoms regardless of allotropic form.

Q49.

Answer: C

Explanation:

0.5 g atom represents 0.5 moles of nitrogen atoms. 8 g of oxygen contains $\frac{8}{16} = 0.5$ moles of oxygen atoms, which has the exact same atom count.

Q50.

Answer: A

Explanation:

4 g of H_2 corresponds to 2 moles of H_2 molecules, yielding 4 moles ($4N_A$) of hydrogen atoms, which is greater than any other option.

Q51.

Answer: C

Explanation:

1.7 g of NH_3 is 0.1 mol. Nitrogen has 7 neutrons and hydrogen has 0, giving 7 neutrons per NH_3 molecule. Total neutrons equal $0.1 \times 7 \times N_A = \frac{N_A}{10} \times 7$.

Q52.

Answer: B

Explanation:

5.6 L of O_2 at STP is 0.25 moles of O_2 molecules. Since O_2 is diatomic, it contains 0.5 moles of O atoms, which equals $0.5 \times 6.02 \times 10^{23} = 3.01 \times 10^{23}$ atoms.

Q53.

Answer: B

Explanation:

Molar mass of ozone (O_3) is 48 g mol^{-1} . 8 g of O_3 is $\frac{8}{48} = \frac{1}{6}$ mol. Total O atoms equal $\frac{1}{6} \times 3 \times N_A = \frac{N_A}{2} = \frac{6.02 \times 10^{23}}{2}$.

Q54.

Answer: C

Explanation:

12 g of $^{12}_6\text{C}$ is 1 mole (N_A atoms). One atom contains $6\text{ p} + 6\text{ e} + 6\text{ n} = 18$ subatomic particles. Total particles = $18 \times 6.022 \times 10^{23} = 1.084 \times 10^{25}$.

Q55.

Answer: B

Explanation:

Since $1\text{ amu} = 1.66 \times 10^{-24}\text{ g}$, the actual mass of one Uranium atom is $238 \times 1.66 \times 10^{-24} = 3.94 \times 10^{-22}\text{ g}$.

Q56.

Answer: B

Explanation:

Mass of 1 mole (6.022×10^{23} molecules) of water is 18 g. Mass of a single water molecule is $\frac{18}{6.022 \times 10^{23}} = 2.99 \times 10^{-23}$ g.

Q57.

Answer: C

Explanation:

Molar mass of CH_4 is 16 g mol^{-1} . Actual mass of one molecule equals $\frac{16}{6.022 \times 10^{23}} = 2.66 \times 10^{-23}$ g.

Q58.

Answer: A

Explanation:

Comparing masses: 1 g atom C = 12 g; $1/2 \text{ mol } CH_4 = 8 \text{ g}$;
 $10 \text{ mL } H_2O = 10 \text{ g}$; $0.5 \text{ mol O atoms} = 8 \text{ g}$. Highest mass is 12 g.

Q59.

Answer: D

Explanation:

Number of molecules depends directly on moles. Moles in options: $CO_2 = 0.1$, $NH_3 = 0.2$, $CH_4 = 0.1$, $SO_2 = \frac{3.2}{64} = 0.05 \text{ mol}$. SO_2 has the least moles and fewest molecules.

Q60.

Answer: A

Explanation:

4.25 g of NH_3 is $\frac{4.25}{17} = 0.25 \text{ moles}$. Total molecules equal $0.25 \times 6.022 \times 10^{23} = 1.505 \times 10^{23}$.

Q61.

Answer: C

Explanation:

Molar mass of $B_2A_3 = \frac{9.0}{0.05} = 180 \implies 2B + 3A = 180$. Molar mass of $B_2A = \frac{10}{0.10} = 100 \implies 2B + A = 100$. Subtracting gives $2A = 80 \implies A = 40$ and $B = 30$.

Q62.

Answer: C

Explanation:

Molar volume of any ideal gas at NTP is 22.4 L mol^{-1} . Therefore, 5.6 L equals $\frac{5.6}{22.4} = \frac{1}{4} \text{ mol}$.

Q63.

Answer: D

Explanation:

Moles of gas = $\frac{2.24}{22.4} = 0.1 \text{ mol}$. Molar mass = $\frac{4.4 \text{ g}}{0.1 \text{ mol}} = 44 \text{ g mol}^{-1}$. Both N_2O (44 g mol^{-1}) and CO_2 (44 g mol^{-1}) have this molar mass.

Q64.

Answer: A

Explanation:

Since mass is constant (1 g), moles $n = \frac{1}{M}$ is inversely proportional to molar mass. CO_2 has the highest molar mass (44 g mol^{-1}), so it has the least moles and fewest molecules.

Q65.

Answer: A

Explanation:

22400 mL of vapor at NTP corresponds to 1 mole. Since $V \text{ mL}$ weighs $W \text{ g}$, 1 mL weighs $\frac{W}{V} \text{ g}$, so 22400 mL weighs $\frac{W}{V} \times 22400 \text{ g}$.

Q66.

Answer: B

Explanation:

Initial moles = $\frac{0.098}{98} = 10^{-3}$ mol. Removed moles
= $\frac{3.01 \times 10^{20}}{6.022 \times 10^{23}} = 0.5 \times 10^{-3}$ mol. Remaining moles
= $10^{-3} - 0.5 \times 10^{-3} = 0.5 \times 10^{-3}$ mol.

Q67.

Answer: C

Explanation:

By Avogadro's law, volume ratio equals mole ratio under identical conditions. For equal mass w , mole ratio is $\frac{w}{2} : \frac{w}{32} : \frac{w}{16} = \frac{1}{2} : \frac{1}{32} : \frac{1}{16} = 16 : 1 : 2$.

Q68.

Answer: A

Explanation:

Moles of $H_2 = 1.0$ mol, moles of $Cl_2 = 0.5$ mol. Reaction $H_2 + Cl_2 \rightarrow 2HCl$ shows Cl_2 is limiting reagent. 0.5 mol Cl_2 produces $2 \times 0.5 = 1.0$ mol HCl.

Q69.

Answer: A

Explanation:

Reaction: $2Mg + O_2 \rightarrow 2MgO$. Moles $O_2 = \frac{0.56}{32} = 0.0175$ mol. Required Mg
= $2 \times 0.0175 = 0.035$ mol = 0.84 g. Excess Mg = $1.0 - 0.84 = 0.16$ g.

Q70.

Answer: A

Explanation:

Let mass ratio be 1 g H_2 and 4 g O_2 . Moles of $H_2 = \frac{1}{2} = 0.5$, moles of
 $O_2 = \frac{4}{32} = 0.125$. Ratio = $\frac{0.5}{0.125} = 4 : 1$.

Q71.

Answer: B

Explanation:

18 mol of water contains $18 \times 6.022 \times 10^{23}$ molecules, which is far greater than 18 g (1 mol), 1.8 g (0.1 mol), or 18 molecules.

Q72.

Answer: D

Explanation:

One mole is defined as the mass of N_A carbon atoms. Changing N_A directly changes the mass of 1 mole of carbon from 12 g to 12×10^{-3} g.

Q73.

Answer: B

Explanation:

Reaction: $MgCO_3 \rightarrow MgO + CO_2$. Molar mass $MgCO_3 = 84$, $MgO = 40$.
Moles $MgO = \frac{8.0}{40} = 0.2$ mol. Pure $MgCO_3 = 0.2 \times 84 = 16.8$ g. Purity
= $\frac{16.8}{20.0} \times 100 = 84\%$.

Q74.

Answer: C

Explanation:

Molar mass $XY_2 = \frac{10}{0.1} = 100 \Rightarrow X + 2Y = 100$. Molar mass
 $X_3Y_2 = \frac{9}{0.05} = 180 \Rightarrow 3X + 2Y = 180$. Subtracting gives
 $2X = 80 \Rightarrow X = 40, Y = 30$.

Q75.

Answer: A

Explanation:

18 mL of water = 18 g = 1 mol ($1N_A$ molecules). This is larger than 0.18 g ($10^{-2}N_A$), 0.00224 L ($10^{-4}N_A$), or 10^{-3} mol ($10^{-3}N_A$).

Q76.

Answer: A

Explanation:

Atoms = $\frac{\text{Mass}}{\text{Atomic Mass}} \times N_A$. Moles of atoms: Li = $\frac{1}{7}$; Ag = $\frac{1}{108}$; Mg = $\frac{1}{24}$;
 $O_2 = \frac{1}{32} \times 2 = \frac{1}{16}$. Li has the largest fraction ($\frac{1}{7}$).

Q77.

Answer: D

Explanation:

Number of atoms = $\frac{\text{Total Mass}}{\text{Mass of 1 atom}} = \frac{12 \text{ g}}{1.9926 \times 10^{-23} \text{ g}} = 6.022 \times 10^{23}$ atoms.

Q78.

Answer: B

Explanation:

Mass = Density $\times$ Volume = $2.15 \text{ g mL}^{-1} \times 2.5 \text{ mL} = 5.375 \text{ g}$. Rounding to 2 significant figures (governed by 2.5 mL) gives 5.4 g.

Q79.

Answer: A

Explanation:

4 mol of helium contains $4N_A$ atoms. This is far larger than 4 u (1 atom), 4 g ($1N_A$ atoms), or 2.271098 L ($0.1N_A$ atoms).

Q80.

Answer: B

Explanation:

Moles $HCl = 0.025 \times 0.75 = 0.01875 \text{ mol}$. Reacted

$NaOH = 0.01875 \times 40 = 0.75 \text{ g} = 750 \text{ mg}$. Initial $NaOH = 1000 \text{ mg}$.

Unreacted $NaOH = 1000 - 750 = 250 \text{ mg}$.

Q81.

Answer: A

Explanation:

1.0 g of $H_2 = \frac{1.0}{2} = 0.5 \text{ mol}$. 14 g of $N_2 = \frac{14}{28} = 0.5 \text{ mol}$. Since mole counts are identical, molecule counts are identical.

Q82.

Answer: C

Explanation:

To find the number of molecules of NaOH, we first calculate the total mass of the solution using its volume and density. Then, using the given percentage by weight, we find the mass of NaOH, convert it into moles by dividing by its molar mass (40 g/mol), and finally multiply by Avogadro's number (N_A). This gives 10^{24} molecules.

Q83.

Answer: D

Explanation:

Molality (m) is defined as the number of moles of solute dissolved per kilogram of solvent. First, we find the moles of NaCl by dividing its given mass by its molar mass (58.5 g/mol). Then, dividing the moles by the mass of the water solvent in kilograms (500 g = 0.5 kg) gives a molality of 0.4 m.

Q84.

Answer: D

Explanation:

Phosphorous acid (H_3PO_3) is a dibasic acid because it contains two ionizable hydrogen atoms attached directly to oxygen atoms (P--OH bonds). Therefore, its n-factor (basicity) is 2. The normality of a solution is calculated by multiplying its molarity by the n-factor ($N = M \times \text{n-factor} = 0.3 \times 2 = 0.6$).

Q85.

Answer: B

Explanation:

To find the mole fraction of oxygen, we first calculate the number of moles of each gas by dividing their given mass by their respective molar masses ($N_2 = 28 \text{ g/mol}$, $O_2 = 32 \text{ g/mol}$). The mole fraction is then the ratio of moles of oxygen to the total moles in the mixture, which evaluates to 0.5.

Q86.

Answer: C

Explanation:

The molarity of a solution can be calculated from its mass percentage and density using the formula $M = \frac{10 \times d \times \%w/w}{M_m}$, where d is the density in g/mL, $\%w/w$ is the mass percentage, and M_m is the molar mass of the solute. Substituting the given values gives $M = \frac{10 \times 0.98 \times 13}{98} = 1.3 \text{ M}$.

Q87.

Answer: A

Explanation:

A 20% (w/w) aqueous glucose solution means that there is 20 g of glucose present in 100 g of the solution, which corresponds to 80 g of water (solvent). Using the molar mass of glucose (180 g/mol), the molality is calculated by dividing the number of moles of glucose by the mass of the solvent in kilograms, yielding $\frac{25}{18}$ m.

Q88.

Answer: B

Explanation:

Using the relationship between molarity (M), molality (m), molar mass of the solute (M_{solute}), and the density of the solution (d), we set up the equation based on a 1 L solution. Solving for density yields 0.95 g/cc.

Q89.

Answer: B

Q90.

Answer: A

Q91.

Answer: B

Q92.

Answer: C

Q93.

Answer: C

Q94.

Answer: A

Q95.

Answer: B

Q96.

Answer: A

Q97.

Answer: B

Q98.

Answer: B

Q99.

Answer: A

Q100.

Answer: B

Q101.

Answer: A

Q102.

Answer: C

Q103.

Answer: C

Q104.

Answer: A

Q105.

Answer: C

Q106.

Answer: B

Q107.

Answer: A

Q108.

Answer: B

Q109.

Answer: C

Q110.

Answer: C

Q111.

Answer: B

Q112.

Answer: B

Q113.

Answer: B

Q114.

Answer: C

Q115.

Answer: A

Q116.

Answer: B

Q117.

Answer: B

Q118.

Answer: C

Q119.

Answer: B

Q120.

Answer: D

Q121.

Answer: A

Q122.

Answer: B

Q123.

Answer: A

Q124.

Answer: B

Q125.

Answer: B

Q126.

Answer: A

Q127.

Answer: A

Q128.

Answer: D

Q129.

Answer: C

Q130.

Answer: A

Q131.

Answer: B

Q132.

Answer: B

Q133.

Answer: C

Q134.

Answer: A

Q135.

Answer: D

Q136.

Answer: C

Q137.

Answer: B

Q138.

Answer: C

Q139.

Answer: A

Q140.

Answer: C

Q141.

Answer: A

Q142.

Answer: B

Q143.

Answer: B

Q144.

Answer: B

Q145.

Answer: A

Q146.

Answer: B

Q147.

Answer: B

Q148.

Answer: C

Q149.

Answer: B

Q150.

Answer: B

Q151.

Answer: B

Q152.

Answer: C

Q153.

Answer: A

Q154.

Answer: A

Q155.

Answer: B

Q156.

Answer: B

Q157.

Answer: A

Q158.

Answer: A

Q159.

Answer: A

Q160.

Answer: A

Q161.

Answer: B

Q162.

Answer: A

Q163.

Answer: A

Q164.

Answer: A

Q165.

Answer: A

Q166.

Answer: A

Q167.

Answer: A

Q168.

Answer: A

Q169.

Answer: A

Q170.

Answer: D

Q171.

Answer: A

Q172.

Answer: A

Q173.

Answer: A

Q174.

Answer: B

Q175.

Answer: A

Q176.

Answer: A

Q177.

Answer: B

Q178.

Answer: A

Q179.

Answer: A

Q180.

Answer: A