

Chemistry

1. **Statement-1:** F atom has a less negative electron gain enthalpy than Cl atom. **Statement-2:** Additional electron is repelled more efficiently by 3p electron in Cl atom than by 2p electron in F atom.

- A) Statement-1 is true, statement-2 is true and statement-2 is correct
B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
C) Statement-1 is true, statement-2 is false.
D) Statement-1 is false, statement-2 is true.

2. The correct order of radii is:

- A) $N < Be < B$
B) $F^- < O^{2-} < N^{3-}$
C) $Na < Li < K$
D) $Fe^{3+} < Fe^{2+} < Fe^{4+}$

3. The set representing correct order of IP_1 is:

- A) $K > Na > Li$
B) $Be > Mg > Ca$
C) $B > C > N$
D) $Fe > Si > C$

4. Identify the least stable ion amongst the following:

- A) Li^-
B) Be^-
C) B^-
D) C^-

5. The increasing order of atomic radii of the following group 13 elements is:

- A) $Al < Ga < In < Tl$
B) $Ga < Al < In < Tl$
C) $Al < In < Ga < Tl$
D) $Al < Ga < Tl < In$

6. The option(s) with only amphoteric oxides is (are):

- A) Cr_2O_3, CrO, SnO, PbO
B) NO, B_2O_3, PbO, SnO_2
C) Cr_2O_3, BeO, SnO, SnO_2
D) ZnO, Al_2O_3, PbO, PbO_2
A) C, D
B) B, A
C) A, C
D) D, A

7. Correct order of covalent character of alkaline earth metal chloride in:

- A) $BeCl_2 < MgCl_2 < CaCl_2 < SrCl_2 < BaCl_2$
B) $BeCl_2 < CaCl_2 < SrCl_2 < MgCl_2$
C) $BeCl_2 > MgCl_2 > CaCl_2 > SrCl_2 > BaCl_2$
D) $SrCl_2 > BeCl_2 > CaCl_2 > MgCl_2$

8. Which of the following π bond will have maximum strength?

- A) $3p\pi - 3p\pi$
B) $2p\pi - 3p\pi$
C) $2p\pi - 2p\pi$
D) $2p\pi - 3d\pi$

9. The shape of IF_4^+ will be:

- A) Square planar
B) Tetrahedral
C) Pentagonal bipyramidal
D) See-saw shape

10. Increasing order of bond length in NO, NO^+ and NO^- is:

- A) $NO > NO^- > NO^+$
B) $NO^+ < NO < NO^-$
C) $NO < NO^+ < NO^-$
D) $NO < NO^+ = NO^-$

11. Which of the following species will have the minimum bond energy:

- A) N_2
B) N_2^-
C) N_2^+
D) N_2^{2-}

12. In solid Argon the atoms are held together:

- A) By ionic bonds
B) By hydrogen bonds
C) By Vander Waal forces
D) None of these

13. The critical temperature of water is higher than that of O_2 because the H_2O molecule has:

- A) fewer electrons than O_2
B) two ionic bonds
C) V-shape
D) dipole moment

14. The polarizability of the following ions is/are in the order of:

- A) $I^- > Br^- > Cl^- > F^-$
B) $I^- > Br^- > F^- > Cl^-$
C) $I^- < Br^- < Cl^- < F^-$
D) $I^- < Br^- < F^- < Cl^-$

15. PCl_5 exists but NCl_5 does not because:

- A) Nitrogen has no vacant 2d-orbitals
B) is unstable
C) Nitrogen atom is much smaller than P
D) Nitrogen is highly inert

16. Two ice cubes are pressed over each other and unite to form one cube. Which force is responsible for holding them together:

- A) Vander Waal's forces
B) Covalent attraction
C) Hydrogen bond formation
D) Dipole-dipole attraction

17. Which of the following compound does not exist?

- A) PF_3
B) PCl_5
C) SF_6
D) SI_6

18. Hybridisation related to NO_2 molecule is:

- A) sp^3
B) sp
C) sp^3d
D) sp^2

19. The bonds present in N_2O_5 are:

- A) Only ionic B) Covalent & coordinate
C) Only covalent D) Covalent & ionic

20. The correct order of increasing C – O bond length of CO , CO_3^{2-} , CO_2 is:

- A) $CO_3^{2-} < CO_2 < CO$ B) $CO_2 < CO_3^{2-} < CO$
C) $CO < CO_3^{2-} < CO_2$ D) $CO < CO_2 < CO_3^{2-}$

21. The 1st, 2nd and 3rd ionization enthalpies I_1, I_2 and I_3 of four atoms with atomic numbers $n, n+1, n+2$ and $n+3$, where $n < 10$, are tabulated below. What is the value of n ?

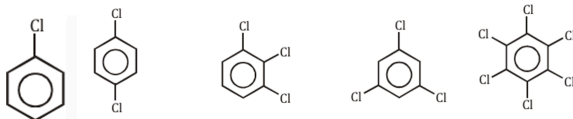
Atomic number	Ionization Enthalpy (kJ/mol)		
	I_1	I_2	I_3
n	1681	3374	6050
$n+1$	2081	3952	6122
$n+2$	496	4562	6910
$n+3$	738	1451	7733

22. The total number of bonding and antibonding electrons in O_2^- are "....." and "....." respectively. [Represent as a single number, e.g., if 14 and 7, then represent as 147]

23. Find the ratio of π -electrons in the C_2 -molecule with that of B_2 molecule according to M.O.T.

24. What is the number of lone pairs on central atom of ICl_4^- ?

25. Find the number of molecules having dipole moment less than the dipole moment of



Maths

26. $\lim_{x \rightarrow 0} \frac{\sin 4x}{1 - \sqrt{1-x}}$ equals:

- A) 4 B) 8
C) 10 D) None of these

27. $\lim_{x \rightarrow 0} \frac{(1+\sin x)^{1/3} - (1-\sin x)^{1/3}}{x}$ equals:

- A) 0 B) 1
C) $\frac{2}{3}$ D) $\frac{1}{3}$

28. The value of $\lim_{x \rightarrow \infty} \frac{2x^3 - 4x + 7}{3x^3 + 5x - 4}$ is:

- A) $\frac{2}{3}$ B) $-\frac{7}{4}$
C) $-\frac{4}{5}$ D) ∞

29. $\lim_{x \rightarrow \infty} \frac{x - \sin x}{x + \cos^2 x}$ equals:

- A) 0 B) 1
C) ∞ D) None of these

30. $\lim_{x \rightarrow \infty} \left\{ \frac{(x+1)^{10} + (x+2)^{10} + \dots + (x+100)^{10}}{x^{10} + 10^{10}} \right\}$ is equal to:

- A) 10^2 B) 10^3
C) ∞ D) 10^4

31. $\lim_{x \rightarrow -\infty} \frac{x^4 \sin(1/x) + x^2}{1 + |x|^3}$ equals:

- A) 0 B) 1
C) -1 D) ∞

32. $\lim_{x \rightarrow \infty} \left(\frac{a_1^{1/x} + a_2^{1/x} + \dots + a_n^{1/x}}{n} \right)^x$, where $a_1, a_2, \dots, a_n > 0$, is:

- A) $3(a_1 a_2 \dots a_n)$ B) $2(a_1 a_2 \dots a_n)$
C) $a_1 a_2 \dots a_n$ D) 0

33. The value of $\lim_{x \rightarrow \infty} \frac{2x^{1/2} + 3x^{1/3} + 4x^{1/4} + \dots + nx^{1/n}}{(2x-3)^{1/2} + (2x-3)^{1/3} + \dots + (2x-3)^{1/n}}$ is:

- A) $\sqrt{2}$ B) 2
C) $\frac{1}{\sqrt{3}}$ D) $2/1$

34. $\lim_{x \rightarrow \infty} \left(\frac{x^2 + 5x + 3}{x^2 + x + 2} \right)^x$ equals:

- A) e^2 B) e^4
C) e^3 D) e

35. $\lim_{x \rightarrow -\infty} \frac{x^2 \sin(\frac{1}{x})}{\sqrt{9x^2 + x + 1}}$ is:

- A) $\frac{1}{3}$ B) $-\frac{1}{3}$
C) 0 D) Does not exist

36. $\lim_{x \rightarrow 0^+} \frac{\tan(5x^{1/3}) \log_e(1+3x^2)}{(\tan^{-1}(3\sqrt{x}))^2 (e^{5x^{4/3}} - 1)}$ is equal to

- A) $\frac{5}{3}$ B) 1
C) $\frac{1}{3}$ D) $\frac{1}{15}$

37. $\lim_{x \rightarrow 0} \left(\frac{x}{8\sqrt{1-\sin x} - 8\sqrt{1+\sin x}} \right)$ is equal to :

- A) 0 B) 4
C) -4 D) -1

38. $\lim_{x \rightarrow 0} \left(\frac{3x^2 + 2}{7x^2 + 2} \right)^{\frac{1}{x^2}}$ is equal to

- A) e B) e^2
C) $\frac{1}{e^2}$ D) $\frac{1}{e}$

39. $\lim_{x \rightarrow 0} \left(\tan \left(\frac{\pi}{4} + x \right) \right)^{\frac{1}{x}}$ is equal to :

- A) 2 B) 1
C) e D) e^2

40. $\lim_{n \rightarrow \infty} n \cos \left(\frac{\pi}{4n} \right) \sin \left(\frac{\pi}{4n} \right)$ is equal to

- A) $\frac{\pi}{8}$ B) $\frac{\pi}{4}$
C) 1 D) ∞

41. $\lim_{x \rightarrow 0} \frac{1 - \cos x + 2 \sin^{-1} x - \sin^3 x}{3 \tan^{-1} x - x^2 + x^5}$ equals

- A) $\frac{2}{3}$ B) 3
C) 4 D) 6

42. $\lim_{x \rightarrow 0} \frac{\tan \frac{x}{2} - \tan \frac{x}{3} - \tan \frac{x}{6}}{\sin^2 x (e^x - 1)} = \frac{k}{36}$, $k \in \mathbb{N}$. Then k is equal to

- A) 31 B) 17
C) 1 D) 2

43. $\lim_{x \rightarrow 0} \frac{8}{x^8} \left(1 - \cos \frac{x^2}{2} - \cos \frac{x^2}{4} + \cos \frac{x^2}{2} \cos \frac{x^2}{4} \right) =$

- A) $\frac{1}{32}$ B) $\frac{1}{16}$
C) $\frac{2}{31}$ D) $\frac{3}{33}$

44. $\lim_{x \rightarrow \frac{\pi}{2}} \frac{(1 - \tan \frac{x}{2})(1 - \sin x)}{(1 + \tan \frac{x}{2})(\pi - 2x)^3}$ is equal to

- A) 3 B) 4
C) $\frac{1}{32}$ D) $\frac{1}{16}$

45. $\lim_{x \rightarrow 0} \frac{\cos^2(1 - \cos^2(1 - \cos^2(1 - \cos^2(\dots))))}{\sin \left[\pi \left(\frac{\sqrt{x+4}-2}{x} \right) \right]}$ is equal to

- A) 4π B) $\frac{4}{\pi}$
C) $\frac{2}{\pi}$ D) 2π

46. $\lim_{x \rightarrow 0} \left(\left(\frac{1 - \cos^2(3x)}{\cos^3(4x)} \right) \left(\frac{\sin^3(4x)}{(\log_e(2x+1))^5} \right) \right)$ is equal to

47. $\lim_{x \rightarrow 0} \frac{(1 - \cos 2x)(3 + \cos x)}{x \tan 4x}$ is equal to

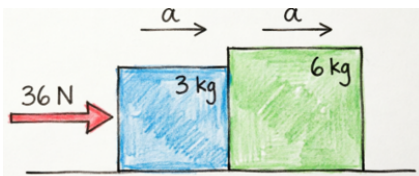
48. $\lim_{x \rightarrow 0} \frac{x \cot(4x)}{\sin^2 x \cot^2(2x)}$ is equal to :

49. $\lim_{x \rightarrow 0} \frac{5(1 - \cos x) + 20 \sin^{-1} x - \sin^2 x}{10 \tan^{-1} x - x^2 + x^4}$ equals

50. $\lim_{x \rightarrow 0} \frac{\tan^3 x + \tan^3 2x + \tan^3 3x}{\tan^3 4x + \tan^3 5x + \tan^3 6x} = \frac{p}{q}$, $(p, q \in \mathbb{N})$. Then least value of $(p + q)$ is equal to

Physics

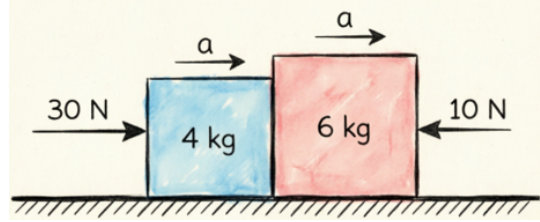
51. From the image given above, a horizontal force of 36 N is applied to the 3 kg block, which pushes the 6 kg block on a frictionless horizontal surface. Find the acceleration of the blocks and the normal force



between them.

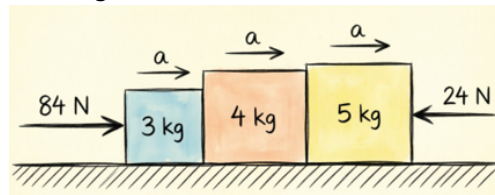
- A) $a = 6 \text{ m/s}^2$, $N = 18 \text{ N}$ B) $a = 4 \text{ m/s}^2$, $N = 12 \text{ N}$
C) $a = 4 \text{ m/s}^2$, $N = 24 \text{ N}$ D) $a = 3 \text{ m/s}^2$, $N = 24 \text{ N}$

52. From the image given below, two blocks kept in contact on a frictionless horizontal surface are pushed from opposite sides. Find the acceleration of the blocks and the normal force between them.



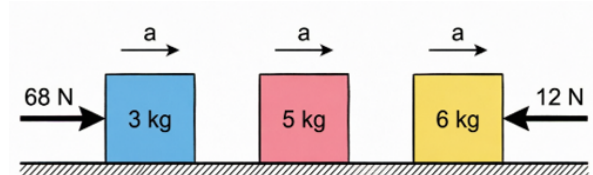
- A) $a = 3 \text{ m/s}^2$, $N = 25 \text{ N}$ B) $a = 4 \text{ m/s}^2$, $N = 26 \text{ N}$
C) $a = 2 \text{ m/s}^2$, $N = 22 \text{ N}$ D) $a = 5 \text{ m/s}^2$, $N = 30 \text{ N}$

53. From the image given below, three blocks kept in contact on a frictionless horizontal surface are pushed from opposite sides. Find the acceleration of the blocks and the normal force between the 4 kg and 5 kg blocks.



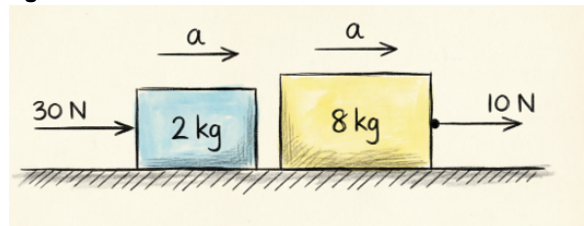
- A) $a = 4 \text{ m/s}^2$, $N = 44 \text{ N}$ B) $a = 5 \text{ m/s}^2$, $N = 49 \text{ N}$
C) $a = 6 \text{ m/s}^2$, $N = 54 \text{ N}$ D) $a = 3 \text{ m/s}^2$, $N = 39 \text{ N}$

54. From the image given below, three blocks kept in contact on a smooth horizontal surface are pushed from opposite sides. Find the interaction force between the 5 kg and 6 kg blocks.



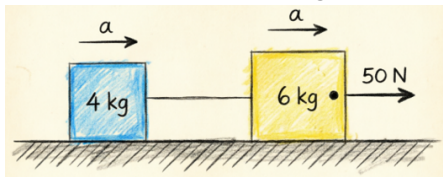
- A) 28 N B) 42 N
C) 24 N D) 36 N

55. From the image given below, two blocks kept in contact on a smooth horizontal surface are acted upon by forces directed rightward: a pushing force on the left block and a pulling force on the right block. Find the contact force between the 2 kg and 8 kg blocks.



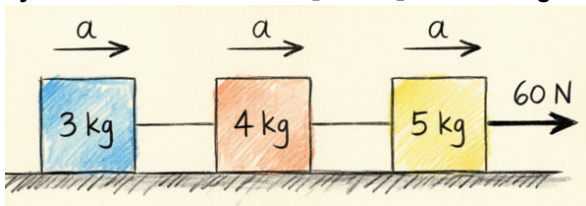
- A) 22 N B) 12 N
C) 30 N D) 0 N

56. From the image given below, two blocks connected by a light inextensible string are placed on a smooth horizontal surface. A horizontal force is applied to the right block. Find the acceleration of each block and the tension in the string.



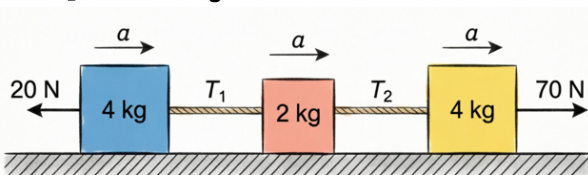
- A) $a = 8 \text{ m/s}^2, T = 32 \text{ N}$ B) $a = 10 \text{ m/s}^2, T = 25 \text{ N}$
 C) $a = 5 \text{ m/s}^2, T = 20 \text{ N}$ D) $a = 6 \text{ m/s}^2, T = 30 \text{ N}$

57. From the image given below, three blocks connected by light inextensible strings are placed on a smooth horizontal surface. A horizontal force is applied to the rightmost block. Find the acceleration of the system and the tensions T_1 and T_2 in the strings.



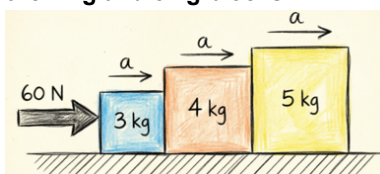
- A) $a = 8 \text{ m/s}^2, T_1 = 24 \text{ N}, T_2 = 40 \text{ N}$ B) $a = 10 \text{ m/s}^2, T_1 = 15 \text{ N}, T_2 = 35 \text{ N}$
 C) $a = 6 \text{ m/s}^2, T_1 = 18 \text{ N}, T_2 = 42 \text{ N}$ D) $a = 4 \text{ m/s}^2, T_1 = 30 \text{ N}, T_2 = 50 \text{ N}$

58. From the image given below, three blocks connected by light inextensible strings are placed on a smooth horizontal surface. Forces are applied to the outer blocks in opposite directions. Find the tensions T_1 and T_2 in the strings.



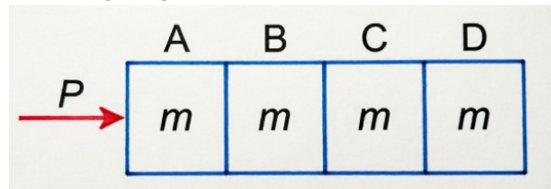
- A) $T_1 = 30 \text{ N}, T_2 = 60 \text{ N}$ B) $T_1 = 50 \text{ N}, T_2 = 40 \text{ N}$
 C) $T_1 = 40 \text{ N}, T_2 = 50 \text{ N}$ D) $T_1 = 45 \text{ N}, T_2 = 55 \text{ N}$

59. From the image given below, three blocks kept in contact on a smooth horizontal surface are pushed by a horizontal force applied to the leftmost block. Find the acceleration of the system and the contact forces between (i) the 3 kg and 4 kg blocks, and (ii) the 4 kg and 5 kg blocks.



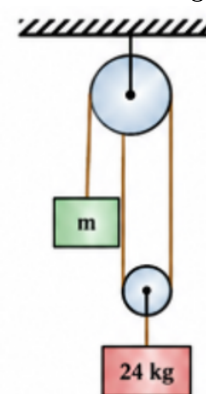
- A) $a = 4 \text{ m/s}^2, N_{34} = 36 \text{ N}, N_{45} = 20 \text{ N}$ B) $a = 20 \text{ m/s}^2, N_{34} = 45 \text{ N}, N_{45} = 25 \text{ N}$
 C) $a = 6 \text{ m/s}^2, N_{34} = 42 \text{ N}, N_{45} = 30 \text{ N}$ D) $a = 30 \text{ m/s}^2, N_{34} = 40 \text{ N}, N_{45} = 20 \text{ N}$

60. From the image given below Calculate : (i) a_{system} (ii) F_{CD} (iii) F_{BC} (iv) F_{AB} corresponding to the following diagram.



- A) $a_{\text{system}} = \frac{P}{4m}, F_{CD} = \frac{P}{4}, F_{BC} = \frac{P}{2}, F_{AB} = \frac{P}{3}$ B) $a_{\text{system}} = \frac{P}{m}, F_{CD} = \frac{P}{4}, F_{BC} = \frac{P}{2}, F_{AB} = \frac{P}{3}$
 C) $a_{\text{system}} = \frac{P}{4m}, F_{CD} = \frac{P}{2}, F_{BC} = \frac{P}{3}, F_{AB} = \frac{P}{4}$ D) $a_{\text{system}} = \frac{P}{3m}, F_{CD} = \frac{P}{4}, F_{BC} = \frac{P}{2}, F_{AB} = \frac{P}{3}$

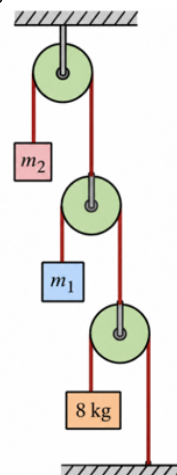
61. In the pulley system shown below, find the mass m if all masses are in equilibrium. Assume massless pulleys and a light, inextensible string, with a suspended mass of 24kg on the lower movable pulley.



pulley.

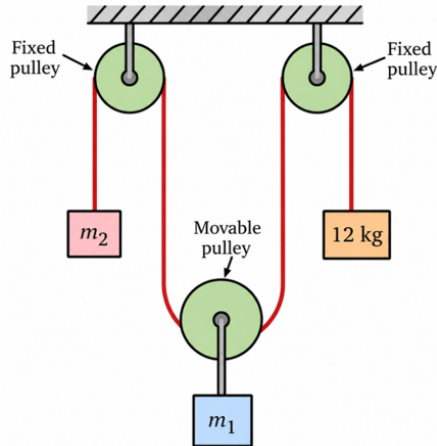
- A) 6kg B) 8kg
 C) 12kg D) 16kg

62. In the pulley system shown, all pulleys and masses are in equilibrium. If the hanging mass at the bottom is 8kg, find the unknown masses m_1 and m_2 .



- A) $m_1 = 16 \text{ kg}, m_2 = 32 \text{ kg}$ B) $m_1 = 8 \text{ kg}, m_2 = 16 \text{ kg}$
 C) $m_1 = 32 \text{ kg}, m_2 = 64 \text{ kg}$ D) $m_1 = 24 \text{ kg}, m_2 = 48 \text{ kg}$

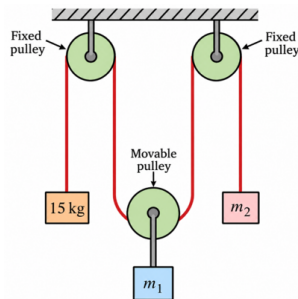
63. A pulley system consists of two fixed pulleys and one movable pulley. A 12kg mass hangs from one end of the rope passing around the movable pulley. The other end of this rope is fixed to the upper support. A second rope supports the movable pulley, with mass m_1 attached to the movable pulley and mass m_2 hanging from the other end of the second rope. If all masses are in equilibrium, find



m_1 and m_2 .

- A) $m_1 = 12\text{kg}, m_2 = 24\text{kg}$ B) $m_1 = 24\text{kg}, m_2 = 24\text{kg}$
 C) $m_1 = 24\text{kg}, m_2 = 12\text{kg}$ D) $m_1 = 36\text{kg}, m_2 = 24\text{kg}$

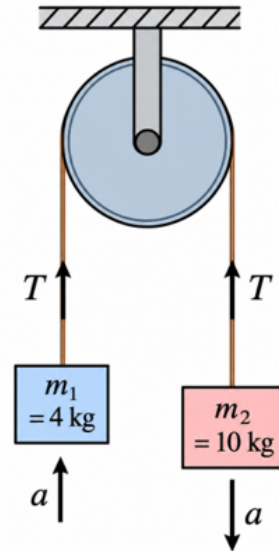
64. From the pulley system shown, a 15kg mass is attached to one end of a rope passing around a movable pulley. The other end passes over a fixed pulley and is connected to m_2 . The movable pulley is attached to m_1 . If all masses are in equilibrium,



find m_1 and m_2 .

- A) $m_1 = 15\text{kg}, m_2 = 30\text{kg}$ B) $m_1 = 30\text{kg}, m_2 = 15\text{kg}$
 C) $m_1 = 45\text{kg}, m_2 = 15\text{kg}$ D) $m_1 = 30\text{kg}, m_2 = 30\text{kg}$

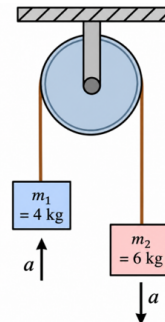
65. Two bodies of mass $m_1 = 4\text{kg}$ and $m_2 = 10\text{kg}$ are attached to the ends of a light, inextensible string passing over a smooth, massless pulley. Find the acceleration a of the system and the tension T in



the string.

- A) $a = \frac{3g}{7}, T = \frac{40g}{7}$ B) $a = \frac{3g}{7}, T = \frac{20g}{7}$
 C) $a = \frac{g}{2}, T = 4g$ D) $a = \frac{g}{7}, T = \frac{40g}{7}$

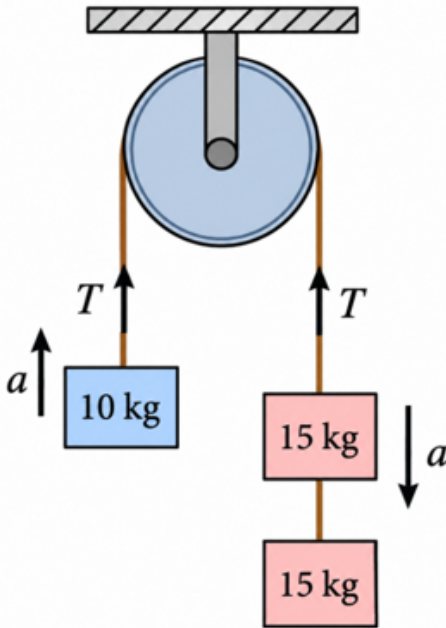
66. From the pulley system shown, two masses $m_1 = 4\text{kg}$ and $m_2 = 6\text{kg}$ are connected by a light, inextensible string passing over an ideal pulley. If the pulley is frictionless and all masses are released from rest, find the acceleration of each mass. Take



$g = 10\text{m/s}^2$.

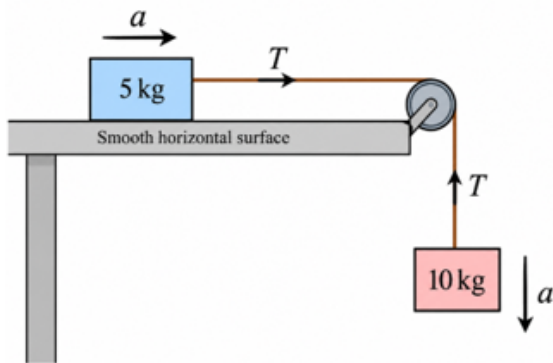
- A) 1m/s^2 B) 2m/s^2
 C) 4m/s^2 D) 5m/s^2

67. From the pulley system shown, find the acceleration a of the system and the string tension T for a 10kg mass on one side and two 15kg masses connected together on the other side. Take $g = 10\text{m/s}^2$ and assume the pulley and string are ideal.



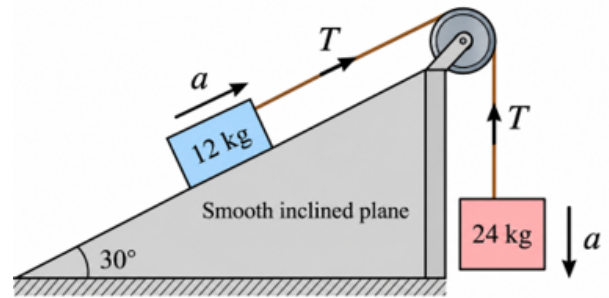
- A) $a = 3\text{m/s}^2$, $T = 130\text{N}$ B) $a = 4\text{m/s}^2$, $T = 140\text{N}$
 C) $a = 5\text{m/s}^2$, $T = 150\text{N}$ D) $a = 6\text{m/s}^2$, $T = 160\text{N}$

68. From the pulley system shown, find the acceleration a of the system and the string tension T when a 5kg block on a smooth horizontal surface is connected by a light string over an ideal pulley to a hanging 10kg block. Take $g = 10\text{m/s}^2$.



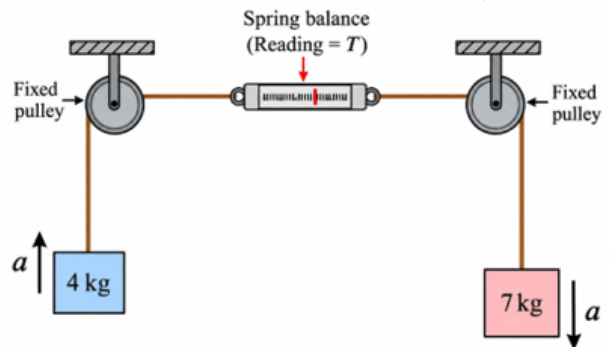
- A) $a = \frac{10}{3}\text{m/s}^2$, $T = \frac{50}{3}\text{N}$ B) $a = 5\text{m/s}^2$, $T = 25\text{N}$
 C) $a = \frac{20}{3}\text{m/s}^2$, $T = \frac{100}{3}\text{N}$ D) $a = 2\text{m/s}^2$, $T = 40\text{N}$

69. From the pulley system shown, find the acceleration a of the system and the string tension T for a 12kg block on a smooth inclined plane of 30° connected to a hanging 24kg block. Assume the pulley and string are ideal. Take $g = 10\text{m/s}^2$.



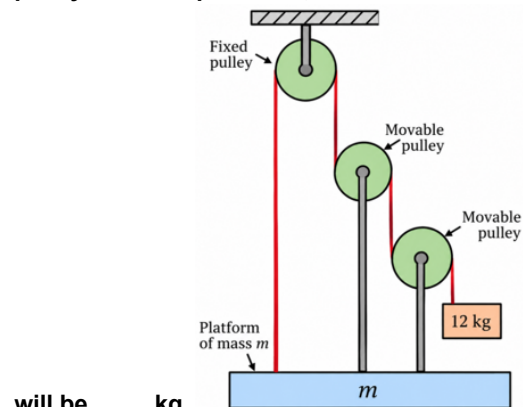
- A) $a = 4\text{m/s}^2$, $T = 108\text{N}$ B) $a = 5\text{m/s}^2$, $T = 120\text{N}$
 C) $a = 6\text{m/s}^2$, $T = 132\text{N}$ D) $a = 8\text{m/s}^2$, $T = 144\text{N}$

70. From the pulley system shown, find the acceleration a of the system and the spring balance reading T when a 4kg block and a 7kg block are connected by a light string over two fixed pulleys, with a spring balance placed in between. Take $g = 10\text{m/s}^2$.



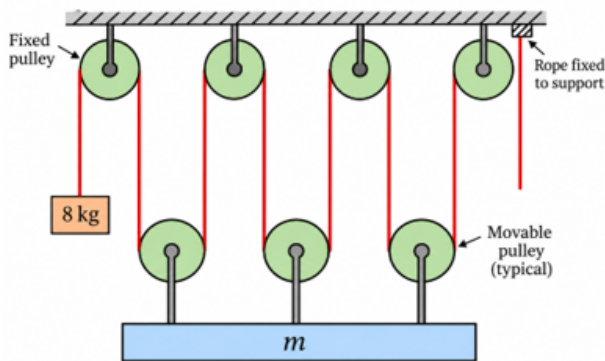
- A) $a = \frac{30}{11}\text{m/s}^2$, $T = \frac{560}{11}\text{N}$ B) $a = \frac{20}{11}\text{m/s}^2$, $T = \frac{480}{11}\text{N}$
 C) $a = 3\text{m/s}^2$, $T = 48\text{N}$ D) $a = 4\text{m/s}^2$, $T = 56\text{N}$

71. From the pulley system shown, a 12kg mass is attached to the end of the lowest rope. Three movable pulleys are connected to the same horizontal platform of mass m . If all masses and pulleys are in equilibrium, find the unknown mass m

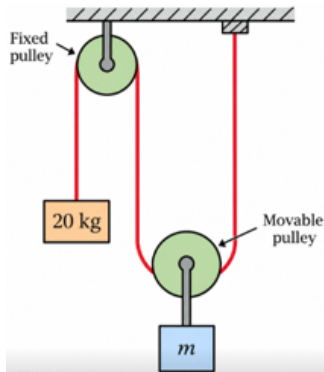


will be ____ kg.

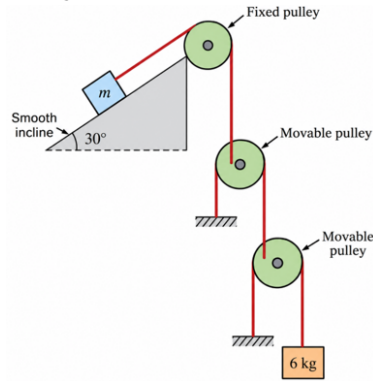
72. From the pulley system shown, a 8kg mass is attached to one end of the rope. The system contains four movable pulleys, all connected to the same horizontal platform of mass m . If all masses and pulleys are in equilibrium, find the unknown mass m ___ kg.



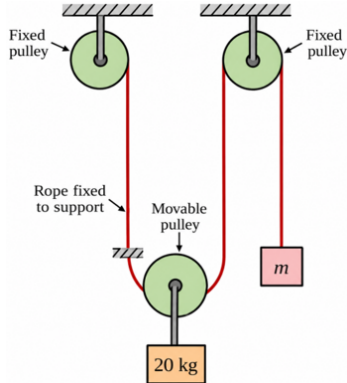
73. From the pulley system shown, a 20kg mass is attached to one end of a light rope. The rope passes around a movable pulley and then over a fixed pulley. The movable pulley supports the unknown mass m . If all masses are in equilibrium, find m ___ kg.



74. From the pulley system shown, a mass of 6kg hangs from the lowest pulley system. The block of mass m is placed on a smooth inclined plane making an angle of 30° with the horizontal. If all masses and pulleys are in equilibrium, find m ___ kg.



75. In the pulley system shown, a 20kg load is attached to the movable pulley. The rope passes around the movable pulley, with one end fixed to the upper support and the other end passing over a fixed pulley and connected to a mass m . If all masses and pulleys are in equilibrium, find m ___ kg.



ANSWER KEY

Chemistry

1.	3	8.	3	15.	1	22.	105
2.	2	9.	4	16.	3	23.	2
3.	2	10.	2	17.	4	24.	2
4.	2	11.	4	18.	4	25.	3
5.	2	12.	3	19.	2		
6.	1	13.	4	20.	4		
7.	3	14.	1	21.	9		

Maths

26.	2	33.	1	40.	2	47.	2
27.	3	34.	2	41.	1	48.	1
28.	1	35.	2	42.	3	49.	2
29.	2	36.	3	43.	1	50.	49
30.	1	37.	3	44.	3		
31.	3	38.	3	45.	2		
32.	3	39.	4	46.	18		

Physics

51.	3	58.	3	65.	1	72.	64
52.	3	59.	2	66.	2	73.	40
53.	2	60.	1	67.	3	74.	48
54.	4	61.	3	68.	3	75.	10
55.	1	62.	1	69.	2		
56.	3	63.	2	70.	1		
57.	2	64.	2	71.	84		

SOLUTIONS

Q1.

Answer: C

Explanation:

Fluorine has a less negative electron gain enthalpy than chlorine because the incoming electron experiences strong inter-electronic repulsion in the compact 2p subshell of fluorine, whereas in chlorine, the 3p subshell is larger and more diffuse. Thus, repulsion is stronger in 2p, making Statement-2 false.

Q2.

Answer: B

Explanation:

F^- , O^{2-} , and N^{3-} are isoelectronic species (10 electrons each). For isoelectronic ions, the ionic radius increases as the nuclear charge Z decreases.

Q3.

Answer: B

Explanation:

Ionization potential decreases down a group as atomic radius increases. In Group 2, the order of first ionization potential is $Be > Mg > Ca$.

Q4.

Answer: B

Explanation:

Beryllium has a fully-filled $2s^2$ subshell. Adding an electron to form Be^- forces the electron into a higher-energy 2p orbital where it experiences strong shielding, making Be^- unstable.

Q5.

Answer: B

Explanation:

Due to the poor shielding effect of the 10 d electrons in Gallium (Ga), its effective nuclear charge increases significantly, causing transition contraction such that $r(Ga) = 135 \text{ pm} < r(Al) = 143 \text{ pm}$.

Q6.

Answer: A

Explanation:

Amphoteric oxides react with both acids and bases. Both options C and D consist entirely of amphoteric oxides, whereas CrO in option A is basic, and NO in option B is neutral.

Q7.

Answer: C

Explanation:

According to Fajan's rules, smaller cations have higher charge density and greater polarizing power, imparting higher covalent character.

Q8.

Answer: C

Explanation:

Smaller, compact 2p orbitals provide the most effective lateral overlap due to shorter internuclear distances, resulting in the strongest π -bond.

Q9.

Answer: D

Explanation:

Central iodine in IF_4^+ has 4 bond pairs and 1 lone pair (steric number = 5, sp^3d hybridization), resulting in a see-saw molecular shape.

Q10.

Answer: B

Explanation:

Bond length is inversely proportional to bond order. Calculating bond orders via MOT yields $NO^+ (3.0) > NO (2.5) > NO^- (2.0)$, giving bond length order $NO^+ < NO < NO^-$.

Q11.

Answer: D

Explanation:

Bond energy is directly proportional to bond order. N_2^{2-} has 16 electrons with a bond order of 2.0, which is lower than $N_2 (3.0)$, $N_2^- (2.5)$, and $N_2^+ (2.5)$.

Q12.

Answer: C

Explanation:

Argon is a non-polar monoatomic noble gas. In the solid state, its atoms are held together by weak dispersion/London forces (Van der Waals forces).

Q13.

Answer: D

Explanation:

H_2O has a strong permanent dipole moment and forms intermolecular hydrogen bonds, creating strong intermolecular attraction and a higher critical temperature than non-polar O_2 .

Q14.

Answer: A

Explanation:

According to Fajan's rules, polarizability of an anion increases with its size because larger electron clouds are more easily distorted by a cation.

Q15.

Answer: A

Explanation:

Nitrogen belongs to Period 2 and lacks d -orbitals in its $n = 2$ valence shell, preventing it from expanding its octet to form 5 covalent bonds.

Q16.

Answer: C

Explanation:

Pressure melts a thin film of water at the interface; upon releasing pressure, the water refreezes and forms new intermolecular hydrogen bonds that join the two ice cubes.

Q17.

Answer: D

Explanation:

Iodine atoms are large and weak oxidizing agents. Severe steric hindrance around the central sulfur atom prevents six bulky iodine atoms from packing around it, making SI_6 non-existent.

Q18.

Answer: D

Explanation:

NO_2 is an odd-electron molecule where nitrogen forms 2 σ -bonds and holds an odd unpaired electron in an sp^2 hybrid orbital (steric number ≈ 3 , sp^2 hybridization).

Q19.

Answer: B

Explanation:

In N_2O_5 ($\text{O}_2\text{N} - \text{O} - \text{NO}_2$), nitrogen atoms form covalent single/double bonds with oxygen atoms and donate lone pairs to form coordinate bonds with terminal oxygen atoms.

Q20.

Answer: D

Explanation:

Calculating C – O bond orders yields $\text{CO}(3.0)$, $\text{CO}_2(2.0)$, and $\text{CO}_3^{2-}(1.33)$. Since bond length $\propto \frac{1}{\text{bond order}}$, the bond length order is $\text{CO} < \text{CO}_2 < \text{CO}_3^{2-}$.

Q21.

Answer: 9

Explanation:

The massive jump between I_1 (496 kJ mol^{-1}) and I_2 (4562 kJ mol^{-1}) for element $n + 2$ indicates an alkali metal with 1 valence electron, which corresponds to Sodium (Na , $Z = 11$). Thus, $n + 2 = 11 \implies n = 9$.

Q22.

Answer: 105

Explanation:

For superoxide ion O_2^- (17 total electrons), the molecular orbital configuration gives 10 bonding electrons (N_b) and 5 valence antibonding electrons (N_a), represented as the number 105.

Q23.

Answer: 2

Explanation:

In C_2 , 4 valence electrons occupy π_{2p} orbitals. In B_2 , 2 valence electrons occupy π_{2p} orbitals. The ratio is $4/2 = 2$.

Q24.

Answer: 2

Explanation:

Central iodine has 7 valence electrons + 1 negative charge = 8 electrons. Subtracting 4 single bonds leaves 4 non-bonding electrons, forming 2 lone pairs.

Q25.

Answer: 3

Q26.

Answer: B

Explanation:

Evaluating the expression $\text{at } x = 0$ yields an indeterminate form of $\frac{0}{0}$. Applying L'Hôpital's Rule by differentiating the numerator and denominator gives the limit value of 8.

Q27.

Answer: C

Explanation:

Using binomial expansion $(1 + y)^n \approx 1 + ny$ for small $y = \sin x$, the numerator simplifies to $\frac{2}{3}\sin x$. Dividing by x and taking the limit as $x \rightarrow 0$ yields $\frac{2}{3}$.

Q28.

Answer: A

Explanation:

For a rational function as $x \rightarrow \infty$ where the polynomial degree of the numerator equals that of the denominator, the limit is the ratio of their leading coefficients.

Q29.

Answer: B

Explanation:

As $x \rightarrow \infty$, the bounded terms $\sin x$ and $\cos^2 x$ become negligible compared with x . Therefore, the ratio approaches 1.

Q30.

Answer: A

Explanation:

There are 100 terms in the numerator, and each term behaves like x^{10} as $x \rightarrow \infty$. The denominator behaves like x^{10} . Hence, the limit is $100 = 10^2$.

Q31.

Answer: C

Explanation:

Since $x \rightarrow -\infty$, we have $|x| = -x$. Using the standard limit $\lim_{u \rightarrow 0} \frac{\sin u}{u} = 1$, the dominant part of the numerator behaves like $-x^3$, while the denominator behaves like $|x|^3$. Hence the limit is -1 .

Q32.

Answer: C

Explanation:

The expression shown in the question has exponent x , so its limit is the geometric mean of $a_1, a_2, \dots, a_n$. Therefore, the marked answer C is incorrect unless the exponent is intended to be nx .

Q33.

Answer: A

Explanation:

As $x \rightarrow \infty$, the term involving $x^{1/2}$ grows faster than all the other terms involving $x^{1/3}, x^{1/4}, \dots, x^{1/n}$. Hence, only the leading terms determine the limit.

Q34.

Answer: B

Explanation:

For the indeterminate form 1^∞ , apply $\exp(\lim_{x \rightarrow \infty} x(f(x) - 1))$. The exponent simplifies to $\lim_{x \rightarrow \infty} \frac{4x^2 + x}{x^2 + x + 2} = 4$, yielding e^4 .

Q35.

Answer: B

Explanation:

Since $x \rightarrow -\infty$, we use the standard limit $\lim_{t \rightarrow 0} \frac{\sin t}{t} = 1$. The numerator behaves like x , while the denominator behaves like $3|x| = -3x$. Hence the limit is $-\frac{1}{3}$.

Q36.

Answer: C

Explanation:

Using standard limit approximations as $x \rightarrow 0^+$ ($\tan u \sim u$, $\log_e(1 + u) \sim u$, $\tan^{-1} u \sim u$, and $e^u - 1 \sim u$), we substitute these asymptotic equivalents into the fraction and simplify the powers of x .

Q37.

Answer: C

Explanation:

Apply the binomial approximation $(1 + y)^n \approx 1 + ny$ for small y . Here, $y = \pm \sin x \approx \pm x$, so the denominator simplifies to $-\frac{1}{4}x$, yielding a limit of -4 .

Q38.

Answer: C

Explanation:

This limit has the indeterminate form 1^∞ . Applying the standard transformation $e^{\lim_{x \rightarrow 0} \frac{1}{x^2} [f(x) - 1]}$, the exponent simplifies to -2 , giving $e^{-2} = \frac{1}{e^2}$.

Q39.

Answer: D

Explanation:

This limit is of the 1^∞ indeterminate form. Using $\tan\left(\frac{\pi}{4} + x\right) = \frac{1 + \tan x}{1 - \tan x}$ and the formula $e^{\lim_{x \rightarrow 0} \frac{1}{x} (f(x) - 1)}$, the exponent evaluates to 2, yielding e^2 .

Q40.

Answer: B

Explanation:

Substitute $\theta = \frac{\pi}{4n}$ so that as $n \rightarrow \infty$, $\theta \rightarrow 0$. Re-expressing n as $\frac{\pi}{4\theta}$, the limit evaluates to $\frac{\pi}{4}$.

Q41.

Answer: A

Explanation:

Using Taylor series expansions near $x = 0$ ($1 - \cos x \approx \frac{x^2}{2}$, $\sin^{-1} x \approx x$, $\tan^{-1} x \approx x$), the dominant lowest-order term in both numerator and denominator is of degree 1, giving $\frac{2x}{3x} = \frac{2}{3}$.

Q42.

Answer: C

Explanation:

Using the tangent identity $\tan(A + B) - \tan A - \tan B = \tan(A + B) \tan A \tan B$ with $A = \frac{\pi}{3}$, $B = \frac{\pi}{6}$, the numerator becomes $\tan \frac{\pi}{2} \tan \frac{\pi}{3} \tan \frac{\pi}{6} \sim \frac{x^3}{36}$. The denominator is $\sim x^3$, so $\frac{k}{36} = \frac{1}{36} \implies k = 1$.

Q43.

Answer: A

Explanation:

Factor the expression as $8 \left(1 - \cos \frac{x^2}{2}\right) \left(1 - \cos \frac{x^2}{4}\right)$. Using $1 - \cos u \approx \frac{u^2}{2}$, the numerator simplifies to $8 \cdot \frac{x^4}{8} \cdot \frac{x^4}{32} = \frac{x^8}{32}$, giving a limit of $\frac{1}{32}$.

Q44.

Answer: C

Explanation:

Substitute $x = \frac{\pi}{2} + h$ as $h \rightarrow 0$. Using $\frac{1 - \tan(x/2)}{1 + \tan(x/2)} = \tan\left(\frac{\pi}{4} - \frac{x}{2}\right) = \tan\left(-\frac{h}{2}\right) \sim -\frac{h}{2}$ and $1 - \sin x = 1 - \cos h \sim \frac{h^2}{2}$, the fraction simplifies to $\frac{(-h/2)(h^2/2)}{(-2h)^3} = \frac{-h^3/4}{-8h^3} = \frac{1}{32}$.

Q45.

Answer: B

Explanation:

As $x \rightarrow 0$, the nested $1 - \cos^2 \theta = \sin^2 \theta$ terms converge to 0, making the numerator $\cos^2 0 = 1$. The rationalized limit $\frac{\sqrt{x+4}-2}{x} \rightarrow \frac{1}{4}$, so the denominator argument is $\frac{\pi}{4}$. Thus, the limit evaluates to $\frac{4}{\pi}$.

Q46.

Answer: 18

Explanation:

Using the fundamental limit approximations as $x \rightarrow 0$: $1 - \cos^2(3x) = \sin^2(3x) \sim (3x)^2 = 9x^2$, $\sin(4x) \sim 4x$, $\log_e(1 + 2x) \sim 2x$, and $\cos^3(4x) \rightarrow 1$, the expression simplifies algebraically to 18.

Q47.

Answer: 2

Explanation:

Using the double-angle identity $1 - \cos 2x = 2 \sin^2 x$ and standard limit approximations $\sin x \sim x$, $\tan 4x \sim 4x$, together with $\lim_{x \rightarrow 0} (3 + \cos x) = 4$, the expression evaluates directly to 2.

Q48.

Answer: 1

Explanation:

Convert all cotangent functions to tangents ($\cot u = \frac{1}{\tan u}$) and apply small-angle approximations ($\tan u \sim u$, $\sin u \sim u$). The terms in x cancel completely, giving a limit of 1.

Q49.

Answer: 2

Explanation:

Divide both the numerator and denominator by x . As $x \rightarrow 0$, $\frac{1-\cos x}{x} \rightarrow 0$, $\frac{\sin^{-1} x}{x} \rightarrow 1$, $\frac{\sin^2 x}{x} \rightarrow 0$, and $\frac{\tan^{-1} x}{x} \rightarrow 1$, yielding $\frac{20}{10} = 2$.

Q50.

Answer: 49

Explanation:

Since $\tan^3(kx) \sim (kx)^3 = k^3 x^3$ as $x \rightarrow 0$, the limit simplifies to $\frac{1^3+2^3+3^3}{4^3+5^3+6^3} = \frac{36}{405} = \frac{4}{45}$. Thus, $p = 4$, $q = 45$, giving $p + q = 49$.

Q51.

Answer: C

Explanation:

Since the surface is frictionless and the blocks move together, the applied force accelerates the combined mass, giving $a = \frac{F}{m_1+m_2} = \frac{36}{9} = 4 \text{ m/s}^2$. The contact (normal) force between the blocks is the only horizontal force on the 6 kg block, so $N = m_2 a = 6 \times 4 = 24 \text{ N}$.

Q52.

Answer: C

Explanation:

The net external force on the two-block system is $F_{\text{net}} = 30 - 10 = 20 \text{ N}$ acting on a total mass of $4 + 6 = 10 \text{ kg}$, giving $a = 20/10 = 2 \text{ m/s}^2$. Isolating the 6 kg block, the contact force N pushes it forward while the 10 N force opposes it, so $N - 10 = 6a$, giving $N = 10 + 12 = 22 \text{ N}$.

Q53.

Answer: B

Explanation:

The net external force on the three-block system is $F_{\text{net}} = 84 - 24 = 60 \text{ N}$ acting on a total mass of $3 + 4 + 5 = 12 \text{ kg}$, giving $a = 60/12 = 5 \text{ m/s}^2$. Isolating the 5 kg block, the contact force N from the 4 kg block pushes it forward while the 24 N force opposes it, so $N - 24 = 5a = 25$, giving $N = 49 \text{ N}$.

Q54.

Answer: D

Explanation:

The net external force on the three-block system is $F_{\text{net}} = 68 - 12 = 56 \text{ N}$ acting on a total mass of $3 + 5 + 6 = 14 \text{ kg}$, giving $a = 56/14 = 4 \text{ m/s}^2$. Isolating the 6 kg block, the contact force N from the 5 kg block pushes it forward while the 12 N force opposes it, so $N - 12 = 6a = 24$, giving $N = 36 \text{ N}$.

Q55.

Answer: A

Explanation:

Both applied forces act rightward, so the net force on the system is $F_{\text{net}} = 30 + 10 = 40 \text{ N}$ acting on a total mass of $2 + 8 = 10 \text{ kg}$, giving $a = 40/10 = 4 \text{ m/s}^2$. Isolating the 2 kg block, the applied 30 N force pushes it forward while the contact force N from the 8 kg block pushes back, so $30 - N = 2a = 8$, giving $N = 22 \text{ N}$.

Q56.

Answer: C

Explanation:

The only external horizontal force on the two-block system is the 50 N pull acting rightward on the 6 kg block. The total mass is $4 + 6 = 10 \text{ kg}$, so the common acceleration is $a = 50/10 = 5 \text{ m/s}^2$. Isolating the 4 kg block, the only horizontal force on it is the string tension T pulling it rightward, so $T = 4a = 20 \text{ N}$.

Q57.

Answer: B

Explanation:

The only external horizontal force on the three-block system is the 60 N pull acting rightward on the 5 kg block. The total mass is $3 + 4 + 5 = 12 \text{ kg}$, so the common acceleration is $a = 60/12 = 5 \text{ m/s}^2$. The tension T_1 pulls only the 3 kg block, giving $T_1 = 3a = 15 \text{ N}$. The tension T_2 pulls the combined 3 kg plus 4 kg subsystem, giving $T_2 = (3 + 4)a = 35 \text{ N}$.

Q58.

Answer: C

Explanation:

The net external force on the three-block system is $F_{\text{net}} = 70 - 20 = 50 \text{ N}$ acting rightward on a total mass of $4 + 2 + 4 = 10 \text{ kg}$, giving a common acceleration $a = 50/10 = 5 \text{ m/s}^2$. Isolating the left 4 kg block gives $T_1 - 20 = 4a = 20$, so $T_1 = 40 \text{ N}$. Isolating the right 4 kg block gives $70 - T_2 = 4a = 20$, so $T_2 = 50 \text{ N}$.

Q59.

Answer: B

Explanation:

The net external force on the system is 60 N rightward, acting on a total mass of 12 kg, so $a = 5 \text{ m/s}^2$. The contact force N_{34} accelerates the $(4 + 5) \text{ kg}$ subsystem, giving $N_{34} = 9 \times 5 = 45 \text{ N}$. The contact force N_{45} accelerates the 5 kg block alone, giving $N_{45} = 5 \times 5 = 25 \text{ N}$.

Q60.

Answer: A

Explanation:

The total mass of the system is $4m$. According to Newton's Second Law, the acceleration of the entire system is $a = \frac{F_{\text{net}}}{M_{\text{total}}} = \frac{P}{4m}$. The contact force between any two blocks is equal to the force required to accelerate the blocks remaining in front of that contact point.

Q61.

Answer: C

Explanation:

In equilibrium, the tension in the string is the same throughout. The lower movable pulley is supported by two vertical segments of the string, so the upward force is twice the tension, balancing the weight of the 24kg mass.

Q62.

Answer: A

Explanation:

For equilibrium, the tension in a rope supporting a movable pulley is twice the tension on either side of that pulley. For the bottom pulley: $T_3 = 8g$ For the middle pulley: $T_2 = 2T_3 = 16g$ Thus, $m_1g = T_2 = 16g \Rightarrow m_1 = 16\text{kg}$ For the top pulley: $T_1 = 2T_2 = 32g$ Thus, $m_2g = T_1 = 32g \Rightarrow m_2 = 32\text{kg}$

Q63.

Answer: B

Explanation:

The 12kg mass produces a rope tension of $T = 12g$. The movable pulley is supported by two tensions, so $m_1g = 2T = 24g$ Thus, $m_1 = 24\text{kg}$. The second rope must also provide the same supporting force to the movable pulley: $m_2g = 2T = 24g$ Therefore, $m_2 = 24\text{kg}$.

Q64.

Answer: B

Explanation:

The tension in the rope is determined by the 15kg mass: $T = 15g$ The movable pulley is supported by two sections of the rope: $m_1g = 2T = 30g$ Therefore, $m_1 = 30\text{kg}$ Since m_2 is also attached to the same rope, $m_2g = T = 15g$ Therefore, $m_2 = 15\text{kg}$

Q65.

Answer: A

Explanation:

Since $m_2 > m_1$, m_2 moves downward and m_1 moves upward. The acceleration is $a = \frac{m_2 - m_1}{m_1 + m_2}g = \frac{10 - 4}{10 + 4}g = \frac{3g}{7}$ The tension is $T = \frac{2m_1m_2}{m_1 + m_2}g = \frac{2(4)(10)}{14}g = \frac{40g}{7}$

Q66.

Answer: B

Explanation:

Since $m_2 > m_1$, the 6kg mass moves downward and the 4kg mass moves upward. Using the Atwood machine formula, $a = \frac{m_2 - m_1}{m_1 + m_2}g = \frac{6 - 4}{6 + 4}(10) = 2\text{m/s}^2$

Q67.

Answer: C

Explanation:

The total mass on the heavier side is $M = 15 + 15 = 30\text{kg}$ Using the Atwood-machine equation, $a = \frac{30 - 10}{30 + 10}g$ $a = \frac{20}{40}(10) = 5\text{m/s}^2$ For the 10kg mass, $T - 10g = 10a$ $T = 10(10 + 5) = 150\text{N}$

Q68.

Answer: C

Explanation:

For the 5kg block on the horizontal surface: $T = 5a$ For the 10kg hanging block: $10g - T = 10a$ Substituting $T = 5a$: $10g = 15a$ $a = \frac{2g}{3} = \frac{20}{3}\text{m/s}^2$ $a = \frac{20}{3}\text{m/s}^2$ Then, $T = 5a = 5\left(\frac{20}{3}\right) = \frac{100}{3}\text{N}$.

Q69.

Answer: B

Explanation:

For the 12kg block, the component of weight down the incline is $12g \sin 30^\circ = 60\text{N}$ For the 24kg hanging block, $24g - T = 24a$ For the block on the incline, $T - 60 = 12a$ Solving gives $a = 5\text{m/s}^2$, $T = 120\text{N}$

Q70.

Answer: A

Explanation:

The 7kg block moves downward and the 4kg block moves upward. $a = \frac{7 - 4}{7 + 4}g = \frac{3g}{11}$ For the 4kg block, $T - 4g = 4a$ Therefore, $T = 4(10) + 4\left(\frac{3g}{11}\right) = \frac{560}{11}\text{N}$.

Q71.

Answer: 84

Explanation:

Starting from the 12kg mass, the tensions double at each movable pulley: $T_1 = 12g$ $T_2 = 2T_1 = 24g$ $T_3 = 2T_2 = 48g$ The platform is supported by the three tensions T_1, T_2, T_3 : $mg = T_1 + T_2 + T_3$ $mg = 12g + 24g + 48g = 84g$ Therefore, $m = 84\text{kg}$.

Q72.

Answer: 64

Explanation:

The tension in the first rope is $T = 8g$ Each movable pulley is supported by two sections of rope, producing an upward force of $2T = 16g$ Since there are four movable pulleys attached to the platform, the total upward force is $4(16g) = 64g$ For equilibrium, $mg = 64g$ Therefore, $m = 64\text{kg}$

Q73.

Answer: 40

Explanation:

The tension in the rope is determined by the 20kg mass: $T = 20g$ The movable pulley is supported by two sections of the rope, so the upward force is $2T = 40g$ For equilibrium, $mg = 2T$ Therefore, $m = 40\text{kg}$

Q74.

Answer: 48

Explanation:

For the 6kg mass: $T_1 = 6g$ Each movable pulley doubles the supporting tension: $T_2 = 2T_1 = 12g$ $T_3 = 2T_2 = 24g$ For the block m on the 30° incline: $mg \sin 30^\circ = T_3$ $mg\left(\frac{1}{2}\right) = 24g$ Therefore, $m = 48\text{kg}$

Q75.

Answer: 10

Explanation:

For the hanging mass m , $T = mg$ The movable pulley is supported by two upward tensions, so $2T = 20g$ Thus, $2mg = 20g$ $m = 10\text{kg}$