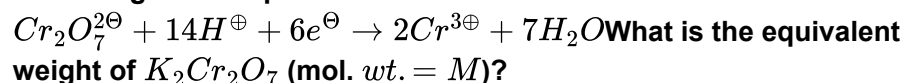


Chemistry

1. In acidic medium, potassium dichromate acts as an oxidant according to the equation:



- A) M B) $M/2$
C) $M/3$ D) $M/6$

2. The equivalent weight of $Na_2S_2O_3$ (Mol. wt. = M) in the reaction,
 $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$ is:

- A) $M/4$ B) $M/3$
C) $M/2$ D) M

3. Equivalent weight of FeC_2O_4 in the change:



- A) $M/3$ B) $M/6$
C) $M/2$ D) $M/1$

4. The mass of oxalic acid crystals ($H_2C_2O_4 \cdot 2H_2O$) that would contain its 0.01 equivalents is:

- A) 4.5 g B) 6.3 g
C) 0.63 g D) 0.45 g

5. In the reaction $Cr_2O_7^{2-} + I^- + H^+ \rightarrow Cr^{3+} + I_2 + H_2O$, the equivalent weight of the reductant in the above equation is: (At. wt. of $Cr = 52$, $I = 127$)

- A) 26 B) 127
C) 63.5 D) 10.4

6. 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}

7. 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

8. A solution of $KMnO_4$ is reduced to MnO_2 . The normality of solution is 0.6. The molarity is :

- A) 1.8 M B) 0.6 M
C) 0.1 M D) 0.2 M

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

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

10. 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

11. 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

12. The mole fraction of solute in aqueous urea solution is 0.2. The mass percent of solute is :

- A) 42.40 B) 10.52
C) 40.30 D) 45.45

13. 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

14. 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

15. 100 ml of 0.3 M HCl solution is mixed with 200 ml of 0.3 M H_2SO_4 solution. What is the molarity of H^+ in resultant solution?

- A) 0.9 M B) 0.6 M
C) 0.4 M D) 0.5 M

16. Statement-I : 16 g each of O_2 and O_3 contains $\frac{N_A}{2}$ and $\frac{N_A}{3}$ atoms respectively. Because Statement-II : 16 g O_2 and O_3 contains same no. of atoms.

- A) Statement-I is true, Statement-II is true; Statement-II is correct explanation for Statement-I. B) Statement-I is true, Statement-II is true; Statement-II is NOT a correct explanation for statement-I
C) Statement-I is true, Statement-II is false D) Statement-I is false, Statement-II is true

17. Elements A and B form two compounds B_2A_3 and B_2A . 0.05 moles of B_2A_3 weigh 9.0 g and 0.10 mole of B_2A weigh 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

18. Out of below correct matching is -

Column-I	Column-II	Column-III
(P) 60 gram sample of hydro carbon that contain 20% H and rest C	(1) %C = 40	(i) No. of atoms of C as well as O = $8N_A$
(Q) 240 gram urea	(2) %H = $\frac{20}{3}$	(ii) No. of C atoms = $4N_A$
(R) 120 gram acetic acid	(3) % O = $\frac{160}{3}$	(iii) No. of total atoms = $16N_A$
(S) 120 gram glucose	(4) % N = 46.7	(iv) No. of total atoms is 2 times of no. of H atom

- A) P - 1 - i B) P - i - ii
C) Q - 2 - iii D) S - 2 - iv

19. In which of following is incorrect -

Column-I	Column-II	Column-III
(P) 60 gram sample of hydro carbon that contain 20% H and rest C	(1) %C = 40	(i) No. of atoms of C as well as O = $8N_A$
(Q) 240 gram urea	(2) %H = $\frac{20}{3}$	(ii) No. of C atoms = $4N_A$
(R) 120 gram acetic acid	(3) % O = $\frac{160}{3}$	(iii) No. of total atoms = $16N_A$
(S) 120 gram glucose	(4) % N = 46.7	(iv) No. of total atoms is 2 times of no. of H atom

- A) Q - 2 - iv B) R - 3 - iv
C) P - 4 - iii D) R - 1 - ii

20. Out of below correct matching is -

Column-I	Column-II	Column-III
(P) 60 gram sample of hydro carbon that contain 20% H and rest C	(1) %C = 40	(i) No. of atoms of C as well as O = $8N_A$
(Q) 240 gram urea	(2) %H = $\frac{20}{3}$	(ii) No. of C atoms = $4N_A$
(R) 120 gram acetic acid	(3) %O = $\frac{160}{3}$	(iii) No. of total atoms = $16N_A$
(S) 120 gram glucose	(4) %N = 46.7	(iv) No. of total atoms is 2 times of no. of H atom

A) $S - 4 - iv$

B) $R - 1 - ii$

C) $P - 4 - iii$

D) $P - 2 - ii$

21. $Na_2SO_4 \cdot xH_2O$ has 50% H_2O . Hence, x is :

22. A solution is prepared by adding 2g of "X" to 1 mole of water. Mass percent of "X" in the solution is ___%:

23. 3.0 molal NaOH solution has a density of 1.12 g/mL. The molarity of the solution is-

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

25. The number of chlorine atoms in 20 mL of chlorine gas at STP is $\times 10^{21}$. $R = 0.083 \text{ L bar mol}^{-1}\text{K}^{-1}$, $N_A = 6.023 \times 10^{23}$

Maths

26. Match the inequalities given in Column-I with their corresponding number line representations in Column-II and interval forms in Column-III.

Column-I	Column-II (Number Line Representation)	Column-III
(A) $-1 < x \leq 4, x \in R$	(Q) A number line showing a segment from an open circle at -1 to a filled dot at 4	(X) $x \in [1, 5) - 2, 3$
(B) $1 \leq x < 5, x \in R$ and $x \neq 2, 3$	(R) A number line showing a segment from a filled dot at 1 to an open circle at 5, with open circles (holes) marked at 2 and 3	(Y) $x \in [-2, 6] \cup (8, \infty)$
(C) $-3 \leq x < 1, x \in R$ or $x = 5$	(S) A number line showing a segment from a filled dot at -3 to an open circle at 1, together with an isolated filled dot at 5	(Z) $x \in [-3, 1) \cup 5$
(D) $-2 \leq x \leq 6$ or $x > 8$	(P) A number line showing a solid segment with filled dots at -2 and 6, together with an open circle at 8 from which a ray extends to the right	(T) $x \in (-1, 4]$

A) (A)-(P)-(X), (B)-(Q)-(Y), (C)-(R)-(Z), (D)-(S)-(T)

B) (A)-(Q)-(T), (B)-(R)-(X), (C)-(S)-(Z), (D)-(P)-(Y)

C) (A)-(T)-(Q), (B)-(X)-(R), (C)-(Z)-(S), (D)-(Y)-(P)

D) (A)-(Q)-(Z), (B)-(R)-(Y), (C)-(S)-(X), (D)-(P)-(T)

27. Solve the inequality $\frac{x^2 - x - 12}{x^2 + 5x} \geq 0$

A)

$x \in (-\infty, -5] \cup (-3, 0) \cup [4, \infty)$

B) $x \in (-5, -3] \cup (0, 4]$

C)

$x \in (-\infty, -5) \cup [-3, 0) \cup [4, \infty)$

D)

$x \in (-\infty, -5) \cup (-3, 0] \cup (4, \infty)$

28. Solve the inequality $\frac{(3-x^2)(x-2)^3}{(x+1)(x^2-2x-3)} \geq 0$

A)

$x \in (-\infty, -1) \cup (-\sqrt{3}, -1) \cup [\sqrt{3}, 2]$

B) $x \in [-\sqrt{3}, -1) \cup [\sqrt{3}, 2]$

C)

$x \in [-\sqrt{3}, -1) \cup (-1, \sqrt{3}] \cup [2, 3)$

D)

$x \in (-\infty, -\sqrt{3}) \cup (-1, \sqrt{3}) \cup (2, \infty)$

29. Solve the inequality $\frac{(x-1)(x-4)}{(x-2)(x-3)^2} \leq 0$

- A) $x \in (-\infty, 1] \cup (2, 3) \cup (3, 4]$ B) $x \in (-\infty, 1) \cup [2, 3] \cup [4, \infty)$
 C) $x \in (-\infty, 1] \cup (2, 4]$ D) $x \in [1, 2) \cup (3, 4]$

30. Solve the inequality $\frac{2x}{x^2-25} \leq \frac{1}{x+1}$

- A) $x \in (-5, -1) \cup (5, \infty)$ B) $x \in (-\infty, -5) \cup (-1, 5)$
 C) $x \in (-\infty, -5] \cup [-1, 5]$ D) $x \in (-\infty, -5) \cup (-1, 5) \cup (5, \infty)$

31. Solve the inequality $\frac{1}{x-2} - \frac{4}{x-3} + \frac{4}{x-4} - \frac{1}{x-5} < \frac{1}{30}$

- A) $(-\infty, -1) \cup (2, 3) \cup (4, 5) \cup (7, 8)$ B) $(-1, 0) \cup (3, 4) \cup (7, 8)$
 C) $(-\infty, -1) \cup (0, 2) \cup (3, 4) \cup (5, 7) \cup (8, \infty)$ D) $(2, 3) \cup (4, 5) \cup (7, 8)$

32. Solve the inequality $\frac{(x-3)(x^2-10x+25)}{x^2+2x+3} \geq 0$

- A) $(3, 5) \cup (5, \infty)$ B) $[3, \infty)$
 C) $(-\infty, 3]$ D) $(-\infty, 3) \cup (5, \infty)$

33. Solve the inequality $\frac{(x+6)^{200}(x+3)^{311}(x-\frac{1}{3})^{501}(x-5)^{800}}{x^{701}(x+1)^{91}} \geq 0$

- A) $(-\infty, -6] \cup [-3, -1] \cup [0, \frac{1}{3}] \cup (5, \infty)$ B) $(-\infty, -6] \cup [-3, -1] \cup (0, \frac{1}{3}] \cup [5, \infty)$
 C) $(-\infty, -3) \cup (-1, 0) \cup (\frac{1}{3}, \infty)$ D) $(-\infty, -3] \cup (-1, 0) \cup [\frac{1}{3}, \infty)$

34. Complete set of values of x : $\frac{(x^2-9x+14)^{103}}{(x^2-8x+15)^{102}} \leq 0$

- A) $x \in [2, 7] - \{3, 5\}$ B) $x \in [2, 3) \cup (5, 7]$
 C) $x \in [2, 7]$ D) $x \in (-\infty, 2] \cup [7, \infty)$

35. The solution set for $(x+1)(x+4)^2(x-2)^3(2x-7)(x-5)^4 \geq 0$ is given by $x \in [a, b] \cup [c, \infty) \cup \{-4\}$, then value of $a + b + c$ is equal to

- A) 3.5 B) 4.5
 C) 5.5 D) 6.0

36. Complete set of values of x satisfying: $\frac{(x-2)^{13}x^{40}}{(x+3)^{2019}(x+4)^{2022}} \geq 0$

- A) $x \in (-\infty, -4) \cup (-4, -3) \cup (2, \infty)$ B) $x \in (-\infty, -3) \cup [2, \infty)$
 C) $x \in (-3, 2] - \{0\}$ D) $x \in (-\infty, -4) \cup (-4, -3) \cup [2, \infty) \cup \{0\}$

37. Solve $\frac{4}{(x-2)(x-6)} + \frac{9}{x-6} + 1 > 0$

- A) $x \in (-\infty, -2) \cup (1, 2) \cup (6, \infty)$ B) $x \in (-2, 1) \cup (2, 6)$
 C) $x \in (-\infty, -2) \cup (1, 6)$ D) $x \in (-2, 2) \cup (6, \infty)$

38. If S is the set of all real x such that $\frac{x^2(4-x)(1-3x)}{(3x+1)(x+3)}$ is negative and $\frac{2x+1}{6x^3-x^2-x}$ is positive, then S contains

- A) $(2, 5)$ B) $(-\frac{5}{2}, -1)$
 C) $(-1, 0)$ D) $(0, 1)$

39. Solve the inequality $\frac{(x-3)(5-x)^2}{(x-1)(x+2)(2-x)^3} \leq 0$

- A) $x \in (-\infty, -2] \cup (1, 2) \cup (3, \infty)$ B) $x \in (-2, 1) \cup (2, 3) \cup (5, \infty)$
 C) $x \in (-\infty, -2) \cup (1, 2) \cup [3, \infty)$ D) $x \in (-2, 1) \cup (2, 3] \cup [5, \infty)$

40. The sum of all the roots of the equation $|x^2 - 6x + 8| - 2x + 6 = 0$ is

- A) $6 + 2\sqrt{2}$ B) $8 + 2\sqrt{2}$
 C) $6 - 2\sqrt{2}$ D) $8 - 2\sqrt{2}$

41. The sum of all the roots of the equation $|x^2 - 6x + 5| - 2x + 5 = 0$ is

- A) $8 - \sqrt{6}$ B) $8 + \sqrt{6}$
 C) $10 - \sqrt{6}$ D) $10 + \sqrt{6}$

42. Solve $|x + 2| + |x - 2| = 4$

- A) $x \in (-2, 2)$ B) $x \in [-2, 2]$
 C) $x \in [2, 4]$ D) $x \in (2, 4)$

43. Solve $|x + 1| + |x - 3| = 4$

- A) $x \in (-1, 3)$ B) $x \in [1, 3]$
 C) $x \in [-1, 3]$ D) $x \in [-1, 1]$

44. Solve $|x - 2| + |x - 3| + |x - 4| = 5$

- A) $x \in [4/3, 14/3]$ B) $x \in \{2, 4\}$
 C) $x \in \{4/3, 14/3\}$ D) No solution

45. Solve $|x + 1| + |x + 2| + |x + 3| = 4$

- A) $x \in \{-3, -1\}$ B) $x \in \{-10/3, -2/3\}$
 C) $x \in [-10/3, -2/3]$ D) No solution

46. Number of positive integral values of x satisfying the inequality

$$\frac{(x-5)^{2017}(x+7)^{2016}(x+2)}{x^{2018}(x-3)^3(x+4)^5(x-7)(x+9)^{2018}} \leq 0 \text{ is}$$

47. The number of real solutions of the equation

$$x|x + 4| + 2|x + 5| - 2 = 0 \text{ is}$$

48. The number of real solutions of the equation

$$x|x + 6| + 2|x + 8| - 2 = 0 \text{ is}$$

49. Number of real solutions of the equation $|x|^2 - 5|x| + 4 = 0$ is

50. Number of real solutions of the equation $|x|^2 - 6|x| + 9 = 0$ is

Physics

51. A block of mass 5 kg is on a rough horizontal surface and is at rest. Now a horizontal force of 35 N is applied to it. If the coefficient of kinetic friction is 0.3 and $g = 10 \text{ m/s}^2$, then the acceleration of the block is

- A) 7 m/s^2 B) 4 m/s^2
 C) 3 m/s^2 D) 10 m/s^2

52. A body of mass 3 kg is being dragged with uniform velocity of 2 m/s on a rough horizontal plane. The coefficient of friction between the body and the surface is 0.20. The amount of heat generated in 5 sec is ($J = 4.2 \text{ joule/cal}$ and $g = 9.8 \text{ m/s}^2$)

- A) 7 cal B) 21 cal
 C) 28 cal D) 14 cal

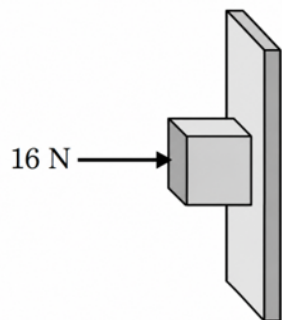
53. A block of mass $M = 10 \text{ kg}$ is resting on a rough horizontal surface for which the coefficient of friction is 0.5. When a force $F = 100 \text{ N}$ is applied at an angle of 37° with the horizontal, the acceleration of the block will be ($g = 10 \text{ m/s}^2$, $\sin 37^\circ = 0.6$, $\cos 37^\circ = 0.8$).

- A) 4 m/s^2 B) 6 m/s^2
 C) 8 m/s^2 D) 10 m/s^2

54. When a body slides down a rough inclined plane inclined at an angle θ to the horizontal, with a coefficient of friction μ , its acceleration is:

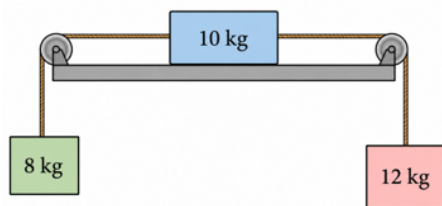
- A) $g(\sin \theta - \mu \cos \theta)$ B) $g(\sin \theta + \mu \cos \theta)$
 C) $g(\cos \theta - \mu \sin \theta)$ D) $g(\mu \sin \theta - \cos \theta)$

55. A horizontal force of 16N is necessary to just hold a block stationary against a vertical wall. The coefficient of friction between the block and the wall is 0.25. What is the weight of the block?



- A) 4N
B) 8N
C) 16N
D) 64N

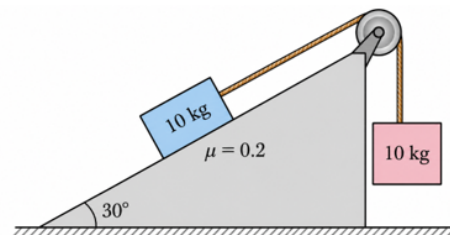
56. Find the acceleration of each block in the given system. A 10kg block rests on a smooth horizontal surface and is connected by separate light strings over frictionless pulleys to an 8kg hanging block on the left and a 12kg hanging block on the right. Take



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

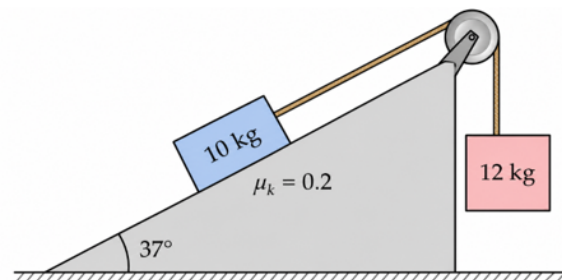
- A) 1.0m/s^2
B) 1.33m/s^2
C) 2.0m/s^2
D) 2.5m/s^2

57. 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.



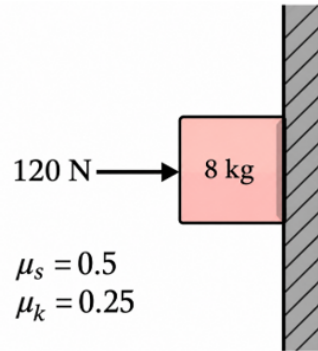
- A) $a = 1.63\text{m/s}^2$, $f = 17.3\text{N}$
B) $a = 2.0\text{m/s}^2$, $f = 20\text{N}$
C) $a = 1.0\text{m/s}^2$, $f = 10\text{N}$
D) $a = 2.5\text{m/s}^2$, $f = 17.3\text{N}$

58. 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.



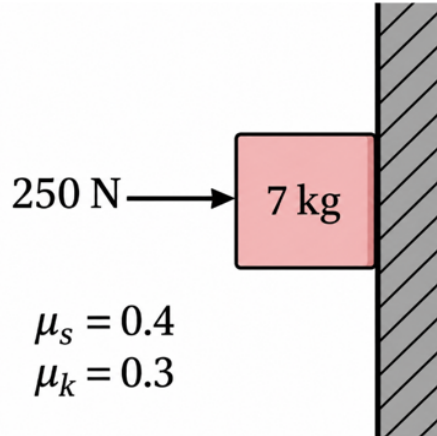
- A) 1m/s^2
B) 2m/s^2
C) 3m/s^2
D) 4m/s^2

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



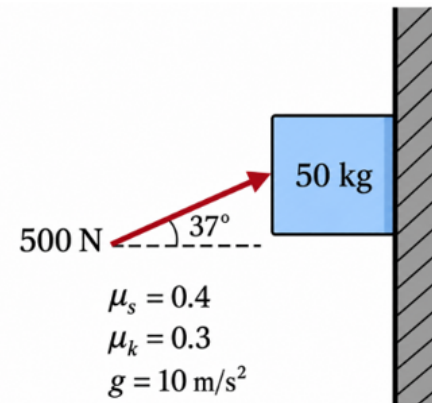
- A) $f = 30\text{N}$, $a = 6.25\text{m/s}^2$ B) $f = 60\text{N}$, $a = 2.5\text{m/s}^2$
 C) $f = 30\text{N}$, $a = 0\text{m/s}^2$ D) $f = 120\text{N}$, $a = 5\text{m/s}^2$

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



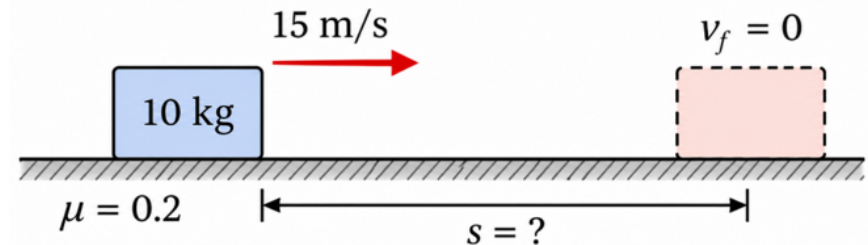
- A) $f = 70\text{N}$, $a = 0\text{m/s}^2$ B) $f = 75\text{N}$, $a = 0\text{m/s}^2$
 C) $f = 70\text{N}$, $a = 2\text{m/s}^2$ D) $f = 100\text{N}$, $a = 0\text{m/s}^2$

61. 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.



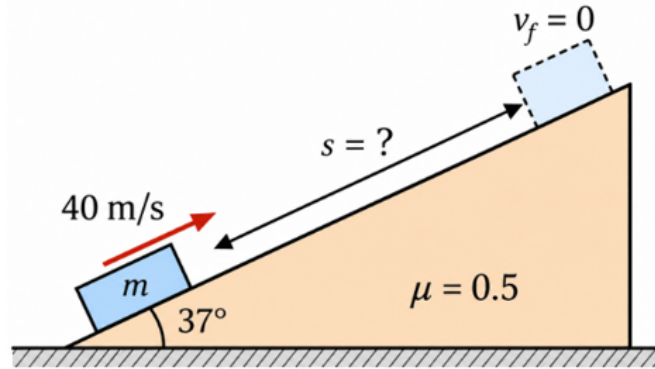
- A) $f = 120\text{N}$, $a = 1.6\text{m/s}^2$ B) $f = 160\text{N}$, $a = 0\text{m/s}^2$
 C) $f = 150\text{N}$, $a = 1\text{m/s}^2$ D) $f = 100\text{N}$, $a = 2\text{m/s}^2$

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



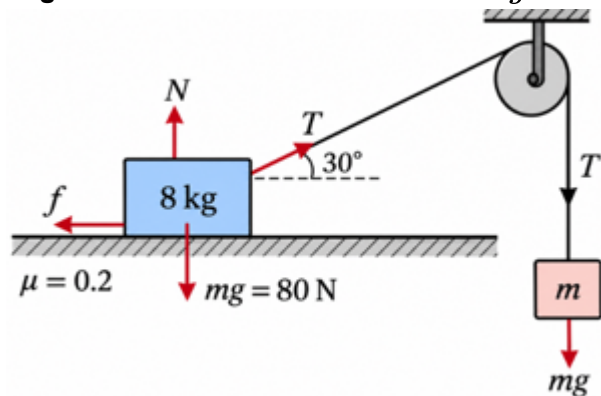
- A) 40m B) 50m
 C) 56.25m D) 60m

63. 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 $\cos 37^\circ = 0.8$.



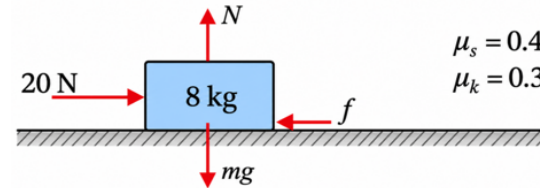
- A) 60m
B) 80m
C) 100m
D) 120m

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



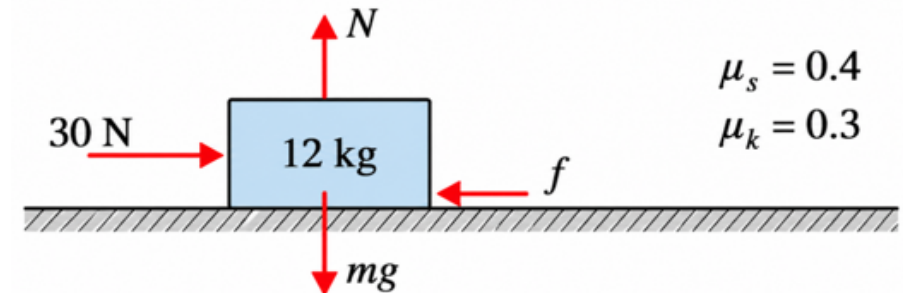
- A) 1.66kg
B) 2.50kg
C) 3.20kg
D) 4.00kg

65. 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.



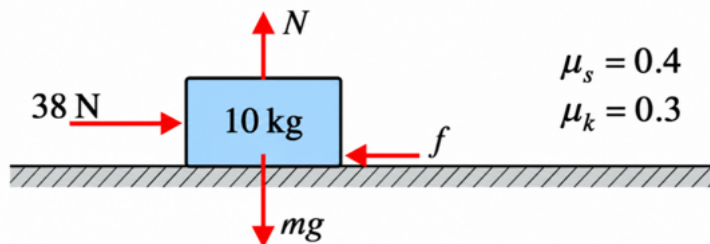
- A) $a = 0$, $f = 20\text{N}$
B) $a = 2.5\text{m/s}^2$, $f = 20\text{N}$
C) $a = 0$, $f = 32\text{N}$
D) $a = 1\text{m/s}^2$, $f = 24\text{N}$

66. 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.



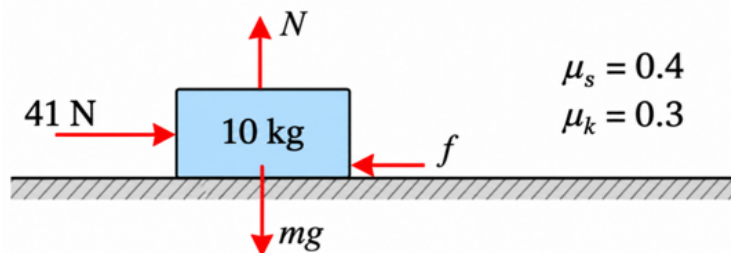
- A) $a = 0$, $f = 30\text{N}$
B) $a = 0.5\text{m/s}^2$, $f = 30\text{N}$
C) $a = 0$, $f = 48\text{N}$
D) $a = 2\text{m/s}^2$, $f = 36\text{N}$

67. 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) $a = 1\text{m/s}^2$, $f = 30\text{N}$

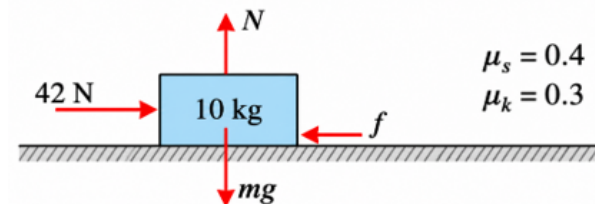
68. In the given figure, a block of mass 10kg is placed on a rough horizontal surface. A horizontal force of 41N is applied to the block. The coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$. Take $g = 10\text{m/s}^2$. Find the acceleration and frictional



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) $a = 0.5\text{m/s}^2$, $f = 30\text{N}$

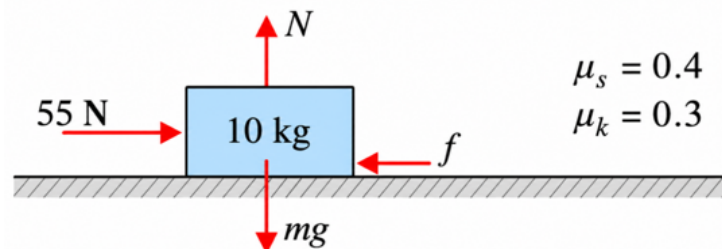
69. In the given figure, find the value of acceleration if $F = 42\text{N}$, given the mass of the block is 10kg, $\mu_s = 0.4$, and $\mu_k = 0.3$. Take



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

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

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

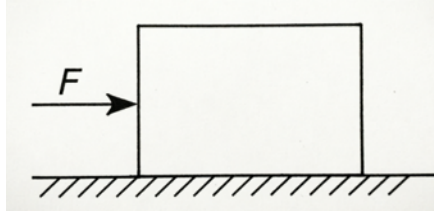


- A) $a = 1.5\text{m/s}^2$ B) $a = 2.5\text{m/s}^2$
 C) $a = 2\text{m/s}^2$ D) $a = 0$

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

72. 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__N

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

74. 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__N

75. A body of mass 3 kg is kept by pressing to a vertical wall by a force of 200 N. The coefficient of friction between wall and body is 0.4. Then the frictional force is equal to (take $g = 10 \text{ m/s}^2$)__N

ANSWER KEY

Chemistry

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

Maths

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

Physics

51.	2	58.	2	65.	1	72.	60
52.	4	59.	1	66.	1	73.	6
53.	2	60.	1	67.	1	74.	120
54.	1	61.	1	68.	1	75.	30
55.	1	62.	3	69.	1		
56.	2	63.	2	70.	2		
57.	1	64.	1	71.	50		

SOLUTIONS

Q1.

Answer: D

Explanation:

The equivalent weight of an oxidizing agent is given by its molecular weight divided by the total number of electrons gained per mole of the substance in the redox reaction (the n -factor). Since 1 mole of $K_2Cr_2O_7$ contains one $Cr_2O_7^{2-}$ ion which accepts 6 electrons in total, the n -factor is 6. Therefore, the equivalent weight is $M/6$.

Q2.

Answer: D

Explanation:

The equivalent weight of a substance in a redox reaction is equal to its molecular weight divided by its n -factor (the total change in oxidation number per mole of the substance). In the given reaction, the sulfur atoms in thiosulfate ($S_2O_3^{2-}$) undergo oxidation to form tetrathionate ($S_4O_6^{2-}$). The average oxidation state of sulfur changes from $+2$ in $S_2O_3^{2-}$ to $+2.5$ in $S_4O_6^{2-}$, resulting in a change of 0.5 per sulfur atom, or 1 electron per mole of $Na_2S_2O_3$. Thus, the n -factor is 1 , making the equivalent weight equal to M .

Q3.

Answer: A

Explanation:

The equivalent weight of a reducing agent in a redox reaction is equal to its molecular weight divided by its n -factor (total number of moles of electrons lost per mole of the substance). In FeC_2O_4 , iron is oxidized from $+2$ to $+3$ (losing 1 electron), and the oxalate ion ($C_2O_4^{2-}$) is oxidized from carbon oxidation state $+3$ to $+4$ in CO_2 (losing 2 electrons, 1 from each carbon atom). The total number of electrons lost per mole of FeC_2O_4 is $1 + 2 = 3$. Thus, the n -factor is 3 , and the equivalent weight is $M/3$.

Q4.

Answer: C

Explanation:

The equivalent weight of oxalic acid dihydrate ($H_2C_2O_4 \cdot 2H_2O$) is equal to its molecular weight divided by its n -factor. Oxalic acid acts as a reducing agent in redox titrations (such as with $KMnO_4$), where each molecule loses 2 electrons, giving an n -factor of 2 . Therefore, the equivalent weight is $126/2 = 63$ g/eq. The mass containing 0.01 equivalents is calculated by multiplying the number of equivalents by the equivalent weight: $0.01 \times 63 = 0.63$ g.

Q5.

Answer: B

Explanation:

The equivalent weight of a substance participating in a redox reaction is equal to its molar or atomic mass divided by its n -factor (the change in oxidation number or number of electrons lost/gained per mole). In the given reaction, the reductant is the iodide ion (I^-), which is oxidized to iodine (I_2). Since each I^- ion loses 1 electron, its n -factor is 1 . Thus, the equivalent weight of I^- is equal to its atomic weight, which is 127 .

Q6.

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.

Q7.

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.

Q8.

Answer: D

Explanation:

The relationship between normality (N) and molarity (M) is given by the formula $N = M \times \text{n-factor}$. When $KMnO_4$ is reduced to MnO_2 in a weakly basic/neutral medium, the change in oxidation state of manganese is from +7 to +4, so the n-factor is 3. Using this n-factor, the molarity is calculated as $0.6/3 = 0.2 \text{ M}$.

Q9.

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 ($N = M \times \text{n-factor} = 0.3 \times 2 = 0.6$).

Q10.

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.

Q11.

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 $M = \frac{10 \times 0.98 \times 13}{98} = 1.3 \text{ M}$.

Q12.

Answer: D

Explanation:

The mole fraction of the solute is given as 0.2, which means out of a total of 1 mole of solution, there are 0.2 moles of urea and 0.8 moles of water. Using the molar masses of urea (60 g/mol) and water (18 g/mol), we calculate the respective masses. The mass percent of solute is then found by dividing the mass of urea by the total mass of the solution and multiplying by 100.

Q13.

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 $\frac{25}{18} \text{ m}$.

Q14.

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.

Q15.

Answer: D

Explanation:

To find the resultant molarity of H^+ ions, we calculate the total millimoles of H^+ contributed by both strong acids (HCl and H_2SO_4) and divide by the total volume of the mixture (300 ml). Since H_2SO_4 is a dibasic acid, it furnishes 2 moles of H^+ per mole of acid. The total millimoles equal $30 + 120 = 150 \text{ mmol}$, resulting in a molarity of $\frac{150}{300} = 0.5 \text{ M}$.

Q16.

Answer: D

Q17.

Answer: C

Q18.

Answer: D

Q19.

Answer: C

Q20.

Answer: B

Q21.

Answer: 8

Q22.

Answer: 10

Q23.

Answer: 3

Q24.

Answer: 18

Q25.

Answer: 11

Q26.

Answer: B

Explanation:

Each inequality converts directly into interval form: included endpoints give closed brackets (filled dots on the number line), excluded endpoints give open brackets (open circles), and isolated points or extra regions appear as unions. Comparing each inequality with its interval form and number line gives (A)-(Q)-(T), (B)-(R)-(X), (C)-(S)-(Z), (D)-(P)-(Y).

Q27.

Answer: C

Explanation:

Factoring the numerator and denominator gives $\frac{(x-4)(x+3)}{x(x+5)} \geq 0$. The critical points are $x = -5, -3, 0, 4$. The sign alternates across these simple roots, being positive on $(-\infty, -5)$, $(-3, 0)$ and $(4, \infty)$. Zeros of the numerator $(-3, 4)$ are included since the inequality is ≥ 0 , while zeros of the denominator $(-5, 0)$ are excluded.

Q28.

Answer: C

Explanation:

Factoring the denominator as $(x+1)(x^2-2x-3) = (x+1)^2(x-3)$, the expression becomes $\frac{(3-x^2)(x-2)^3}{(x+1)^2(x-3)} \geq 0$. The critical points are $x = \pm\sqrt{3}$ and $x = 2$ (numerator zeros, included) and $x = -1, 3$ (denominator zeros, excluded). Since $(x+1)^2$ has even power, the sign does not change at $x = -1$, but the point itself is excluded. The sign scheme yields positive regions $[-\sqrt{3}, -1) \cup (-1, \sqrt{3}] \cup [2, 3)$.

Q29.

Answer: A

Explanation:

The critical points are $x = 1, 4$ (numerator zeros, included) and $x = 2, 3$ (denominator zeros, excluded). Since $(x-3)^2$ has an even power, the sign does not change at $x = 3$, but the point itself is excluded. The sign scheme yields negative regions $(-\infty, 1)$ and $(2, 3) \cup (3, 4)$. Including the numerator zeros gives $(-\infty, 1] \cup (2, 3) \cup (3, 4]$.

Q30.

Answer: B

Explanation:

Moving all terms to one side gives $\frac{2x(x+1)-(x^2-25)}{(x^2-25)(x+1)} \leq 0$, i.e., $\frac{x^2+2x+25}{(x-5)(x+5)(x+1)} \leq 0$. The numerator has negative discriminant $(4 - 100 = -96)$, so it is always positive. Hence the fraction is negative exactly when the denominator $(x-5)(x+5)(x+1) < 0$, which occurs on $(-\infty, -5) \cup (-1, 5)$.

Q31.

Answer: C

Explanation:

Grouping the terms as $\left(\frac{1}{x-2} - \frac{1}{x-5}\right) - 4\left(\frac{1}{x-3} - \frac{1}{x-4}\right)$ gives $\frac{-3}{(x-2)(x-5)} + \frac{4}{(x-3)(x-4)}$. Substituting $w = (x-2)(x-5)$, so that $(x-3)(x-4) = w+2$, the inequality becomes $\frac{w-6}{w(w+2)} < \frac{1}{30}$, which simplifies to $\frac{(w-10)(w-18)}{w(w+2)} > 0$, yielding $w \in (-\infty, -2) \cup (0, 10) \cup (18, \infty)$. Translating back to x produces $(-\infty, -1) \cup (0, 2) \cup (3, 4) \cup (5, 7) \cup (8, \infty)$.

Q32.

Answer: B

Explanation:

The denominator $x^2 + 2x + 3$ has discriminant $4 - 12 = -8 < 0$ with positive leading coefficient, so it is always positive. The numerator factors as $(x-3)(x-5)^2$, and since $(x-5)^2 \geq 0$ everywhere, the sign of the expression is governed by $x-3$. Hence the expression is ≥ 0 exactly when $x \geq 3$ (the zero at $x=5$ already lies in this range), giving $[3, \infty)$.

Q33.

Answer: D

Explanation:

Factors with even powers, $(x+6)^{200}$ and $(x-5)^{800}$, never change sign (they only contribute zeros at $x = -6, 5$, where the expression equals 0 and is included). Factors with odd powers, $(x+3)^{311}$, $(x - \frac{1}{3})^{501}$ in the numerator and x^{701} , $(x+1)^{91}$ in the denominator, change sign at $-3, \frac{1}{3}, 0, -1$. The sign scheme alternates across these odd points, and the numerator zeros $-6, -3, \frac{1}{3}, 5$ are included while the denominator zeros $-1, 0$ are excluded, giving $(-\infty, -3] \cup (-1, 0) \cup [\frac{1}{3}, \infty)$.

Q34.

Answer: A

Explanation:

Factoring gives $\frac{((x-2)(x-7))^{103}}{((x-3)(x-5))^{102}} \leq 0$. The denominator has an even power, so it is positive wherever defined (i.e., for $x \neq 3, 5$), and the points $x = 3, 5$ must be excluded. Thus the inequality reduces to $(x-2)(x-7) \leq 0$ (odd power preserves sign), which holds on $[2, 7]$. Removing the excluded points gives $[2, 7] - \{3, 5\}$.

Q35.

Answer: B

Explanation:

The even-power factors $(x+4)^2$ and $(x-5)^4$ do not change sign; $x = -4$ lies in a negative region so it appears as the isolated point $\{-4\}$, while $x = 5$ lies inside a positive region and is absorbed. The odd-power factors $(x+1)$, $(x-2)^3$ and $(2x-7)$ flip the sign at $-1, 2, 3.5$. The sign scheme gives positive regions $(-1, 2)$ and $(3.5, \infty)$, and including the zeros yields $[-1, 2] \cup [3.5, \infty) \cup \{-4\}$, so $a = -1$, $b = 2$, $c = 3.5$ and $a + b + c = 4.5$.

Q36.

Answer: C

Explanation:

Only odd powers change sign: $(x-2)^{13}$ (numerator) flips at 2, and $(x+3)^{2019}$ (denominator) flips at -3 . The even powers x^{40} and $(x+4)^{2022}$ never change sign: $x = 0$ is a zero of the expression (included, and isolated since the sign is negative around it), while $x = -4$ is a pole (excluded, without sign change). The sign of the expression equals the sign of $(x-2)(x+3)$, giving positive regions $(-\infty, -4)$, $(-4, -3)$ and $(2, \infty)$; adding the zeros 2 and 0 yields $(-\infty, -4) \cup (-4, -3) \cup [2, \infty) \cup \{0\}$.

Q37.

Answer: A

Explanation:

Combining all terms over the common denominator $(x-2)(x-6)$ gives

$\frac{4+9(x-2)+(x-2)(x-6)}{(x-2)(x-6)} > 0$. The numerator simplifies to

$x^2 + x - 2 = (x+2)(x-1)$, so the inequality becomes $\frac{(x+2)(x-1)}{(x-2)(x-6)} > 0$. The

sign scheme over the critical points $-2, 1, 2, 6$ (all excluded since the inequality is strict) yields positive intervals $(-\infty, -2) \cup (1, 2) \cup (6, \infty)$.

Q38.

Answer: B

Explanation:

For the first expression, $x^2 > 0$ away from 0, and rewriting

$(4-x)(1-3x) = 3(x-4)(x-\frac{1}{3})$ gives the sign condition $\frac{(x-4)(x-\frac{1}{3})}{(x+\frac{1}{3})(x+3)} < 0$,

solved by $(-3, -\frac{1}{3}) \cup (\frac{1}{3}, 4)$. Factoring the second denominator as

$x(2x-1)(3x+1)$, its sign scheme gives positivity on

$(-\infty, -\frac{1}{2}) \cup (-\frac{1}{3}, 0) \cup (\frac{1}{2}, \infty)$. Intersecting, $S = (-3, -\frac{1}{2}) \cup (\frac{1}{2}, 4)$, which fully contains the interval $(-\frac{5}{2}, -1)$.

Q39.

Answer: C

Explanation:

The even power $(5-x)^2$ never changes sign; its zero $x=5$ simply makes the expression 0 (included). The odd-power factors change sign at $-2, 1, 2$

(denominator poles, excluded) and at 3 (numerator zero, included). The sign scheme is negative on $(-\infty, -2)$, $(1, 2)$ and $(3, \infty)$ (the point 5 inside $(3, \infty)$ gives equality), so the solution is $(-\infty, -2) \cup (1, 2) \cup [3, \infty)$.

Q40.

Answer: A

Explanation:

Rewriting as $|x^2 - 6x + 8| = 2x - 6$, the quadratic $x^2 - 6x + 8$ is nonnegative for $x \leq 2$ or $x \geq 4$ and negative for $2 < x < 4$. In the first region the equation becomes $x^2 - 8x + 14 = 0$, giving $x = 4 \pm \sqrt{2}$, of which only $4 + \sqrt{2}$ lies in the region; in the second region it becomes $x^2 - 4x + 2 = 0$, giving $x = 2 \pm \sqrt{2}$, of which only $2 + \sqrt{2}$ lies in $(2, 4)$. The roots are $4 + \sqrt{2}$ and $2 + \sqrt{2}$, summing to $6 + 2\sqrt{2}$.

Q41.

Answer: B

Explanation:

Rewriting as $|x^2 - 6x + 5| = 2x - 5$, the quadratic $x^2 - 6x + 5$ is nonnegative for $x \leq 1$ or $x \geq 5$ and negative for $1 < x < 5$. In the first region the equation becomes $x^2 - 8x + 10 = 0$, giving $x = 4 \pm \sqrt{6}$, of which only $4 + \sqrt{6}$ lies in the region; in the second region it becomes $x^2 - 4x = 0$, giving $x = 0, 4$, of which only 4 lies in $(1, 5)$. The roots are $4 + \sqrt{6}$ and 4, summing to $8 + \sqrt{6}$.

Q42.

Answer: B

Explanation:

The expression $|x+2| + |x-2|$ is the sum of distances from x to -2 and 2 . Since the distance between -2 and 2 is exactly 4, every point of the segment $[-2, 2]$ satisfies the equation, while outside this segment the sum of distances exceeds 4. Case analysis confirms the solution set is $[-2, 2]$.

Q43.

Answer: C

Explanation:

The left side $|x+1| + |x-3|$ measures the sum of distances from x to -1 and to 3 . The distance between -1 and 3 is exactly 4, so every point of the segment $[-1, 3]$ satisfies the equation, while points outside give a sum greater than 4. Case analysis confirms the solution set is $[-1, 3]$.

Q44.

Answer: C

Explanation:

The left side is piecewise linear with critical points 2, 3, 4. On $x \leq 2$ it equals $9 - 3x$, giving $x = 4/3$ (valid); on $2 \leq x \leq 3$ it equals $5 - x$, giving $x = 0$ (invalid); on $3 \leq x \leq 4$ it equals $x - 1$, giving $x = 6$ (invalid); on $x \geq 4$ it equals $3x - 9$, giving $x = 14/3$ (valid). Hence the solution set is $\{4/3, 14/3\}$.

Q45.

Answer: B

Explanation:

The left side is piecewise linear with critical points $-3, -2, -1$. On $x \leq -3$ it equals $-3x - 6$, giving $x = -10/3$ (valid); on $-3 \leq x \leq -2$ it equals $-x$, giving $x = -4$ (invalid); on $-2 \leq x \leq -1$ it equals $x + 4$, giving $x = 0$ (invalid); on $x \geq -1$ it equals $3x + 6$, giving $x = -2/3$ (valid). Hence the solution set is $\{-10/3, -2/3\}$.

Q46.

Answer: 4

Explanation:

Odd powers change sign, even powers do not. The sign-changing points are $-4, -2, 3, 5, 7$, while $x = -7$ (even numerator power) is a zero included without sign change and $x = 0, -9$ (even denominator powers) are excluded poles without sign change. The sign scheme gives negative regions $(-\infty, -4), (-2, 3), (5, 7)$; including the numerator zeros -2 and 5 , the solution contains $[-2, 3)$ and $[5, 7)$ among positive values. The positive integers in the solution are 1, 2, 5, 6, i.e., 4 values.

Q47.

Answer: 2

Explanation:

The critical points of the moduli are $x = -5$ and $x = -4$. For $x \geq -4$ the equation reduces to $x^2 + 6x + 8 = 0$ giving $x = -2, -4$, both valid. For $-5 \leq x < -4$ it reduces to $x^2 + 2x - 8 = 0$ giving $x = 2, -4$, neither lying in the half-open interval. For $x < -5$ it reduces to $x^2 + 6x + 12 = 0$, which has no real roots. Hence there are exactly 2 real solutions.

Q48.

Answer: 3

Explanation:

The critical points are $x = -8$ and $x = -6$. For $x \geq -6$ the equation becomes $x^2 + 8x + 14 = 0$ with roots $-4 \pm \sqrt{2}$, both valid since $-4 - \sqrt{2} \approx -5.41 \geq -6$. For $-8 \leq x < -6$ it becomes $x^2 + 4x - 14 = 0$ with roots $-2 \pm 3\sqrt{2}$, of which only $-2 - 3\sqrt{2} \approx -6.24$ lies in the interval. For $x < -8$ it becomes $x^2 + 8x + 18 = 0$, which has no real roots. Hence there are exactly 3 real solutions.

Q49.

Answer: 4

Explanation:

Substitute $y = |x|$ where $y \geq 0$ to get the quadratic equation $y^2 - 5y + 4 = 0$. Factoring gives $(y - 1)(y - 4) = 0$, so $y = 1$ or $y = 4$. Since both values are non-negative, they yield $|x| = 1$ giving $x = \pm 1$ and $|x| = 4$ giving $x = \pm 4$. Thus, there are 4 real solutions in total.

Q50.

Answer: 2

Explanation:

Substitute $y = |x|$ where $y \geq 0$ to get the quadratic equation $y^2 - 6y + 9 = 0$. Factoring gives $(y - 3)^2 = 0$, so $y = 3$. Since $3 \geq 0$, it is a valid value for $|x|$. Solving $|x| = 3$ yields $x = 3$ and $x = -3$. Thus, there are exactly 2 real solutions.

Q51.

Answer: B

Explanation:

Once the block slides, the opposing kinetic friction is $f = \mu mg = 0.3 \times 5 \times 10 = 15$ N. The net driving force is $F - f = 35 - 15 = 20$ N, so the acceleration is $a = \frac{F - \mu mg}{m} = \frac{20}{5} = 4$ m/s².

Q52.

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 $H = \frac{W}{J} = \frac{58.8}{4.2} = 14 \text{ cal}$.

Q53.

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.

Q54.

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 $a = g(\sin \theta - \mu \cos \theta)$.

Q55.

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.

Q56.

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: $a = 1.67 \text{ m/s}^2$

Q57.

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.

Q58.

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: $12g - 10g \sin 37^\circ - f = (12 + 10)a$ $120 - 60 - 16 = 22a$ $44 = 22a$ $a = 2 \text{ m/s}^2$

Q59.

Answer: A

Explanation:

Weight of the block: $W = mg = 8(10) = 80\text{N}$ Maximum static friction:
 $f_{s,\max} = \mu_s N = 0.5(120) = 60\text{N}$ 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, $a = \frac{50}{8} = 6.25\text{m/s}^2$

Q60.

Answer: A

Explanation:

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

Q61.

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:
 $f_{s,\max} = \mu_s N = 0.4(400) = 160\text{N}$ 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, $a = \frac{80}{50} = 1.6\text{m/s}^2$

Q62.

Answer: C

Explanation:

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

Q63.

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, $s = 80\text{m}$

Q64.

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: $m \approx 1.66\text{kg}$

Q65.

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, $a = 0$.

Q66.

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, $a = 0$, $f = 30\text{N}$

Q67.

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, $a = 0$, $f = 38\text{N}$

Q68.

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, $a = \frac{11}{10} = 1.1\text{m/s}^2$

Q69.

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, $a = \frac{12}{10} = 1.2\text{m/s}^2$

Q70.

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, $a = \frac{25}{10} = 2.5\text{m/s}^2$

Q71.

Answer: 50

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 $F = \frac{mg}{\mu} = \frac{3 \times 10}{0.6} = 50\text{ N}$.

Q72.

Answer: 60

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 $F = \mu_s N = \mu_s mg = 0.75 \times 8 \times 10 = 60\text{ N}$.

Q73.

Answer: 6

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, $f = 6\text{ N}$.

Q74.

Answer: 120

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 $f_{\max} = \mu N = 0.4 \times 300 = 120\text{ N}$.

Q75.

Answer: 30

Explanation:

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