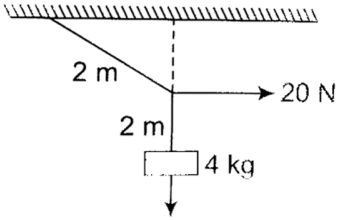
Max Marks: 60 **Date: 18.09.2022**

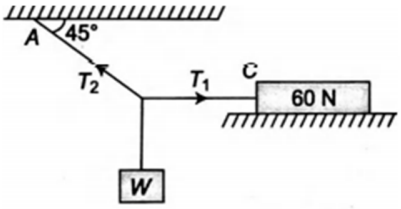
JB 1 MR BATCH
PHYSICS : DCT
Topic: Newton's Laws of Motion

1. A mass of 4 kg is suspended by a rope of length 4 m from a ceiling. A force of 20 N in the horizontal direction is applied at the mid-point of the rope as shown in figure. What is the angle which the rope makes with the vertical in equilibrium? Neglect the mass of the rope. Take g = 10 ms^{-2}



(a) $\tan^{-1}2$ (b) $\tan^{-1}\left(\frac{1}{2}\right)$ (c) $\tan^{-1}\sqrt{2}$ (d) $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$

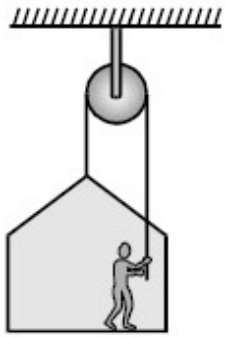
2. In the figure, a block of weight 60 N is placed on a rough surface. The coefficient of friction between the block and the surfaces is 0.5. What should be the weight W such that the block does not slip on the surface?



(a) 60 N (b) $\frac{60}{\sqrt{2}}$ N (c) 30 N (d) $\frac{30}{\sqrt{2}}$ N

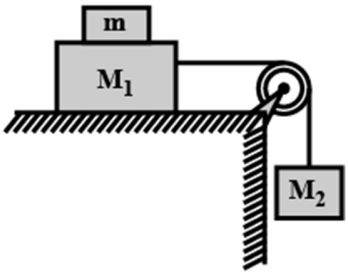
Space for Rough Work

3. A man is raising himself and the crate on which he stands with an acceleration of 5 m/s^2 by a massless rope-and-pulley arrangement. Mass of the man is 100 kg and that of the crate is 50 kg. If g = 10 m/s^2, the contact force between man and the crate is



(a) 2250 N (b) 1125 N (c) 750 N (d) 375 N

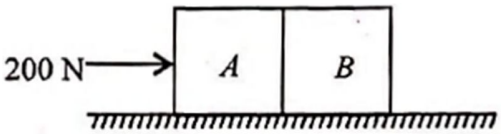
4. Two blocks of masses M_1 and M_2 are connected with a string passing over a pulley as shown in figure. The block M_1 lies on horizontal surface. The coefficient of friction between the block M_1 and the horizontal surface is μ. The system accelerates. What additional mass m should be placed on the block M_1 so that the system does not accelerate?



(a) $\frac{M_2 - M_1}{\mu}$ (b) $\frac{M_2}{\mu} - M_1$ (c) $M_2 - \frac{M_1}{\mu}$ (d) $(M_2 - M_1)\mu$

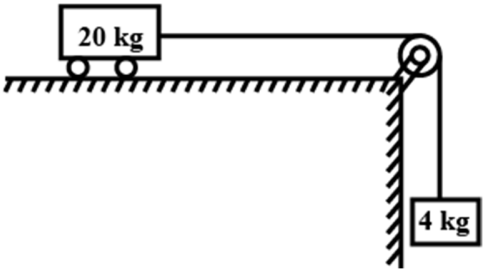
Space for Rough Work

5. Two blocks A and B of masses 10 kg and 15 kg are placed in contact with each other rest on a rough horizontal surface as shown in the figure. The coefficient of friction between the blocks and surface is 0.2. A horizontal force of 200 N is applied to block A. The acceleration of the system is (Take g = 10 ms^{-2})



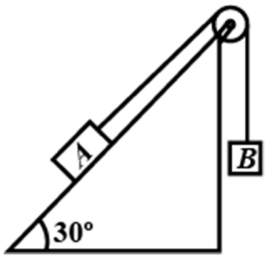
(a) 4 m s^{-2} (b) 6 m s^{-2} (c) 8 m s^{-2} (d) 10 m s^{-2}

6. A trolley of mass 20 kg is attached to a block of mass 4 kg by a massless string passing over a frictionless pulley as shown in the figure. If the coefficient of kinetic friction between trolley and the surface is 0.02, then the acceleration of the trolley and block system is (Take g = 10 ms^{-2})



(a) 1 ms^{-2} (b) 2 ms^{-2} (c) 1.5 ms^{-2} (d) 2.5 ms^{-2}

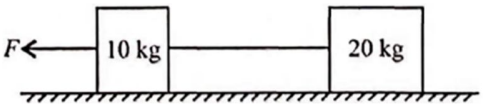
7. Block A of weight 100 N rests on a frictionless inclined plane of slope angle 30° as shown in the figure. A flexible cord attached to A passes over a frictionless pulley and is connected to block B of weight W. Find the weight W for which the system is in equilibrium.



(a) 25 N (b) 50 N (c) 75 N (d) 100 N

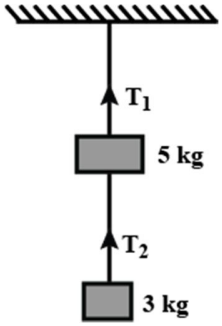
Space for Rough Work

8. Two blocks of masses 10 kg and 20 kg are connected by a massless string and are placed on a smooth horizontal surface as shown in the figure. If a force F = 600 N is applied to 10 kg block, then the tension in the string is



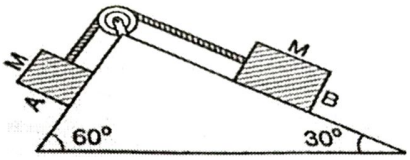
(a) 100 N (b) 200 N (c) 300 N (d) 400 N

9. Two masses of 5 kg and 3 kg are suspended with the help of massless inextensible strings as shown in figure. The whole system is going upwards with an acceleration of 2 m s^{-2}. The tensions T_1 and T_2 are respectively (Take g = 10 m s^{-2})



(a) 96 N, 36 N (b) 36 N, 96 N (c) 96 N, 96 N (d) 36 N, 36 N

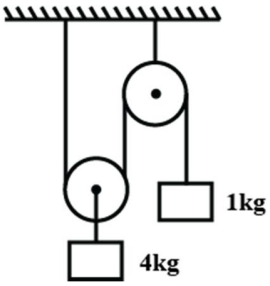
10. Two blocks each of mass M are resting on a frictionless inclined plane as shown in figure. Then



(a) The block A moves down the plane (b) The block B moves down the plane
(c) Both the blocks remain at rest (d) Both the blocks move down the plane

Space for Rough Work

11. In the system shown in the figure, the acceleration of 1 kg mass is



(a) $\frac{g}{4}$ downwards (b) $\frac{g}{2}$ downwards (c) $\frac{g}{2}$ upwards (d) $\frac{g}{4}$ upwards

12. A monkey of mass 40 kg climbs on a massless rope which can stand a maximum tension of 500 N. In which of the following cases will the rope break? (Take $g = 10\ m\ s^{-2}$)

(a) The monkey climbs up with an acceleration of $5\ m\ s^{-2}$

(b) The monkey climbs down with an acceleration of $5\ m\ s^{-2}$

(c) The monkey climbs up with a uniform speed of $5\ m\ s^{-1}$

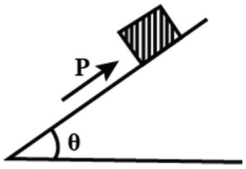
(d) The monkey falls down the rope freely under gravity.

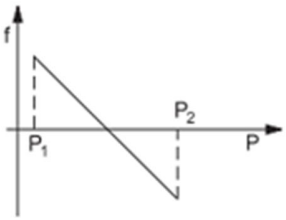
13. A mass of 1 kg is suspended by means of a thread. The system is (i) lifted up with an acceleration of $4.9\ m\ s^2$ (ii) lowered with an acceleration of $4.9\ m\ s^{-2}$. The ratio of tension in the first and second case is

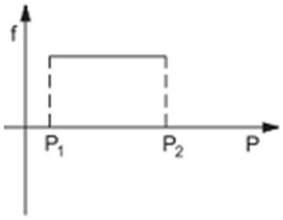
(a) 3 : 1 (b) 1 : 2 (c) 1 : 3 (d) 2 : 1

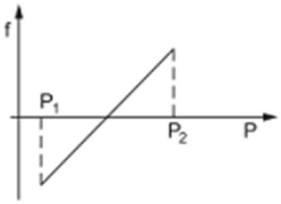
Space for Rough Work

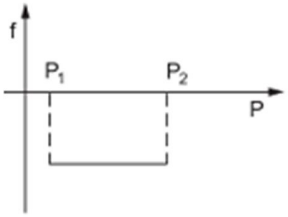
14. A block of mass m is on an inclined plane of angle θ. The coefficient of friction between the block and the plane is μ and tan θ > μ. The block is held stationary by applying a force P parallel to the plane. The direction of force pointing up the plane is taken to be positive. As P is varied from $P_1 = mg(\sin\theta - \mu\cos\theta)$ to $P_2 = mg(\sin\theta + \mu\cos\theta)$, the frictional force f versus P graph will look like



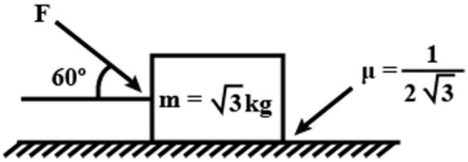
(a)


(b)


(c)


(d)


15. What is the maximum value of the force F such that the block shown in the arrangement, does not move?



(a) 20 N (b) 10 N (c) 12 N (d) 15 N

Space for Rough Work

Max Marks: 60 **Date: 18.09.2022**

JB 1 MR BATCH
CHEMISTRY: DCT
Topic: Periodic & Moles (Till Titration)+ States of Matter

16. 10 mL of 0.5 N HCl, 30 mL of 0.1 N HNO_3 and 75 mL of 0.1 M H_2SO_4 are mixed together. The normality of the resulting solution will be:

(a) 0.2 N (b) 0.1 N (c) 0.4 N (d) 0.5 N

17. The amount of $KMnO_4$ required to prepare 100 mL of a 0.1 N solution in an acidic medium is:

(a) 3.16 g (b) 1.58 g (c) 0.316 g (d) 31.6 g

18. 0.185 g of an iron wire containing 99.8% iron is dissolved in an acid to form ferrous ions. The solution requires 33 mL of $K_2Cr_2O_7$ solution for complete reaction. The normality of the $K_2Cr_2O_7$ solution is:

(a) 0.05 (b) 0.02 (c) 0.20 (d) 0.10

19. Volume of 0.1 M ferrous oxalate solution required to react completely with 60 ml of 0.1 N acidified $KMnO_4$ solution.

(a) 30 mL (b) 20 mL (c) 150 mL (d) 10 mL

20. 26.8 g of $Na_2SO_4 \cdot nH_2O$ contains 12.6 g of water. The value of n is:

(a) 1 (b) 10 (c) 6 (d) 7

21. Which of the following series of compounds have same mass percentage of carbon?

(a) CO_2, CO (b) CH_4, C_6H_6, C_2H_2
(c) C_2H_2, C_6H_6, $C_{10}H_8$ (d) HCHO, CH_3COOH, $C_6H_{12}O_6$

22. A compound contains 38.8% C, 16.0% H and 45.2% N. The empirical formula of the compound would be:

(a) CH_3NH_2 (b) CH_3CN (c) C_2H_5CN (d) $CH_2(NH)_2$

23. Helium atom is two times heavier, than a hydrogen molecule at 298 K. The average kinetic energy of helium is

(a) two times that of hydrogen molecule
(b) same as that of hydrogen molecule
(c) four times that of hydrogen molecule
(d) half that of hydrogen molecule

Space for Rough Work

24. The compressibility of a gas is less than unity at STP, therefore,

(a) $V_m > 22.4$ L (b) $V_m < 22.4$ L (c) $V_m = 22.4$ L (d) $V_m = 44.8$ L

25. If density of a certain gas at 30° C and 768 Torr is 1.35 kg/m^3, then density at STP is

(a) 1.48 kg/m^3 (b) 1.27 kg/m^3 (c) 1.35 kg/m^3 (d) 1.00 kg/m^3

26. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is

(a) ion-ion interaction (b) ion-dipole interaction (c) London force (d) hydrogen bond

27. For the non-zero volume of the molecules, real gas equation for n moles of the gas will be

(a) $\left(p + \frac{a}{V_2}\right)V = RT$ (b) $pV = nRT + nbp$ (c) $p(V - nb) = nRT$ (d) (b) and (c) true

28. At 298 K, which of the following gases has the lowest average molecular speed?

(a) CO_2 at 0.20 atm (b) He at 0.40 atm (c) CH_4 at 0.80 atm (d) NO at 1.00 atm

29. Which of the following gases follows non-ideal behaviour?

(a) N_2 gas having density 1.25 g L^{-1} at STP

(b) 2.8 g CO gas in 0.1 L flask exerting a pressure of 24.63 atm at 300 K

(c) 1.6 g CH_4 in 0.5 L flask at 273 K exerting a pressure of 4 atm

(d) 0.1 g H_2 gas at STP occupies volume of 1.12 L

30. Which of the following properties of liquids arise (s) due to the molecular and thermal interaction?

(a) Vapour pressure (b) Surface tension (c) Viscosity (d) All of these

Space for Rough Work

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JB 1 MR BATCH
MATHEMATICS : DCT
Topic: Log + Complex Number + Quadratic Equation

31. The number of zeros coming immediately after the decimal point in the value of $(5)^{25}$ is:

(a) 16 (b) 17 (c) 18 (d) None of these

32. The number of solutions of $\log_2 (x + 5) = 6 - x$ is:

(a) 2 (b) 0 (c) 3 (d) None of these

33. The set of real values of x for which $\log_{0.2} \frac{x+2}{x} \le 1$ is:

(a) $\left(-\infty, -\frac{5}{2}\right] \cup (0, +\infty)$ (b) $\left[\frac{5}{2}, +\infty\right)$

(c) $(-\infty, -2) \cup (0, +\infty)$ (d) none of these

34. If the number $\frac{(1-i)^n}{(1+i)^{n-2}}$ is real and positive, then n is:

(a) any integer (b) 2λ (c) $4\lambda + 1$ (d) none of these

35. $i^n + i^{n+1} + i^{n+2} + i^{n+3}$ is equal to:

(a) 1 (b) –1 (c) 0 (d) none of these

36. If $b + ic = (1 + a)z$ and $a^2 + b^2 + c^2 = 1$, then $\frac{1+iz}{1-iz}$ is equal to:

(a) $\frac{a-ib}{1-c}$ (b) $\frac{a-ib}{1+c}$ (c) $\frac{a+ib}{1-c}$ (d) $\frac{a+ib}{1+c}$

37. $\left|(1+i)\left(\frac{2+i}{3+i}\right)\right|$ is equal to:

(a) $-\frac{1}{2}$ (b) $\frac{1}{2}$ (c) 1 (d) –1

Space for Rough Work

38. If $z = 1 + I$, then the multiplicative inverse of z^2 is:

(a) $1 - i$ (b) $\frac{i}{2}$ (c) $-\frac{i}{2}$ (d) $2i$

39. The values of x and y which satisfy the equation $\frac{(1+i)x-2i}{3+i}+\frac{(2-3i)y+i}{3-i}=i$ are:

(a) $x = 0, y = 1$ (b) $x = 1, y = 0$ (c) $x = 3, y = -1$ (d) $x = -1, y = 3$

40. If $(x + iy)^{1/3} = a + ib$, then $\frac{x}{a}+\frac{y}{b}=$

(a) $2(a^2 - b^2)$ (b) $4(a^2 - b^2)$ (c) $8(a^2 - b^2)$ (d) none of these

41. If $(1 + i)(1 + 2i)(1 + 3i) \ldots (1 + ni) = \alpha + i\beta$, then $2.5.10\ldots.. (1 + n^2) =$

(a) $\alpha - i\beta$ (b) $\alpha^2 - \beta^2$ (c) $\alpha^2 + \beta^2$ (d) none of these

42. $\sqrt{-1-\sqrt{-1-\sqrt{-1-...\text{to}\infty}}} =$

(a) 1 (b) –1 (c) $-\omega$ (d) ω^2

43. The value of α and β for which α, β are roots of $x^2 - 3ax + \beta = 0$ are

(a) $1, \frac{1}{2}$ (b) 1, 1 (c) 2, 1 (d) 1, 2

44. If α, β are roots of $ax^2 + bx + c = 0$ such that $\alpha^2 + \beta^2 = 1$, then:

(a) $b^2 + a^2 + 2ac = 0$ (b) $b^2 - a^2 = 2ac$ (c) $b^2 + a^2 + 2ac$ (d) None of these

45. If $9^x - 4(3^{x+2}) + 3^5 = 0$, then the solution pair is

(a) (1, 3) (b) (2, 4) (c) (1, 2) (d) (2, 3)

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Space for Rough Work

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Max Marks: 60 **Date: 18.09.2022**

JB 1 MR BATCH
PHYSICS: DCT ANSWER KEY
Topic: Newton's Laws of Motion

1.	(b)	2.	(c)	3.	(a)	4.	(a)	5.	(b)
6.	(c)	7.	(b)	8.	(d)	9.	(a)	10.	(a)
11.	(c)	12.	(a)	13.	(a)	14.	(a)	15.	(a)

Max Marks: 60 **Date: 18.09.2022**

CHEMISTRY: DCT ANSWER KEY
Topic: Periodic & Mole (Till titration), States of Matter

16.	(a)	17.	(c)	18.	(d)	19.	(b)	20.	(d)
21.	(d)	22.	(a)	23.	(b)	24.	(b)	25.	(a)
26.	(d)	27.	(d)	28.	(a)	29.	(c)	30.	(d)

Max Marks: 60 **Date: 18.09.2022**

MATHEMATICS: DCT ANSWER KEY
Topic: Log + Complex Number + Quadratic Equation

31.	(b)	32.	(d)	33.	(a)	34.	(c)	35.	(c)
36.	(d)	37.	(c)	38.	(c)	39.	(c)	40.	(b)
41.	(c)	42.	(d)	43.	(d)	44.	(b)	45.	(d)