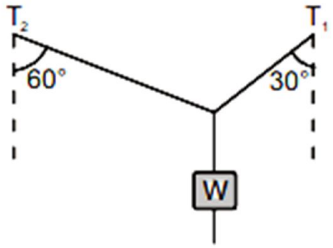
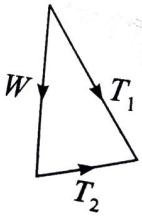
Max Marks: 60 **Date: 04.09.2022**

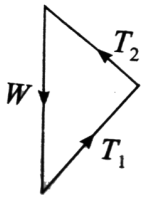
JB 1 MR BATCH
PHYSICS : DCT
Topic: Normal reaction, tension, friction, spring force

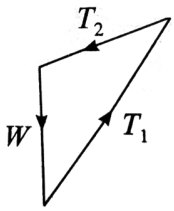
1. A weight W is supported by two strings inclined at 60º and 30º to the vertical. The tensions in the strings are T_1 and T_2 as shown. If these tensions are to be determined in terms of W using a triangle of forces, which of these triangles should you draw? (block is in equilibrium)



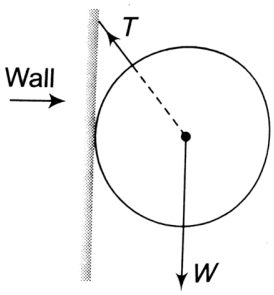
(a) 

(b) 

(c) 

(d) 

2. A uniform sphere of weight w and radius 3 m is being held by a string of length 2 m attached to a frictionless wall as shown in the figure. The tension in the string will be:



(a) 5w/4 (b) 15w/4 (c) 15w/16 (d) none of these

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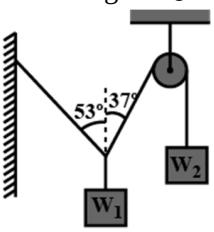
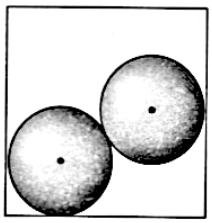
3. Two weight W_1 and W_2 in equilibrium and at rest are suspended as shown in figure. Then the ratio W_1/W_2 is:



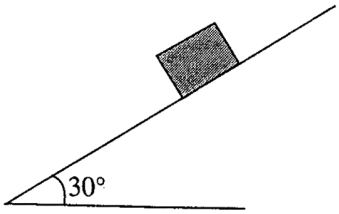
(a) 5/4 (b) 4/5 (c) 8/5 (d) none of these

4. Two smooth spheres each of radius 5 cm and weight W rest one on the other inside a fixed smooth cylinder of radius 8 cm. The reactions between the spheres and the vertical side of the cylinder are:



(a) W/4 and 3W/4 (b) W/4 and W/4 (c) 3W/4 and 3W/4 (d) W and W

5. Figure shows a block kept on a rough inclined plane. The maximum external force down the incline for which the block remains at rest is 1 N while the maximum external force up the incline for which the block is at rest is 7N. The coefficient of static friction μ is:



(a) $\frac{\sqrt{3}}{2}$ (b) $\frac{1}{\sqrt{6}}$ (c) $\sqrt{3}$ (d) $\frac{4}{3\sqrt{3}}$

6. A block of mass 20 kg is acted upon by a force F = 30 N at an angle 53° with the horizontal in downward direction as shown. The coefficient of friction between the block and the horizontal surface is 0.2. The friction force acting on the block by the ground is ($g = 10\ mm/s^2$)

(a) 40.0 N (b) 30.0 N (c) 18.0 N (d) 44.8 N

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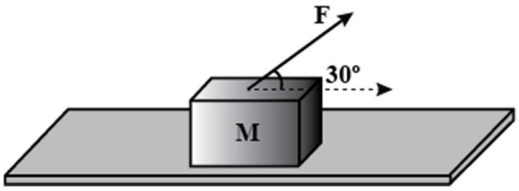
7. A 60 kg body is pushed with just enough force to start it moving across a floor and the same force continues to act afterwards. The coefficient of static friction and sliding friction are 0.5 and 0.4 respectively. The acceleration of the body is

(a) 6 m/s^2 (b) 4.9 m/s^2 (c) 3.92 m/s^2 (d) 1 m/s^2

8. A block of mass M = 5 kg is resting on a rough horizontal surface for which the coefficient of friction is 0.2. When a force F = 40 N is applied, the acceleration of the block will be (g = 10 m/s^2)



(a) 5.73 m/sec^2 (b) 8.0 m/sec^2 (c) 3.17 m/sec^2 (d) 10.0 m/sec^2

9. A fireman of mass 60 kg slides down a pole. He is pressing the pole with a force of 600 N. The coefficient of friction between the hands and the pole is 0.5, with what acceleration will the fireman slide down (g = 10 m/s^2)

(a) 1 m/s^2 (b) 2.5 m/s^2 (c) 10 m/s^2 (d) 5 m/s^2

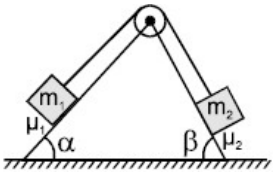
10. The force required just to move a body up an inclined plane is double the force required just to prevent the body sliding down. If the coefficient of friction is 0.25, the angle of inclination of the plane is

(a) 37° (b) 45° (c) 30° (d) 53°

11. A force of 750 N is applied to a block of mass 102 kg to prevent it from sliding on a plane with an inclination angle 30° with the horizontal. If the coefficients of static friction and kinetic friction between the block and the plane are 0.4 and 0.3 respectively, then the frictional force acting on the block is

(a) 750 N (b) 500 N (c) 345 N (d) 250 N

12. Two blocks of masses m_1 and m_2 connected by a string are placed gently over a fixed inclined plane, such that the tension in the connecting string is initially zero. The coefficient of friction between m_1 and inclined plane is μ_1; between μ_2 and the inclined plane is μ_2. The tension in the string shall continue to remain zero if



(a) $\mu_1 > \tan\alpha$ and $\mu_2 < \tan\beta$ (b) $\mu_1 < \tan\alpha$ and $\mu_2 > \tan\beta$
(c) $\mu_1 > \tan\alpha$ and $\mu_2 > \tan\beta$ (d) $\mu_1 < \tan\alpha$ and $\mu_2 < \tan\beta$

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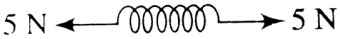
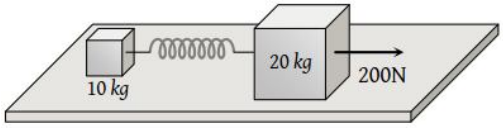
13. The tension in the spring is



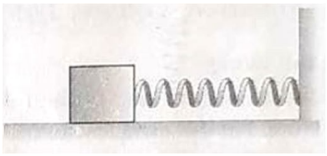
(a) Zero (b) 2.5 N (c) 5 N (d) 10 N

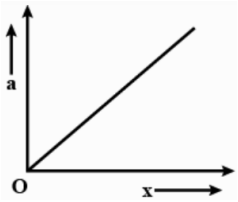
14. The masses of 10 kg and 20 kg respectively are connected by a massless spring as shown in figure. A force of 200 N acts on the 20 kg mass. At the instant shown, the 10 kg mass has acceleration 12 m/sec^2. What is the acceleration of 20 kg mass?

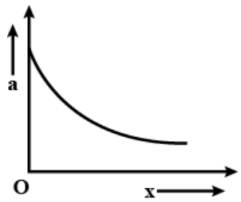


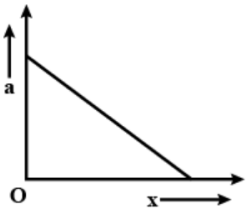
(a) 12 m/sec^2 (b) 4 m/sec^2 (c) 10 m/sec^2 (d) Zero

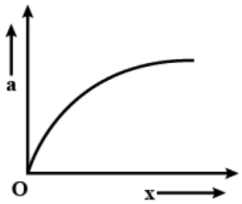
15. An ideal spring is compressed and placed horizontally between a vertical fixed was and a block free to slide over a smooth horizontal table top as shown in the figure. The system is released from rest. The graph which represents the relation between the magnitude of acceleration 'a' of the block and the distance 'x' travelled by it (as long as the spring is compressed) is



(a) 

(b) 

(c) 

(d) 

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Max Marks: 60 **Date: 04.09.2022**

JB 1 MR BATCH
MATHEMATICS : DCT
Topic: AP and GP

16. If three positive real numbers a, b, c are in A.P. such that abc = 4, then the minimum value of b is

(a) $2^{1/3}$ (b) $2^{2/3}$ (c) $2^{1/2}$ (d) $2^{3/2}$

17. The maximum sum of the series $20+19\frac{1}{3}+18\frac{2}{3}+...$ is

(a) 310 (b) 300 (c) 320 (d) none of these

18. The largest term common to the sequences 1, 11, 21, 31, … to 100 terms and 31, 36, 41, 46, … to 100 terms is

(a) 381 (b) 471 (c) 281 (d) none of these

19. If the sides of a right angles triangle are in A.P., then the sines of the acute angles are

(a) $\frac{3}{5},\frac{4}{5}$ (b) $\frac{1}{\sqrt{3}},\sqrt{\frac{2}{3}}$ (c) $\frac{1}{2},\frac{\sqrt{3}}{2}$ (d) none of these

20. If S_n denotes the sum of n terms of A.P., then $S_{n+3} - 3S_{n+2} + 3S_{n+1} - S_n$ =

(a) $2S_n$ (b) S_{n+1} (c) $3S_n$ (d) 0

21. In a A.P. of which a is the first term, if the sum of the first p terms is zero, then the sum of the next q terms is

(a) $-\frac{a(p+q)p}{q+1}$ (b) $\frac{a(p+q)p}{q+1}$ (c) $-\frac{a(p+q)p}{q-1}$ (d) none of these

22. If S_n denotes the sum of first n terms of an A.P. and $\frac{S_{3n}-s_{n-1}}{S_{2n}-s_{2n-1}}=31$, then the value of n is

(a) 21 (b) 15 (c) 16 (d) 19

23. If a, b and c are in A.P., then $a^3 + c^3 - 8b^3$ is equal to

(a) 2abc (b) 6abc (c) 4abc (d) none of these

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24. The number of terms of an A.P. is even; the sum of the odd terms is 24, and of the even terms is 30, and the last term exceeds the first by 10/2, then the number if terms in the series is

(a) 8 (b) 4 (c) 6 (d) 10

25. If the sum of the n terms of an A.P. is $cn(n-1)$, where $c \neq 0$, then the sum of the square of these terms is

(a) $c^2n(n+1)^2$ (b) $\frac{2}{3}c^2n(n-1)(2n-1)$

(c) $\frac{2c^2}{3}n(n+1)(2n+1)$ (d) none of these

26. Consider an A.P. $a_1, a_2, a_3, \ldots$ such that $a_3 + a_5 + a_8 = 11$ and $a_4 + a_2 = -2$, then the value of $a_1 + a_6 + a_7$ is

(a) –8 (b) 5 (c) 7 (d) 9

27. Let $a_1, a_2, a_3, \ldots$ be terms of an A.P. If $\frac{a_1 + a_2 + \ldots + a_p}{a_1 + a_2 + \ldots + a_q} = \frac{p^2}{q^2}, p \neq q$, then $\frac{a_6}{a_{21}}$ equals

(a) 41/11 (b) 7/2 (c) 2/7 (d) 11/41

28. If S_n denotes the sum of first n terms of an A.P. whose first term is a and S_{nx}/S_x is independent of x, then S_p =

(a) p^3 (b) p^2a (c) pa^2 (d) a^3

29. Three numbers form an increasing G.P. If the middle number is doubled, then the new numbers are in A.P. The common ratio of the G.P. is

(a) $2-\sqrt{3}$ (b) $2+\sqrt{3}$ (c) $\sqrt{3}-2$ (d) $3+\sqrt{2}$

30. If $|a| < 1$ and $|b| < 1$, then the sum of the series $1 + (1 + a)b + (1 + a + a^2)b^2 + (1 + a + a^2 + a^3)b^3 + \ldots$. is

(a) $\frac{1}{(1-a)(1-b)}$ (b) $\frac{1}{(1-a)(1-ab)}$

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

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Max Marks: 60 **Date: 04.09.2022**

JB 1 MR BATCH
PHYSICS : DCT ANSWER KEY
Topic: Normal reaction, tension, friction, spring force

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

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JB 1 MR BATCH
MATHEMATICS : DCT ANSWER KEY
Topic: AP and GP

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