JEE-ADVANCED-2013-P1-Model

Time:09:00 A.M to 12:00 Noon **IMPORTANT INSTRUCTIONS** **Max Marks: 180**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 10)	Questions with Single Correct Choice	2	0	10	20
Sec – II(Q.N : 11 – 15)	Questions with Multiple Correct Choice	4	-1	5	20
Sec – III(Q.N : 16 – 20)	Questions with Integer Answer Type	4	-1	5	20
Total				**20**	**60**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 – 30)	Questions with Single Correct Choice	2	0	10	20
Sec – II(Q.N : 31 – 35)	Questions with Multiple Correct Choice	4	-1	5	20
Sec – III(Q.N : 36 – 40)	Questions with Integer Answer Type	4	-1	5	20
Total				**20**	**60**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 41 – 50)	Questions with Single Correct Choice	2	0	10	20
Sec – II(Q.N : 51 – 55)	Questions with Multiple Correct Choice	4	-1	5	20
Sec – III(Q.N : 56 – 60)	Questions with Integer Answer Type	4	-1	5	20
Total				**20**	**60**

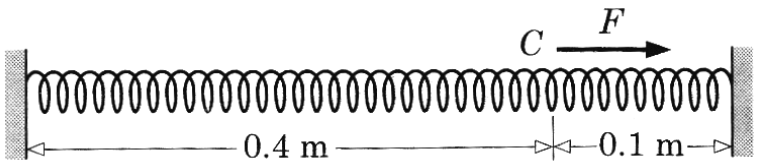
PHYSICS: Max.Marks : 60

SECTION I

Single Correct Answer Type

This section contains **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

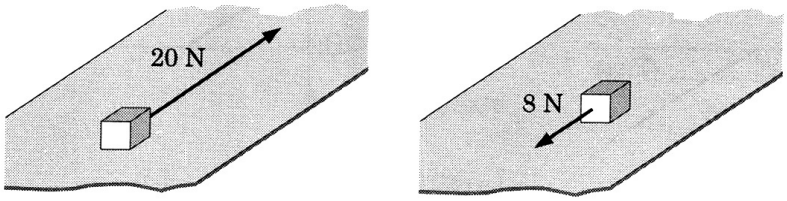
1. A light spring of force constant 1.0N/cm is fixed between two walls. When a force of F = 5.0 N is exerted along the spring at point C as shown. What will be the displacement of point C?



A) 8 mm B) 22.2 mm

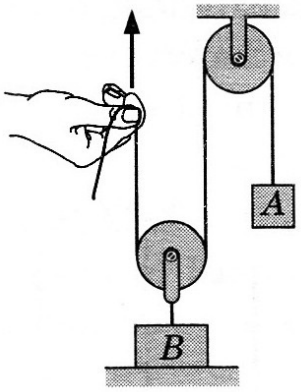
C) 40 mm D) Spring's relaxed length must be known

2. If a block is pulled up an inclined plane with a force of 20N along the line of greatest slope, the block slides up with constant velocity. If the block is pulled down the inclined plane with a force of 8 N along the line of greatest slope, the block slides down with constant speed. The force of kinetic friction between the block and the plane is



A) 8N B) 12N C) 14N D) None of these

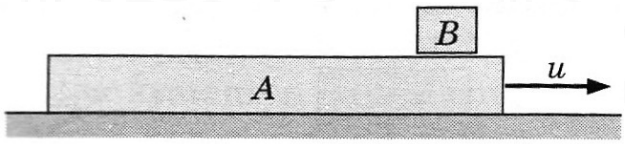
3. In the system shown, initially, the block A is hanging at rest and the block B is touching the floor. Mass of the block A and B are m and 2m respectively. Pulleys have negligible masses, negligible friction, and the thread is extremely light and almost inextensible. Acceleration due to gravity is g. The free end of the thread is pulled up. When it acquires speed v_0, then the speeds of the blocks are



A) $V_A = 2V_o / 3, V_B = V_o / 3$ B) $V_A = V_o / 3, V_B = 2V_o / 3$

C) $V_A = V_o / 3, V_B = V_o / 3$ D) $V_A = V_o / 3, V_B = zero$

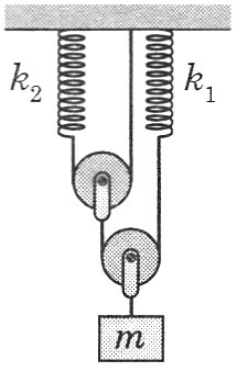
4. A large plank of mass M is moving with velocity u on a horizontal frictionless floor. A block is mass m gently placed on the plank without any velocity. If the block slides a distance l relative to the planks before it stops sliding, find the coefficient of friction between the block and the plank



A) $\mu = \dfrac{Mu^2}{2gl(m+M)}$ B) $\mu = \dfrac{Mu^2}{gl(m+M)}$

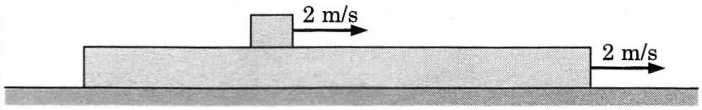
C) $\mu = \dfrac{M}{m}\dfrac{u^2}{gl}$ D) None of these

5. In the arrangement shown, the springs are light and have a stiffness $k_1 = 200N/m \text{ and } k_2 = 100N/m$. The pulleys are light and there is no friction at their axles. A block of mass m = 8 kg block suspended from the lower pulleys is initially held at rest maintaining strings vertically straight and springs relaxed. Now the force supporting the block is gradually reduced and eventually removed. Now the block hangs motionless in equilibrium. How far does the block descend during the process of reduction of the force supporting it? Acceleration due to gravity is $g = 10m/s^2$



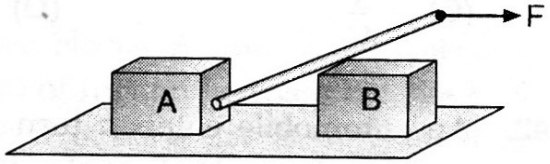
A)10cm B) 15cm C) 1.6m D) None of these

6. A block lies on a long plank moving at 2 m/s as shown. The coefficient of friction between the block and the plank is 0.1. The plank starts decelerating uniformly and stops in 0.5s. Acceleration due gravity is 10m/s^2. The total distance slid by the block on the plank is



A) 37.5cm B) 1.5m C) 75cm D) None of these

7. A horizontal force F is applied on a very light rod inserted between the two identical blocks A and B placed over a rough surface as shown in figure. If the force F is gradually increased, then which of the blocks will move first? (Friction coefficient is same between the blocks and the ground)

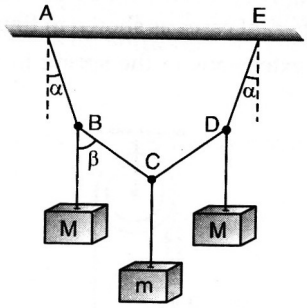


A) A B) B

C) Both move simultaneously

D) This depends on the friction coefficient between the blocks and the ground

8. The figure represents a light inextensible string ABCDE in which AB = BC = CD = DE and to which are attached masses M, m and M at the points B, C and D, respectively. The system hangs freely in equilibrium with ends A and E of the string fixed in the same horizontal line shown in figure. It is given that $tan\alpha = \frac{3}{4}$ and $tan\beta = \frac{12}{5}$. Then the tension in the string BC is



A) 2mg B) $\frac{13}{10}mg$ C) $\frac{3}{10}mg$ D) $\frac{20}{11}mg$

9. A ball of mass m is thrown upward with a velocity *v*. If air exerts an average resisting force F, the velocity with which the ball returns to the thrower is

A) $\upsilon\sqrt{\frac{mg}{mg+F}}$ B) $\upsilon\sqrt{\frac{F}{mg+F}}$ C) $\upsilon\sqrt{\frac{mg-F}{mg+F}}$ D) $\upsilon\sqrt{\frac{mg+F}{mg-F}}$

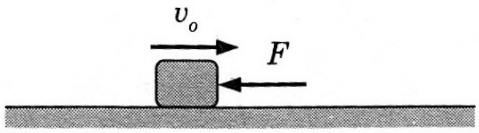
10. A plumb bob is hung from the ceiling of a train compartment. The train moves on an inclined track of inclination 30^o with horizontal. Acceleration of train up the plane is $a_0 = \frac{g}{2}$. The angle which the string supporting the bob makes with normal to the ceiling in equilibrium is

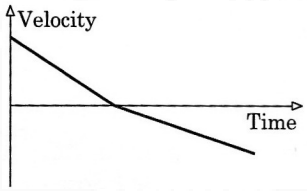
A) 30^o B) $tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$ C) $tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ D) $tan^{-1}(2)$

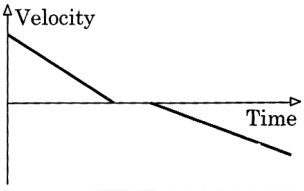
SECTION II
Multiple Correct Answer(s) Type

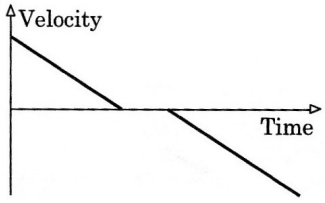
This section contains **5 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct.**

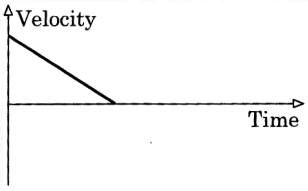
11. A constant force F is applied to a block moving with velocity v_0 on a rough horizontal surface opposite to the direction of initial velocity. Which of the following may represent correct velocity – time graph for ensuing motion



A) 

B) 

C) 

D) 

12. A body is kept on a smooth inclined plane having an inclination of 1 in x. Then,

A) Slope of inclined plane is $\frac{1}{x}$ B) Slope of inclined plane is $\frac{1}{\sqrt{x^2-1}}$

C) If the body of mass m to remain stationary relative to the incline by accelerating the inclined plane , the incline must offer a normal reaction of $mg\frac{x}{\sqrt{x^2-1}}$

D) For the body to remain stationary relative to the incline, the incline must be given a horizontal acceleration of $\frac{g}{\sqrt{x^2-1}}$

13. A uniform chain of length L lies on a smooth horizontal table with its length perpendicular to the edge of the table and a small portion of the chain is hanging over the edge. The chain starts sliding due to the weight of the hanging part.

A) The acceleration of the chain is $\frac{gx}{L}$; where x is the length of the hanging part of chain.

B) The acceleration of the chain is $\frac{g}{L}(L-x)$; where x is the length of the hanging part of chain

C) The velocity of the chain is $x\sqrt{\frac{g}{L}}$; where x is the length of the hanging part of chain.

D) The velocity of the chain is $(L-x)\sqrt{\frac{g}{L}}$; where x is the length of the hanging part to chain.

14. A block of weight W is suspended from a spring balance. The lower surface of the block rests on a weighing machine. The spring balance reads W_1 and the weighing machine reads W_2. Assuming all W, W_1, W_2 to have the same units, which of the following is/are correct?

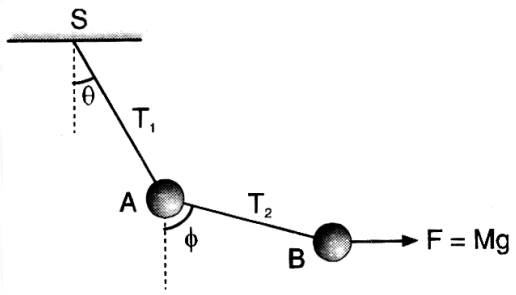
A) $W = W_1 + W_2$, when the system is at rest.

B) $W > W_1 + W_2$, when the system moves down with some acceleration.

C) $W_1 > W_2$, when the system moves up with some acceleration

D) Data is insufficient to find the relation between $W_1 \& W_2$

15. The spheres A and B as shown have mass M each. The strings SA and AB are light and inextensible with tensions $T_1 \& T_2$ respectively. A constant horizontal force F = Mg is acting on B. For the system to be in equilibrium we have

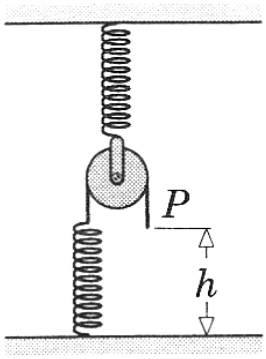


A) $tan\phi = 1$ B) $tan\theta = 0.5$ C) $T_2 = \sqrt{2}Mg$ D) $T_1 = \sqrt{5}Mg$

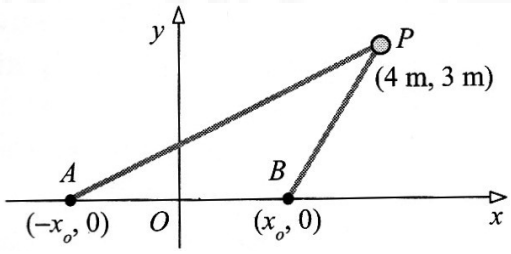
SECTION III
Integer Answer Type

This section contains **5 questions.** The answer to each question is single digit integer, ranging from 0 to 9 (*both inclusive*).

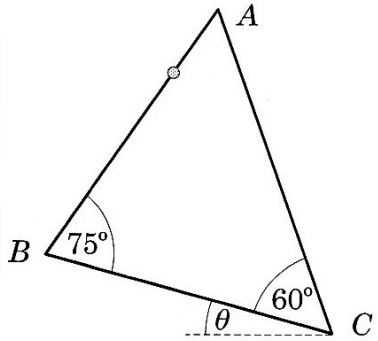
16. A light frictionless pulley is suspended by a light spring. A light inextensible thread passes over the pulley. One end P of the thread is free and the other end is affixed to another light spring. This spring is affixed to the ground at its lower end. Both the springs are identical and have force constant k = 500 N/m. The free end P is h = 10.0cm above the ground. The minimum constant force that should be applied to the end P to bring it to the ground is 5n (in Newton) find n = ?



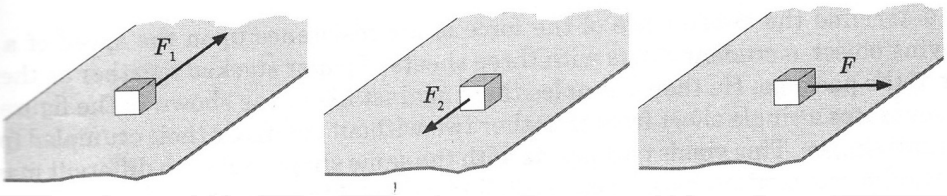
17. Two identical elastic strings of negligible relaxed lengths are tied at fixed points A and B at their one of the ends. Their other ends are tied to a small ball. The system is in gravity free space. To hold the ball in equilibrium at point (4m, 3m) an external force of magnitude F = 1000N is required. Then the force constant k of the strings is k = 20n (in N/m) then find n = ?



18. A rigid triangular frame ABC made of thin rod is fixed in the vertical plane. A small beads starting from rest takes equal time to slide down arms AB and AC. If there is no friction between the bead and the arms then the angle θ, which the arm BC of the frame makes with the horizontal is given by $\theta=5n$ (in degrees) find n =?



19. The block rests motionless on an inclined plane. To drag the block up the plane with constant speed, it is necessary to apply a force $F_1=\sqrt{12}N$ along the line of greatest slope up the incline and to drag the block down the plane with constant speed, it is necessary to apply a force $F_2=\sqrt{3}N$ along the line of greatest slope up the incline. Find the minimum horizontal force F(in N) applied parallel to the plane required to initiate sliding.



20. A block of mass m made by chalk placed on a rough horizontal floor is projected with velocity u along the floor. Coefficient of friction between the block and the floor is μ. If due to wear, the block looses mass at constant rate r kg/m then if total distance travelled by the block before it stops, is $\frac{3u^2}{(n)\mu g}$ then find n = ? (Assume that it stops before it is completely worn out)