CODE	ANURAG-4

SPECTRUM

GATEWAY TO IITS

REVISION-TEST- (PHYSICS)

NEWTON'S LAWS OF MOTION-1

Test Date:..........................

Time: 1 hours *Maximum marks: 100*

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

INSTRUCTIONS

A. General:

1. This booklet is your Question Paper containing 60 questions. The booklet has 14 pages.
2. The question paper CODE is printed on the right hand top corner of this booklet.
3. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers, and electronic gadgets in any form are not allowed to be carried inside the examination hall.
4. The answer sheet, a machine–readable Objective Response Sheet (ORS), is provided separately.
5. DO NOT TAMPER WITH / MUTILATE THE ORS OR THE BOOKLET.

B. Filling the ORS

6. On the lower part of the ORS, write in ink, your name in box L1, your Registration No. in box L2 and Name of the Centre in box L3. **Do not write these anywhere else.**
7. Write your Registration No. in ink, in the box L4 provided in the lower part of the ORS and darken the appropriate bubble **UNDER** each digit of your Registration No. with a good quality HB pencil.
8. The ORS has a **CODE** printed on its lower and upper parts.
9. Make sure the CODE on the ORS is the same as that on this booklet and put your signature in ink in box L5 on the ORS affirming that you have verified this.
10. IF THE CODES DO NOT MATCH, ASK FOR A CHANGE OF THE BOOKLET.

D. Marking Scheme:

16. For each questions in **Section I**, you will be **awarded 4 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In case of bubbling of incorrect answer, **minus one (–1) mark** will be awarded.

Roll Number

Name of the Student

I have read all the instructions and shall abide by them

……..…………………………………………………………

Signature of the Candidate

I have verified all the information filled in by the Candidate

……………………………………………………………..

Signature of the Invigilator

PHYSICS

Newton's Laws of Motion

Time : 2 hours

Note : The marking scheme is (+3, –1) for all questions

Section : I

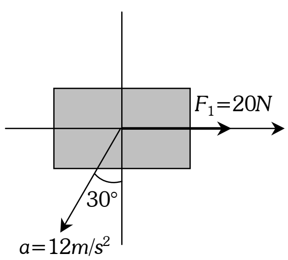
For question number 1 to 14 choose the correct/most appropriates. Only one option should be chosen

1. A flat plate moves normally with a speed v_1 towards a horizontal jet of water of uniform area of cross-section. The jet discharges water at the rate of volume V per second at a speed of v_2. The density of water is ρ. Assume that water splashes along the surface of the plate at right angles to the original motion. The magnitude of the force acting on the plate due to the jet of water is

(a) $\rho V v_1$ (b) $\rho V(v_1 + v_2)$

(c) $\dfrac{\rho V}{v_1 + v_2} v_1^2$ (d) $\rho\left[\dfrac{V}{v_2}\right](v_1 + v_2)^2$

2. There are two forces on the $2kg$ box in the overhead view of following figure, but only one is shown. The figure also shows the acceleration. The magnitude of second force and it's direction from $+x$ axis is given by



(a) $38N, \tan^{-1}\left(\dfrac{3\sqrt{3}}{5}\right)$

(b) $38N, \tan^{-1}\left(\dfrac{3\sqrt{3}}{8}\right)$

(c) $20N, \tan^{-1}\left(\dfrac{2\sqrt{3}}{5}\right)$

(d) $20N, \tan^{-1}\left(\dfrac{2\sqrt{3}}{7}\right)$

3. A 40 kg girl and an 8.4 kg sled, are on the frictionless ice of a frozen lake, 15m apart but connected by a rope of negligible mass. the girl exerts a horizontal 5.2 N force on the rope. How far from the girl's initial position do they meet

(a) 1 m (b) 1.7 m

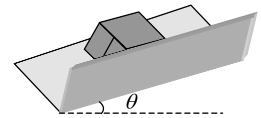
(c) 2.6 m (d) 5.2 m

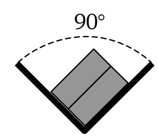
4. If a car's wheels are locked (kept from rolling) during emergency braking, the car slides along the road. Ripped off bits of tire and small melted section of road form the "skid marks" of length 290 m. Assuming coefficient of kinetic friction $\mu_K = 0.6$ and the car's acceleration was constant during the braking, how fast was the car going when the wheel's become locked

(a) 58 m/s (b) 10 m/s

(c) 100 m/s (d) 78 m/s

5. A crate slides down an inclined right angled trough. The coefficient of kinetic friction between the crate and the trough is μ_k. What is the acceleration of the crate





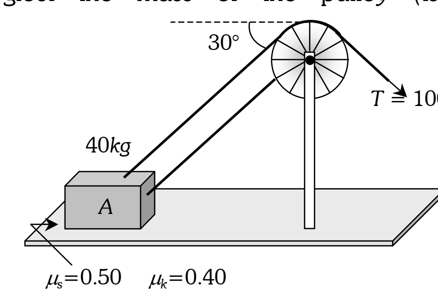
(a) $g\sin\theta$

(b) $g(\sin\theta - \sqrt{2}\mu_k\cos\theta)$

(c) $g(\sin\theta - \mu_k\cos\theta)$

(d) $g(\sin\theta - 2\mu_k\cos\theta)$

6. What will be the acceleration of block A for the instant depicted. Neglect the mass of the pulley (take $g = 10 m/s^2$)



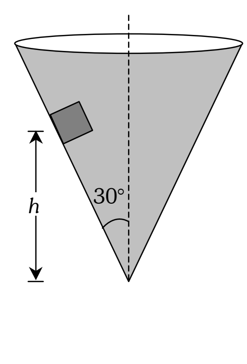
(a) 1.33 m/s^2

(b) 2.66 m/s^2

(c) 4.75 m/s^2

(d) 0

7. A small block of mass m is placed inside a hollow cone rotating about a vertical axis with angular velocity ω as shown in the figure. The semivertex angle of the cone is 30° and the coefficient of friction between the cone and the block is $\mu = \dfrac{1}{\sqrt{3}}$. If the block is to remain at a constant height h above the apex of the cone, the minimum value of ω is (take g = 10 m/s^2)



(a) $\dfrac{10}{h}$

(b) $\sqrt{\dfrac{10}{h}}$

(c) $\sqrt{\dfrac{20}{h}}$

(d) $\sqrt{\dfrac{30}{h}}$

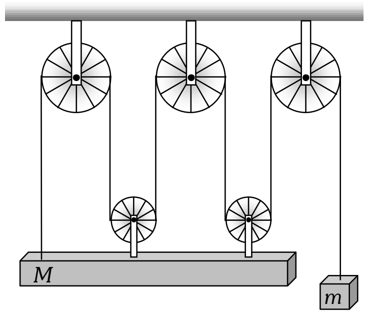
8. What is the acceleration of the mass M as shown in figure the pulleys are light and frictionless and strings are light and inextensible

(a) $\left(\dfrac{5M-m}{25m-M}\right)g$

(b) $5\left(\dfrac{5m-M}{25m-M}\right)g$

(c) $\dfrac{(M-5m)g}{(m-25M)}$

(d) $\left(\dfrac{5m-M}{25m-M}\right)g$



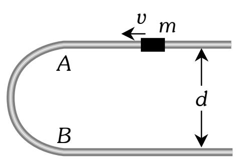
9. A U shaped smooth wire has a semi-circular bending between A and B as shown in the figure. A bead of mass m moving with uniform speed v through the wire enters the semicircular band at A and leaves at B. The average force exerted by the bead on the part AB of the wire is

(a) 0

(b) $\dfrac{4mv^2}{\pi d}$

(c) $\dfrac{2mv^2}{\pi d}$

(d) None of these



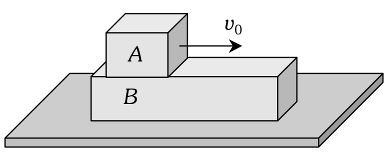
10. A block A of mass m is placed over a plank B of mass $2m$. Plank B is placed over a smooth horizontal surface. The coefficient of friction between A and B is $\frac{1}{2}$. Block A is given a velocity v_0 towards right. Acceleration of B relative to A is

(a) $\dfrac{g}{2}$

(b) g

(c) $\dfrac{3g}{4}$

(d) Zero



Smooth

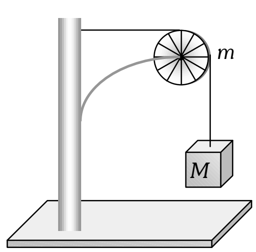
11. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by

(a) $\sqrt{2}Mg$

(b) $\sqrt{2}mg$

(c) $\sqrt{(M+m)^2+m^2}\,g$

(d) $\sqrt{(M+m)^2+M^2}\,g$



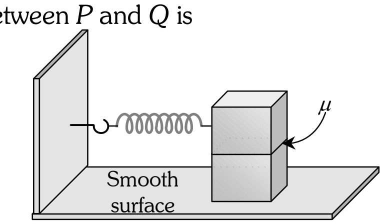
12. A block P of mass m is placed on a frictionless horizontal surface. Another block Q of same mass is kept on P and connected to the wall with the help of a spring of spring constant k as shown in the figure. μ_s is the coefficient of friction between P and Q. The blocks move together performing SHM of amplitude A. The maximum value of the friction force between P and Q is

(a) μ_s

(b) $kA/2$

(c) Zero

(d) $\mu_s\, mg$



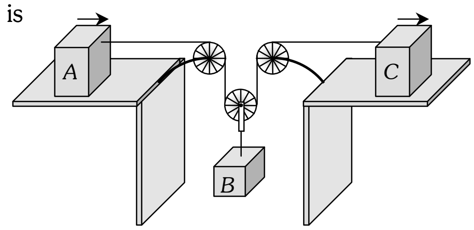
13. Blocks A and C start from rest and move to the right with acceleration $a_A = 12t\ m/s^2$ and $a_C = 3\ m/s^2$. Here t is in seconds. The time when block B again comes to rest is

(a) 2 s

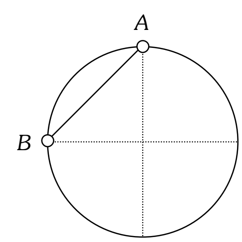
(b) 1 s

(c) 3/2 s

(d) 1/2 s



14. Two beads A and B of equal masses m are connected by a light in-extensible cord. They are constrained to move on a frictionless ring in vertical plane. The blocks are released from rest as shown in figure. The tension in the cord just after the release is



(a) $mg/4$ (b) $\sqrt{2}mg$

(c) $mg/2$ (d) $mg/\sqrt{2}$

Section II

For question number 15 to 24 choose all the correct options. Your answer will be denote correct only, If all the correct options and no incorrect option is chosen

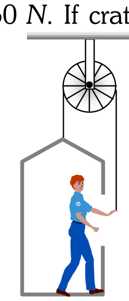
15. A man in a crate which hangs along side building. When the man of mass 50 kg pulls the rope, the force exerted by him on the floor of crate is 250 N. If crate weight is 25 kg. Then

(a) Tension in the rope is 750 N

(b) Tension in the rope is 450 N

(c) Acceleration of the system is 2 m/s^2

(d) Acceleration of the system is $\dfrac{10}{3}$ m/s^2



16. A time varying force applied on a body of m is $F = at - bt^2$ where a and b are arbitrary constants. The correct options is/are

(a) The force is maximum at $t = \dfrac{a}{2b}$

(b) Maximum impulse is $\dfrac{a^3}{12b^2}$

(c) Maximum force is $\dfrac{a^2}{4b}$

(d) Maximum force is $\dfrac{a^2}{2b}$

17. A curved road is banked for speed v_0. When a car moves along the road with a constant speed v, the force of friction between the road and the tyres is F. Which of the following statement (s) is (are) correct

(a) If $v = 0, F = 0$

(b) If $v < v_0$, F acts outwards

(c) If $v > v_0$ F acts inwards

(d) If $v = v_0, F = 0$

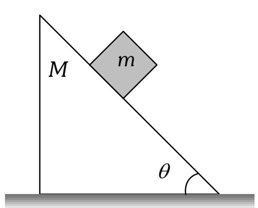
18. A block of mass m slides down on a wedge of mass M as shown in figure. Let $\vec{\mathbf{a}}_1$ be the acceleration of the wedge and $\vec{\mathbf{a}}_2$ the acceleration of block. N_1 is the normal reaction between block and wedge and N_2 the normal reaction between wedge and ground. Friction is absent everywhere. Select the correct alternative (s)

(a) $N_2 < (M + m)g$

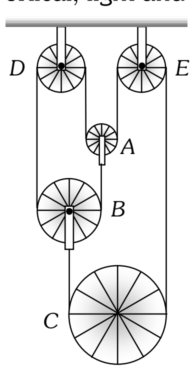
(b) $N_1 = m(g\cos\theta - |\vec{\mathbf{a}}_1|\sin\theta)$

(c) $N_1 \sin\theta = M|\vec{\mathbf{a}}_1|$

(d) $m\vec{\mathbf{a}}_2 = -M\vec{\mathbf{a}}_1$



19. In the pulley system shown the movable pulleys A,B and C have mass m each, D and E are fixed pulleys. The strings are vertical, light and inextensible. Then



(a) The tension throughout the string is the same and equals $T = 2mg/3$

(b) Pulleys A and B have acceleration $g/3$ each in downward direction and pulley C has acceleration $g/3$ in upward direction

(c) Pulleys A, B and C all have acceleration $g/3$ in downward direction

(d) Pulley A has acceleration $g/3$ in downward direction and pulleys B and C have acceleration $g/3$ each in upward direction

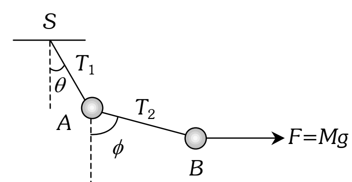
20. The spheres A and B shown have mass M each. The strings SA and AB are light and inextensible with tensions T_1 and T_2 respectively. A constant horizontal force $F = Mg$ is acting on B. For the system to be in equilibrium we have

(a) $\tan\phi = 1$

(b) $\tan\theta = 0.5$

(c) $T_2 = \sqrt{2}\,Mg$

(d) $T_1 = \sqrt{5}\,Mg$



21. A lift is moving downwards. A body of mass m kept on the floor of the lift is pulled horizontally. If μ is the coefficient of friction between the surfaces in contact then

(a) Frictional resistance offered by the floor is μmg when lift moves up with a uniform velocity of $5\,ms^{-1}$

(b) Frictional resistance offered by the floor is μmg when lift moves up with a uniform velocity of $3\,ms^{-1}$

(c) Frictional resistance offered by the floor is $5m\mu$ when lift accelerates down with an acceleration of $4.8\,ms^{-2}$

(d) Frictional resistance (f) offered by the floor must lie in the range $0 \le f < \infty$

22. 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

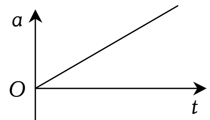
(a) The acceleration of the chain is $\dfrac{gx}{L}$; where x is the length of the hanging part of chain

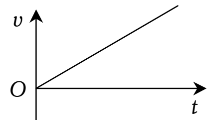
(b) The acceleration of the chain is $\dfrac{g}{L}(L-x)$; where x is the length of the hanging part of chain

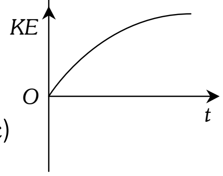
(c) The velocity of the chain is $x\sqrt{g/L}$; where x is the length of the hanging part of chain

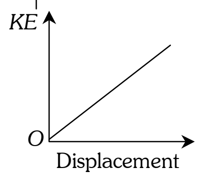
(d) The velocity of the chain is $(L-x)\sqrt{g/L}$; where x is the length of the hanging part of chain

23. A block is resting over a smooth horizontal plane. A constant horizontal force starts acting on it at $t = 0$. Which of the following graphs is/are correct

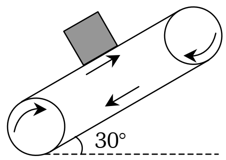
(a) 

(b) 

(c) 

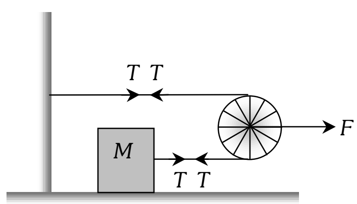
(d) 

24. A block of mass 1 kg is stationary with respect to a conveyor belt that is accelerating with 1 m/s^2 upwards at an angle of 30° as shown in figure. Which of the following statements are correct ? $(g = 10 m/s^2)$



(a) Force of friction on the block is 6 N upwards
(b) Force of friction on the block is 1.5 N upwards
(c) Contact force between the block and the belt is 10.5 N
(d) Contact force between the block and the belt is $5\sqrt{3}$ N

25. Pulley and strings are massless. The force acting on the block of mass M



(a) $2F$
(b) F
(c) $\frac{F}{2}$