TIME – 3 HOURS   MAXIMUM MARKS – 60

General Instructions:

(a)   All questions are compulsory.

(b)   There are 21 questions in total. Questions 1 to4 carry one mark each, questions 5 to 6 carry two marks each, questions 7 to 17carry three marks each, question 18 carries four mark and questions 19 to 21 carry five marks each.

(c)   Use of calculators is not permitted.

(d)   You may use the following physical constants wherever necessary:
$c = 3 \times 10^8$ m/s, $h = 6.6 \times 10^{-34}$ Js $e = 1.6 \times 10^{-19}$ C,   Boltzmann constant $k = 1.38 \times 10^{23}$ J/K Avogadro's number $N_A = 6.023 \times 10^{23}$/mole, Mass of neutron $m_n = 1.6 \times 10^{-27}$ kg

1.   Write S.I unit of luminous intensity and temperature?

2.   Two balls of different masses are thrown vertically upward with same initial speed. Which one will rise to a greater height?

3.   What is the relative velocity of two bodies having equal velocities moving in same direction?

4.   If force is acting on a moving body perpendicular to the direction of motion, then what will be its effect on the speed and direction of the body?

5.   E, m, L and G denote energy, mass, angular momentum and gravitational constant respectively. Determine the dimensions of EL^2/ m^5G^2 (Here angular momentum L= Linear momentum X distance).

6.   Three identical blocks each having a mass m, are pushed by a force F on a frictionless table as shown in figure.
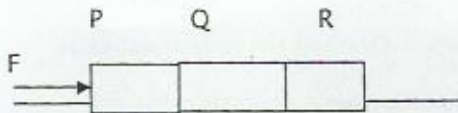
What is the acceleration of the blocks? What is the net force on the block P? What force does P apply on Q and Q apply on R?

7.   State and prove conservation of mechanical energy.

8.   A physical quantity P is related to four observations a, b, c and d as follows:
$P = a^3b^2/\sqrt{cd}$
If % error in a, b, c, and d is 1%, 3%, 4% and 5%, find % error in P.

9.   Derive $V^2 - U^2 = 2as$ using graphical method.

10.   State Triangle law of vector addition and find the resultant along with its direction of two vectors using this law.

11.   The ceiling of a long hall is 25m high. What is the maximum horizontal distance that a ball thrown with a speed of 40m/s can go without touching the ceiling of hall

12.   A man weighs 70kg. He stands on a weighting machine in a lift, which is moving
(a)   Upwards with a uniform speed of 10m/s.
(b)   Downwards with a uniform acceleration of 5m/s².
(c)   Upwards with a uniform acceleration of 5m/s2. Take g = 9.8m/s².
What would be the readings on the scales in each case?

13. State and prove the principle of law of conservation of linear momentum?

OR

State Newton's second law of motion. Express it mathematically and hence obtain a relation between force and acceleration.

14. (a) State impulse – momentum theorem?

(b) A ball of mass 0.1kg is thrown against a wall. It strikes the wall normally with a velocity of 30m/s and rebounds with a velocity of 20m/s. Calculate theimpulse of the force exerted by the ball on the wall.

15. What is meant by a positive work, negative work and zero work? Illustrate your answer with examples?

16. A body of mass 0.5kg travels in a straight line with velocity $v = \alpha x^{3/2}$ where $\alpha = 5\ m^{-1/2}s^{-1}$. What is the work done by the net force during its displacement from x=0 to x=2m?

17. State Hook's law and derive the expression for the potential energy stored in a spring?

18. Having seen a big stone falling from the top of a tower Ravi pulled his friend Kiran away. The stone hit Ravi slightly and he got hurt. But he was saved from a major accident.

(i) What made Ravi act in such a way?

(ii) From the top of a tower 100 m in height, a ball is dropped and at the same time another ball is projected vertically upwards from the ground with a velocity of 25 m/s. Find when and where the two balls meet. Take g = 9.8 m/sec².

19. A body is projected at an angle of Θ with horizontal with initial velocity u. Find expression for:

(i) Maximum height attained (ii) time of flight (iii) horizontal range.

OR

(i) What is a projectile? Prove that path of a projectile is parabolic when it is projected at an angle Θ with horizontal.

(ii) Find the angle of projection for which horizontal range is maximum.

20. What do you mean by banking of roads? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at an angle Θ.

OR

(i) State the laws of friction and define co-efficient of friction.

(ii) Name types of friction and distinguish between them by plotting force vs friction graph.

(iii) It is easier to maintain the motion of a body than to start it, why?

21. (i)Prove that in an elastic collision in one dimension the relative velocity of approach before impact is equal to the relative velocity of separation after impact?

(ii)A body of mass 3kg makes an elastic collision with another body at rest and Continues to move in the original direction with a speed equal to one – third of its original speed. Fine the mass of the second body.

OR

(i) What do you mean by elastic collision? Calculate the velocities of two bodies after elastic collision.

(ii) What will happen if a light body collides with a heavy mass at rest?