Radhika

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HALF YEARLY EXAMINATION 2024-25 **NG-70**

PHYSICS

Time : 3 hrs.] **Class XI** **[M.M. : 70**

General Instructions—

(i) There are 33 questions in all. All questions are compulsory

(ii) This question paper has five sections : Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

Section A contains sixteen questions in which twelve MCQ of 1 mark and four Assertion and Reasoning based, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of 4 marks each and section E contains three long questions of five marks each.

(iii) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions. Use of calculators is not allowed.

(iv) You may use the following values of physical constants where ever necessary

$c = 3\times10^{8}$ m/s

$m_e = 9.1\times10^{-31}$ kg

$e = 1.6\times10^{-19}$ C

$\mu_0 = 4\pi\times10^{-7}$ TmA^{-1}

$h = 6.63\times10^{-34}$ Js

$\varepsilon_0 = 8.854\times10^{-12}$ C^{2}N^{-1}m^{-2}

Avogadro's number = 6.023×10^{23} per gram mole

SECTION-A

Multiple Choice Questions (MCQ)— **1×16=16**

1. The value of 0.98 – 0.989 with regard to the significant digit will be :

P. T. O.

(a) 0.009 (b) 0.090×10^{-1}

(c) 0.09×10^{-1} (d) None of these

2. One body is dropped while a second body is thrown downwards with an initial velocity of 1 ms^{-1} simultaneously. The separation between these is 18 m after a time :

(a) 4.5 s (b) 9 s

(c) 18 s (d) 36 s

3. The dimensional formula for angular momentum is same as that for :

(a) torque (b) Plank's constant

(c) gravitational constant (d) impulse

4. A bucket is placed in the open where the rain is falling vertically. If a wind begins to blow at double the velocity of the rain, how will be the rate of filling of the bucket change?

(a) Remains unchanged (b) Doubled

(c) Halved (d) Becomes four times

5. A man weighing 50 kg carries a load of 10 kg to the top of the building in 5 minutes. The work done by him is 10^5 J. If he carries the same load in 10 minutes, the work done by him will be :

(a) 10^5 J (b) 5×10^5 J

(c) 12×10^5 J (d) 2.5×10^5 J

6. Which of the following numerical values has three significant figures ?

(a) 5.055 (b) 0.050

(c) 50.50 (d) 0.500

7. The displacement-time graph of a moving object is a straight line. Then,

(a) its acceleration may be uniform

(b) its velocity may be uniform

(c) its acceleration may be variable

(d) both its velocity and acceleration may be uniform

8. A bus is moving on a straight road towards north with a uniform speed of 50 kmh^{-1} when it turns left through 90°. If the speed remains unchanged after turning, the increase in the velocity of the bus in the turning process is :

(a) zero
(b) 50 kmh^{-1}
(c) 70.7 kmh^{-1} along south-west direction
(d) 70.7 Kmh^{-1} along north-west direction

9. A heavy log of wood having weight W is having one of its end on the ground and the other on the shoulder of a man. It makes an angle 60° with the horizontal. What is the weight experienced by the man?

(a) W
(b) W/2
(c) W cos θ
(d) W sin θ

10. The work performed on an object does not depend upon :

(a) the displacement
(b) the force applied
(c) the angle at which the force is applied to the displacement
(d) initial velocity of the object.

11. If the density of Earth is doubled keeping its radius constant then acceleration due to gravity will become (the present value is 9.8 ms^{-2})

(a) 9.8 ms^{-2}
(b) 4.9 ms^{-2}
(c) 19.6 ms^{-2}
(d) 2.45 ms^{-2}

12. A satellite is orbiting around the Earth with a period T. If the Earth suddenly shrinks to half its radius without change in mass, the period of revolution of the satellite will be :

(a) T
(b) T/2
(c) $\frac{T}{\sqrt{2}}$
(d) 2T

Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is NOT the correct explanation of A.

(c) A is true but R is false.

(d) A is false and R is also false.

(e) A is false but R is true

13. **Assertion (A) :** A body loses weight when it is at the centre of the earth.

Reason (R) : At the centre of earth, $g = 0$. Therefore, weight $= mg = 0$.

14. **Assertion (A) :** A spring has potential energy, both when it is compressed or stretched.

Reason (R) : In compressing or stretching, work is done on the spring against the restoring force.

15. **Assertion (A) :** If dot product and cross product of A and B are zero, it implies that one vector A and B must be a null verctor.

Reason (R) : Null vector is a vector with zero magnitude.

16. **Assertion (A) :** The position-time graph of a uniform motion, in one dimension of a body cannot have negative slope.

Reason (R) : In one - dimensional motion the position does not reverse, so it cannot have a negative slope.

SECTION-B

Short answer type questions— **2×5=10**

17. What is the angle between two forces of 2N and 3N having resultant as 4N?

18. Two blocks of masses m_1, m_2 are connected by light spring on a smooth horizontal surface. The two masses are pulled apart and then released. Prove that the ratio of their acceleration is inversely proportional to their masses.

19. The escape velocity of a projectile on earth's surface is 11.2 kms^{-1}. A body is projected out with thrice this speed. What is the speed of the body far away from the earth? Ignore the presence of the sun and other planets.

20. An object of mass 0.4 kg moving with a velocity of 4 m/s collides with another object of mass 0.6 kg moving in same direction with a velocity of 2 m/s. If the collision is perfectly inelastic, what is the loss of K.E. due to impact?
21. A constant force acting on a body of mass 3.0 kg changes its speed from 2 m/s^2 to 3.5 m/s^2 in 25 s. The direction of the motion of the body remains unchanged. What is the magnitude and direction of the force?

SECTION-C

Answer the following questions : 3×7=21

22. A body weighs 63 N on the surface of the Earth. What is the gravitational force on it due to the Earth at a height equal to half the radius of the Earth?
23. State and prove work energy theorem analytically?
24. The position of a particle is given by $\vec{r} = 3.0t\hat{i} - 2.0t^2\hat{j} + 4.0\hat{k}$
Where t is in seconds and the coefficients have the proper units for r to be in metres.
(a) Find the v and a of the particle.
(b) What is the magnitude and direction of velocity of the particle at t = 2.0 s?
25. E, m, *l* and G denote energy, mass, angular momentum and gravitational constant respectively. Determine the dimensions of El^2/m^5G^2.
26. Calculate 1 N will be equal to how many dyne.

OR

Convert the universal gravitational constant value from MKS unit to CGS unit by using application of dimension analysis.

27. A body of mass m is thrown with velocity 'v' at angle of 30° to the horizontal and another body B of the same mass is thrown with velocity v at an angle of 60° to the horizontal. Find the ratio of the horizontal range and maximum height of A and B?
28. A block of mass 10 kg is sliding on a surface inclined at a angle of 30° with the horizontal. Calculate the acceleration of the block. The coefficient of kinetic friction between the block and the surface is 0.5.

SECTION-D

Case Based Study Questions— 4×2=8

29. Case Study :

Read the following paragraph and answer the questions—

Average speed and average velocity when an object is in motion, its position changes with time. So, the quantity that describes how fast is the position changing w.r.t. time and in what direction is given by average velocity. It is defined as the change in position or displacement (Δx) divided by the time interval (Δt) in which that displacement occurs. However, the quantity used to describe the rate of motion over the actual path, is average speed. It defined as the total distance travelled by the object divided by the total time taken.

(i) A 250 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 750 m is :

(a) 56 s (b) 68 s

(c) 80 s (d) 92 s

(ii) A truck requires 3 hr to complete a journey of 150 km. What is average speed?

(a) 50 km/h (b) 25 km/h

(c) 15 km/h (d) 10 km/h

(iii) Average speed of a car between points A and B is 20 m/s, between B and C is 15 m/s and between C and D is 10 m/s. What is the average speed between A and D, if the time taken in the mentioned sections is 20s, 10s and 5s, respectively?

(a) 17.14 m/s (b) 15 m/s

(c) 10 m/s (d) 45 m/s

(iv) A cyclist is moving on a circular track of radius 40 m completes half a revolution in 40 s. Its average velocity (in m/s) is :

(a) zero (b) 2

(c) 4p (d) 8p

30. Case Study :

Read the following paragraph and answer the questions.

Conservation of Momentum

This principle is a consequence of Newton's second and third laws of motion. In an isolated system (i.e., a system having no external force), mutual forces (called internal forces) between pairs of particles in the system causes momentum change in individual particles. Let a bomb be at rest, then its momentum will be zero. If the bomb explodes into two equal parts, then the parts fly off in exactly opposite directions with same speed, so that the total momentum is still zero. Here, no external force is applied on the system of particles (bomb).

(i) A shell of mass 10 kg is moving with a velocity of 10 ms^{-1} when it blasts and forms two parts of mass 9 kg and 1 kg respectively. If the first mass is stationary, the velocity of the second is :

(a) 1 m/s (b) 10 m/s

(c) 100 m/s (d) 1000 m/s

(ii) A bullet of mass 10 g is fired from a gun of mass 1 kg with recoil velocity of gun 5 m/s. The muzzle velocity will be :

(a) 30 km/min (b) 60 km/min

(c) 30 m/s (d) 500 m/s

(iii) A bullet of mass 0.1 kg is fired with a speed of 100 m/s. The mass of gun being 50 kg, then the velocity of recoil becomes :

(a) 0.05 m/s (b) 0.5 m/s

(c) 0.1 m/s (d) 0.2 m/s

(iv) Two masses of M and 4M are moving with equal kinetic energy. The ratio of their linear momenta is :

(a) 1 : 8 (b) 1 : 4

(c) 1 : 2 (d) 4 : 1

SECTION-E

Answer the following questions : 5×3=15

31. (a) Prove the trajectory of a projectile motion is a parabolic path. And derive the horizontal range in that case. 3

(b) What is the angle of projection at which horizontal range and maximum height are equal? 2

OR

(a) Derivetime of flight and maximum height when a ball is thrown at some angle from the x coordinate. 3

(b) What is the angle of projection at which horizontal range and maximum height are equal. 2

32. (a) A monkey of mass 40 kg climbs on a rope which can stand a maximum tension of 600 N. In which of the following cases will the rope break : the monkey

(i) climbs up with an acceleration of 1

(ii) climbs down with an acceleration of 1

(iii) climbs up with a uniform speed of 1

(iv) falls down the rope nearly freely under gravity? 1

(Ignore the mass of the rope).

(b) Name the factor on which coefficient of friction depends? 1

OR

(a) A helicopter of mass 1000 kg rises with a vertical acceleration of 15 ms^{-1}. The crew and the passengers weigh 300 kg. Give the magnitude and direction of the :

(i) force on the floor by the crew and passengers. 1

(ii) action of the rotor of the helicopter on the surrounding air. 1

(iii) force on the helicopter due to the surrounding air. 1

(b) Friction is a self adjusting force. Justify. 2

33. (a) Obtain on expression showing variation of acceleration due to gravity with height? 3

(b) Two planets of radii r_1, and r_2 are made from the same material. Calculate the ratio of the acceleration due to gravity on the surface of the planets. 2

OR

(a) Define gravitational potential at a point in the gravitational field. Obtain a relation for it. What is the position at which it is (i) maximum (ii) minimum. 3

(b) Assuming the earth to be a sphere of uniform mass density, how much would a body weigh half way down to the centre of the earth if it weighed 250 N on the surface? 2