MANISH

XI DPS, R.K.P.

S-3

Half Yearly Examination 2015-16

Subject : Physics (Set 2)

Time : 3 hrs. Marks : 70

General Instructions :–

(1) All questions are compulsory.

There are 26 questions in all.

(2) This question paper has five sections A, B, C, D and E.

(3) Section A contains 5 questions of one mark each, Section B contains 5 questions of two marks each, Section C contains 12 questions of 3 marks each. Section D contains one value based question of 4 marks and Section E contains 3 questions of 5 marks each.

(4) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the 3 questions of 5 marks.

P.T.O.

SECTION A

1. Is it possible that a cycle has a northward velocity and a southwards acceleration. If yes how ?

2. If $\vec{C} = \vec{A} \times \vec{B}$ identify a pair of perpendicular vector.

3. The velocity of a particle (v) is given by

$$v = at + \frac{b}{t+c}$$ (where t is time)

a, b, c are constants.

What is the dimensions of b ?

4. Define force.

5. Force $7\hat{i} - 4\hat{j} + 5\hat{k}$ displaces a body through a displacement of $5\hat{i} + 4\hat{j} - 3\hat{k}$. Calculate work done.

SECTION B

6. Name the types of errors possible. What is meant by significant digits ?

7. What are advantages of dimensional analysis. (Write any 2)

8. Derive the expression for displacement of a body in the n^{th} second of its motion.

9. To a driver driving east in a car with a velocity of 40 km / h, a bus appears to move towards north with a velocity of $40\sqrt{3}$ km/h. What is actual velocity and direction of motion of the bus ?

OR

Determine the area of a parallogram whose adjacent sides are formed by the vectors

$$\vec{A} = \hat{i} - 3\hat{j} + \hat{k}, \quad \vec{B} = \hat{i} + \hat{j} + \hat{k}.$$

10. Draw a graph showing variation of frictional force with respect to applied external force, on it mark the region of static, limiting and kinetic friction.

SECTION C

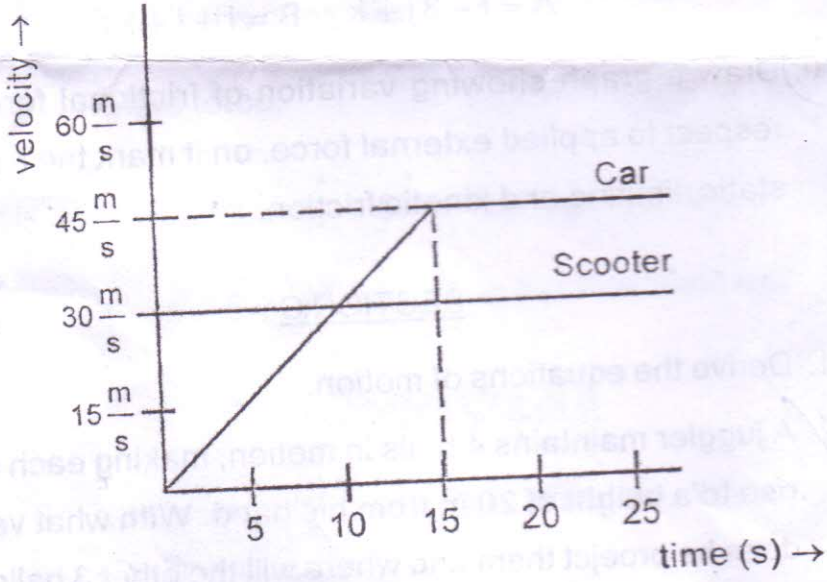
11. Derive the equations of motion.

12. A juggler maintains 4 balls in motion, making each in turn rise to a height of 20 m from his hand. With what velocity does he proejct them and where will the other 3 balls be at the instant when the 4^{th} one is just leaving his hand ? (Take g = 10 m / s^2).

P.T.O.

13. On a 2 lane road, Car A is travelling with a speed of 36 km / h. Two Cars B and C approach Car A in opposite directions with a speed of 54 km / h each. At a certain instant when distance AB is equal to AC, both being 1 km, B decides to overtake A before C does. What is the minimum acceleration of Car B required to avoid an accident ?

14. As soon as a car starts from rest in a certain direction, a scooter moving with uniform speed overtakes the car. Their velocity-time graphs are shown. Calculate :



(i) Difference in distance travelled by car and scooter in 15 sec.

Contd.....

(ii) Time when car will catch up with scooter.

(iii) Distance of car and scooter from starting point at that instant.

OR

The velocity of a train increases at a constant rate α from zero to v and then remain constant for an interval and finally decreases to zero at a constant rate β. If x is the total distance covered by the particle, then prove that total time taken is :

$$t = \frac{x}{v} + \frac{v}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$$

15. Derive the expression for time of flight, range and maximum height attained when an object is projected at an angle with the ground. Use a neat labelled diagram for the motion.

16. State the parallogram law of vector addition.

Two forces whose magnitudes are in the ratio 3:5 give a resultant of 35 N. If the angle of inclination is 60°, Calculate each force.

17. On a certain day, rain was falling vertically with a speed of

35 m/s. A wind started blowing after sometime with a speed of 12 m/s in east to west direction. In which direction should a boy waiting at a bus stop hold his umbrella ? How would your answer change if there was no wind blowing and the boy was cycling from east to west with a speed of 12 m/s. Given $\tan^{-1}\left(\frac{12}{35}\right) = 19°$

18. Derive an expression for centripetal acceleration in uniform circular motion.

Calculate the angular speed of a wheel making 420 rpm.

19. Define :

(a) Static friction

(b) Impulse

(c) Angle of repose

20. State and derive the work energy theorem for a variable force.

21. What is a conservative force. Give 2 examples of such a force. Write the relationship between potential energy and a conservative force.

22. State the law of conservation of energy and prove it in the case of freely falling body. Draw the variation of energy versus height.

SECTION – D

23. Manu was a village boy studying in a small school. One day on the way to school he saw that a truck was being unloaded by labourers who were lifting very heavy bags directly out of the truck. He asked them to use an inclined plane to unload the bags by sliding them.

    (i) What are the values exhibited by Manu ?

    (ii) How does the method suggested by him help ?

    (iii) Will the work done be the same ? Or will it decrease ?

    (iv) Draw a free body diagram showing a mass placed on a inclined plane when the mass is about to slide down.

SECTION – E

24. (a) State the principle of dimensional homogenity.

    (b) Reynolds number N_R (a dimensionless quantity) is a function of the density of a liquid ρ, its average

speed v and coefficient of viscosity η. N_R is also directly proportional to D the diameter of the pipe.

Show using dimensional analysis that $N_R \alpha \frac{\rho V D}{\eta}$.

(c) The length and breadth of a rectangle are 25.0 cm and 16.7 cm respectively. These have been measured with an accuracy of 0.1 cm. Determine the percentage error in area of rectangle.

OR

(a) If displacement $y = a \sin(\omega t - k x)$ where t is time, x is position; find the dimensions of a, ω, k.

(b) Show that the maximum fractional error in product of 2 quantities is equal to the sum of fractional errors in individual quantities.

(c) In an experiment the values of two resistance are $R_1 = 5.0 \pm 0.2\ \Omega$ and $R_2 = 10.0 \pm 0.1\ \Omega$. Find their combined resistance in parallel.

25. (a) What is a pseudo force ? When does it act ?

(b) A mass 'm' kg is placed on a weighing machine on a lift. What is the reading of the weighing machine when lift is :

Contd.....

(i) moving with upward acceleration 'a'

(ii) moving with downward acceleration 'a'

(iii) moving upward with no acceleration

(iv) falling freely when cable is cut ?

OR

25. (a) State the law of conservation of linear momentum.

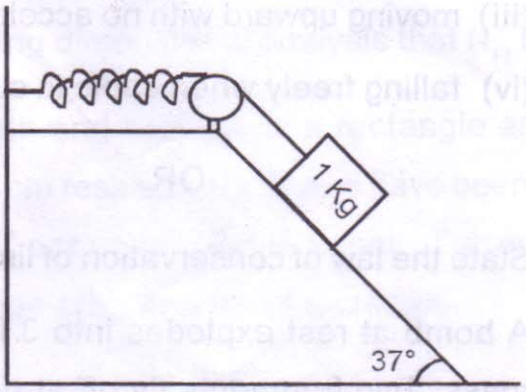
(b) A bomb at rest explodes into 3 fragments of equal mass. Two fragments fly off at right angles to each other with velocities 9 m/s and 12 m/s. Find the velocity of 3rd fragment ?

(c) A machine gun of mass 10 kg fires 10 g bullets at the rate of 10 bullets/s with a speed of 500 m/s. What force is required to hold the gun in position.

26. (a) A ball falls under gravity from a height of 10 m with an initial downward velocity u. If collides with the ground loses 50% of its energy and then rises back to same height. Find initial velocity 'u'

(b) A 1 kg block situated on a rough incline is connected to a spring of spring constant $100\frac{N}{m}$ as shown.

The block is released from rest with the spring in unstretched position. The block moves 10 cm down the incline before coming to rest. Find coeff.



of friction between block and the incline. Assume spring is massless and pulley is frictionless.

OR

(a) Derive the expression for potential engery stored in a stretched spring.

(b) 2 springs have force constants k_1 and k_2, $(k_1 > k_2)$. On which spring is more work done if

(i) they are stretched by same force

(ii) stretched by same amount ?

(c) If the linear momentum of a body increases by 20%, what will be % increase in K.E of body ?