QB365

Model Question Paper 1

11th Standard CBSE

Physics

Reg.No. : | | | | | | |

Time : 02:00:00 Hrs

Total Marks : 100

Section-A

1) Give two approaches to study Physics. **1**

2) Which group of Physics has recently came into existence? **1**

3) Name the scientific principle behind the technology, 'nuclear reactor'. **1**

4) In macroscopic level pf Physics, gravitational force is dominant as compared to electromagnetic force, why? **1**

5) How much stronger nuclear force is compared to electromagnetic force? **1**

6) Is strong nuclear force, charge dependent? **1**

7) Is it possible to have length and velocity both as fundamental quantities?Why? **1**

8) Precisions describes the limitations of the measuring instruments.It is statements false? **1**

9) Obtain the dimensional formula for coefficient of viscosity. **1**

10) Three vectors not lying in a plane can never end up to give a null vector. Is it true? **1**

Section-B

11) Some of the most profound statements on the nature of science have come from Albert Einstein, one of the greatest scientists of all time. What do you think did Einstein mean when he said, "The most incomprehensible thing about the world is that it is comprehensible"? **2**

12) "It is more important to have beauty in the equation of Physics than to have them agree with experiments". the great British physicist PAM Dirac held this view. Criticize this statement. Look out for some equations and result in this book which strike you as beautiful. **2**

13) A jeweller put a diamond weighing 5.42 g in a box weighing 1.2 Kg. Find the total weight of the box and the diamond to correct number of significant figures. **2**

14) Express an acceleration of 10 m/s^2 in km/h^2. **2**

15) For what condiion, an object could be considered as a point object? Describe in brief **2**

16) The displacement o a particle is given by at^2. What is the dependency of accleration on time? **2**

17) A car travelling with a speed of 90 km / h ion a straight road is ahead of a scooter travelling with a speed of 60 km / h. How would the relative velocity be alerted , if scooter is ahead of the car? **2**

18) Explain the property of two vectors A and B if **2**

19) The angle between vector A and B is 60^0 .What is the ratio of A.B and $|\vec{A} \times \vec{B}|$ **2**

20) Write in about 1000 words, a fiction piece based on your speculation on the science and technology of the twenty second century. **2**

21) India has had a long and unbroken tradition of great scholarship in Mathematics, astronomy, linguistics, logic and ethics. Yet, in parallel with this, several superstitious and obscurantistic attitudes and practices flourished in our society and unfortunately continue even today among many educated people too. How will you use your knowledge of science to develop strategies to counter these attitudes? **2**

22) Write down the number of significant figures in the following **2**

34.000 m.

23) Each side of a cube is measured to be 7.203 m.What are the total surface area and the volume of the cube to appropriate significant figures? **2**

24) Read each statement below carefully and state with reasons and examples if it true or false. **2**

A particle in 1-D motion

with zero speed may have non-zero velocity.

25) Read each statement below carefully and state with reasons and examples if it true or false. **2**

A particle in 1-D motion

with constant speed must have zero acceleration

26) State which of the following situations are possible and give an example for each of these? **2**

An object with a constant acceleration but with zero velocity.

27) magnitude of average velocity over an interval of time and the average speed over the same interval. [Average speed of a particle over an interval of time is defined as **2**

the total path length divided by the time interval]. Show in both (a) and (b) that the second quantity is either greater than or equal to first. When is the equality sign true? [For simplicity, consider one-dimensional motion only]

28) Can you associate vectors with? **2**

The length of a wire bent into a loop

29) There are two displacement vectors,one of the magnitude 3m and the other of 4m.How would two vectors be added so that the magnitude of the resultant vector be **2**

5m

30) If unit vector $\hat{a}$ and $\hat{b}$ are inclined at angle then prove that $|\hat{a} - \hat{b}| = 2sin \frac{\theta}{}$ **2**

Section-C

31) Write down the number of significant figure in the following. **5**

12.000

32) The sun's angular diameter is measured to be 1920. The distance r of the sun from the earth is 1.496×10^{11} m. What is the diameter of the sun? **5**

33) Write down the number of significant figure in the following. **5**

0.060

34) Obtain equation of motion for constant acceleration using method of calculus **5**

35) Two resistors of resistance $R_1 = 100 \pm 3\ \Omega$ and $R_2 = 200 \pm 4\ \Omega$ are connected (i) in series, (ii) in parallel. Find the equivalent resistance of the parallel combination. **5**

Use for the relation $\frac{\triangle R'}{R'} = \frac{\triangle R_1}{R_1^2} + \frac{\triangle R_2}{R_2^2}$ and $\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2}$.

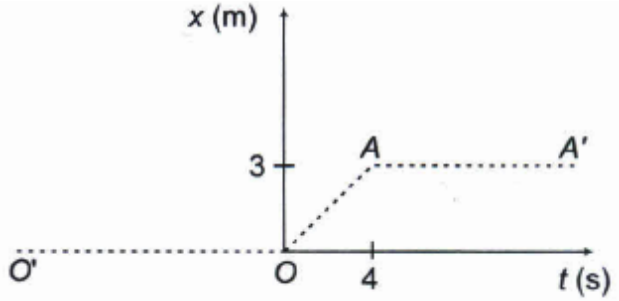
36) In an experimental setup, the density of a small sphere is to be determined. The diameter of the small sphere is measured with the help of a screw gauge, whose pitch is 0.4 mm and there are 50 divisions on the circular scale. The reading on the main scale is 2.5 mm and that on the circular scale is 20 divisions. If the measured mass of the sphere has a relative error of 2%, find the relative percentage error in density. **5**

37) Using a screw gauge, the diameter of a metal rod was measured. The observation are given as follows: 0.39mm, 0.37 mm, 0.41mm, 0.38mm, 0.38mm, 0.37mm, 0.40mm, 0.39mm. Calculate the most accurate value of the diameter **5**

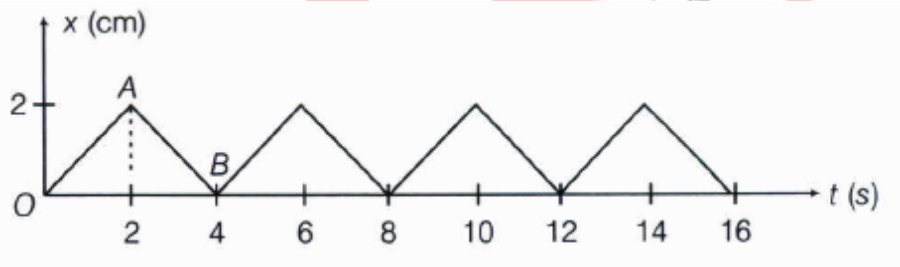
38) Give the magnitude and direction of the net force acting on **5**

(iv) a car moving with a constant velocity of 30 km / h on a rough road.

39) Figure below shows the position-time graph of a particle of mass 4 kg. What is the (i) force on the particle for t < 0, t >4s,0< t < 4s? (ii) impulse at t =0 and t =4s? (Consider one-dimensional motion only). **5**



40) Figure below shows the position-time graph of a body of mass 0.04 kg. Suggest a suitable physical context for this motion. What is the time between two consecutive impulses received by the body? What is the magnitude of each impulse? **5**



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Section-A

1) Two approaches to study Physics are unification and reduction. **1**

2) An intermediate group of Physics namely mesoscopic Physics has recently came into existance. **1**

3) Controlled nuclear fission is the scientific principle behind the technology of steam engine. **1**

4) **1**

Because, matter as a whole is electrically neutral due to presence of both negative and positive charge in equal quantity.

5) A strong nuclear force is 100 times stronger than the electromagnetic force in strength. **1**

6) Strong nuclear force is not charge dependent. **1**

7) No, since length is fundamental quantity and velocity is the derived quantity. **1**

8) No, the statement is true **1**

9) Coefficient of viscosity $(\eta) = \frac{Fdx}{A.dv}$ **1**

$$= \frac{[MLT^{-2}][L]}{[L^2][LT^{-1}]} = [M^1L^{-1}T^{-1}]$$

10) Yes, because they cannot be represented by the three sides of a triangle taken in the same order **1**

Section-B

11) **2**

The physical world, when seen by a layman, presents us with such a wide diversity of things. It seems incomprehensible, i.e. as if it cannot be understood.

On study and analysis, the scientists find that the physical phenomena from atomic to astronomical ranges can be understood in terms of only a few basic concepts, i.e. the physical world becomes comprehensible. This is what is meant by Einstein's statement made above.

12) **2**

The statement of great British physicist PAM Dirac is partially true.

e.g. F = ma, $E = mc^2$ are some of the simple and beautiful equations of physics which have universal application.

However, this is not the case always. The equations involved in general theory of simple nor beautiful. They are rather difficult to understand.

13) Weight of diamond = 5.42 g = 0.00542 Kg **2**

Total weight = 1.2 + 0.00542

= 1.20542 kg = 1.2 kg

14) Acceleration= $(10\ m/(1s)^2)$ **2**

$=(10X10^{-3}/[1/60X60])^2$

$=(3600)^2\ X\ 10^{-2}\ km/h^2$

$=1.29X10^5\ km/h^2$.

15) An object could be considered as a point object if it covers a distance much larger than its own size. **2**

e.g., If a bus of 5 m in size move 100 km, then the bus can be considered as a point object.

16) Let x be the displacement . Then, $x = at^2$ **2**

$\therefore$ Velocity of the object , $v = \frac{dx}{dt}$

Accleration of the object , $a = \frac{dv}{dt}$

It means that a is constant.

17) Let v_c and v_s be the velocities of the car and the scooter , respectively. **2**

v_c = 90 km /h and 60 km / h [given]

when the car is ahead of the scooter b, then the relative velocity is

$v_{cs} = v_c - v_s$

= 90 - 60

= 30 km / h (away from the scooter)

When the scooter is ahead of the car, then the relative velocity is $v_{cs} = v_c - v_s$

= 90 - 60

= 30 km / h (toward the scooter)

18) As we know that **2**

$$|A+B| = \sqrt{A^2+B^2+2AB \quad cos \quad \theta}$$

And $|A-B| = \sqrt{A^2+B^2-2AB \quad cos \quad \theta}$

But as per question, we have

$$\sqrt{A^2+B^2+AB \quad cos \quad \theta} = \sqrt{A^2+B^2-2AB \quad cos\theta}$$

Squaring both sides, we have (4 AB cos)=0

$$\sqrt{A^2+B^2+AB \quad cos \quad \theta} = \sqrt{A^2+B^2-2AB \quad cos\theta}$$

Hence, the two vectors A and B are perpendicular to each other

19) $\therefore$ Ratio is **2**

$$\frac{A.B}{|A.B|} = \frac{AB \quad cos \quad \theta}{AB \quad sin \quad \theta} = cot \quad \theta$$

$$= cot \quad 60^o = \frac{1}{\sqrt{3}}$$

$$As, \qquad \theta = 60^o, cot 60^o = \frac{1}{\sqrt{3}}$$

20) **2**

Imagine you alongwith your friends are in a spaceship which is moving towards Mars. The body of the speceship is made of a specially designed matter which become more harder as its temperature increases. nuclear power plants in spaceship.

Two of them work alternatively and third is for emergency. The speed of the spaceship is very high and all of you are very happy. The energy produced in power plants are converted into electric energy which runs the motors of the spaceship.

You alongwith your friends reach safely on Mars, collects data, takes photographs and then returns to the Earth. In return journey is working and due to overheating. its efficiency is decreasing continuously.

You and your friends try to reduce the temperature of the plant and try to repair the fuse of the other power plants. Finally, fuse of one other plant is repaired and start to work before the first plant crosses the danger limit of an excess of temperature. Finally, you and your friends return safely on Earth.

21) **2**

Illogical practices, superstitious attitudes which are still flourishing in our society can be removed only by educating the society

Mass media like radio, TV, newspaper, magazine etc, can play a vital role in it. Programmes should be framed to target these illogical practices

22) 34.000 m has five significant digits. **2**

23) Given, Side of the cube=7.203 m **2**

Total surface area=$6 \times (side)^2 = 6 \times (7.203)^2$

$$= 311.299254 \quad m^2 = 311.3m^2$$

[Rounded off to 4 significant figures]

Volume=(side)^3=(7.203)^3

=373.714754 m^3

=373.7 m^3.

[Rounded off to 4 significant figures]

24) **2**

False, because velocity is the speed of body in a given direction. When speed is zero, the magnitude of velocity of body is zero, hence velocity is zero.

25) **2**

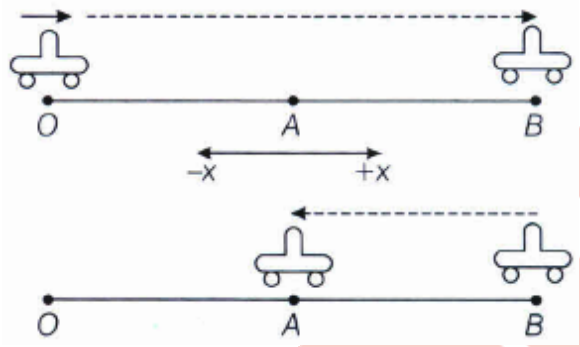
True, when a particle is moving along a straight line with a constant speed, its velocity remains constant with time. Therefore, acceleration (i,e. change in velocity/time) is zero.

26) **2**

When an object is projected upwards, its velocity at the top-most point is zero even though the acceleration on it is 9.8m/s^2(g).

27) **2**

Let us consider an example,



A car starts from 0 and moves along positive x-axis, The car stops at B and starts moving towards negative x-axis, Finally, the car reaches at A.

For the motion from O to B.

So, |Displacement| = Distance covered

|Average velocity| = Average speed

For the motion from $O \rightarrow B \rightarrow A$

So,|Displacement| < Distance covered

|Average velocity| < Average speed

28) We cannot associate a vector with the length of a wire bent into a loop **2**

29) The magnitude of resultant R of two vectors A and B is **2**

Given by,

$$R = \sqrt{A^2 + B^2 + 2AB \quad cos \quad \theta}$$

$$= \sqrt{3^2 + 4^2 + 2 \times 3 \times 4 \quad cos \quad \theta}$$

R is m ,if $\theta = 90^o$

30) For any vector **2**

$a \Rightarrow |a|^2 = a.a$

$\therefore \left|\hat{a} - \hat{b}\right|^2 = (\hat{a} - \hat{b}).(\hat{a} - \hat{b})$

$= \hat{a}.\hat{a} - \hat{a}.\hat{b} - \hat{b}.\hat{a} + \hat{b}.\hat{b}$

$= 1 - 2\hat{a}.\hat{b} + 1 \qquad [\because \hat{a}.\hat{a} = 1 \times 1 \times cos0^o = 1]$

$= 2 - 2 \times 1 \times cos \quad \theta$

$- 2(1 - cos \quad \theta)$

$= 2.2sin^2\frac{\theta}{2} = 4sin^2\frac{\theta}{2} \qquad [\because 1 - cos2\theta = 2sin^2\theta]$

Hence, $\left|\hat{a} - \hat{b}\right| = 2sin\frac{\theta}{2}$

Section-C

31) Five **5**

32) Given, Angular diameter, $\theta = 1920$ " **5**

Distance of the sun from earth, $r = 1.496 \times 10^{11}m$

The diameter of the sun, d=?

$\theta = 1920$ "$= 1920 \times 4.85 \times 10^{-6}rad$

=9.31×10^{-3} rad

We know that, $d = \theta r$

$d = 9.31 \times 10^{-3} \times 1.496 \times 10^{11} = 1.39 \times 10^9 m$

Thus, the diameter of the sun is $1.39 \times 10^9 m$

33) Two **5**

34) From the definition of average acceleration **5**

Integrating both sides and taking the limit for velocity u to v and for time 0 to *t*

$\int_u^v dv = \int_0^t v \quad dt = a\int_0^t dt = a[t]_0^t$ [a is constant]

$v - u = at$

$v = u + at$

Now ,from the definition of velocity,

$\int_{x_0}^x dx = \int_0^t vdt = \int_0^t (u + at)dt = v_0[t]_0^t + a\left[\frac{t^2}{2}\right]_0^t$

$x - x_0 = ut + \frac{1}{2}at^2$

$x = x_0 = ut + \frac{1}{2}at^2$

Now,can write

$a = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx} \quad or \quad v \quad dv = a \quad dx$

Integrating both sides and taking the limit for displacement x_0 to x and for the time 0 to t

$\int_u^v v \quad dv = \int_{x_0}^x a \quad dx; \quad \frac{v^2 - u^2}{2} = a(x - x_0)$

$v^2 = u^2 + 2a(x - x_0)$

This method is also be used for motion with non- uniform acceleration

35) Here, $R_1 = (100 \pm 3)\,\Omega, R_2 = (200 \pm 4)\,\Omega$ **5**

Parallel combination

$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{100} + \frac{1}{200} = \frac{3}{200}$$

$$R' = \frac{200}{3} = 66.7\Omega$$

$$\frac{\triangle R'}{R'^2} = \frac{\triangle R_1}{R_1^2} + \frac{\triangle R_2}{R_2^2}$$

$$\triangle R' = \triangle R_1 \left(\frac{R'}{R_1}\right)^2 + \triangle R_2 \left(\frac{R'}{R_2}\right)^2$$

$$= 3\left(\frac{200}{3\times 100}\right)^2 + 4\left(\frac{200}{3\times 200}\right)^2 = 1.8\Omega$$

$$Hence, \quad R' = (66.7 \pm 1.8)\,\Omega$$

36) Least count of screw gauge $= \frac{Pitch}{Total \quad division \quad on \quad circular \quad scale}$ **5**

Least count $= \frac{0.5}{50}$ = 0.01 mm = $\triangle r$

Diameter = main scale + circular scale $\times$ Least count

$$= 2.5 + 20 \times \frac{0.5}{50} = 270mm$$

$$\frac{\triangle r}{r} = \frac{0.001}{270}$$

$$Density, \quad D = \frac{Mass}{Volume} = \frac{M}{\frac{4}{3}\pi\left(\frac{r}{2}\right)^3}$$

Here, r is diameter,

$$\frac{\triangle D}{D} \times 100 = \left[\frac{\triangle M}{M} + 3\left(\frac{\triangle r}{r}\right)\right] \times 100$$

$$= \frac{\triangle M}{M} \times 100 + 3 \times \frac{\triangle r}{r} \times 100$$

= 2% + 3 $\times \frac{1}{27}$ = 3.11%.

Hence, relative percentage error in the density is 3.11%.

37) Mean diameter **5**

$$(\bar{d}) = \frac{d_1+d_2+d_3+d_4+d_5+d_6+d_7+d_8}{8}$$

$$= \frac{0.39+0.38+0.37+0.41+0.38+0.37+0.40+0.39}{8}$$

$$= 0.38625mm \approx 0.39mm$$

Most accurate value =0.39mm

absolute errors,

$$\triangle d_1 = |0.39 - 0.39| = 0mm$$

$$\triangle d_2 = |0.39 - 0.38| = 0.01mm$$

$$\triangle d_3 = |0.39 - 0.37| = 0.02mm$$

$$\triangle d_4 = |0.39 - 0.41| = 0.02mm$$

$$\triangle d_5 = |0.39 - 0.38| = 0.01mm$$

$$\triangle d_6 = |0.39 - 0.37| = 0.02mm$$

$$\triangle d_7 = |0.39 - 0.40| = 0.01mm$$

$$\triangle d_8 = |0.39 - 0.39| = 0mm$$

Mean absolute error is given by

$$\frac{\triangle \bar{d} = |\triangle d_1| + |\triangle d_2| + |\triangle d_3| + |\triangle d_4| + |\triangle d_5| + |\triangle d_6| + |\triangle d_7| + |\triangle d_8|}{8}$$

$$= \frac{0+0.01+0.02+002+0.01+0.02+0.01+0}{8}$$

$$= 0.01125mm = 0.01mm$$

38) **5**

Force F = ma, therefore force acting on a particle in unaccelerated (a = 0) motion is zero.

As car is moving with a constant velocity, therefore, its acceleration is zero. i.e., a = 0 therefore, net force acting on the car F = ma = 0.

39) **5**

(a) For t < 0, the position-time graph is OO', for which displacement of the particle is zero, therefore, particle is at rest at the origin. Hence, acceleration and force acting on particle will also be zero.

(b) For t >4s, the position-time graph A A' is parallel to time axis. Therefore, for t >4s particle remains at a fixed distance of 3m from the origin. It means particle is at rest. Therefore, acceleration and force acting on particle will be zero. •

(c) For O < t < 4s, the position-time graph OA is a straight line inclined at an angle from time axis, which is representing uniform motion of the particle, i. e. the particle is moving with a constant velocity. Therefore, acceleration and force acting on the particle will be zero.

(ii) Impulse at t = 0

(a) Impulse = change in momentum

= mv - mu = m (v -u)

Before t = 0, particle is at rest, hence u = 0

After t = 0, particle is moving with a constant velocity.

Velocity of the particle = slope of position-time graph $= \frac{3m}{4s} = 0.75m/s$

Impulse = change in momentum

=4 (0.75- 0)=3 kg- m/s

(b) Impulse at t = 4s

Before t = 4s , particle is moving with a constant speed,u =0.75 m/s

After t = 4s , particle is again at rest v =0

Impulse = Change in momentum = m (v - u)

=4(0-0.75)

= -3 kg-rn/s

40)

Mass of the body,m=0.04 kg

The position time graph OA from t= 0 to t=2s is a straight line therefore body is moving with a constant velocity.

Velocity of the body,v=Slope of x-t graph

$$=\frac{2-0}{2-0}=1cm/s=10^{-2}m/s \quad [\because 1 \quad cm=10^{-2}m]$$

Part AB of position time graph is also a straight line.Therefore velocity of the body

$$v'=\frac{0-2}{0-2}=-1 \quad cm/s=-10^{-2}cm/s$$

Negative sign shows that the direction of velocity is reversed after 2 s and it is being repeated.

A suitable physical context for this motion is a ball moving with a constant velocity of 10^{-2} m/s between two walls located at x=0 and at x=2m and rebounded repeadedtly on striking each wall.

magnitude of the impulse imparted to the ball after every two seconds

=chage in momentum of teh ball

=mv-mv'=m(v-v')

$=0.04[10^{-2}-(-10^{-2})]=8\times10^{-4}kg-m/s$