SUCCESS KEY TEST SERIES

Annual Examination [MODEL ANSWER]

Std: 11th Science | **Subject: Physics** | **Time: 3 Hours**

Date : | **Sample Answer Key** | **Max Marks: 70**

Section A (MCQ & VSA 1 MARKS Questions)

Q.1 Select and write the correct answer: **10**

(i) Ans. (b)

(ii) Ans. (d)

(iii) Ans. (c)

(iv) Ans. (a)

(v) Ans. (d)

(vi) Ans. (b)

(vii) Ans. (d)

(viii) Ans. (a)

(ix) Ans. (a)

(x) Ans. (c)

$E = 1.8 \times 10^3$ V/m, d = 3.6 mm = 3.6×10^{-3} mm

$V = E\,d = 1.8 \times 103 \times 3.6 \times 10^{-3}$

V = 6.48 V

Q.2 Answer the following: **8**

(i) Ans. The velocity vector of a stationary particle is a zero vector.

(ii) Ans. Displacement = Final position – Initial position
= 10 m – 5 m = 5 m
Velocity = Displacement / Time
= 5 m / 5 s = 1 m/s

(iii) Ans. The principle of conservation of linear momentum states that the total momentum of an isolated system is conserved during ay interaction.

(iv) Ans. The initial and final velocities of the bodies get exchanged when two bodies of equal masses undergo elastic head on collision, i.e.
$v_1 = u_2$ and $v_2 = u_1$

(v) Ans. The object feels heavier in a lift which has a net acceleration in the upward direction.

(vi) Ans. The triple point is the temperature and pressure at which solid, liquid, and vapour phases of a particular substance coexist in equilibrium.

(vii) Ans. The characteristic of sound which is determined by the value of frequency

(viii) Ans. Resistivity of a conductor is numerically the resistance per unit length, and per unit area of cross section of material of the conductor.

Section B (SA I - 2 MARKS EACH)

Attempt any Eight: **16**

Q.3 Ans. (i) No, the answers will not be the same.
(ii) This is because the least count of a metre scale is 0.1 cm, so the probability of systematic error is high.

Q.4 Ans. $\left|\vec{a}\right| = \sqrt{1^2 + 2^2} = \sqrt{5}$

$$\left|\vec{b}\right| = \sqrt{2^2 + 1^2} = \sqrt{5}$$

The magnitudes of $\vec{a}$ and $\vec{b}$ are equal. However, their corresponding components are not equal i.e., $a_x \neq b_x$ and $a_y \neq b_y$. Hence, the two vectors are not equal.

Q.5 Ans. Given :

Initial velocity (u) = 120 km/h^{-1} = $120 \times \frac{5}{18} = \frac{100}{3}$ ms^{-1}

Distance (s) = 100 m,

Final velocity (v) = 0

The formula to find the average retardation of the car (a) and the time taken by car (t) are;

i. $v^2 - u^2 = 2as$

ii. $v = u + at$

Calculation :

Using formula (i),

$$0 - \left(\frac{100}{3}\right)^2 = 2a \times 100$$

$$a = \frac{-10000}{9} \times \frac{1}{200} = -\frac{50}{9}\ \text{ms}^{-2}$$

Now from formula (ii),

$$t = \frac{v-u}{a} = \frac{\left(0 - \frac{100}{3}\right)}{-\frac{50}{9}} = 6\ \text{s}$$

i) Average retardation of the car is $\frac{50}{9}$ ms $^{-2}$.

ii) Time taken by the car to come to rest is 6 s.

Q.6 Ans. The acceleration due to gravity decreases with increase in altitude of the body from the surface of the Earth.

$$g_h = g\left(1 + \frac{h}{R}\right)^{-2}$$

Q.7 Ans. Given :

$m = 37$ kg, $\mu_S = 0.3$, $g = 9.8$ m/s²

To find the value of limiting force (F_L), the formula to be used is:

$F_L = \mu_S N = \mu_S mg$

Calculation :

Using the formula,

$F_L = 0.3 \times 37 \times 9.8 = 108.8$ N

The force required to move the block is 108.8 N.

Q.8 Ans. Given :

distance (s) = 1360 m,

time for first echo = 3 s,

time for second echo = 5 s

To find the speed of sound (v), the formula to be used is:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

Calculation :

Time for first echo = 3 s

$\therefore$ the time taken by sound to travel through agiven

distance $t_1 = \frac{3}{2} = 1.5$ s

Time for second echo = 5 s

$\therefore$ time taken by sound to travel through a given distance t_2

$= \frac{5}{2} = 2.5$ s

$\therefore$ the total time taken by sound to travel given distance, T

$= 1.5 + 2.5 = 4$ s

$$v = \frac{1360}{4}$$

$\therefore \quad v = 340$ m/s

Therefore the speed of sound is 340 m/s.

Q.9 Ans. (i) Convex mirrors forms diminished images of the object irrespective of the position of the object.
(ii) Concave mirror can form a magnified image as well as diminished image depending on the position of the object.

Position of the object	**Magnified/Diminished**
At infinity	Diminished to a point
At a distance beyond 2f	Diminished
At 2f	Of the same size as the object
At a distance between f and 2f	Magnified
At f	At infinity
At a distance less than f	Magnified

Q.10 Ans. Given :

$q_1 = +q,\ q_2 = -2q$

$F = 0.2\ N$

$r = 25\ cm = 25 \times 10^{-2}\ m$

To find the charge (q), the formula to be used is:

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

Calculation :

Using the formula,

$$-0.2 = \frac{9\times10^9 \times q \times (-2q)}{(25\times10^{-2})^2}$$

$$\therefore \quad q^2 = \frac{0.2\times(25\times10^{-2})^2}{9\times10^9\times2}$$

$$\therefore \quad q^2 = 6.944\times 10^{-13}$$

$$\therefore \quad q = 0.833 \times 10^{-6}\ C = 0.833\ \mu C$$

Therefore, the value of charge is 0.833 μC.

Q.11 Ans. Given :

$l = 6$ m, D = 0.5 mm

r = 0.25 mm = 0.25×10^{-3} m, R = 50 Ω

To find the resistivity (ρ) and conductivity (σ), the formulas to be used are:

i) $\rho = \frac{RA}{l} = \frac{R\pi r^3}{l}$ ii) $\sigma = \frac{1}{\rho}$

Calculation :

Using formula (i),

$$\rho = \frac{50\times 3.14\times 2\times\left(0.25\times 10^{-3}\right)^2}{6}$$

$= 1.636 \times 10^{-6}$ Ωm

Using formula (ii),

$$\sigma = \frac{1}{1.636\times 10^{-6}} = 6.12\times 10^5 \ \Omega\text{m}$$

i) 1.636×10^{-6} Ω/m is the resistivity of the wire.
ii) 6.12×10^5m/Ω is the conductivity of the wire.

Q.12 Ans. 1. In both cases we get two magnets, each having north and south pole.
2. Transverse to it's length: magnetic strength remains same but length become half,
3. Along its length: length remains same but magnetic strength becomes half

Q.13 Ans. $B_0 = 4\times 10^{-4}$ T, $q = 5\ \mu\text{C} = 5\times 10^{-6}$ C

$v = 5\times 10^5$ m/s

$E_0 = cB_0 = \left(3\times 10^8\right)\times\left(4\times 10^{-4}\right) = 12\times 10^4$ N/C

Maximum electric free $= qE_0$

$= \left(5\times 10^{-6}\right)\left(12\times 10^4\right)$

$= 60\times 10^{-2} = 0.6$ N

Q.14 Ans. We know that for an ideal diode, the resistance is zero when forward biased and infinite when reverse biased.

(i) Figure b shows the circuit when the diode is forward biased. an ideal diode behaves as a conductor and the circuit is similar to two resistance is parallel.

R_{AB} = (30×30) / (30+30) = 900/60 = 15 Ω

(ii) Figure c shows the circuit when the diode is reverse biased. it does not conduct and behaves as an open switch, path ACB. Therefore, R_{AB} = 30 Ω, the only resistance in the circuit along the path ADB.

Section C (SA II - 3 MARKS EACH)

Attempt any Eight: **24**

Q.15 Ans.

Scalars	Vectors
Distance travelled	Displacements
Speed	Velocity
Energy	Force
	Work done

Q.16 Ans. (i) Instantaneous velocity = dx/dt

(ii) Instantaneous acceleration = d^2x/dy^2

Explanation:

The motion of an object is described by x = f (t)

We have to find the instantaneous velocity and acceleration

Instantaneous velocity = dx/dt

Therefore, Instantaneous velocity = dx/dt = df(t)/dt= f (t)

Hence Instantaneous velocity = f(t)

Acceleration, a = d^2x/dy^2

Substitute the values, then we get

a = d^2 f (t)/dt^2 = f''(t)

Hence, acceleration = f''(t)

Q.17 Ans. 1. There are situations where Newton's law cannot be applied.

2. Newton's laws are applicable only in the inertial frames of reference. If the body is in a frame of reference of acceleration (a), we need to use a pseudo force F = ma in addition to all the other forces while writing the force equations.

3. Newton's laws are applicable for point objects and rigid bodies.

4. For objects moving with speeds comparable to that of light, Newton's laws of motion do not give results that match with the experimental results and Einstein special theory of relativity has to be used.

5. Behaviour and interaction of objects having atomic or molecular sizes cannot be explained using Newton's laws of motion, and quantum mechanics has to be used.

Q.18 Ans. (A) Let r_1 = Present distance between the Earth and sun

T = 365 days.

If $r_2 = 3r_1$ to find T_2 =?

According to Kepler's law of period $T_1^2 \propto r_1^3$ and $T_2^2 \propto r_2^3$

$$\therefore \frac{T_2^2}{T_1^2} = \frac{r_2^3}{r_1^3}$$

$$\therefore \frac{T_2}{T_1} = \left(\frac{r_2}{r_1}\right)^{3/2}$$

$$= \left(\frac{3r_1}{r_1}\right)^{3/2}$$

$$\therefore \frac{T_2}{T_1} = \sqrt{27}$$

$$T_2 = T_1 \times \sqrt{27}$$

$$= 365 \times \sqrt{27}$$

$$= 1897 \text{ days}$$

(B) If $r_2 = 2r_1$

$$\frac{T_2^2}{T_1^2} = \frac{r_2^3}{r_1^3}$$

$$\frac{T_2^2}{T_1^2} = \left(\frac{2r_1}{r_1}\right)^{3/2}$$

$$\therefore \frac{T_2}{T_1} = \sqrt{8}$$

$$T_2 = T_1 \times \sqrt{8}$$

$$= 365 \times \sqrt{8} = 1032 \text{ days}$$

Q.19 Ans. Given :

$F_L = 68.5$ N, $F_k = 43$ N, $m = 37$ kg, $g = 9.8$ m/s²

To find thecoefficient of static friction (μ_S)

And the coefficient of kinetic friction (μ_k), the formulas to be used are:

i) $\mu_S = \frac{F_L}{N} = \frac{F_L}{mg}$

ii) $\mu_k = \frac{F_k}{N} = \frac{F_k}{mg}$

Calculation :

Using the formula (i),

$$\therefore \mu_S = \frac{F_s}{N} = \frac{68.5}{37 \times 9.8} = 0.1889$$

Usingformula (ii),

$$\therefore \mu_k = \frac{F_k}{N} = \frac{43}{37 \times 9.8} = 0.1186$$

i) The coefficient of static friction is 0.1889. ii) The coefficient of kinetic friction is 0.1186.

Q.20 Ans. (i) Radiation is the transfer of heat energy from one place to another via emission of EM energy.

(ii) All objects possess thermal energy due to their temperature.

(iii) The rapidly moving molecules of a hot body emit EM waves travelling with a velocity of light.

(iv) These are called thermal radiations.

(v) These carry energy with them and transfer it to a low-speed molecules of a cold body on which they fall.

(vi) This results in an increase in the molecular motion of the cold body and its temperature rise.

(vii) Thus the transfer of heat energy by radiation is a two-fold process.

Q.21 Ans. Given

$T_1 = 20\ °C$

$T_2 = 180\ °C$

$A_1 = 286\ cm^2$

$B = 4.9 \times 10^{-5}\ /°C$

We have

$$\beta = \frac{A_2 - A_1}{A_1(T_2 - T_1)}$$

$\therefore A_2 = A_1\ [1 + \beta\ (T_2 - T_1)]$

$= 286\ [1 + 4.9 \times 10^{-5}\ (180 - 20)]$

$= 286\ [1 + 4.9 \times 10^{-5} \times 160]$

$= 286\ [1 + 784.0 \times 10^{-5}]$

$= 286\ [1 + 0.00784]$

$= 286\ [1.00784]$

$\therefore A_2 = 288.24\ cm^2$

Q.22 Ans. A wave in which the particles of a medium vibrate in a direction perpendicular to the direction of propagation of the wave is called a transverse wave.

Characteristics of transverse waves:

(i) All the particles of the medium vibrate perpendicular to the direction of propagation of the wave.

(ii) The medium is divided into alternate crests and troughs when a transverse wave propagates through the medium.

(iii) A crest and an adjacent trough form one complete cycle of transverse waves.

(iv) Crests and troughs traverse in a medium and are responsible for energy propagation in a medium.

(v) Transverse waves can travel through solids and on the surface of the liquids only.

(vi) There is no change in pressure and density as the transverse wave propagates through the medium.

(vii) Transverse waves can be polarized.

(viii) Medium conveying a transverse wave must possess elasticity of shape.

Q.23 Ans. Given:

$R_1 = 10$ cm, $R_2 = -8$ cm,

$u = -10$ cm and $n = 1.5$

From the Lens maker's equation,

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\therefore \frac{1}{f} = (1.5-1)\left(\frac{1}{10} - \frac{1}{-8}\right)$$

$$= 0.5 \times \frac{9}{40} = \frac{9}{80}$$

$$\therefore\ f = \frac{80}{9}\ \text{cm}$$

Now,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

$$\therefore \frac{1}{v}=\frac{1}{f}+\frac{1}{u}$$

$$=\frac{9}{80}+\frac{1}{-10}=\frac{1}{80}$$

$v = 80$ cm

Therefore, the final position of the image will be at 80 cm from the lens.

Q.24 Ans. Given:

$R_1 = 1\ k\Omega = 10^3\ \Omega$

$R_2 = 2\ k\Omega = 2 \times 10^3\ \Omega,\ V = 9\ V$

To find the parallel equivalent resistance (R_p)

And the current through 1 kΩ and 2 kΩ (I_1 and I_2), the formulas to be used are:

i) $\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}$

ii) $V = IR$

Calculation :

Using the formula (i)

$$\frac{1}{R_p}=\frac{1}{10^3}+\frac{1}{2\times10^3}=\frac{3}{2\times10^3}$$

$$\therefore R_p=\frac{2\times10^3}{3}=0.66\ k\Omega$$

From formula (ii),

$$I_1=\frac{V}{R_1}=\frac{9}{10^3}=9\times10^{-3}\ A=9\ mA$$

$$I_2=\frac{V}{R_2}=\frac{9}{2\times10^3}=4.5\times10^{-3}\ A=4.5\ mA$$

i) For the parallel combination the equivalent resistance is 0.66 kΩ. ii) Current flowing through 1 kΩ and 2 kΩ resistance are 9 mA and 4.5 mA respectively.

Q.25 Ans. Radio waves are produced by accelerated motion of charges in a conducting wire. The frequency of waves produced by the circuit depends upon the magnitudes of the inductance and the capacitance. Thus, by choosing suitable values of the inductance and the capacitance, radio waves of desired frequency can be produced.

Uses :

1) Radio waves are used for wireless communication purpose.
2) They are used for radio broadcasting and transmission of TV signals.
3) Cellular phones use radio waves to transmit voice communication in the ultra high frequency (UHF) band.

Q.26 Ans. 1. Consider a p-type semiconductor connected to terminals of a battery. When the circuit is switched on, electrons are attracted to the positive terminal of the battery and occupy nearby holes. This generates holes at the positions which were previously occupied by electrons.

2. Similarly, electrons at other positions also move towards the positive terminal and create holes in the positions they occupied previously. Finally the hole is captured at the negative terminal by the electron supplied by the battery at that end.

3. This keeps the density of holes constant and maintains the current so long as the battery is working. Thus, physical transportation is of the electrons only.

4. However, it feels like the holes are moving towards the negative terminal of the battery. Positive charge is attracted towards negative terminal. Thus holes, which are not actual charges, behave like a positive charge.

5. In this case, there is an indirect movement of electrons and their drift speed is less than that in the n-type semiconductors. The mobility of holes is less than that of the electrons which lead to less conductivity.

Section D (SA II - 4 MARKS EACH)

Attempt any Three: **12**

Q.27 Ans. (i) (a) The relative error represented by percentage (i.e., multiplied by 100) is called the percentage error.

(b) The ratio of the mean absolute error in the measurement of a physical quantity to its arithmetic mean value is called relative error.

(ii)

Given:

Diameter of the sphere (d) = 2.14 cm

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

$$= \frac{4}{3} \times 3.142 \times \left(\frac{2.14}{2}\right)^3 \left(\because r = \frac{d}{2}\right)$$

$$= \frac{4}{3} \times 3.142 \times (1.07)^3$$

$$= 5.132113475 \text{ cm}^3$$

In the final result after multiplication or division, the number of significant figure in the answer must be equal to the original number with the least significant figures.

Therefore, the volume up to correct significant figures = 5.13 cm^3.

Q.28 Ans. Given that, 64% of the initial potential energy is converted to kinetic energy for every bounce.

i) In case of inelastic collisions, the coefficient of restitution is given by,

$$e = -\frac{v_s}{u_s} = -\frac{v}{u} \text{ .... } (1)$$

$$\therefore e^2 = \frac{v^2}{u^2}$$

$$\therefore v^2 = e^2 \times u^2$$

$$\therefore \frac{1}{2}mv^2 = e^2 \times \frac{1}{2}mu^2$$

$$\therefore (\text{K.E.})_f = e^2 \times (\text{K.E.})_i$$

$$\therefore \frac{(\text{K.E.})_f}{(\text{K.E.})_i} = e^2$$

$$\therefore \frac{64}{100} = e^2$$

$$\therefore e = 0.8$$

ii) From equation (1)

$v = -eu$

$\therefore$ after the first bounce,

$v_1 = -eu$

After second bounce,

$v_2 = -ev_1 = -e(-eu) = e^2u$

And after third bounce,

$v_3 = -ev_2 = -e(e^2u) = -e^3u$

But $u = \sqrt{2gh}$

$\therefore v_3 = -e^3 \times \sqrt{2gh} = (0.8)^3 \times \sqrt{2 \times 10 \times 5}$ .... ($\because h = 5$ m given)

$= -(0.8)^3 \times 10$

$= -5.12$ m/s

iii) Impulse given by the ball during thethird bounce is,

$$J = \Delta p = mv_3 - mv_2$$
$$= m \times (-e^3u - e^2u)$$
$$= -m \times e^2u \times (e + 1)$$
$$= -100 \times 10^{-3} \times (0.8)^2 \times 10 \times (0.8 + 1)$$
$$= -1.152 \text{ Ns}$$

iv) Average force exerted in 250 ms,

$$F = \frac{J}{t} = \frac{-1.152}{250 \times 10^{-3}}$$
$$= -4.608 \text{ N}$$

v) Average pressure for area

$0.5 \text{ cm}^2 = 0.5 \times 10^{-4} \text{ m}^2$

$$P = \frac{F}{A} = \frac{4.608}{0.5 \times 10^{-4}} = 9.216 \times 10^4 \text{ N/m}^2$$

i) Coefficient of restitution is 0.8.
ii) Speed after third bounce is 5.12 m/s.
iii) Impulse given by ball during the third bounce is 1.152 Ns.
iv) Average force exerted by the ground is 4.608 N
v) Average pressure exerted on a given area is 9.216×10^4 N/m².

Q.29 Ans. (i) 1. The ability of an optical material to disperse the constituent colors is known as the dispersive power.

2. It is measured for any two colors as the ratio of the angular separation to the mean deviation for those two colors.

(ii)

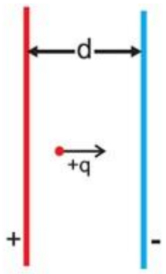
For astronomical telescope,

$$L = f_o + f_e \quad \therefore\ 1.05 = 1 + f_e \quad \therefore\ f_e = 0.05 \text{ m} = 5 \text{ cm}$$

Under normal adjustments,

$$M = \frac{f_o}{f_e} = \frac{1}{0.05} = 20$$

Q.30 Ans. Consider a potential difference V applied between two parallel plates separated by a distance 'd'. The electric field between them directed from plate A to plate B as shown.



If we move the charge +q from the negative plate B to the positive plate A, the work done against the field is W = Fd

The potential difference V between the two plates is given by

W = Vq, but W = Fd

Vq = Fd

F/q = V/d = E

Thus the electric field between the plates is given by,

E = V/d

Normally the value of d will be very small so that even a small voltage can produce a reasonably large electric field.

Q.31 Ans. (i) 1. Magnetic lines of force originate from the north pole and end at the south pole.

2. The magnetic lines of force of a magnet or a solenoid from closed loops. This is in contrast to the case of an electric dipole, where the electric lines of force originate from the positive charge and end on the negative charge.

(ii)

Given

$$B_{eq} = 4 \times 10^{-5} T$$

$$r = 6.4 \times 10^{6} m$$

Assume that Earth is a bar magnet with N and S poles being the geographical South and North poles, respectively. The equatorial magnetic field due to Earth's dipole can be written as

$$B_{eq} = \frac{\mu_0 m}{4\pi r^3}$$

$$m = 4\pi B_{eq} \times r^3 / \mu_0$$

$$= 4 \times 10^{-5} \times \left(6.4 \times 10^{6}\right)^3 \times 10^{7} = 1.05 \times 10^{20} Am^2$$