1. In an ac circuit with voltage V and current I the power dissipated is

A. VI
B. $\frac{1}{2}$Vi
C. $\frac{1}{\sqrt{2}}$VI
D. Depends on the phase between V and I

2. The primary winding of transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an a.c. supply of 20 V, 50 Hz. The secondary will have an output of

A. 200V, 50Hz
B. 2V, 50Hz
C. 200V, 500Hz
D. 2V, 5Hz

3. The number of turns in the primary coil of a transformer is 200 and the number of turns in the secondary coil is 10. If 240 volts ac are applied to the primary, the output from the secondary will be

A. 48A
B. 24V
C. 12V
D. 6V

4. Which quantity is increased in step-down transformer?

A. Current
B. Voltage
C. Power
D. Frequency

5. The average power dissipation in a pure capacitor in AC circuit is

A. $\frac{1}{2}CV^2$
B. CV^2
C. $2CV^2$
D. zero

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6. In an L-R circuit, time constant is that time in which current grows from zero to the value
   A. $0.63\ I_0$ B. $0.50\ I_0$
   C. $0.37\ I_0$ D. I_0

7. Quantity that remains unchanged in a transformer is
   A. Voltage B. Current
   C. Frequency D. None of these

8. The direction of induced current is such that it opposes the very cause that has produced it. This is the law of
   A. Lenz B. Faraday
   C. Kirchoff D. Fleming

9. A particle is moving in a uniform magnetic field, then
   A. its momentum changes but total energy remains the same
   B. Both momentum and total energy remains the same
   C. Both changes
   D. Total energy change but momentum remains

10. A particle moving in a magnetic field has increase in its velocity, then its radius of the circle
    A. Decreases B. Increases
    C. Remains the same D. Becomes half

Alternating Current

1. In L.C.R series A.C. circuit, the phase angle between current and voltage is
   A. Any angle between 0 and $\pm\frac{\pi}{2}$ B. $\frac{\pi}{2}$
   C. π D. Any angle between 0 and $\frac{\pi}{2}$

2. In an A.C. circuit, a resistance of R ohm is connected in series with an inductance L. If phase angle between voltage and current be 45°, the value of inductive reactance will be
   A. $\frac{R}{4}$ B. $\frac{R}{2}$
   C. R
   D. Cannot be found with the given data.

3. A 220 V, 50 Hz. A.C. source is connected to an inductance of 0.2 H and a resistance of 20 ohm in series. What is the current in the circuit?
   A. 10 A B. 5 A
   C. 33.3 A D. 3.33 A

4. A capacitor acts as an infinite resistance for
   A. AC B. DC

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C. Both AC and DC
D. Neither AC nor DC

5. An ideal choke (used along with fluorescent tube) would be
A. A pure resistor
B. A pure capacitor
C. A pure inductor
D. A combination of an inductor and a capacitor

6. The peak voltage in a 220 volt A.C. supply is nearly
A. 220 volt
B. 253 volt
C. 311 volt
D. 440 volt

7. In a capacitive circuit
A. Current leads voltage by phase of $\pi/2$
B. Voltage leads current by phase of $\pi/2$
C. Current and voltage are in same phase
D. Sometime current and sometime voltage leads.

8. The reactance of a coil when used in the domestic A.C. power supply (220 volts, 50 cycles per second) is 50 ohms. The inductance of the coil is nearly
A. 2.2 henry
B. 1.6 henry
C. 0.22 henry
D. 0.16 henry

9. Energy is stored in the choke coil in the form of
A. Heat
B. Magnetic energy
C. Electric energy
D. Electro-magnetic energy

10. The henry is the unit for
A. Resistance
B. Magnetic flux
C. Magnetic field
D. Inductance

Physics of Solids

1. The dimensional formula for the modulus of elasticity is same as that for:
A. Stress
B. Strain
C. Velocity
D. Surface tension

2. Which of the modulus of elasticity is involved in compressing a rod to decrease its length?
A. Young's modulus
B. Bulk modulus
C. Modulus of rigidity
D. None of the above

3. Steel is preferred for making springs over copper. Why?
A. Steel is cheaper
B. Young's modulus of steel is more than that of copper
C. Young's modulus of copper is more than that of steel
D. Steel is less likely to be oxidized.

4. The modulus of rigidity of a liquid is:
A. Zero
B. 1

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C. Infinity
D. A value not one of those mentioned above

5. How does the Young's modulus vary with the increase of temperature?
A. Decrease
B. Increases
C. Remains constant
D. First increases and then decreases

6. A wire is stretched to double of its length. The strain is:
A. 2
B. 1
C. Zero
D. 0.5

7. According to the Hooke's law the force required to change the length of a wire by 'l' is proportional to:
A. l^{-2}
B. l^{-1}
C. l
D. l^{2}

8. For obtaining appreciable extension, the wire should be:
A. Short and thin
B. Long and thin
C. Short and tick
D. Long and thick

9. A cable that can support a load W is cut into two equal parts. The maximum load that can be supported by either part is:
A. $\frac{W}{4}$
B. $\frac{W}{2}$
C. W
D. 2W

10. A cable breaks if stretched by more than 2 mm. It is cut into two equal parts. How much either part can be stretched without breaking?
A. 0.25 m
B. 0.5 m
C. 1 mm
D. 2 mm

Electronics

1. In case of p-n junction diode, at high value of reverse bias, the current rises sharply. The value of reverse bias is known as:
A. Cut off voltage
B. Zener voltage
C. Inverse voltage
D. Critical voltage

2. In a common base transistor circuit, the current gain is 0.98. On changing the emitter current by 5.00 mA, the change in collector current is:
A. 0.196 mA
B. 2.45 mA
C. 4.9 mA
D. 5.1 mA

3. When we apply reverse bias to a junction diode, it
A. Lowers the potential barrier
B. Raises the potential barrier
C. Increase the majority carrier current
D. Increase the minority carrier current

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4. When boron is added as an impurity to silicon, the resulting material is.
   A. n type conductor B. n type semiconductor
   C. p-type conductor D. p-type semiconductor

5. The forbidden gap with in germanium and silicon are 0.7 eV and 1.1 eV respectively. It implies, that
   A. Both silicon and germanium are perfect conductors at very low temperatures but very good insulators at room temperatures
   B. Both silicon and germanium are perfect insulators at room temperatures
   C. Both silicon and germanium are perfect insulators at low temperatures but start conduction at room temperatures with silicon somewhat better conductor than germanium
   D. Same as (C) above but with germanium shown better conductivity at room temperature.

6. A p-n junction has a thickness of the order of:
   A. 1 cm B. 1 mm
   C. 10^{-6} cm D. 10^{-12} cm

7. The part of a transistor which is heavily doped to produce large number of majority carriers is
   A. Emitter B. Base
   C. Collector
   D. Any of the above depending on nature of transistor.

8. When n-type of semiconductor is heated,
   A. Number of electrons increases while that of holes decreases
   B. Number of holes increases while that of electrons decreases
   C. Number of electrons and holes remains same
   D. Number of electrons and holes increases equally.

9. Copper and germanium are cooled to 70K from room temperature, then
   A. Resistance of copper increases while that of germanium decreases
   B. Resistance of copper decreases while that of germanium increases
   C. Resistance of both decreases D. Resistance of both increases

10. Radio waves of constant amplitude can be generated with
   A. Rectifier B. Filter
   C. FET D. oscillator

Dawn of Modern Physics

1. A photocell with a constant p.d. of V volt across it illuminated by a point source from a distance of 25 cm. When the source is moved to a distance of 1m, the electrons emitted by the photocell
   A. Carry 1/4th their previous energy
   B. Are 1/16th as numerous as before
   C. Are 1/4th as numerous as before
   D. Carry 1/4th their previous momentum

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2. Shining light of wavelength λ and intensity I on a surface S produces photoelectrons at rate R and with maximum kinetic energy E. Consider the following statements for the effect of changing one parameter at a time:
   a. Doubling I always doubles R
   b. Doubling I does not change E at all
   c. Making λ half always makes E more than 2-fold.

   The true statements are:
   A. I and II only
   B. II and III only
   C. I and III only
   D. All three

3. A monochromatic source of light is placed at a large distance d from a metal surface. Photoelectrons are ejected at rate n, kinetic energy being E. If the source is brought nearer to distance d/2, the rate and kinetic energy per photoelectron become nearly
   A. 2n and 2E
   B. 4n and 4E
   C. 4n and E
   D. N and 4E

4. The frequency of the incident light falling on a photosensitive metal plate is doubled, the kinetic energy of the emitted photoelectrons is
   A. Double the earlier value
   B. Unchanged
   C. More than doubled
   D. Less than doubled

5. When light of wavelength 300 nm (nanometer) falls on a photoelectric emitter, photoelectrons are liberated. For another emitter, however, light of 600 nm wavelength is sufficient for creating photoemission. What is the ratio of the work functions of the two emitters?
   A. 1 : 2
   B. 2 : 1
   C. 4 : 1
   D. 1 : 4

6. Ultra-violet radiation of 6.2 eV falls on an aluminium surface. K.E. of fastest electron emitted is (Work function = 4.2 eV)
   A. 3.2 × 10-21 J
   B. 3.2 × 10-19 J
   C. 7 × 10-25 J
   D. 9 × 10-32 J

7. A photoelectric cell converts
   A. Electrical energy to light energy
   B. Light energy to light energy
   C. Light energy to electrical energy
   D. Light energy to elastic energy

8. The essential distinction between X-rays and γ-rays is that
   A. γ-rays have smaller wavelength than X-rays
   B. γ-rays emanate from nucleus while X-rays emanate from outer part of the atom
   C. γ-rays have greater ionizing power than X-rays
   D. γ-rays are more penetrating than X-rays

9. A beam of light of wavelength γ and with illumination L falls on a clean surface of sodium. If N photoelectrons are emitted each with kinetic energy E, then
   A. $N \propto L$ and $E \propto \lambda$
   B. $N \propto L$ and $E \propto 1/\lambda$
   C. $N \propto L$ and $E \propto L$
   D. $N \propto 1/\lambda$ and $E \propto 1/L$

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10. The minimum wavelength of the X-rays produced by electrons accelerated through a potential difference of V volts is directly proportional to

A. $\sqrt{V}$
B. V^2
C. $1/\sqrt{V}$
D. 1/V

Atomic Spectra

1. There are discrete energy levels in atoms. It was first experimentally demonstrated by

A. Rutherford's experiment
B. Franck Hertz experiment
C. Marsden's experiment
D. Sommerfield experiment

2. Which of the following sources give discrete emission spectrum?

A. Incandescent electric bulb
B. Sun
C. Mercury vapour lamp
D. Candle

3. In which of the following states does the incandescent substance give continuous spectrum?

A. Vapours in atomic state
B. Vapours in molecular state
C. Solid or fluid in bulk state
D. Solid or fluid in plasma state

4. Band spectrum in produced by

A. H
B. He
C. H_2
D. Na

5. Who explained the origin of the Fraunhoffer lines?

A. Fraunhoffer
B. Kirchhoff
C. Fresnel
D. Snell

6. The nuclear model of atom was proposed by

A. J. J. Thomson
B. E. Rutherford
C. Neil Bohr
D. Summerfield

7. To explain his theory Bohr used

A. Conservation of linear momentum
B. Conservation of angular momentum
C. Conservation of quantum frequency
D. Conservation of energy

8. In which region of electromagnetic spectrum does the Lyman series of hydrogen atom lie

A. Ultraviolet
B. Infrared
C. Visible
D. X-ray

9. According to classical theory the proposed circular path of an electron in Rutherford model of atom will be

A. Circular
B. Straight line
C. Parabolic
D. Spiral

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10. Electrons in the atom are held in the atom due to

A. Coulomb forces
B. Nuclear forces
C. Gravitational forces
D. Van der Waal's forces

Nuclear Physics

1. The nucleus 6C12 absorbs an energetic neutron and emits a beta particle (β). The resulting nucleus is

A. $_7N^{14}$
B. $_5B^{13}$
C. $_7N^{13}$
D. $_6C^{13}$

2. The mass defect for the nucleus of helium is 0.0303 a.m.u. What is the binding energy per nucleon for helium in MeV?

A. 28
B. 7
C. 4
D. 1

3. When a hydrogen atom is bombarded, the atom is excited to the n = 4 state of hydrogen atom. The energy released when the atom falls from n = 4 state to the ground state is

A. 1.275 eV
B. 12.75 eV
C. 5 eV
D. 8 eV

4. The mass of a proton is 1847 times that of an electron. An electron and a proton are projected into a uniform electric field in a direction at right angles to the direction of the field with the same initial kinetic energy. The

A. Both the trajectories will be equally curved
B. The proton trajectory will be less curved than the electron trajectory
C. The electron trajectory will be less curved than the proton trajectory
D. The relative curving of the trajectories will be dependent on the value of the initial kinetic energy.

5. As the electron in Bohr orbit of hydrogen atom passes from stat n = 2 to n = 1, the kinetic energy K and potential energy U change as

A. K two-fold, U also two-fold
B. K four-fold, U also four-fold
C. K four-fold, U two-fold
D. K two-fold, U four-fold

6. The half-life of a radio-isotope is 5 years. The fraction of atoms decayed in this substance after 15 years will be:

A. 1
B. 3/4
C. 7/8
D. 5/8

7. The structure of solids is investigated by using

A. Cosmic Rays
B. X-rays
C. Intra red Radiation
D. γ-rays

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8. The de Broglie wave corresponding to a particle of mass m and velocity v has a wavelength associated with it

A. $\frac{h}{mv}$ B. hm v

C. $\frac{mh}{v}$ D. $\frac{m}{hv}$

9. The cathode of a photoelectric cell is changed such that the work function changes from W1 to W2 (W2 > W1). If the current before and after change are I1 and I2, all other conditions remaining unchanged, then (assuming hv > W2)

A. $I_1 = I_2$ B. $I_1 < I_2$

C. $I_1 > I_2$ D. $I_1 < I_2 < 2I_1$

10. The average binding energy of a nucleon inside an atomic nucleus is about

A. 8 MeV B. 8 eV

C. 8 joules D. 8 ergs.

Measurements

Answers

1	A	6	B
2	C	7	A
3	D	8	A
4	A	9	C
5	B	10	D

Explanation

1. Compare the dimensional formulae for surface tension and viscosity.

2. $[a] = \left[\frac{v}{t}\right] = LT^{-2}$

$\left[\frac{b}{t}\right] = [v] \Rightarrow [b] = [vt] = L$

and [c] = [t] = T.

3. Knowledge based question.

4. Knowledge based question.

5. $K = \frac{1}{2}mv^2$

Hence $\frac{\Delta K}{K} = \frac{\Delta m}{m} + \frac{2\Delta v}{v}$.

6. $\frac{J\Omega}{Vs} = \frac{J \times (V/A)}{V \times s} = \frac{J}{As} = \frac{J}{C} = V$.

7. Knowledge based question.

8. Knowledge based question.

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9. $[E]=\left[\frac{dV}{dx}\right]=\frac{volt}{metre}$.

10. $I=\frac{E}{At}=\frac{J}{m^2 s}=Wm^{-2}$.

Vectors and Scalars

Answers

1	A	6	D
2	D	7	C
3	D	8	C
4	C	9	B
5	D	10	B

Explanation

1. As density is mass per unit volume, both mass and volume are scalars so the relation between them is also a scalar. Density needs direction to describe. The answer is A.
2. Momentum is the product of velocity and mass. Velocity is a vector and mass is scalar as the product of scalar and vector is a vector so momentum is a vector quantity. While the other choices are not vectors. The answer is D.
3. Force, acceleration, and velocity need direction to describe. The answer is D.
4.
5. As the force is acting along Y- axis so the component along X-axis is zero. The right answer choice is d.
6. When two forces act in opposite direction to each other, their resultant is minimum. The answer is D.
7. When forces act in the same direction, their resultant is the sum of their magnitudes. The answer is C.
8. As the vectors are non-zero, the resultant zero is possible if $\cos\theta = 0$, which possible if $\theta = 90^0$. The answer is C.
9. Cos 180 = -1
10. Sin 0 = 0

Motion and Force

Answers

1	D	6	B
2	B	7	A
3	B	8	B
4	C	9	A
5	D	10	B

Explanation

1. $6^2 + 8^2 = 10^2$.

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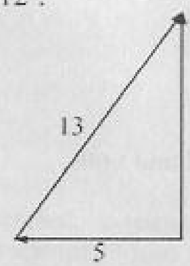
2. Use v = u + at

3. $V = \dfrac{2x}{\dfrac{x}{40} + \dfrac{x}{60}} = \dfrac{2\times40\times60}{60\times40} = 48\ km\ h^{-1}$.

4. See figure. Here $13^2 = 5^2 + 12^2$.



5. Relative velocity of the parrot w.r.t. the train = $[10 - (-5)\ ms^{-1}] = 15\ ms^{-1}$. Time taken by the parrot to cross the train = 150/15 = 10 s.

6. $\dfrac{x(4)}{x(5)} = \dfrac{\frac{g}{2}(2\times4-1)}{\frac{g}{2}(2\times5-1)} = \dfrac{7}{9}$.

7. Use $h = \dfrac{1}{2}gt^2$.

8. $v = u + \int_0^2 a\,dt$.

9. $x_n = u + (a/2)(2n - 1)$

10. Constant velocity means constant speed as well same direction throughout.

Work and Energy

Answers

1	C	6	B
2	C	7	A
3	B	8	D
4	C	9	A
5	C	10	B

Explanation

1. If E = KE and p = momentum. Then

$E = \dfrac{1}{2}mv^2 = \dfrac{1}{2}\dfrac{m^2v^2}{m} = \dfrac{1}{2}\dfrac{p^2}{m}$

Therefore $\dfrac{P_1^2}{m_1} = \dfrac{P_2^2}{m_2}$

That is $\dfrac{P_1}{P_2} = \sqrt{\dfrac{m_1}{m_2}} = \sqrt{\dfrac{1}{4}} = \dfrac{1}{2}$

2. $W = Fs\cos\phi$. Hence W = 25J, F = 5N, s = 10m. Therefore $\cos\phi = 1/2$. Hence $\phi = 60^o$.

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3. When the kinetic energy is halved, the potential energy is equal to the kinetic energy. That is mgh = (490/2)J = 245J. This gives h = 12.5m.
4. Use $k = p^2/M$.
5. $K = P^2/m$
Here $K_1 = K_2$. That is
$p_A^2 / M_A = P_B^2 / M_A = P_B^2 / M_B$.
6. $P = \frac{W}{t}$. Hence P = 2kW = 200 W.
W = Mgh = M × 10 × 10 = 100 M and t 60s.
This gives M = 1200kg.
Its volulme = 1200 liters.
7. Momentum is conserved. Hence
$P_b = P_r$ Or $P_b^2 = P_r^2$
Since $p^2 = MK$, we have $M_bK_b = M_rk_r$
That is $K_r = \frac{M_b}{M_r} K_b$
Because $M_b > M_r$. Hence $K_r < K_b$.
8. $W = F_x$. Here x = 0.
9. Force is always perpendicular to the velocity.
10. $K = p^2 / 2m$. Hence $\frac{K_1}{K_2} = \frac{P_1^2}{2m_1} \times \frac{2m_2}{P_2^2}$
$= \frac{m_2}{m_1} = \frac{3}{2}$. Hence $K_2 = 10J$.
Hence $K_1 = 15J$.

Circular Motion

Answers

1	C	6	C
2	A	7	B
3	C	8	A
4	A	9	B
5	B	10	D

Explanation

1. Only kinetic energy is constant. The velocity and acceleration change in direction. Displacement changes both in magnitude and direction
2. $\vec{L} = \vec{r} \times \vec{p}$. It is axial vector.
3. Central force is directed along the line joining the particles. Hence it applies no torque.
4. The angular momentum remains constant in the orbit of the earth.
5. Due to rotation, the decrease in weight is maximum at the equator and zero at the poles.
6. Factual statement.

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7. Couple consists of two equal and opposite forces, which cause pure rotational motion.
8. Angular velocity is related to the rotating body.
9. $I_1\omega_1 = I_2\omega_2$

Or $I_1\frac{2\pi}{T_1} = I_2\frac{2\pi}{T_2}$

Also $I_2 = M\left(\frac{D}{2}\right)^2 = \frac{I_1}{4}$

Here $T^1 = 24$ h.

So we find $T^2 = 6$ h.

10. When the hands are outstretched, moment of inertia increases and angular velocity decreases so that angular momentum remains unchanged.

Fluid Mechanics

Answers

1	A	6	A
2	B	7	B
3	C	8	D
4	A	9	A
5	C	10	A

Explanation

1. When raindrop moves through air, a drag up ward force acts on it. This upward force depends on velocity of the raindrop. After certain time, this upward force becomes equal to the weight of the raindrop.
2. Refer to the review section of the chapter. The terminal velocity varies inversely with R.
3. According to Bernoulli's equation, the sum of energies is constant for different points.
4. Intermolecular forces stretch the upper layer of the liquids, which provide the surface tension of the liquid.
5. The air adjacent to the moving bus moves with the bus, hence its pressure is reduced.
6. Viscosity of the thick ink in the ballpoint prevents it to flow fast through the tip.
7. With the increase in temperature, the Kinetic energies of the molecules increases, this reduces the intermolecular forces.
8. The drag force at a point depends on the instantaneous velocity at that point.
9. Factual question.
10. The density of blood (with out RBCs and WBC) is equal to that of water.

Oscillations

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Answers

1	A	6	B
2	D	7	D
3	C	8	C
4	D	9	D
5	D	10	D

Explanation

1. Simple harmonic waves are set up in a string fixed at the two ends.
2. Spring gains P.E. both on stretching as well as compressing. Work done against gravitation also increases the P.E.
   When the bubble rises, the P.E. is higher at the bottom due to upthrust. So it decreases when the bubble rises.
3. Time period of a simple pendulum does not depend on its mass.
4. $T = 2\pi\sqrt{\frac{M}{k}}$.
5. $T = 2\pi\sqrt{\frac{l}{g}}$.
6. $U_p = \frac{1}{2}m\omega^2 y^2$

   Here $y = \frac{A}{2}$

   $E = \frac{1}{2}m\omega^2 A^2$
7. Use $f = \frac{1}{2\pi}\sqrt{\frac{k}{M}}$.
8. In SHM, the PE is maximum at extreme position and kinetic energy is maximum at the mean position.
9. For simple pendulum
   $T = 2\pi\sqrt{l/g}$
   At Quetta, g is less as compared to that at Karachi. So, to keep T unchanged, the length l should also be decreased.
10. KE + PE = constant is in accordance with the law of conservation of energy.

Waves

Answers

1	B	6	D
2	D	7	D
3	C	8	C
4	B	9	D
5	C	10	C

Explanation

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1. Frequency does not change on refraction.
2. Constant phase difference is the essential condition for coherence of sources.
3. Use $c \propto \sqrt{T}$.
4. For production of beats different frequencies are essential. The different amplitudes affect the minimum and maximum amplitude of the beats and different phase affect the time of occurrence of minimum and maximum.
5. $I = 2\pi^2 A^2 f^2 c\rho$, where A = amplitude, c = velocity of the wave, f = frequency and ρ = density of the medium. Here A is double and f becomes one fourth. Hence I becomes one fourth.
6. Longitudinal waves transmit disturbance in the direction of propagation. Particles move parallel or antiparallel to the velocity of the wave. Thus they transmit energy, momentum and mass in the propagation direction.
7. The particle have maximum K.E. at mean position.
8. $\frac{v_{rms}}{v_{sound}} = \sqrt{3/\gamma}, \gamma = 1.4$.
9. Knowledge based question.
10. $y = b\cos(\omega t - kx)$ or
 $y = \sin(\omega t - kx + \pi/2)$.

Physical Optics

Answers

1	D	6	D
2	D	7	A
3	D	8	D
4	B	9	B
5	C	10	D

Explanation

1. Knowledge based question.
2. Knowledge based question.
3. Knowledge based question.
4. Knowledge based question.
5. Because of short wavelength it bends only at very very small obstacles or apertures.
6. Origin of spectra cannot be explained by Huygen's principle.
7. $\beta \propto \lambda$. The wavelength of blue light is less than that of yellow light.
8. Distance of second dark fringe from the central maximum $y = \frac{3}{2}\frac{D\lambda}{d}$. Here y = 10^{-3} mm.
9. The contrast depends on the relative value of the maximum and minimum intensities. If A_1 and A_2 be the amplitude of the interfering waves then:

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$$\frac{I_{max}}{I_{min}} = \frac{(A_1 + A_2)^2}{(A_1 - A_2)^2} = \frac{(A_1/A_2)+1}{(A_1A_2-1)^2}$$

and $A_1/A_2 = [I_1/I_2]^{1/2}$.

10. Photo electric effect can be explained on the basic of quantum theory.

Optical Instruments

Answers

1	D	6	C
2	D	7	A
3	B	8	A
4	A	9	A
5	C	10	B

Explanation

1. Less light will enter the telescope.

2. Amount light.

3. $M = \frac{L}{f_o}\left[1 + \frac{D}{f_e}\right]$. As L increases, M also increases.

4. Use $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$. Here u = -f/2. Hence v = f and m = v/u = 2.

5. $\frac{1}{f} = \left[\frac{\mu_2}{\mu_1} - 1\right]\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

Since f is –VE in water, therefore μ_2 is less than the refractive index of water μ_2 = 1.33. Hence μ_2 lies between 1 and 1.33.

6. (i) $L = f_o + f_e = 16 + 0.02 = 16.02$ m.

(ii) Magnification $= \frac{f_o}{f_e} = -800$.

(iii) The telescope produces inverted image.

(iv) Size of the objective of telescope is larger than that of the eyepiece.

7. $20 = M = f_o/f_e$ and $L = 105\ f_o + f_e$.

8. f_o/f_e.

9. Total length $= l = f_o + f_e$.

10. Image followed by astronomical telescope is not erect.

Heat and Thermodynamics

Answers

1	A	6	B
2	B	7	C
3	B	8	A
4	B	9	A
5	A	10	C

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Explanation

1. $\frac{1}{3}Nmc^2 = \frac{2}{3}\times\left(\frac{1}{2}Nm\right)c^2 = \frac{2}{3}$ K.E.
2. Number of translational degrees of freedom are same for all types of gases.
3. As the temperature increases, the average velocity increases. Socollisions are faster.
4. Work done is not a thermodynamic function.
5. absolute temperature $\propto$ average KE $\propto$ (rms speed)^2.
6. For Boyle's law, temperature should be constant.
7. PV = nRT.
8. K.E. $\propto$ nRT.

Section 2

9. According to Boyle's law,

PV = constant

$\Rightarrow \quad P_1V_1 = P_2V_2$

Here $P_2 = P_1 + \frac{P_1}{20}$ or $P_2 = \frac{21}{20}P_1$

Substituting it in eqn. (n), we get

$V_2 = \frac{20}{21}V_1$ or $V_2 = 0.9524\ V_1$

Thus V_2 is 95.24% of V_1. In other words, volume decreased by 4.76%.

10. Since pressure is constant, then

$\frac{V}{T}$ = constant

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

or $\quad \frac{V}{273+27} = \frac{3V}{273+x}$

or $\quad x = 627°C$.

Electrostatics

Answers

1	B	6	D
2	A	7	C
3	B	8	B
4	A	9	D
5	B	10	A

Explanation

1. $5\times(0.06)^2 = F\times(0.04)^2$

Hence F = 11.25 N.

2. In the second case, the charges will be -2 μC and +3 μC

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Here $40 \propto 3 \times 8$. Hence $F \propto -2 \times 3$

which gives $F = -\frac{6}{24} \times 40 = -10N$

3. $n = \frac{q}{e} = \frac{6.35 \times 10^{-19}}{1.6 \times 10^{-19}} \cong 4$.

4. $E = \frac{F}{q} = \frac{N}{C}$.

5. The charge at the centre causes non zero electric field everywhere.

6. If we consider the cube as the Gaussian surface, then flux through it is q/ε_0. Since, each face of the cube is symmetrical, so flux associated with each side is same. Hence, flux through one of the side is $q/6\varepsilon_0$.

7. Flux, $\phi = \frac{q}{\varepsilon_0}$

Here, $q = 1C$

So $\phi = \varepsilon_0^{-1}$.

8. Net charge enclosed by the hollow sphere is zero, therefore, the electric flux through the hollow sphere is also zero.

9. The electric field $E = 9 \times 10^9 \times \frac{q}{r^2}$

Hence, $q = \frac{E.r^2}{9 \times 10^9} = \frac{2 \times (0.6)^2}{9 \times 10^9}$

$= 8 \times 10^{-11}$ C.

10. Electric field at the centre of a hollow charged sphere is zero.

Current Electricity

Answers

1	D	6	A
2	B	7	A
3	C	8	D
4	A	9	D
5	C	10	A

Explanation

1. $P = \frac{V^2}{R} = \frac{(110)^2}{10} = \frac{12100}{10} = 1210$ W

2. $R = \frac{V^2}{P}$ Hence $R_1 = \frac{V^2}{200}$ and $R_2 = \frac{V^2}{100}$

That is $R_2 = 2R_1$

3. If $r_2 = nr_1$, then $R_2 = \frac{R_1}{n^4}$ Here $n = \frac{1}{2}$.

Hence $R_2 = 16 R_1$.

4. $P_1 = \frac{(200)^2}{R} = 100$

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$$P_2 = \frac{(160)^2}{R} = \frac{(16)^2}{(200)^2} \times 100 = \frac{16^2}{4} = \frac{256}{4} = 64W$$

5. $50 = 4.5\,(10 - r)$

$4.5\,r = 50 - 45 = 5$

$r = \frac{5}{4.5} = \frac{50}{45} = \frac{10}{9} = 1.1\Omega$.

6. Current in the wire is

$I = \frac{P}{V} = \frac{2.2 \times 10^3}{22000} = \frac{1}{10}A$

Power loss $= I^2R = \left(\frac{1}{10}\right)^2 \times 10 = 0.1$ W.

7. Knowledge based question.
8. $P = I^2 R$ That is $22.5 = (15)^2 \times R$

This gives $R = 0.10\ \Omega$.

9. Resistivity is a constant independent of the dimensions of the wire.
10. Knowledge based question.

Electromagnetism

Answers

1	D	6	D
2	B	7	C
3	A	8	C
4	B	9	D
5	C	10	C

Explanation

1. $R' = (n - 1)\,G_v$. Here $n = \frac{10}{2} = 5$.

Hence $R' = (5 - 1) \times 2000\ \Omega = 8000\ \Omega$

2. Diamagnetic materials move towards weaker fields.
3. Electric field does work on the charge.
4. Knowledge based question.
5. Magnetic lines of force are continuous both inside and outside the magnet.
6. Ammeter is a low resistance device, whereas voltmeter is a high resistance device.
7. Magneic moment $P_m = I\,A = I \times \pi\, r^2$

$$= I \times \pi\left(\frac{L}{2\pi}\right)^2$$

Hence $P_m \propto L^2$

8. See the figure below

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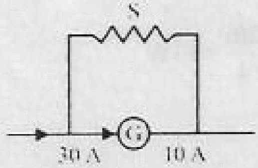

Here 10 × R = 20 × S

Hence S = R/2

9. Li' would experience large magnetic force because of heavy mass.

10. Current in a moving coil galvanometer.

$I = \frac{k\theta}{NBA}$,

where $\frac{k}{NBA}$ =G= galvanometer constant. Therefore I α θ (deflection).

Electromagnetic Induction

Answers

1	D	6	A
2	A	7	C
3	C	8	A
4	A	9	A
5	D	10	B

Explanation

1. $P = \frac{E_0 I_0}{2}\cos\phi$.

2. Turn ratio $t = \frac{5000}{500} = 10{:}10 = \frac{E_0}{E_i} = \frac{E_0}{20}$

Hence E_0 = 200 V. Frequency remains unchanged.

3. $\frac{E_s}{E_p} = \frac{n_s}{n_p}$ or $E_s = \frac{n_s}{n_p} \times E_p = \frac{10}{200} \times 240$

=12 V.

4. Step down transformer lowers the emf and increases the current.

5. $P_a = \frac{I_0 E_0}{2}\cos 0$. Hence $\phi = 90$.

6. $I = I_0(1 - e^{-\frac{Rt}{L}})$. Here time constant = L/R is the time in which current grows to 63% of I_0.

7. The transformer does not change the frequency of ac.

8. Knowledge based question.

9. For motion of a charged particle in a magnetic field, we have $r = \frac{mv}{q_0 B}$ Hence r ∝ v.

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10. $\frac{1}{L_s} = \frac{1}{L_1} + \frac{1}{L_2} = \frac{1}{L} + \frac{1}{L}$. Hence $L_s = \frac{L}{2}$.

Alternating Current

Answers

1	A	6	C
2	C	7	A
3	D	8	D
4	B	9	B
5	C	10	D

Explanation

1. $\tan\phi = \frac{\omega L - \frac{1}{\omega C}}{R}$

Here $\tan\phi$ can vary from $-\infty$ to $+\infty$. Hence ϕ lies between $-\frac{\pi}{2}$ and $+\frac{\pi}{2}$.

2. $\tan\phi = \frac{\omega L}{R} = \frac{X_L}{R}$

Here $\phi = 45^\circ$. Hence $X_L = R$.

3. $I = \frac{220}{\sqrt{(20)^2 + (2\times\pi\times50\times0.2)^2}}$

$= \frac{220}{20\times3.3} = \frac{220}{66} = 3.33\,A$.

4. $X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

For dc, f = 0, therefore $X_C = \infty$.

5. It is a low resistance and a high inductance coil.

6. Peak value voltage $E_0 = \sqrt{2}\ E_{rms}$

$= 1.414 \times 220 = 311$ vlts.

7. Knowledge based question.

8. Here $X_L = 50$ ohm, $v = 50$ C.P.S.

Inductance of the coil,

$L = \frac{X_L}{\omega} = \frac{X_L}{2\pi v} = \frac{50}{2\pi\times50} = \frac{1}{2\times3.14} = 0.16$ H.

9. Energy stored in the choke coil in the form of magnetic energy.

10. Co-efficient of self-inductance or mutual inductance is measured in henry (H).

Also $1\mu = \frac{1\,Wb}{1A} = 1\ Wb\ A^{-1}$ = 1 Weber/ampere.

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Physics of Solids

Answers

1	A	6	B
2	A	7	C
3	B	8	B
4	A	9	C
5	A	10	C

Explanation

1. Knowledge based questions.
2. Knowledge based questions.
3. Knowledge based questions.
4. Liquids have no shape.
5. The intratomic binding energy decreases with temperature. So, more strain is produced at higher temperature. Hence, Y decreases.
6. Strain = l/L. Here length is doubled, hence l = L.
7. According to Hooke's law stress ∝ strain.
   Than is $\frac{F}{A} \propto \frac{l}{L}$
   Since A and L are fixed, therefore F ∝ l.
8. $l = \frac{FL}{AY}$. For large l, A should be small and L large.
9. Te breaking stress does not depend on the length of the cable. It does depend on the area of cross section. Also, see the following explanations.
10. The breaking load remains unchanged; therefore breaking strain should be same as before. Since length of the cable is reduced to half, hence change in length should also be halved.

Electronics

Answers

1	D	6	C
2	C	7	A
3	B	8	D
4	D	9	B
5	D	10	D

Explanation

1. Knowledge based question.
2. $\alpha = \frac{\Delta I_c}{\Delta I_e}$. Here $\Delta I_c = 5.00$ A, $\alpha = 0.98$.
3. Knowledge based question.
4. Knowledge based question.
5. Knowledge based question.

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6. Knowledge based question.
7. The emitter is heavily doped.
8. When a free electron is produced, simultaneously is similar to that of conductors.
9. At low temperature the behavior of semiconductors in similar to that of conductors.
10. Oscillator can be used to generate electromagnetic waves.

Dawn of Modern Physics

Answers

1	B	6	A
2	D	7	C
3	C	8	B
4	C	9	B
5	B	10	D

Explanation

1. Intensity of light is inversely proportional to the square of distance. In this case, the distance becomes 4 times.
2. Rate of emission depends on intensity of light, but kinetic energy is independent of it. Decreasing λ increase frequency. When λ is halved, frequency is doubled and kinetic energy becomes more than double.
3. Rate of electron emission $\propto$ intensity. Intensity becomes 4 times when distance is halved. Kinetic energy depends on the frequency of photons. It is not affected by the distance.
4. $h\nu = \omega + \frac{1}{2}mv^2 = \omega + KE$.

   That is $KE = h\nu - \omega$. When ν is doubled KE becomes $= 2h\nu - \omega$. It is more than 2 $(h\nu - \omega)$.
5. Work function $= hc/\lambda_0$ where λ_0 is threshold wavelength. Hence $\omega_1/\omega_2 = \lambda_2/\lambda_1 = 2/1$.
6. $h\nu = \omega_0 + KE$. Here $h\nu = 6.2$ eV, $\omega_0 = 4.2$ eV, hence $KE = 2eV = 2 \times 1.6 \times 10^{-19}$ J $= 3.2 \times 10^{-19}$ J.
7. In photoelectric effect, the light is absorbed and electrons are emitted.
8. The wavelength of the γ-rays is shorter. However, the main distinguishing feature is the nature of emission.
9. Number of photons emitted is proportional to the intensity. Also $\frac{hc}{\lambda} = \omega_0 + E$.
10. $h\nu_{max} = eV$. Or $\frac{hc}{\lambda_{min}} = eV$ Hence $\lambda_{min} \propto \frac{1}{V}$

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Atomic Spectra

Answers

1	B	6	B
2	C	7	B
3	C	8	A
4	C	9	D
5	B	10	A

Explanation

1. It is statement of a fact.
2. Mercury vapours give line spectrum
3. When the substance in bulk is at very high temperature, continuous spectrum is produced.
4. Molecules give band spectrum.
5. Kirchhoff explained the Fraunhoffer lines on the basis of his law of radiations
6. It is statement of a fact
7. Bohr postulated that the angular momentum of the electron = $nh/2\pi$.
8. It is statement of a fact.
9. Due to the continuous loss of energy, the electron will move along a spiral path towards the nucleus.
10. The coulomb force of the nucleus keeps the electrons bound to the nucleus.

Nuclear Physics

Answers

1	C	6	B
2	B	7	B
3	B	8	A
4	A	9	A
5	C	10	A

Explanation

1. $_6C^{12} + _0n^1 \rightarrow _6C^{13} \rightarrow _7N^{13} + \phi - _1e^0$.
2. 1 amu = 931 MeV. Hence 0.0303 amu = 0.0330 × 931 MeV = 28.2 MeV ≅ 28 MeV.

   B.E./nucleon = $\frac{28}{4}$=7 MeV.
3. $E_n = -1\frac{13.6}{n^2}$ eV.E_4 = - 0.85 eV.

   Hence $E_4 - E_1$ = 12.75 eV.
4. The deflection of the charged particle in an electric field is given by $y = \frac{1}{2}\frac{q_0E}{m}\frac{x^2}{v^2}$.

   Here x is the distance covered by the charged particle in the direction of initial

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motion. Hence $y = \frac{1}{4}\frac{q_0 E}{K}x^2$, where $K = \frac{1}{2}mv^2$ = KE. This shows that the deflection is independent of mass of the particle.

5. Amount left after 15 hours (i.e., 3 half lines) = $(1/2)^3$th part. Hence amount undecayed = (7/8)th part.

6. After 8 seconds, the counting rate falls to (1/16)th = $\left(\frac{1}{2}\right)^4$ th part. Hence time period is (8/4)s = 2s. Therefore after 6 seconds the counting rate should be $(1/2)^3$th part of 1600. That is it should be $\frac{1}{8} \times 1600 = 200$.

7. X-ray diffraction helps in the study of the structure of solids.

8. de Broglie wavelength is $\lambda = h/p = h/mv$.

9. The work function has no effect on current so long it has $h\nu > W$. The photoelectric current is proportional to the intensity of light. Since, there is no change is the intensity of light, therefore $I_1 = I_2$.

10. This is a statement of fact.

END OF THE SECTION

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