AIEEE-2011

PHYSICS

61. A Carnot engine operating between temperatures T_1 and T_2 has efficiency 1/6. When T_2 is lowered by 62 K, its efficiency increases to 1/3. Then T_1 and T_2 are, respectively:

(1) 310 K and 248 K

(2) 372 K and 310 K

(3) 372 K and 330 K

(4) 330 K and 268 K

ANS…..2

62. A pulley of radius 2 m is rotated about its axis by a force F = (20 t – $5t^2$) newton (where t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotation is 10 kg m^2, the number of rotations made by the pulley before its direction of motion if reversed, is:

(1) more than 9

(2) less than 3

(3) more than 3 but less than 6

(4) more than 6 but less than 9

ANS…..3

63 Three perfect gases at absolute temperatures T_1 , T_2 and T_3 are mixed. The masses of molecules are m_1 , m_2 and m_3 and the number of molecules are n_1 , n_2 and n_3 respectively. Assuming no loss of energy, the final temperature of the mixture is:

(1) $\frac{n_1^2T_1^2 + n_2^2T_2^2 + n_3^2T_3^2}{n_1T_1 + n_2T_2 + n_3T_3}$

(2) $\frac{T_1 + T_2 + T_3}{3}$

(3) $\frac{n_1T_1 + n_2T_2 + n_3T_3}{n_1 + n_2 + n_3}$

(4) $\frac{n_1T_1^2 + n_2T_2^2 + n_3T_3^2}{n_1T_1 + n_2T_2 + n_3T_3}$

ANS…..2

64. A boat is moving due east in a region where the earth's magnetic field is 5.0×10^{-5} $NA^{-1}m^{-1}$ due north and horizontal. The boat caries a vertical aerial 2 m long. If the speed of the boat is 1.50 ms^{-1}, the magnitude of the induced emf in the wire of aerial is:

(1) 0.15 mV

(2) 1 mV

(3) 0.75 mV

(4) 0.50 mV

ANS…..1

65. A thin horizontal circular disc is rotating about a vertical axis passing through its centre. An insect is at rest at a point near the rim of the disc. The insect now moves along a diameter of the disc to reach its other end. During the journey of the insect, the angular speed of the disc:

(1) first increases and then decrease

(2) remains unchanged

(3) continuously decreases

(4) continuously increases

ANS…..1

66. Two identical charged spheres suspended from a common point by two massless strings of length *l* are initially a distance *d* (*d* << *l*) a part because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result the charges approach each other with a velocity *v*. Then as a function of distance *x* between them,

(1) $v \propto x$

(2) $v \propto x^{-1/2}$

(3) $v \propto x^{-1}$

(4) $v \propto x^{1/2}$

ANS…..2

67. 100 g of water is heated from 30ºC to 50ºC. Ignoring the slight expansion of the water, the change in its internal energy is (specific heat of water is 4184 J/kg/K):

(1) 2.1 kJ

(2) 4.2 kJ

(3) 8.4 kJ

(4) 84 kJ

ANS…..3

68. The half life of a radioactive substance is 20 minutes. The approximate time interval $t_2 - t_1$ between the time t_2 when $\frac{2}{3}$ of it has decayed and time t_1 when $\frac{1}{3}$ if it had decayed is:

(1) 28 min

(2) 7 min

(3) 14 min

(4) 20 min

ANS…..4

69. Energy required for the electron excitation in Li^{++} from the first to the third Bohr orbit is:

(1) 122.4 eV

(2) 12.1 eV

(3) 36.3 eV

(4) 108.8 eV

ANS…..4

70. The electrostatic potential inside a charged spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the cetnre; a, b are constants . Then the charge density inside the ball is:

(1) –6 $a\varepsilon_0$

(2) –24 $\pi a\varepsilon_0 r$

(3) –6 $a\varepsilon_0 r$

(4) –24 $\pi a\varepsilon_0$

ANS…..1

71. Work done in increasing the size of a soap bubble from a radius of 3 cm to 5 cm is nearly (Surface tension of soap solution = 0.03 Nm^{-1}):

(1) 0.4π mJ

(2) 4π mJ

(3) 0.2π mJ

(4) 2π mJ

ANS…..1

72. A resistor 'R' and 2μF capacitor in series is connected through a switch to 200 V direct supply. Across the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5 s after the switch has been closed. ($\log_{10}$ 2.5=0.4)

(1) $3.3\times10^{7}\,\Omega$

(2) $1.3\times10^{4}\,\Omega$

(3) $1.7\times10^{5}\,\Omega$

(4) $2.7\times10^{6}\,\Omega$

ANS…..4

73. A current I flows in an infinitely long wire cross section in the form of a semi circular ring of radius R. The magnitude of the magnetic induction along its axis is:

(1) $\frac{\mu_0 I}{4\pi R}$

(2) $\frac{\mu_0 I}{\pi^2 R}$

(3) $\frac{\mu_0 I}{2\pi^2 R}$

(4) $\frac{\mu_0 I}{2\pi R}$

ANS…..2

74. An object moving with speed of 6.25 m/s, is decelerated at a rate given by :

$$\frac{dv}{dt} = -2.5\sqrt{v}$$

where *v* is the instantaneous speed. The time taken by object, to come to rest, would be

(1) 8s

(2) 1 s

(3) 2s

(4) 4s

ANS…..3

75. Direction:

The question has a paragraph followed by two statements, ***Statement – 1*** *and* ***Statement – 2****. Of the given four alternatives after the statements, choose the one that describes the statements.*

A thin air film is formed by putting the convex surface of a plane – convex lens over a plane glass plate. With monochromatic light, this film gives an interference pattern due to light reflected from the top (convex) surface and the bottom (glass plate)surface of the film

Statement – 1:

When light reflected from the air glass plate interface, the reflected wave surface a phase change of π.

Statement – 2:

The centre of the interference pattern is dark.

(1) Statement -1 is false, Statement – 2 is true

(2) Statement – 1 is true, Statement – 2 is false

(3) Statement – 1 is true, Statement – 2 is true and Statement – 2 is the correct explanation of Statement – 1

(4) Statement – 1 is true, Statement – 2 is true and Statement – 2 is **not** the correct explanation of Statement 1

ANS…..3

76. Two bodies of masses *m* and 4*m* are placed at a distance *r*. The gravitational potential at a point on the line joining them where the gravitational field is zero is:

(1) $-\frac{9Gm}{r}$

(2) zero

(3) $-\frac{4Gm}{r}$

(4) $-\frac{6Gm}{r}$

ANS…..1

77. This question has **Statement – 1** and **Statement – 2**. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement – 1:

Sky wave signals are used for long distance radio communication. These signals are in general, less stable than ground wave signals.

Statement – 2:

The state of of ionosphere varies from hour to hour, day to day and season to season.

(1) Statement -1 is false, Statement – 2 is true

(2) Statement – 1 is true, Statement – 2 is false

(3) Statement – 1 is true, Statement – 2 is true and Statement – 2 is the correct explanation of Statement – 1

(4) Statement – 1 is true, Statement – 2 is true and Statement – 2 is **not** the correct explanation of Statement 1

ANS…..1

78. A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at t = 0. The time at which the energy is stored equally between the electric and the magnetic fields is:

(1) $\sqrt{LC}$ (2) $\pi\sqrt{LC}$

(3) $\frac{\pi}{4}\sqrt{LC}$ (4) $2\pi\sqrt{LC}$

ANS…..3

79. This question has **Statement – 1** and **Statement – 2**. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement – 1:

A metallic surface is irradiated by a monochromatic light of frequency $\nu > \nu_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are $K_{\max}$ and V_0 . If the frequency incident on the surface is doubled, both the K_{max} and V_0 are also doubled.

Statement – 2:

The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light.

(1) Statement -1 is false, Statement – 2 is true

(2) Statement – 1 is true, Statement – 2 is false

(3) Statement – 1 is true, Statement – 2 is true and Statement – 2 is the correct explanation of Statement – 1

(4) Statement – 1 is true, Statement – 2 is true and Statement – 2 is **not** the correct explanation of Statement 1

ANS…..1

80. Water is flowing continuously from a tap having an internal diameter 8×10^{-3} m. The water velocity as it leaves the tap is 0.4 ms^{-1}. The diameter of the water stream at a distance 2×10^{-1} m below the tap is close to:

(1) 3.6×10^{-3} m

(2) 5.0×10^{-3} m

(3) 7.5×10^{-3} m

(4) 9.6×10^{-3} m

ANS…..1

81 A mass M, attached to a horizontal spring, executes S.H.M. with amplitude A_1. When the mass M passes through its mean position then a smaller mass m is placed over it and both of them move together with amplitude A_2. The ratio of $\left(\frac{A_1}{A_2}\right)$ is:

(1) $\left(\frac{M+m}{M}\right)^{1/2}$

(2) $\frac{M}{M+m}$

(3) $\frac{M+m}{M}$

(4) $\left(\frac{M}{M+m}\right)^{1/2}$

ANS…..1

82. Two particles are executing simple harmonic motion of the same amplitude *A* and frequency ω along the *x*-axis. Their mean position is separated by distance X_0 $X_0 > A$. If the maximum separation between them is $X_0 + A$, the phase difference between their motion is:

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{2}$

(3) $\frac{\pi}{3}$ (4) $\frac{\pi}{4}$

ANS…..3

83. If a wire is stretched to make it 0.1% longer, its resistance will:

(1) decrease by 0.05% (2) increase by 0.05%

(3) increase by 0.2% (4) decrease by 0.2%

ANS…..3

84. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountain is *v*, the total area around the fountain that gets wet is:

(1) $\pi\frac{v^2}{g^2}$ (2) $\pi\frac{v^2}{g}$

(3) $\pi\frac{v^4}{g^2}$ (4) $\frac{\pi}{2}\frac{v^4}{g^2}$

ANS…..3

85. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio of specific heats γ. It is moving with speed *v* and is suddenly brought to rest. Assuming no heat is lost to the surroundings, its temperature increases by:

(1) $\frac{\gamma-1}{2R}Mv^2\mathrm{K}$ (2) $\frac{\gamma-1}{2\ \gamma+1\ R}Mv^2\mathrm{K}$

(3) $\frac{\gamma-1}{2\gamma R}Mv^2\mathrm{K}$ (4) $\frac{\gamma Mv^2}{2R}\mathrm{K}$

ANS…..1

86. A screw gauge gives the following reading when used to measure the diameter of a wire.

Main scale reading : 0 mm

Circular scale reading : 52 divisions

Given that 1 mm on main scale corresponds to 100 divisions of the circular scale.

The diameter of wire from the above data is:

(1) 0.005 cm

(2) 0.52 cm

(3) 0.052 cm

(4) 0.026 cm

ANS…..3

87 A mass m hangs with the help of a string wrapped around a pulley on a frictionless bearing. The pulley has mass m and radius R . Assuming pulley to be a perfect uniform circular disc, the acceleration of the mass m, if the string does not slip on the pulley, is:

(1) $\frac{g}{3}$

(2) $\frac{3}{2}$ g

(3) g

(4) $\frac{2}{3}$ g

ANS…..4

88. The transverse displacement y(x, t) of a wave on a string is given by

$y(x,t) = e^{-ax^2+bt^2+2\sqrt{ab}\,xt}$.

This represents a :

(1) standing wave of frequency $\frac{1}{\sqrt{b}}$

(2) wave moving in +x direction with speed $\sqrt{\frac{a}{b}}$

(3) wave moving in –x direction with speed $\sqrt{\frac{b}{a}}$

(4) standing wave of frequency $\sqrt{b}$

ANS…..3

89. A car is fitted with a convex side-view mirror of focal length 20 cm. A second car 2.8 m behind the first car is overtaking the fist car at a relative speed of 15 m/s. The speed of the image of the second car as seen in the mirror of the first one is:

(1) 15 m/s

(2) $\frac{1}{10}$ m/s

(3) $\frac{1}{15}$ m/s

(4) 10 m/s

ANS…..3

90. Let the *x* – *z* plane be the boundary between two transparent media. Medium 1 in $z \geq 0$ has a refractive index of $\sqrt{2}$ and medium 2 with z < 0 has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $\vec{A} = 6\sqrt{3}\hat{i} + 8\sqrt{3}\hat{j} - 10\hat{k}$ is incident on the plane of separation. The angle of refraction in medium 2 is:

(1) 75º

(2) 30º

(3) 45º

(4) 60º

ANS…..3