AIEEE-2011

PHYSICS

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

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(2) 372 K and 310 K

Entrance

(3) 372 K and 330 K

(4) 330 K and 268 K

ANS.....2

A pulley of radius 2 m is rotated about its axis by a force $F = (20 \text{ t} - 5t^2)$ 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 m², 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

Entrance

(4) more than 6 but less than 9

Entrance

ANS....3

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 m_1 , m_2 and m_3 respectively. Assuming no loss of energy, the final temperature of the mixture is:

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

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

(3)
$$\frac{n_1 T_1 + n_2 T_2 + n_3 T_2}{n_1 + n_2 + n_3}$$

(4)
$$\frac{n_1 T_1^2 + n_2 T_2^2 + n_3 T_3^2}{n_1 T_1 + n_2 T_2 + n_3 T_3}$$

A boat is moving due east in a region where the earth's magnetic field is 5.0×10^{-5} NA⁻¹m⁻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

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 ($d \ll l$) 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

100 g of water is heated from 30°C to 50°C. 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

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(4) 20 min

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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) $0.4\pi \,\text{mJ}$

(2) $4\pi \,\mathrm{mJ}$

(3) $0.2\pi \,\text{mJ}$

(4) $2\pi \,\text{mJ}$

ANS.....1

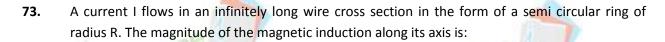
72. A resistor 'R' and 2μ F capacitor in series is connected through a switch to 200 V direct supply. Across the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5 s after the switch has been closed. ($\log_{10} 2.5 = 0.4$)

(1)
$$3.3 \times 10^7 \Omega$$

(2)
$$1.3 \times 10^4 \Omega$$

(3)
$$1.7 \times 10^5 \Omega$$

(4)
$$2.7 \times 10^6 \Omega$$



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

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

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

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

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 . Entrance

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

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- (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

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

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

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

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, Entrance 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

- 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}

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:

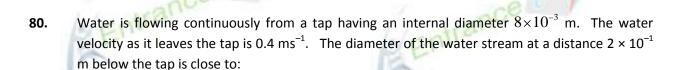
A metallic surface is irradiated by a monochromatic light of frequency $\nu > \nu_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are $K_{
m max}$ and $V_{
m 0}$. If the frequency incident on the surface is doubled, both the K_{max} and V_0 are also doubled.

Statement - 2:

The maximum kinetic energy and the stopping potential of photoelectrons emitted from a Entrance 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



(1) $3.6 \times 10^{-3} \,\mathrm{m}$

(2) 5.0×10^{-3} m

(3) 7.5×10^{-3} m

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(4) 9.6×10^{-3} m

ANS....1

A mass M, attached to a horizontal spring, executes S.H.M. with amplitude A₁. 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 A₂. 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)
$$\frac{\pi}{3}$$

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

- **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%

Entrance

(3) increase by 0.2%

(4) decrease by 0.2%

ANS....3

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

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

(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:

$$(1) \quad \frac{\gamma - 1}{2R} M v^2 K$$

(2)
$$\frac{\gamma - 1}{2 + 1 R} M v^2 K$$

$$(3) \quad \frac{\gamma - 1}{2\gamma R} M v^2 K$$

$$(4) \frac{\gamma M v^2}{2R} K$$

ANS.....1

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

Main scale reading: 0 mm

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

- 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

Entrance

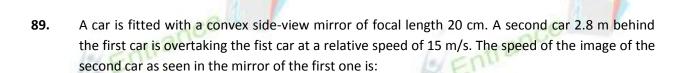
ANS.....4

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}



(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 $z \ge 0$ 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) 759

(2) 309

(3) 459

(4) 609

ANS....3



