Graduate Aptitude Test in Engineering

Notations :

1.Options shown in green color and with ✔ icon are correct.

2.Options shown in red color and with ✖ icon are incorrect.

Question Paper Name: XE: ENGINEERING SCIENCES 31st Jan Shift1
Number of Questions: 153
Total Marks: 100.0

Wrong answer for MCQ will result in negative marks, (-1/3) for 1 mark Questions and (-2/3) for 2 marks Questions.

General Aptitude

Number of Questions: 10
Section Marks: 15.0

Q.1 to Q.5 carry 1 mark each & Q.6 to Q.10 carry 2 marks each.

Question Number : 1 Question Type : MCQ

Choose the most appropriate word from the options given below to complete the following sentence.

The principal presented the chief guest with a _____, as token of appreciation.

(A) momento (B) memento (C) momentum (D) moment

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 2 Question Type : MCQ

Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence:

Frogs _____.

(A) croak (B) roar (C) hiss (D) patter

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 3 Question Type : MCQ

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Choose the word most similar in meaning to the given word:

Educe

(A) Exert (B) Educate (C) Extract (D) Extend

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 4 Question Type : MCQ

Operators □, ◊ and ⟶ are defined by: $a \square b = \frac{a-b}{a+b}$; $a \lozenge b = \frac{a+b}{a-b}$; $a \longrightarrow b = ab$.

Find the value of $(66 \square 6) \longrightarrow (66 \lozenge 6)$.

(A) −2 (B) −1 (C) 1 (D) 2

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 5 Question Type : MCQ

If $\log_x (5/7) = -1/3$, then the value of x is

(A) 343/125
(B) 125/343
(C) −25/49
(D) −49/25

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 6 Question Type : MCQ

The following question presents a sentence, part of which is underlined. Beneath the sentence you find four ways of phrasing the underlined part. Following the requirements of the standard written English, select the answer that produces the most effective sentence.

Tuberculosis, together with its effects, ranks one of the leading causes of death in India.

(A) ranks as one of the leading causes of death
(B) rank as one of the leading causes of death
(C) has the rank of one of the leading causes of death
(D) are one of the leading causes of death

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Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 7 Question Type : MCQ

Read the following paragraph and choose the correct statement.

Climate change has reduced human security and threatened human well being. An ignored reality of human progress is that human security largely depends upon environmental security. But on the contrary, human progress seems contradictory to environmental security. To keep up both at the required level is a challenge to be addressed by one and all. One of the ways to curb the climate change may be suitable scientific innovations, while the other may be the Gandhian perspective on small scale progress with focus on sustainability.

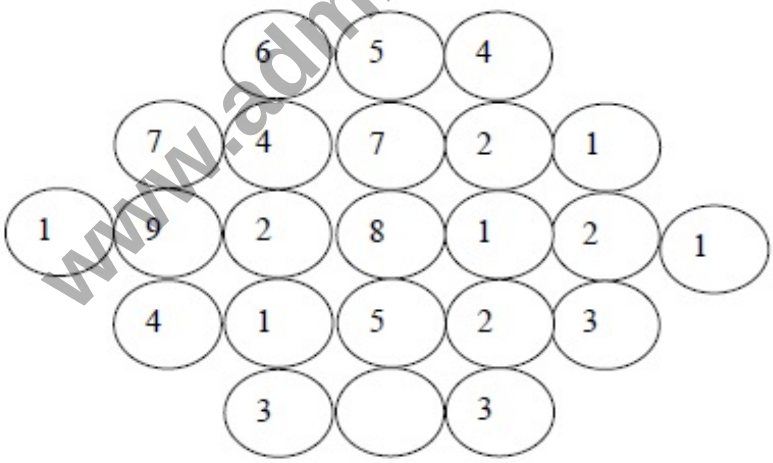
(A) Human progress and security are positively associated with environmental security.
(B) Human progress is contradictory to environmental security.
(C) Human security is contradictory to environmental security.
(D) Human progress depends upon environmental security.

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 8 Question Type : NAT

Fill in the missing value



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Correct Answer :

3

Question Number : 9 Question Type : MCQ

A cube of side 3 units is formed using a set of smaller cubes of side 1 unit. Find the proportion of the number of faces of the smaller cubes visible to those which are NOT visible.

(A) 1 : 4 (B) 1 : 3 (C) 1 : 2 (D) 2 : 3

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 10 Question Type : MCQ

Humpty Dumpty sits on a wall every day while having lunch. The wall sometimes breaks. A person sitting on the wall falls if the wall breaks.

Which one of the statements below is logically valid and can be inferred from the above sentences?

(A) Humpty Dumpty always falls while having lunch
(B) Humpty Dumpty does not fall sometimes while having lunch
(C) Humpty Dumpty never falls during dinner
(D) When Humpty Dumpty does not sit on the wall, the wall does not break

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

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	Engg Math
Number of Questions:	11
Section Marks:	15.0

Q.11 to Q.35 carry 1 mark each & Q.36 to Q.65 carry 2 marks each.

Question Number : 11 Question Type : MCQ

Considering the matrix

$$\begin{pmatrix} 0 & -1 & 2 \\ 1 & 0 & 3 \\ -2 & -3 & 0 \end{pmatrix}$$

which one of the following statements is **INCORRECT**?

(A) One of its eigenvalues is zero.
(B) It has two purely imaginary eigenvalues.
(C) It has a non-zero real eigenvalue.
(D) The sum of its eigenvalues is zero.

Options :

1. ✖ A
2. ✖ B

3. ✔ C
4. ✖ D

Question Number : 12 Question Type : NAT

The value of x where the function $f(x) = \sin(x) + \cos(x)$, defined over the domain $0 \leq x \leq 2\pi$, attains a minimum is

Correct Answer :
3.92 to 3.93

Question Number : 13 Question Type : MCQ

The radius of convergence of the following power series is

$$\sum_{n=0}^{\infty} \frac{(x-3)^n}{3^n n!}$$

(A) zero (B) 1 (C) 3 (D) ∞

Options :
1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 14 Question Type : MCQ

For a complex number k and a complex variable z, the complex function $(z+k)^2$ is analytic

(A) for all k.
(B) only for all k whose imaginary component is zero.
(C) only for all k whose real component is zero.
(D) only when k is zero.

Options :
1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 15 Question Type : NAT

The divergence of a vector field $\vec{v}(x,y,z) = 2^x\,\vec{i} + 2^y\,\vec{j} + 2^z\,\vec{k}$ at a point (1,1,1) is

Correct Answer :
4.15 to 4.16

Question Number : 16 Question Type : MCQ

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The type of the differential equation $(1-x)\frac{d^3y}{dx^3} - \sqrt{1+\left(\frac{dy}{dx}\right)^2} + 5y = \cos(x)$ is

(A) linear and first order.
(B) non-linear and first order.
(C) linear and third order.
(D) non-linear and third order.

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 17 Question Type : MCQ

A box has ten light bulbs out of which two are defective. Two light bulbs are drawn from this box one after the other without replacement. The probability that both light bulbs drawn are **NOT DEFECTIVE** is

(A) $\frac{8}{45}$ (B) $\frac{28}{45}$ (C) $\frac{16}{25}$ (D) $\frac{4}{5}$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 18 Question Type : MCQ

The value of the following limit is

$$\lim_{x\to\infty}\left(\frac{x-\sin(x)}{x+\sin(x)} + \frac{\ln x}{x}\right)$$

(A) zero (B) 1 (C) 2 (D) ∞

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 19 Question Type : MCQ

The value of the Fourier coefficient, A_0, in the series $\{A_0 + \sum_{n=1}^{\infty}(a_n\cos(nx) + b_n\sin(nx)\}$ of a function $f(x) = x^2$ with a period 2π defined over an interval $0 \le x \le 2\pi$ is

(A) $\frac{4\pi^2}{3}$ (B) $\frac{2\pi^2}{3}$ (C) $\frac{\pi^2}{3}$ (D) $\frac{\pi^2}{6}$

Options :

1. ✔ A

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2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 20 Question Type : MCQ

The general solution, $y(x)$, for the differential equation $x\frac{d^2y}{dx^2} - \frac{dy}{dx} - 1 = 0$ is (c_1 and c_2 are real constants)

(A) $c_1\frac{x^2}{2} + 2x + c_2$ (B) $c_1\frac{x^2}{2} - x + c_2$

(C) $c_1\frac{x^2}{2} + x + c_2$ (D) $c_1\frac{x^2}{2} - 2x + c_2$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 21 Question Type : NAT

The minimum number of iterations required to evaluate $\sqrt{28}$, correct up to three decimal places, by the Newton-Raphson method with an initial guess of 5 is

Correct Answer :

2

Fluid Mechanics

Number of Questions:	22
Section Marks:	35.0

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Question Number : 22 Question Type : MCQ

The gap δ between two concentric cylinders, each of height h, is filled with an oil. The torque required to rotate the inner cylinder at an angular velocity of ω against the fixed outer cylinder is T. The diameter of the inner cylinder is d and $\delta << d$. The dynamic viscosity of the oil is given by

(A) $\frac{4\pi\delta T}{d^3\omega h}$ (B) $\frac{4\delta T}{\pi d^3\omega h}$ (C) $\frac{4\pi\delta T}{d^2\omega h^2}$ (D) $\frac{4\delta T}{\pi d\omega h^3}$

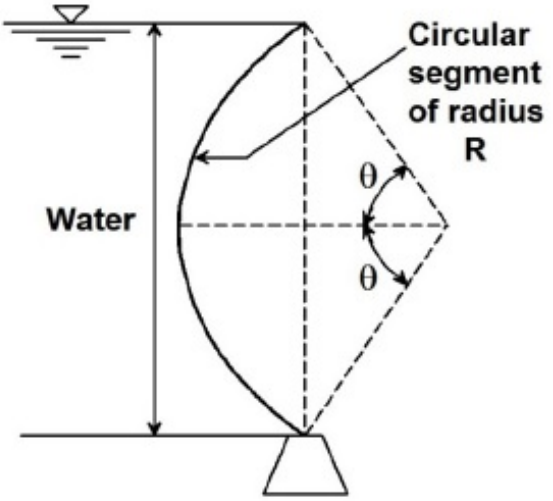
Options :

1. ✖ A
2. ✔ B
3. ✖ C

4. ✖ D

Question Number : 23 Question Type : MCQ

Water is retained against a sluice gate in the form of a circular segment as shown in the figure. If ϱ and g are the density of water and gravitational acceleration respectively, the upward force exerted by the gate on the water per unit depth perpendicular to the plane of the figure is



(A) $\varrho R^2\left(\theta - \frac{1}{2}\sin 2\theta\right)g$

(B) $\varrho R^2\left(\cos^2\theta - \frac{1}{2}\sin\theta\right)g$

(C) $\varrho R^2\left(\cos\theta - \frac{1}{2}\sin\theta\right)g$

(D) $\varrho R^2\left(\cos^2\theta - \frac{1}{2}\sin^2\theta\right)g$

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 24 Question Type : MCQ

A two-dimensional velocity field is given by $\vec{V} = 10(y^3 - x^2y)\hat{\imath} + 2Cxy^2\hat{\jmath}$, where $\hat{\imath}$ and $\hat{\jmath}$ are the unit vectors in the directions of the rectangular Cartesian coordinates x and y, respectively. If the flow is incompressible, the constant C should be

(A) -10 (B) 0 (C) 5 (D) 10

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 25 Question Type : NAT

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Let $\vec{V}$ and T denote the velocity vector and temperature in a flow field. The rate of change of temperature experienced by a fluid particle as it is passes through the point (x_1, y_1, z_1) at a time t_1 is 2.5 °C/s. The rate of change of temperature at a time t_1 at the point (x_1, y_1, z_1) is 4.8 °C/s. The quantity $\vec{V}.\vec{\nabla}T$ at (x_1, y_1, z_1) and t_1 in °C/s is _____

Correct Answer :

-2.4 to -2.2

Question Number : 26 Question Type : MCQ

In a simple Couette flow apparatus, the gap h between the parallel plates is filled with a liquid of density ϱ and dynamic viscosity μ, and one plate is dragged at a velocity of U parallel to itself, while the other plate is fixed. The magnitude of vorticity at any point in the flow is

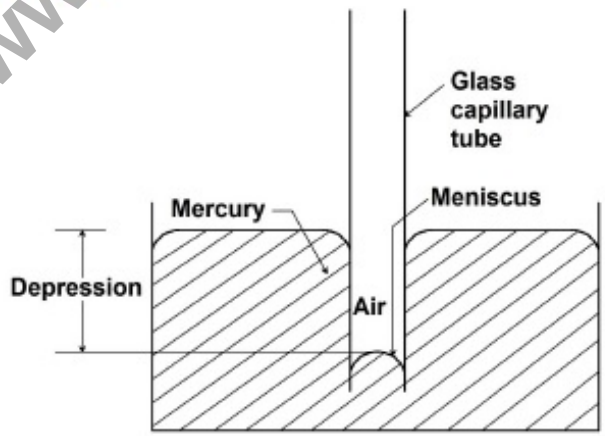
(A) $\frac{\mu}{\varrho h^2}$ (B) 0 (C) $\frac{1}{h^2}\sqrt{\frac{\mu U h}{\varrho}}$ (D) $\frac{U}{h}$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 27 Question Type : NAT

An open glass capillary tube of 2 mm bore is lowered into a cistern containing mercury (density = 13600 kg/m^3) as shown in the figure. Given that the contact angle between mercury and glass = 140°, surface tension coefficient = 0.484 N/m and gravitational acceleration = 9.81 m/s^2, the depression of mercury in the capillary tube below the free surface in the cistern, in mm, is



Correct Answer :

5.5 to 5.7

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Question Number : 28 Question Type : MCQ

Consider a combined forced-free vortex. The central region with radius R and angular velocity ω is the forced vortex and the rest is the free vortex. The pressure at the edge of the combined vortex is p_o. If the density of the fluid is ρ, the pressure at the center of the combined vortex is

(A) $p_o - \rho\omega^2 R^2$ (B) $p_o - \frac{1}{2}\rho\omega^2 R^2$ (C) $p_o + \frac{1}{2}\rho\omega^2 R^2$ (D) $p_o + \rho\omega^2 R^2$

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 29 Question Type : MCQ

Which one of the following is true at the point of separation of a boundary layer:

(A) Transition occurs from laminar to turbulent flow
(B) The flow relaminarizes from turbulent regime
(C) The shear stress vanishes
(D) The relation between stress and rate of strain ceases to be linear

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 30 Question Type : MCQ

A certain fluid flow phenomenon is described by Reynolds, Weber and Ohnesorge numbers. The Weber and Ohnesorge numbers are defined as $\text{We} = \frac{\rho U^2 L}{\sigma}$, and $\text{Oh} = \frac{\mu}{\sqrt{\rho\sigma L}}$, respectively, where σ is the surface tension, ρ is the density, μ is the dynamic viscosity, U is the velocity and L is the characteristic dimension. If Re denotes the Reynolds number, which of the following relations is true?

(A) $\text{We}=\text{Oh Re}^2$ (B) $\text{We}=\text{Oh}^2\text{ Re}^2$ (C) $\text{We}=\text{Oh}^2\text{ Re}$ (D) $\text{We}=\text{Oh Re}$

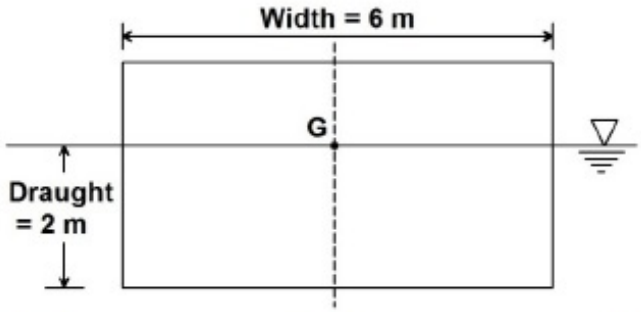
Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 31 Question Type : MCQ

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A rectangular boat 6 m wide and 15 m long (dimension perpendicular to the plane of the figure) has a draught of 2 m. The side view of the boat is as shown in the figure. The centre of gravity G of the boat is at the free surface level. The metacentric height of the boat in m is



(A) −1.0 (B) 0.5 (C) 1.5 (D) 2.0

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 32 Question Type : MCQ

Water drains out into atmosphere from a small orifice located at the bottom of a large open tank. If the initial height of the water column is H, the time taken to empty the tank is proportional to

(A) $H^{1/2}$ (B) H (C) $H^{3/2}$ (D) H^2

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 33 Question Type : MCQ

Consider a two-dimensional velocity field given by $\vec{V} = \pi y\hat{\imath} - \pi x\hat{\jmath}$, where $\hat{\imath}$ and $\hat{\jmath}$ are the unit vectors in the directions of the rectangular Cartesian coordinates x and y, respectively. A fluid particle is located initially at the point (−1, 1). Its position after unit time is

(A) (−2,−2) (B) (1,−1) (C) (1,1) (D) (3,−1)

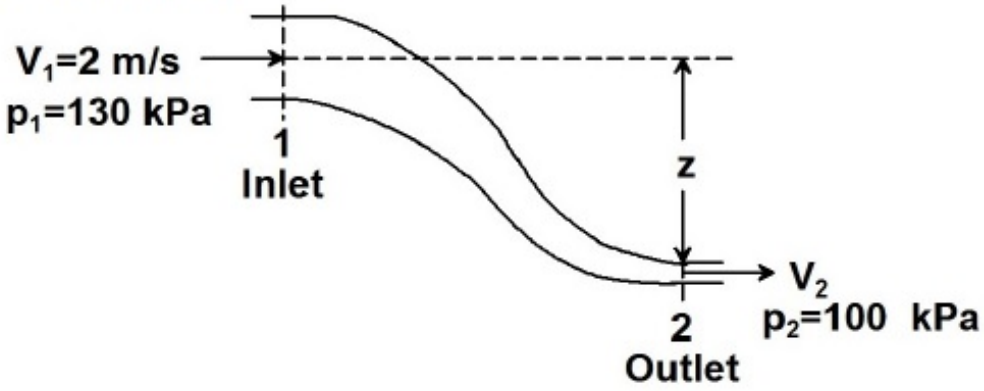
Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 34 Question Type : NAT

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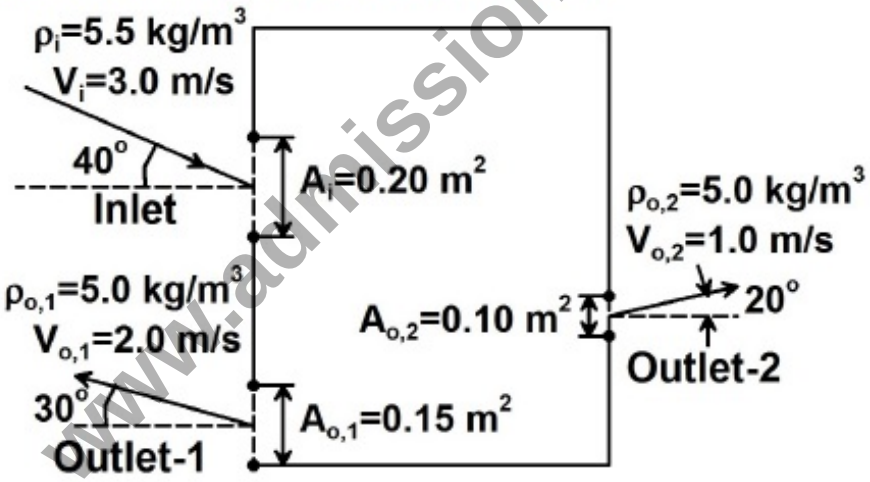
The figure shows a reducing area conduit carrying water. The pressure p and velocity V are uniform across sections 1 and 2. The density of water is 1000 kg/m^3. If the total loss of head due to friction is just equal to the loss of potential head between the inlet and the outlet, then V_2 in m/s will be _____



Correct Answer :
7.9 to 8.1

Question Number : 35 Question Type : NAT

A fluid enters a control volume through an inlet port (denoted with subscript 'i') and leaves through two outlet ports (denoted with subscripts 'o,1' and 'o,2') as shown in the figure. The velocities may be assumed to be uniform across the ports. The rate of change of mass in the control volume in kg/s, at the instant shown in the figure, is

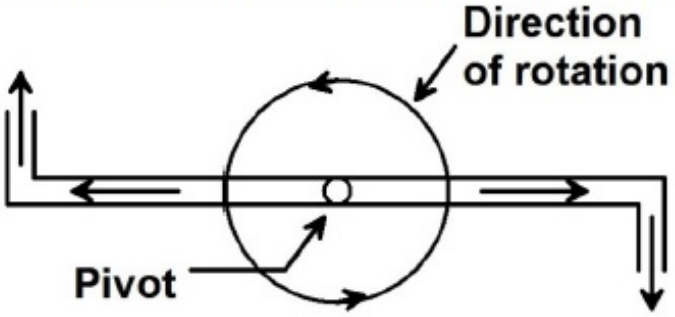


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Correct Answer:
0.7 to 0.8

Question Number : 36 Question Type : NAT

The total discharge of water through a lawn sprinkler shown in the figure is one liter per minute. The velocity of the jet at each end, relative to the arm, is $2\pi/30$ m/s. The density of water is 1000 kg/m^3 and the length of each arm is 0.1 m. If the frictional torque of the pivot is $\pi/36$ mN.m, the rotational speed, in revolutions per minute, of the sprinkler is _____



Correct Answer :

14 to 16

Question Number : 37 Question Type : MCQ

Consider a two-dimensional potential flow field with the radial and tangential velocity components, $v_r = \frac{m}{2\pi r}$ and $v_\theta = \frac{k}{2\pi r}$, respectively, where m and k are constants. The stream function is such that it increases along the direction of traverse of a line in the flow field if the flow is from left to right across that line. The stream function ψ for this flow field, with $\psi = 0$ at $r = a$ and $\theta = 0$, is

(A) $\frac{m\pi\theta}{2} + \frac{k\pi}{2}\ln\frac{r}{a}$

(B) $\frac{m\pi\theta}{2} - \frac{k\pi}{2}\ln\frac{r}{a}$

(C) $\frac{m\theta}{2\pi} + \frac{k}{2\pi}\ln\frac{r}{a}$

(D) $\frac{m\theta}{2\pi} - \frac{k}{2\pi}\ln\frac{r}{a}$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 38 Question Type : MCQ

A steady, two-dimensional, inviscid and incompressible flow field is described in rectangular Cartesian coordinates as $u = ax$ and $v = -ay$, where u and v are the components of the velocity vector in the x and y directions, respectively. Gravity acts along the negative y-direction. The pressure distribution, with the reference pressure taken as zero at the origin, with usual notation, is given by

(A) $-\frac{1}{2}\rho a^2(x^2 + xy + y^2) - \rho g y$

(B) $-\frac{1}{2}\rho a^2(x^2 - xy + y^2) - \rho g y$

(C) $-\frac{1}{2}\rho a^2(x^2 + y^2) - \rho g y$

(D) $-\frac{1}{2}\rho a^2(x^2 - y^2) - \rho g y$

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Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 39 Question Type : NAT

A cylinder of radius 0.1 m rotating clockwise about its own axis at an angular velocity of $100/\pi$ radians per second is placed in a cross-stream of air flowing at a velocity of 10 m/s from left to right. The density of air is 1.2 kg/m^3. The lift force per unit length of the cylinder in N/m is _____

Correct Answer :

23 to 25

Question Number : 40 Question Type : MCQ

The velocity profile in turbulent flow through a pipe is approximated as $\frac{u}{u_{max}} = \left(\frac{y}{R}\right)^{1/7}$, where u_{max} is the maximum velocity, R is the radius and y is the distance measured normal to the pipe wall towards the centerline. If u_{av} denotes the average velocity, the ratio $\frac{u_{av}}{u_{max}}$ is

(A) $\frac{2}{15}$ (B) $\frac{1}{5}$ (C) $\frac{1}{3}$ (D) $\frac{49}{60}$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 41 Question Type : NAT

A steel sphere (density = 7900 kg/m^3) of diameter 0.1 m is dropped from rest in water (density = 1000 kg/m^3). The gravitational acceleration is 9.81 m/s^2. Assuming that the drag coefficient is constant and equal to 1.33, the terminal velocity attained by the sphere in m/s is _____

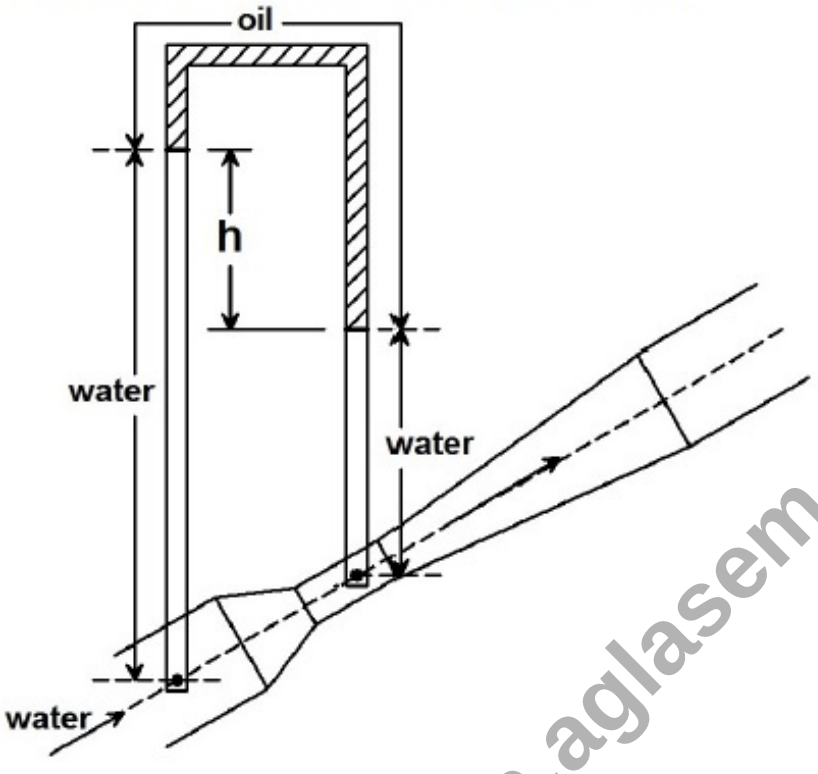
Correct Answer :

2.5 to 2.7

Question Number : 42 Question Type : NAT

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An inclined venturimeter connected to an inverted manometer is shown in the figure. The cross-sectional areas at the inlet and the throat are 2×10^{-3} m^2 and 2×10^{-4} m^2, respectively. The densities of water and oil are 1000 kg/m^3 and 800 kg/m^3, respectively. The gravitational acceleration is 9.81 m/s^2. If the discharge of water through the venturimeter is 5×10^{-4} m^3/s, neglecting viscous effects and assuming uniform velocities across the inlet and the throat, the manometer reading h, in m, will be _____

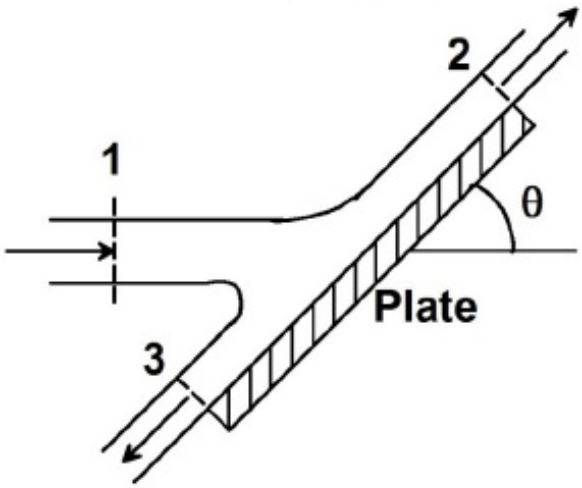


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Correct Answer :
1.5 to 1.7

Question Number : 43 Question Type : NAT

A plane jet of water with volumetric flow rate 0.012 m^3/s and cross-sectional area 6×10^{-4} m^2 strikes a stationary plate inclined at angle θ and leaves as two streams, as shown in the figure. The ratio of the discharge through section 2 to that through section 3 is 3:1. The velocities may be considered uniform across the cross-sections and the effects of friction may be neglected. The density of water is 1000 kg/m^3. Ignoring the effects of gravity, the magnitude of the normal force exerted on the plate, in N, is



Correct Answer:
205 to 210

Mat Science

Number of Questions:	22
Section Marks:	35.0

Question Number : 44 Question Type : MCQ

Arrange the following elements in order of increasing melting point:
(P) gallium (Q) tungsten (R) aluminium (S) gold

(A) P < R< Q < S
(B) S < P < R < Q
(C) P < R < S < Q
(D) R < S < Q < P

Options :
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 45 Question Type : MCQ

When the atoms in a solid are separated by their equilibrium distance,

A) the potential energy of the solid is lowest
B) the force of attraction between the atoms is maximum
C) the force of repulsion between the atoms is zero
D) the potential energy of the solid is zero

Options :
1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 46 Question Type : MCQ

To which of the following category of materials does Teflon (PTFE) belong?

(A) Thermosets (B) Thermoplastics (C) Elastomers (D) Block copolymers

Options :
1. ✖ A
2. ✔ B
3. ✖ C

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4. ✖ D

Question Number : 47 Question Type : MCQ

Which of the following statements is TRUE about the glass transition temperature (T_g)?

(A) T_g appears below the melting temperature in a perfectly crystalline material
(B) Upon heating through T_g, heat capacity remains constant but the thermal expansion coefficient changes
(C) Upon heating through T_g, heat capacity changes but the thermal expansion coefficient remains the same
(D) Upon heating through T_g, both the heat capacity and thermal expansion coefficient change

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 48 Question Type : MCQ

The slope of a graph of $\log_e$(conductivity) versus 1/T (where T is the temperature) for an intrinsic semiconductor with energy gap E_g, is

(A) $E_g/2k$ (B) $-E_g/2k$ (C) E_g/k (D) $-E_g/k$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 49 Question Type : MCQ

Which is NOT a ceramic forming process?

(A) extrusion (B) slip casting (C) forging (D) tape casting

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 50 Question Type : MCQ

Which of the following is NOT a soft magnetic material?

(A) Iron-silicon steel
(B) Nickel zinc ferrite
(C) Nickel iron alloy
(D) Alnico

Options :

1. ✖ A
2. ✖ B

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3. ✖ C
4. ✔ D

Question Number : 51 Question Type : MCQ

The eutectic reaction is
[Note: S – solid; L– liquid]

(A) $S_1 \rightleftharpoons S_2 + S_3$
(B) $L \rightleftharpoons S_1 + S_2$
(C) $L_1 + S_1 \rightleftharpoons L_2 + S_2$
(D) $L_1 + S_1 \rightleftharpoons S_2 + S_3$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 52 Question Type : MCQ

Vacancies play an important role in

(A) deformation twinning
(B) self diffusion
(C) strain hardening
(D) cross-slip

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 53 Question Type : MCQ

Match the techniques listed in Column I with the characteristics of the materials measured in Column II.

Column I	**Column II**
P. DSC	1. Density of states
Q. XRD	2. Glass transition temperature
R. STM	3. Cathodoluminescence
S. SEM	4. Crystal structure
	5. Thermal expansion coefficient

(A) P-2, Q-3, R-4, S-1
(B) P-5, Q-4, R-5, S-1
(C) P-2, Q-4, R-1, S-3
(D) P-3, Q-5, R-4, S-2

Options :

1. ✖ A
2. ✖ B

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3. ✔ C

4. ✖ D

Question Number : 54 Question Type : NAT

The mass of an electron would increase _____ times its original mass if it travels at 96% of the speed of light.

Correct Answer :

3.5 to 3.6

Question Number : 55 Question Type : NAT

With increasing temperature from 15°C in winter to 45°C in summer, the length of an iron rail track increases by 0.05 cm. Calculate the original length of the iron rail track in cm. (linear thermal expansion coefficient of iron is $11.0 \times 10^{-6} K^{-1}$)

Correct Answer:

151 to 152

Question Number : 56 Question Type : NAT

What is the thickness (in μm) of a germanium crystal layer that would be required for absorbing 80% of the incident radiation whose wavelength is 1.3 μm? The absorption coefficient (α) of germanium at 1.3 μm is $3.3 \times 10^{5}\ m^{-1}$.

Correct Answer :

4.8 to 4.9

Question Number : 57 Question Type : NAT

A 1 kg sacrificial anode of Mg (atomic weight: 24.31 amu) is attached to the base of a ship. If the anode lasts for 60 days, what is the average corrosion current (in Amperes) during that period?

Correct Answer :

1.50 to 1.55

Question Number : 58 Question Type : NAT

A capacitor has a 0.075 cm thick $BaTiO_3$ dielectric with a dielectric constant of 2000 and an electrode area of 0.2 cm^2. What is the capacitance of this capacitor in nF?

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Correct Answer :
0.470 to 0.475

Question Number : 59 Question Type : NAT

A hot pressed ceramic composite material consists of 30 volume % SiC whiskers in an Al_2O_3 matrix. The measured bulk density of this composite is 3.65 g cm^{-3}. If the theoretical density of SiC is 3.22 g cm^{-3} and that of Al_2O_3 is 3.95 g cm^{-3}, estimate the porosity (%) of the composite, assuming that the linear rule of mixtures is valid in this case.

Correct Answer :
2.0 to 2.3

Question Number : 60 Question Type : MCQ

Match the technical ceramics listed in Column I with their common applications listed in Column II

Column I	Column II
P. Y-doped ZrO_2	1. Lasers
Q. UO_2	2. Turbine engine
R. Si_3N_4	3. Integrated circuit substrate
S. AlN	4. Oxygen sensor
T. Cr doped Al_2O_3	5. Nuclear fuel
	6. Thermistor

(A) P-6, Q-4, R-5, S-1, T-3
(B) P-4, Q-5, R-2, S-3, T-1
(C) P-3, Q-1, R-2, S-6, T-5
(D) P-1, Q-4, R-5, S-2, T-1

Options :
1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 61 Question Type : MCQ

Creep in metals is defined as

(A) the maximum energy a solid can absorb elastically
(B) the maximum energy a solid can absorb by plastic deformation
(C) the stress at which plastic deformation starts
(D) slow plastic deformation due to diffusion of atoms usually at high temperature (T > half the melting point)

Options :
1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

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Question Number : 62 Question Type : MCQ

Calculate the planar density of the (100) plane in an fcc crystal given that R is the atomic radius of the element.

(A) $0.25\ R^2$ (B) $0.25/R^2$ (C) $1/R^2$ (D) $4/R^2$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 63 Question Type : NAT

The diffusion coefficient of copper atoms in aluminium is found to be $1.28 \times 10^{-22}\ m^2s^{-1}$ at T=400K and $5.75 \times 10^{-19}\ m^2s^{-1}$ at T=500K. Find the temperature (in Kelvin) at which the value of the diffusion coefficient is $10^{-16}\ m^2s^{-1}$

Correct Answer :

588 to 592

Question Number : 64 Question Type : NAT

Calculate the density of copper in kg m^{-3} given that copper has an fcc lattice with a lattice parameter of 0.365 nm. Copper has an atomic weight of 63.54 amu.

Correct Answer :

8675 to 8680

Question Number : 65 Question Type : NAT

What would be the maximum number of electron-hole pairs that can be generated using a silicon detector irradiated by x-ray of energy 1.54 keV. The band gap of silicon is 1.1 eV.

Correct Answer :

1399 to 1401

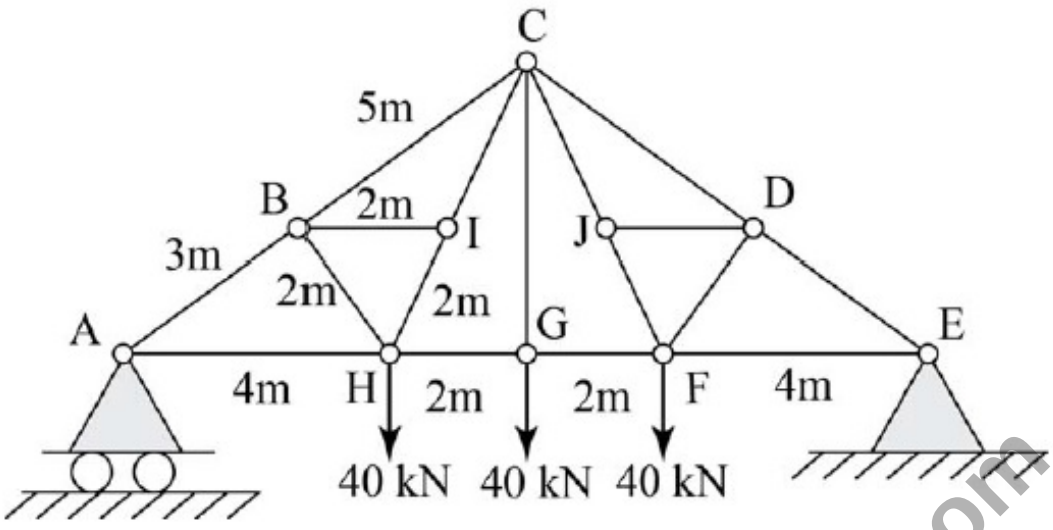
Solid Mechanics

Number of Questions:	22
Section Marks:	35.0

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Question Number : 66 Question Type : NAT

Find the force (in kN) in the member **BH** of the truss shown.

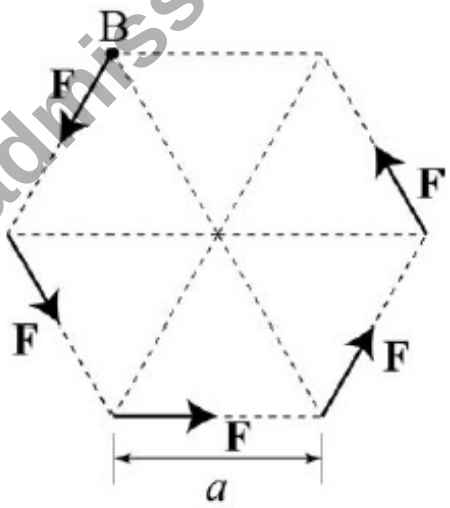


Correct Answer:

0

Question Number : 67 Question Type : MCQ

Consider the forces of magnitude **F** acting on the sides of the regular hexagon having side length a. At point **B**, the equivalent force and couple are, respectively,



(A) **F**(←) and $3\sqrt{3}Fa$ (clockwise)
(B) **F**(→) and $\sqrt{3}Fa$ (clockwise)
(C) **F**(←) and $\sqrt{3}Fa$ (counter clockwise)
(D) **F**(→) and $3\sqrt{3}Fa$ (counter clockwise)

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

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Question Number : 68 Question Type : NAT

Bar-1 has a diameter d, length L, and elastic modulus E and subjected to tensile load P, resulting in an elongation of Δ_1. Bar-2 has diameter, $2d$, length $2L$, an elastic modulus $2E$ and subjected to tensile load $2P$, resulting in an elongation of Δ_2. Find the ratio Δ_1/Δ_2.

Correct Answer :

1.9 to 2.1

Question Number : 69 Question Type : MCQ

In a plane stress problem, the principal stresses at a point are **30MPa** and **-15MPa**. At the same point, on an element whose sides make an angle of **45°** with respect to the principal axes, the normal stresses (in **MPa**) are

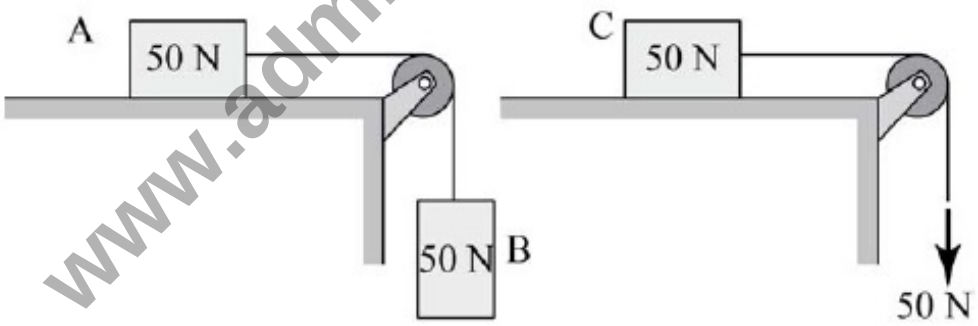
(A) 15/2 and 15/2 (B) 30/2 and 30/2 (C) 15/2 and -15/2 (D) 30/2 and -30/2

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 70 Question Type : MCQ

Two systems shown below start from rest. For the system shown on the left, two **50N** blocks are connected by a cord. For the system shown on the right, the **50N** block is pulled by a **50N** downward force. Neglect friction. Which of the following is true?



(A) Blocks **A** and **C** have the same acceleration.
(B) Block **C** will have a larger acceleration than block **A**.
(C) Block **A** will have a larger acceleration than block **C**.
(D) Block **A** will not move.

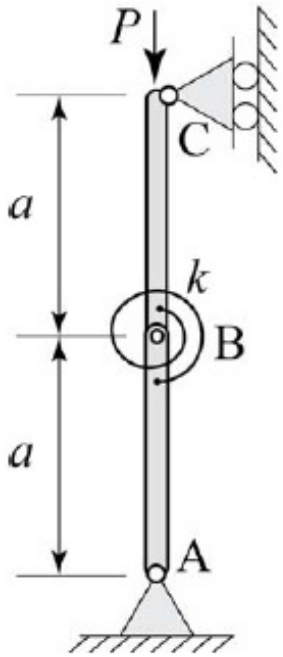
Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 71 Question Type : NAT

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Two massless rigid bars, each of length $a = 0.5\text{m}$, are connected by a rotational spring having stiffness $k = 1000\ \text{N.m/rad}$. Find the buckling load P (in kN).



Correct Answer :

4

Question Number : 72 Question Type : MCQ

A simply supported beam having a rectangular cross-section of depth d is subjected to a vertical concentrated load P at the mid-span. The maximum shear stress in a section occurs at

(A) $d/2$ from the top of the cross-section
(B) $d/3$ from the top of the cross-section
(C) $2d/3$ from the top of the cross-section
(D) Top of the cross-section

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 73 Question Type : NAT

A steel block of size $100\times50\times25\ \text{mm}^3$ is subjected to a uniform pressure on all faces. The dimension of the 100mm edge reduces by 25μm (note $1\ \mu\text{m} = 10^{-6}\text{m}$). Find the applied pressure (in GPa). Use $E = 240\ \text{GPa}$ and $\nu = 0.3$.

Correct Answer:

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0.14 to 0.16

Question Number : 74 Question Type : MCQ

Which one of the following statements is true?

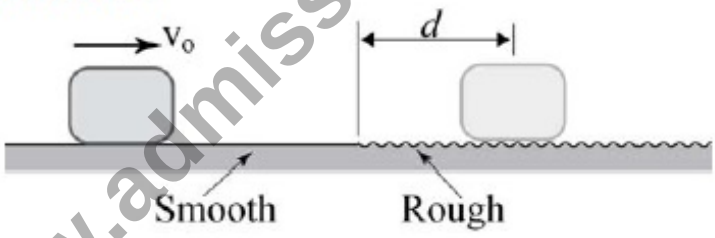
(A) In a tensile test on a rod made of ductile material, failure occurs along a plane making **45°** with respect to the axis of the rod
(B) In a tensile test on a rod made of brittle material, failure occurs along a plane making **45°** with respect to the axis of the rod
(C) In a torsion test on a rod made of ductile material, failure occurs along a plane making **45°** with respect to the axis of the rod
(D) In a torsion test on a rod made of brittle material, failure occurs along a plane making **0°** with respect to the axis of the rod

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 75 Question Type : NAT

A block is travelling with a constant speed v_o on a smooth surface when the surface suddenly becomes rough with a coefficient of friction μ, which causes the block to stop after a distance d. When the block travels twice as fast, i.e. at a speed $2v_o$, it travels a distance D on the rough surface before stopping. Find the ratio D/d.



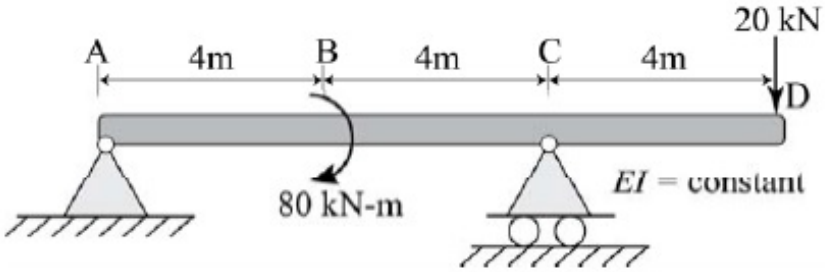
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Correct Answer :

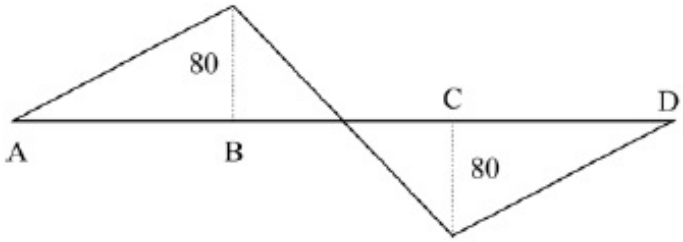
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Question Number : 76 Question Type : MCQ

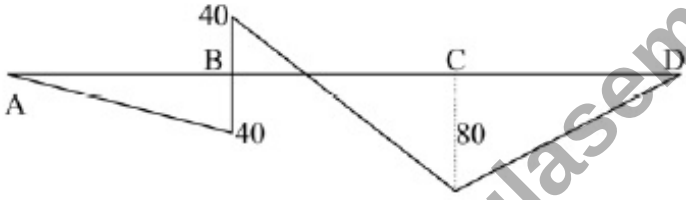
The beam shown below is loaded with a concentrated clockwise moment of **80kN-m** at point **B**. The bending moment diagram (in **kN-m**) is



(A)



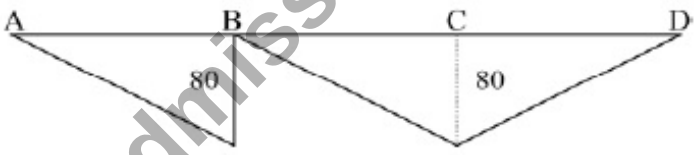
(B)



(C)



(D)



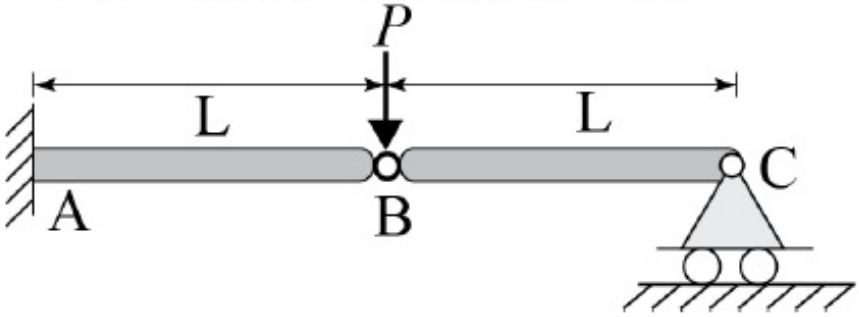
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Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 77 Question Type : MCQ

The beam shown has an internal hinge at **B**. A vertical load $P = 25$**kN** is applied at **B**. Use **L = 2m**. Magnitude of the reactions (i.e. forces and moments) at **A** and **C** are



(A) Vertical reaction force at **C** is **12.5kN**, vertical reaction force at **A** is **12.5kN**, moment reaction at A is **0kN-m**.

(B) Vertical reaction force at **C** is **0kN**, vertical reaction force at **A** is **25kN**, moment reaction at **A** is **50kN-m**.

(C) Vertical reaction force at **C** is **25kN**, vertical reaction force at **A** is **0kN**, moment reaction at **A** is **50kN-m**.

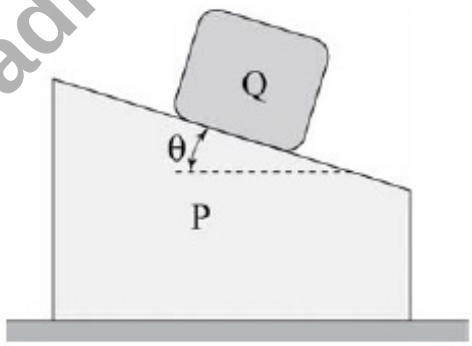
(D) Vertical reaction force at **C** is **0kN**, vertical reaction force at **A** is **25kN**, moment reaction at **A** is **25kN-m**.

Options :

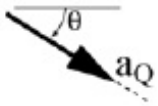
1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

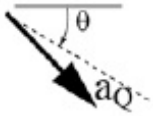
Question Number : 78 Question Type : MCQ

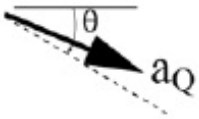
Blocks **P** and **Q** are released from rest in the positions shown. Neglect friction between all surfaces, i.e., both blocks can translate freely. Then the direction of the acceleration of block **Q** (i.e. a_Q) is



(A) 

(B) 

(C) 

(D) 

Options :

1. ✖ A
2. ✖ B

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3. ✔ C

4. ✖ D

Question Number : 79 Question Type : NAT

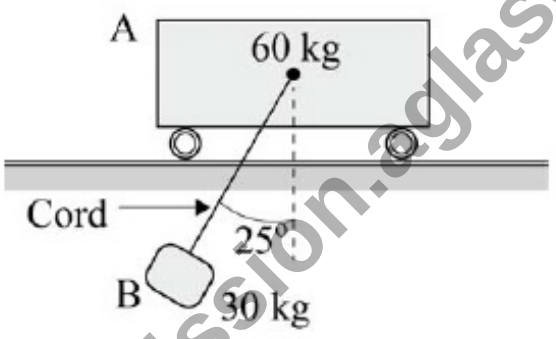
The acceleration, a, of a particle as a function of its position, x, is given by the relation $\boldsymbol{a = 0.1 + \sin \frac{x}{b}}$, where a and x are expressed in $\mathbf{m/s^2}$ and **meters**, respectively. Consider $b = \mathbf{1m}$. When $x = 0$, velocity is $v = \mathbf{1m/s}$. Find v (in **m**/s) when $x = \boldsymbol{\pi}$ **meters**.

Correct Answer:

2.3 to 2.4

Question Number : 80 Question Type : NAT

The **30kg** block **B** shown below is suspended by a **2m** cord attached to the **60kg** cart **A**. Friction is negligible. If the system is released from rest in the position shown, find the ratio of the velocity magnitudes $|v_A|/|v_B|$ when the cord is vertical.



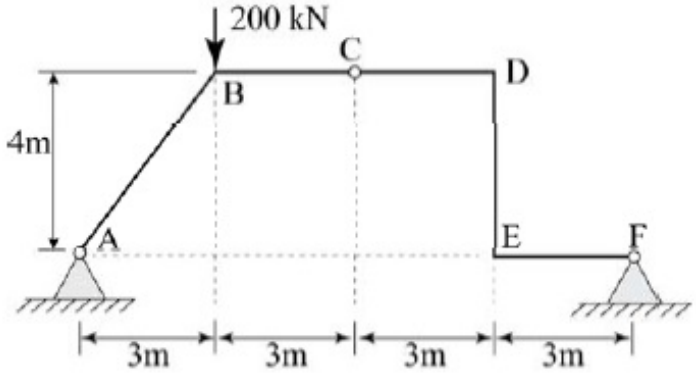
Correct Answer :

0.5

Question Number : 81 Question Type : NAT

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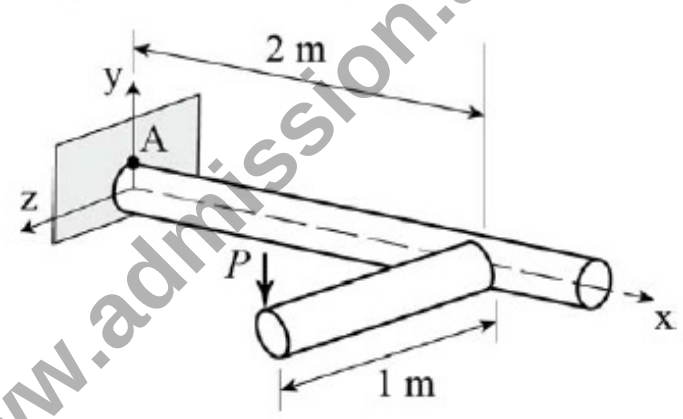
The plane frame shown has an internal hinge at C. Find the magnitude of axial force (in kN) in member BC.



Correct Answer:
74 to 76

Question Number : 82 Question Type : MCQ

Two **50mm** diameter solid steel rods are rigidly connected together at right angles and loaded as shown. Use $P = 1000\pi$ **kN**. At point **A**, located at the top of the cross-section at the fixed end, the magnitude of bending stress (σ) and shear stress (τ) are



(A) $\sigma = 256$ MPa, $\tau = 512$ MPa
(B) $\sigma = 512$ MPa, $\tau = 256$ MPa
(C) $\sigma = 512$ MPa, $\tau = 128$ MPa
(D) $\sigma = 128$ MPa, $\tau = 512$ MPa

Options :
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 83 Question Type : NAT

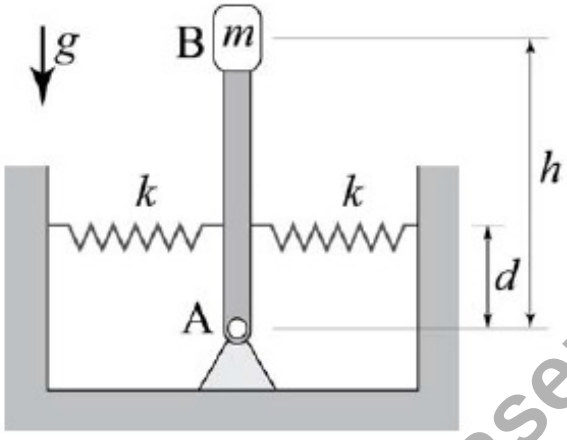
At a temperature of **40°C**, a rod tightly fits between two rigid walls such that the compressive stress in the rod is **60MPa**. Given **E = 200GPa** and $\alpha = 20\times10^{-6}$/°C, find the temperature at which the rod will just lose contact with the walls.

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Correct Answer :
25

Question Number : 84 Question Type : NAT

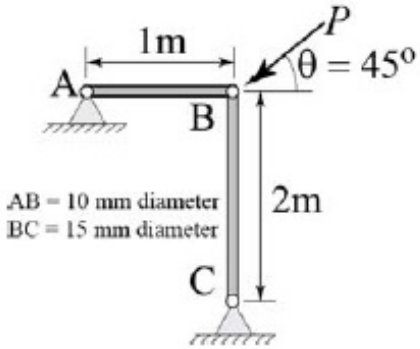
A massless rigid rod **AB** of length h is pinned at end **A** and carries mass m at end **B**. The rod is also supported by two linear springs of stiffness k at a height d from the end **A**. Use $m = 4\text{kg}$, $h = 0.5\text{m}$, $d = 0.2\text{m}$, $k = 600\text{N/m}$ and $g = 10\ \text{m/s}^2$. For small oscillations about the position shown, find the frequency of free vibration (in **rad/s**).



Correct Answer :
5.2 to 5.4

Question Number : 85 Question Type : NAT

Find the maximum force P (in **kN**) that can be applied to the planar structure **ABC** so as to prevent buckling in any of the members. Consider buckling only in the plane of the structure. Joint **B** is a pin connection. Use $E = 200\text{GPa}$ for both members. The diameter of member **AB** is **10 mm** and the diameter of member **BC** is **15 mm**.

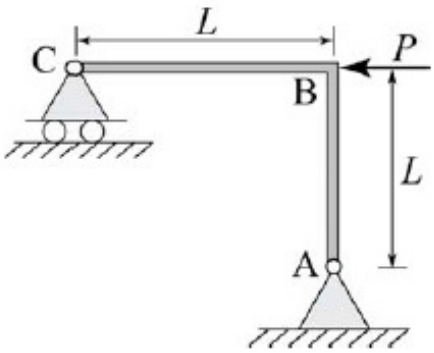


Correct Answer :
1.3 to 1.45

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Question Number : 86 Question Type : MCQ

The plane frame shown is analyzed by neglecting axial and shear deformations. The horizontal displacement of **joint B** is



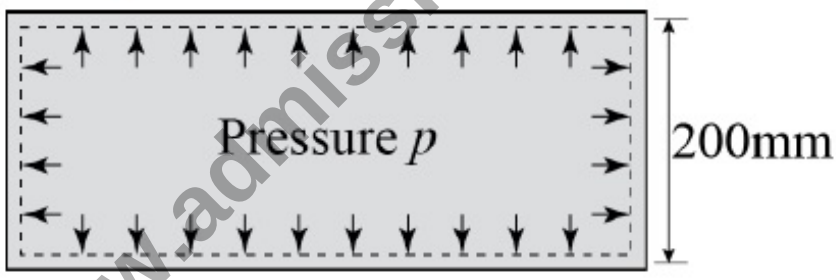
(A) $\frac{2PL^3}{3EI}$ (B) $\frac{PL^3}{EI}$ (C) $\frac{3PL^3}{2EI}$ (D) $\frac{PL^3}{2EI}$

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 87 Question Type : NAT

A thin walled cylindrical pressure vessel having mean radius **100mm** and wall thickness **5mm**, is subjected to internal pressure p. If the factor of safety is **2** and the yield stress in shear is **100MPa**, find the maximum value of p (in **MPa**).



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Correct Answer :

5

Thermodynamics

Number of Questions:	22
Section Marks:	35.0

Question Number : 88 Question Type : MCQ

A gas expands following the relation PV^n = constant, from the initial state P_1, V_1 to final volume $V_2 = 2V_1$. For the values of 'n' mentioned below, maximum displacement work is obtained for

(A) n = −1 (B) n = 0 (C) n = 1 (D) n = 1.4

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 89 Question Type : NAT

A 100 Ω electrical resistor is heated steadily by passing a current of 20 A. If heating is performed in the ambient at 30°C, the rate of increase in entropy of the universe in kW/K is _____.

Correct Answer:

0.130 to 0.135

Question Number : 90 Question Type : MCQ

As per Clausius inequality, a system operating on an irreversible cycle transfers

(A) more entropy to the sink than what it receives from the source
(B) as much entropy to the sink as it receives from the source
(C) less entropy to the sink than what it receives from the source
(D) less entropy to the sink than that corresponding to a reversible cycle

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 91 Question Type : MCQ

The critical point of a substance corresponds to the state

(A) at which the solid, liquid and vapor phases are in equilibrium
(B) beyond which liquid will require very large amount of heat to become vapor
(C) beyond which solid sublimates directly to the vapor state
(D) beyond which the distinction between liquid and vapor phases disappears

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 92 Question Type : MCQ

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Consider the process of sensible cooling of air with 60% relative humidity at constant pressure. Which one of the following statements is **TRUE** for this process?

(A) Both humidity ratio and relative humidity increase during the process.
(B) The humidity ratio decreases continuously due to condensation.
(C) The dry bulb temperature decreases but the wet bulb temperature increases.
(D) The humidity ratio remains constant.

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 93 Question Type : NAT

The coefficient of performance (COP) of a reversible refrigerator operating between two thermal reservoirs is 4.0. The efficiency (in percentage) of a reversible heat engine operating between the same temperature limits is _____.

Correct Answer :

19.5 to 20.5

Question Number : 94 Question Type : MCQ

Differential change in specific enthalpy of a superheated vapor for which ideal gas approximation does not hold, is given by the expression

(A) $dh = C_p\,dT$

(B) $dh = C_p\,dT + \left.\frac{\partial h}{\partial v}\right|_T dv$

(C) $dh = C_p\,dT + \left.\frac{\partial h}{\partial p}\right|_T dp$

(D) $dh = C_v\,dT + \left.\frac{\partial h}{\partial p}\right|_T dp$

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 95 Question Type : NAT

An ideal gas mixture of oxygen (molecular weight = 32 kg/kmol) and carbon dioxide (molecular weight = 44 kg/kmol) has a mass composition of 40% and 60% respectively. If the total pressure is 200 kPa, the partial pressure of oxygen (in kPa) is _____.

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Correct Answer:
92 to 100

Question Number : 96 Question Type : MCQ

In an ideal Rankine cycle, increase in superheat of vapor at the exit of boiler leads to

(A) decrease in net work output from the cycle
(B) increase in cycle efficiency
(C) decrease in cycle efficiency
(D) decrease in quality of steam at the exit of the turbine

Options :
1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 97 Question Type : MCQ

Two moles of air at 1 atm, 21.1°C goes through an adiabatic device and separates into a hot stream of 0.4 moles at 1 atm, 176.3°C and a cold stream of 1.6 moles at 1 atm, –17.7°C, without any external work. It can be concluded that

(A) the total entropy change is zero
(B) the total entropy change for the process is positive
(C) the device violates Second Law of Thermodynamics
(D) the device violates First Law of Thermodynamics

Options :
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 98 Question Type : MCQ

For a real gas undergoing volume expansion through a porous plug with $\alpha=\frac{1}{v}\frac{\partial v}{\partial T}\Big|_p$, the Joule-Thomson cooling effect is observed if

(A) $0 < \alpha T < 1$ (B) $\alpha T = 1$ (C) $\alpha T > 1$ (D) $\alpha T = 0$

Options :
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

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Question Number : 99 Question Type : NAT

A lead bullet at 100°C traveling at 500 m/s, strikes a target and adiabatically comes to rest. If the specific heat of lead is 92 J/kg °C, melting temperature is 327.5 °C and heat of fusion is 108 kJ/kg, the percentage mass of lead in the bullet that is melted by collision is _____.

Correct Answer :

95 to 97

Question Number : 100 Question Type : NAT

An air-water vapor mixture with volume 100 m^3 at 100 kPa, 35°C is at 75 % relative humidity. Taking saturation pressure of vapor at 35°C as 5.63 kPa, the mass of vapor in the mixture in kg is _____.

Correct Answer :

2.9 to 3.0

Question Number : 101 Question Type : MCQ

An ideal gas of 1 kg mass enclosed inside a rigid vessel at the initial temperature 1200 K is employed as a heat source. The specific heat C_v of the gas is 718 J/kg K. The maximum work in kJ that can be developed by operating a heat engine between the ideal gas and the ambient at 300 K is

(A) 646.2 (B) 484.7 (C) 387.7 (D) 347.6

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 102 Question Type : NAT

The boiling point of water changes from 99.62°C to 105.99°C when the system pressure is changed from 1 bar to 1.25 bar. The boiling point value (in °C) corresponding to a pressure of 1.5 bar is _____.

Correct Answer :

111.0 to 111.6

Question Number : 103 Question Type : MCQ

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An ideal gas expands in an adiabatic frictionless nozzle from the inlet conditions of 31 bar, 800 K to the ambient pressure of 1 bar at the outlet. The specific heat C_p for the gas is 1 kJ/kg K and the specific heat ratio $\gamma = 1.4$. Neglecting inlet kinetic energy, the velocity of the gas (in m/s) at the nozzle exit is

(A) 32 (B) 500 (C) 707 (D) 1000

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 104 Question Type : MCQ

One kmol of hydrogen (molecular weight = 2 kg/kmol, specific heat ratio $\gamma = 1.4$) at 1 bar, 300 K mixes with one kmol of nitrogen (molecular weight = 28 kg/kmol, specific heat ratio $\gamma = 1.4$) at 1 bar, 300 K in an adiabatic vessel. The final mixture is also at 1 bar, 300 K. The entropy change (in kJ/K) for the process is

(A) -5.76 (B) zero (C) 5.76 (D) 11.53

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 105 Question Type : MCQ

A cycle 1-2-3-1 is proposed with the following processes:
1-2: Constant pressure expansion, 2-3: Reversible adiabatic expansion, 3-1: Irreversible adiabatic compression. Which one of the following statements is **TRUE**?

(A) The net work of the cycle is zero because there is no heat transfer.
(B) The cycle is feasible and can deliver net positive work.
(C) The cycle is impossible according to Kelvin-Planck statement.
(D) The cycle is impossible in accordance with First Law of Thermodynamics.

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 106 Question Type : NAT

One kg of saturated liquid-vapor mixture of water at 150 kPa ($u_f = 467$ kJ/kg, $v_f = 0.001053$ m^3/kg; $u_g = 2520$ kJ/kg and $v_g = 1.159$ m^3/kg) with quality of 0.7 is enclosed in a piston cylinder assembly. Heat is added at constant pressure to this system while a paddle wheel transfers a work of 50 kJ. The mixture eventually attains saturated vapor state. The amount of heat added to the mixture (in kJ) is _____.

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Correct Answer:
617 to 619

Question Number : 107 Question Type : NAT

Air enters a pipe at 1 bar and flows isothermally at the rate of 1 kg/s. Due to pipe friction, the pressure drop between two sections of the pipe is 7 % of the pressure at inlet section. For ambient temperature, $T_0 = 300$ K, the rate of irreversibility (in W) between the two sections is _____.

Correct Answer :
6235 to 6245

Question Number : 108 Question Type : NAT

A pump raises pressure of saturated liquid water at 100 kPa (density $\rho = 959$ kg/m^3) to 2 MPa. The isentropic efficiency of the pump is 0.92. The work done by the pump (in J/kg) is _____.

Correct Answer :
2100 to 2200

Question Number : 109 Question Type : NAT

In a Brayton cycle with air ($\gamma = 1.4$) as working fluid, $T_{min} = 300$ K and $T_{max} = 1000$ K. The pressure ratio corresponding to maximum net work per cycle is _____.

Correct Answer:
8.20 to 8.25

Polymer Science

Number of Questions:	22
Section Marks:	35.0

Question Number : 110 Question Type : MCQ

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The biodegradable polymer among the following polymers is

(A) poly(lactic acid)
(B) poly(butylene terephthalate)
(C) polystyrene
(D) polypropylene

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 111 Question Type : MCQ

Notched impact strength of a plastic decreases with

(A) increase in notch tip radius
(B) increase in notch depth
(C) increase in temperature
(D) decrease in notch depth

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 112 Question Type : MCQ

The compound used as a reactive diluent in unsaturated polyester resins is

(A) benzene
(B) cresol
(C) styrene
(D) adipic acid

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 113 Question Type : NAT

The diameter of a die of an extruder producing extrudate of diameter 2.4 mm with a die-swell ratio of 2 is _____mm.

Correct Answer :

1.2

Question Number : 114 Question Type : NAT

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The degree of polymerization of Nylon 6 (ignore end-groups) with molar mass of 1,00,000 g mol^{-1} is _____.

Correct Answer :
883 to 887

Question Number : 115 Question Type : MCQ

The polymer synthesized by ring opening polymerization is

(A) poly(acrylic acid)
(B) Nylon 6
(C) poly(ethylene terephthalate)
(D) Nylon 66

Options :
1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 116 Question Type : MCQ

Which among the following are used as initiators for free radical polymerization?

P. K_2SO_4 Q. $K_2S_2O_8$ R. AIBN S. *t*-Butyl hydroperoxide + Fe^{2+}

(A) P, Q & R only
(B) Q, R & S only
(C) P, R & S only
(D) P, Q, R & S

Options :
1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 117 Question Type : MCQ

Weight average molecular weight can be determined by

(A) Osmometry
(B) Ebulliometry
(C) End group analysis
(D) Light scattering

Options :
1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 118 Question Type : MCQ

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Butyl rubber is a copolymer of

(A) Isobutylene and butadiene
(B) Butadiene and 1-butene
(C) Isobutylene and isoprene
(D) Isoprene and 1-butene

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 119 Question Type : MCQ

Match the characterization technique with the polymer property it is used to determine

Technique	Property
P. X-ray diffraction	1. Melting temperature
Q. Differential scanning calorimetry	2. Crystallinity & crystal size
R. Thermogravimetric analysis	3. Glass transition temperature
S. Dynamic mechanical analysis	4. Ash content

(A) P-3; Q-1; R-4; S-2
(B) P-3; Q-4; R-2; S-1
(C) P-2; Q-4; R-1; S-3
(D) P-2; Q-1; R-4; S-3

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 120 Question Type : MCQ

Match the following plastic additives with their function

Additive	Function
P. Di-isooctyl phthalate	1. Antioxidant
Q. 4-Methyl-2,6-*t*-butylphenol	2. Plasticizer
R. Dicumyl peroxide	3. Antistatic agent
S. Quaternary ammonium compound	4. Cross-linking agent

(A) P-2; Q-4; R-1; S-3
(B) P-4; Q-1; R-3; S-2
(C) P-2; Q-1; R-4; S-3
(D) P-3; Q-1; R-4; S-2

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

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Question Number : 121 Question Type : MCQ

The correct statement with respect to electrical property of polymeric materials is

(A) For non-polar materials, dielectric constant is independent of frequency & temperature
(B) For polar materials, dielectric constant depends on frequency but not on temperature
(C) For non polar materials, power losses are high and depend on temperature & frequency
(D) For polar materials, power losses are low and independent of frequency

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 122 Question Type : MCQ

The order of melting point for the given polymers is

(A) Nylon 66 > PTFE > Nylon 6 > PP
(B) Nylon 66 > Nylon 6 > PTFE > PP
(C) PTFE > Nylon 66 > Nylon 6 > PP
(D) PTFE > Nylon 6 > Nylon 66 > PP

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 123 Question Type : MCQ

Match the processing technique used to manufacture the appropriate product

Processing Technique	Product
P. Calendering	1. Pipes
Q. Extrusion	2. Disposable cups
R. Injection Molding	3. Sheets
S. Thermoforming	4. Nylon gears

(A) P-3; Q-2; R-1; S-4
(B) P-3; Q-1; R-2; S-4
(C) P-3; Q-1; R-4; S-2
(D) P-3; Q-2; R-4; S-1

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 124 Question Type : MCQ

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Match the thermosetting resins to the raw materials they are synthesized from

Resin	Raw material
P. Epoxy	1. Cresol + furfural
Q. Phenolic	2. Diethylene glycol + diallyl phthalate
R. Unsaturated polyester	3. Bisphenol A + epichlorohydrin
S. Allyl	4. Maleic acid + 1,2-propylene glycol

(A) P-4; Q-2; R-3; S-1
(B) P-3; Q-1; R-2; S-4
(C) P-3; Q-2; R-1; S-4
(D) P-3; Q-1; R-4; S-2

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 125 Question Type : NAT

The damping factor of a solid polymer under sinusoidal loading in single cantilever mode showing 80 percent recovery in modulus is _____.

Correct Answer:
0.25

Question Number : 126 Question Type : NAT

A styrene-butadiene random copolymer with equal weight fraction of polystyrene (T_g = 100 °C) and polybutadiene (T_g = −100 °C) shows a single glass transition peak. The T_g of the copolymer is _____°C.

Correct Answer :
-37 to -36

Question Number : 127 Question Type : NAT

In a unidirectional carbon fibre reinforced epoxy composite, the ratio of fibre-to-matrix moduli is 30 and the fibres take up 50% of the cross-section. The percentage of applied force taken up by the fibres is _____.

Correct Answer :
96 to 97

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Question Number : 128 Question Type : NAT

The viscoelastic behavior of a plastic is represented by spring and dashpot elements having constants of 2 GN m^{-2} and 90 GN s m^{-2}, respectively. If a constant stress of 12 MN m^{-2} is applied, the strain predicted by Maxwell model after 50 s is _____ %.

Correct Answer:

1.2 to 1.3

Question Number : 129 Question Type : MCQ

Match the elastomers given below to their suitable application

Elastomer	Application
P. EPDM	1. Golf balls
Q. Polyurethane	2. Fuel transfer hose
R. Nitrile rubber	3. Cable insulation
S. Polybutadiene	4. Footwear

(A) P-3; Q-4; R-2,; S-1
(B) P-4; Q-3; R-2; S-1
(C) P-3; Q-2; R-4; S-1
(D) P-1; Q-4; R-2; S-3

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 130 Question Type : MCQ

Match the following reagents to their function in natural rubber latex technology

Reagent	Function
P. Ammonia	1. Prevent storage hardening
Q. Hydroxylamine	2. Delay plugging mechanism
R. Formic acid	3. Stabilizer
S. Ethephone	4. Coagulating agent

(A) P-3; Q-1; R-2; S-4
(B) P-3; Q-2; R-4; S-1
(C) P-3; Q-1; R-4; S-2
(D) P-3; Q-4; R-1; S-2

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 131 Question Type : NAT

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1.0 g of a polybutadiene sample with carboxylic acid groups at both the ends requires 2.5 mL of 0.1 M KOH for complete neutralization. The molecular weight of the polymer in g mol^{-1} is _____.

Correct Answer :
8000

Food Technology

Number of Questions:	22
Section Marks:	35.0

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Question Number : 132 Question Type : MCQ

Standard pasteurization protocol for milk is adequate for destroying

(A) *Clostridium sporogenes* (B) *Bacillus cereus*
(C) *Clostridium botulinum* (D) *Listeria monocytogenes*

Options :
1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 133 Question Type : MCQ

Which one of the following is NOT a component of an evaporator?

(A) Heat exchanger (B) Vacuum separator
(C) Condenser (D) Cyclone separator

Options :
1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 134 Question Type : MCQ

Among the following animal foods, the fat content is least in

(A) Beef (B) Chicken meat (C) Pork (D) Lamb flesh

Options :
1. ✖ A
2. ✔ B
3. ✖ C

4. ✖ D

Question Number : 135 Question Type : MCQ

The enzyme that hydrolyzes starch to maltose is

(A) α-amylase
(B) β-amylase
(C) glucoamylase
(D) cyclodextrin glucanotransferase

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 136 Question Type : MCQ

Which one of the following is NOT enriched in endosperm during parboiling of paddy?

(A) Thiamine (B) Niacin (C) Iron (D) Fat

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 137 Question Type : MCQ

Heat-treated legume seed proteins are more digestible than those of untreated legume seed proteins due to

(A) reaction of reducing sugars with ε-amino group of lysine
(B) increased binding of lectins to intestinal mucosal cells
(C) thermolabile nature of lectins and Kunitz-type protease inhibitors
(D) thermolabile nature of Bowman-Birk type of inhibitor

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 138 Question Type : MCQ

What is the percent relative humidity at which both the dry bulb and wet bulb thermometers would record equal temperatures?

(A) 0 (B) 10 (C) 50 (D) 100

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

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Question Number : 139 Question Type : MCQ

How many fold would the *g*-number of a centrifuge increase by doubling both the spinning speed and bowl diameter?

(A) 2 (B) 4 (C) 8 (D) 16

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 140 Question Type : MCQ

The gradual decrease in viscosity of tomato paste during storage can be prevented by quickly heating it to 82 °C, because

(A) water soluble pectin interacts with calcium
(B) hemicellulose prevents decrease in viscosity
(C) lignin prevents decrease in viscosity
(D) pectin methyl esterase is inactivated

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 141 Question Type : MCQ

Match the enzyme in **Group I** with its corresponding application in **Group II**

Group I	**Group II**
(P) Chymosin	(1) Removal of cooked flavor from milk
(Q) Sulfhydryl oxidase	(2) Soybean milk coagulation
(R) β–Galactosidase	(3) For rennet puddings
(S) Microbial proteases	(4) Lactose removal

(A) P-3, Q-2, R-1, S-4 (B) P-3, Q-1, R-4, S-2
(C) P-1, Q-3, R-4, S-2 (D) P-4, Q-3, R-2, S-1

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 142 Question Type : NAT

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Milk is flowing at 0.12 m^3/min in a 2.5 cm diameter pipe. The temperature of the milk is 21 °C and the corresponding viscosity and density are 2.1 x 10^{-3} Pas and 1029 kg/m^3, respectively. If the flow is found to be turbulent under the given conditions, the Reynolds number is _____

Correct Answer :
49000 to 50225

Question Number : 143 Question Type : NAT

Whole milk (34,950 kg) containing 4% fat is to be separated in 6 h period into skim milk with 0.45% fat and cream with 45% fat. The flow rate of cream stream (kg/h) from the separator is _____

Correct Answer :
455 to 475

Question Number : 144 Question Type : MCQ

Match the edible plant tissue in **Group I** with the type of carotenoid given in **Group II**

Group I	**Group II**
(P) Corn	(1) Lycopene
(Q) Red pepper	(2) β-Carotene
(R) Pumpkin	(3) Capsanthin
(S) Tomato	(4) Lutein

(A) P-3, Q-4, R-2, S-1
(B) P-2, Q-1, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-1, Q-2, R-4, S-3

Options :
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 145 Question Type : MCQ

Undesirable bitterness frequently encountered in cured cheese is due to the

(A) presence of naringen
(B) formation of limonin
(C) overall hydrophobicity of amino acid side-chains in peptide
(D) conversion of humulone to isohumulone

Options :
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

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Question Number : 146 Question Type : MCQ

Green tea is considered to be a more healthy option than black tea because it

(A) has high content of polyphenols
(B) is richer in thearubigin
(C) does not require any sweetener during tea preparation
(D) has no microbial load

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 147 Question Type : MCQ

Multiple effect evaporation leads to

(A) reduction in operating cost and reduction in capital cost
(B) increase in operating cost and increase in capital cost
(C) increase in operating cost and reduction in capital cost
(D) reduction in operating cost and increase in capital cost

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 148 Question Type : NAT

A dilute pineapple juice is heated in a double pipe heat exchanger from 28 °C to 75 °C by heat exchanging with hot water flowing in shell in counter current direction. Hot water is entering the shell at 95 °C and leaving at 85 °C. The log mean temperature difference (°C) is _____

Correct Answer:

35 to 36

Question Number : 149 Question Type : NAT

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Heat is transferred by radiation to a loaf of bread in an oven at a uniform temperature of 177 °C. The total surface area and temperature of the loaf are 0.0645 m^2 and 100 °C, respectively. The surface emissivity of the loaf is 0.85 and the value of Stefan-Boltzmann constant is 5.67×10^{-8} $W.m^{-2}.K^{-4}$. The net heat transfer (W) is _____

Correct Answer :
67.8 to 68.2

Question Number : 150 Question Type : NAT

Granulated sugar, having an average particle size of 500 µm, is milled to produce icing sugar having an average particle size of 25 µm. The power requirement was 10 kW as obtained by Rittinger's law. If the same mill were to be used to produce fondant sugar having an average particle size of 20 µm at the same capacity, the power requirement (kW) would be _____

Correct Answer :
12.4 to 12.8

Question Number : 151 Question Type : NAT

One ton of soybean containing 18% oil, 35% protein, 27.1% carbohydrates, 9.4% of fibre and ash, and 10.5% moisture is crushed and pressed. The residual oil content in the pressed cake is 6%. Assuming that there is no loss of protein and water with oil, the amount of oil (kg) obtained from the crusher is _____

Correct Answer :
127 to 128

Question Number : 152 Question Type : MCQ

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Match the processing method in **Group I** with the operation carried out in **Group II**

Group I	Group II
(P) Degumming	(1) Crystallization of triacylglycerol by cooling to remove fat crystals
(Q) Deacidifying	(2) Passing heated oil over charcoal
(R) Bleaching	(3) Using alkaline solution to remove fatty acids
(S) Winterizing	(4) Wetting with water to remove lecithin

(A) P-3, Q-1, R-4, S-2
(B) P-4, Q-3, R-1, S-2
(C) P-4, Q-3, R-2, S-1
(D) P-3, Q-1, R-2, S-4

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 153 Question Type : MCQ

The order of succession of microbes in the spoilage of milk, involving (P) *Lactobacillus*, (Q) protein digesting bacteria, (R) *Lactococcus lactis*, (S) yeasts and molds, is

(A) S>R>Q>P (B) S>Q>R>P (C) R>P>S>Q (D) Q>S>P>R

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

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