# National Testing Agency

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|---|---|
| **Question Paper Name :** | B Tech 25072021 Shift S2 |
| **Subject Name :** | B TECH |
| **Creation Date :** | 2021-07-25 19:49:44 |
| **Duration :** | 180 |
| **Total Marks :** | 300 |
| **Display Marks:** | Yes |

## B TECH

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|---|---|
| **Group Number :** | 1 |
| **Group Id :** | 864351226 |
| **Group Maximum Duration :** | 0 |
| **Group Minimum Duration :** | 180 |
| **Show Attended Group? :** | No |
| **Edit Attended Group? :** | No |
| **Break time :** | 0 |
| **Group Marks :** | 300 |
| **Is this Group for Examiner? :** | No |

## Physics Section A

| | |
|---|---|
| **Section Id :** | 864351794 |
| **Section Number :** | 1 |
| **Section type :** | Online |
| **Mandatory or Optional :** | Mandatory |

| | |
|---|---|
| **Number of Questions :** | 20 |
| **Number of Questions to be attempted :** | 20 |
| **Section Marks :** | 80 |
| **Enable Mark as Answered Mark for Review and Clear Response :** | Yes |
| **Sub-Section Number :** | 1 |
| **Sub-Section Id :** | 8643511021 |
| **Question Shuffling Allowed :** | Yes |

**Question Number : 1 Question Id : 86435118370 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The force is given in terms of time $t$ and displacement $x$ by the equation

$$F = A\cos Bx + C\sin Dt$$

The dimensional formula of $\frac{AD}{B}$ is :

**Options :**

86435161691. $[M^1 L^1 T^{-2}]$

86435161692. $[M^2 L^2 T^{-3}]$

86435161693. $[M^0 L T^{-1}]$

86435161694. $[M L^2 T^{-3}]$

**Question Number : 2 Question Id : 86435118371 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A balloon was moving upwards with a uniform velocity of 10 m/s. An object of finite mass is dropped from the balloon when it was at a height of 75 m from the ground level. The height of the balloon from the ground when object strikes the ground was around : (takes the value of $g$ as 10 m/s$^2$)

**Options :**

86435161695. 125 m

86435161696. 300 m

86435161697. 200 m

86435161698. 250 m

**Question Number : 3 Question Id : 86435118372 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The instantaneous velocity of a particle moving in a straight line is given as $v=\alpha t+\beta t^2$, where $\alpha$ and $\beta$ are constants. The distance travelled by the particle between 1 s and 2 s is :

**Options :**

86435161699. $3\alpha+7\beta$

86435161700. $\frac{3}{2}\alpha+\frac{7}{3}\beta$

86435161701. $\frac{\alpha}{2}+\frac{\beta}{3}$

86435161702. $\frac{3}{2}\alpha+\frac{7}{2}\beta$

**Question Number : 4 Question Id : 86435118373 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The relation between time t and distance $x$ for a moving body is given as $t = mx^2 + nx$, where $m$ and $n$ are constants. The retardation of the motion is : (Where $v$ stands for velocity)

**Options :**

86435161703. $2\ mv^3$

86435161704. $2\ nv^3$

86435161705. $2\ mnv^3$

86435161706. $2\ n^2v^3$

**Question Number : 5 Question Id : 86435118374 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Two vectors $\vec{X}$ and $\vec{Y}$ have equal magnitude. The magnitude of $\left(\vec{X} - \vec{Y}\right)$ is n times the magnitude of $\left(\vec{X} + \vec{Y}\right)$. The angle between $\vec{X}$ and $\vec{Y}$ is :

**Options :**

86435161707. $\cos^{-1}\left(\frac{n^2 - 1}{-n^2 - 1}\right)$

86435161708.

$\cos^{-1}\left(\frac{-n^2-1}{n^2-1}\right)$

86435161709. $\cos^{-1}\left(\frac{n^2+1}{-n^2-1}\right)$

86435161710. $\cos^{-1}\left(\frac{n^2+1}{n^2-1}\right)$

**Question Number : 6 Question Id : 86435118375 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A force $\vec{F} = \left(40\hat{i} + 10\hat{j}\right)$N acts on a body of mass 5 kg. If the body starts from rest, its position vector $\vec{r}$ at time $t = 10$ s, will be :

**Options :**

86435161711. $\left(400\,\hat{i} + 100\,\hat{j}\right)$ m

86435161712. $\left(100\,\hat{i} + 400\,\hat{j}\right)$ m

86435161713. $\left(100\,\hat{i} + 100\,\hat{j}\right)$ m

86435161714. $\left(400\,\hat{i} + 400\,\hat{j}\right)$ m

**Question Number : 7 Question Id : 86435118376 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Consider a planet in some solar system which has a mass double the mass of earth and density equal to the average density of earth. If the weight of an object on earth is W, the weight of the same object on that planet will be :

**Options :**

86435161715. $W$

86435161716. $2\,W$

86435161717. $\sqrt{2}\,W$

86435161718. $2^{\frac{1}{3}}\,W$

**Question Number : 8 Question Id : 86435118377 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Two spherical soap bubbles of radii $r_1$ and $r_2$ in vacuum combine under isothermal conditions. The resulting bubble has a radius equal to :

**Options :**

86435161719. $\frac{r_1 + r_2}{2}$

86435161720. $\frac{r_1\, r_2}{r_1 + r_2}$

86435161721. $\sqrt{r_1 r_2}$

86435161722. $\sqrt{r_1^2 + r_2^2}$

**Question Number : 9 Question Id : 86435118378 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A heat engine has an efficiency of $\frac{1}{6}$. When the temperature of sink is reduced by 62°C, its efficiency get doubled. The temperature of the source is :

**Options :**

86435161723. $37°C$

86435161724. $62°C$

86435161725. $99°C$

86435161726. $124°C$

**Question Number : 10 Question Id : 86435118379 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

In a simple harmonic oscillation, what fraction of total mechanical energy is in the form of kinetic energy, when the particle is midway between mean and extreme position.

**Options :**

86435161727. $\frac{3}{4}$

86435161728. $\frac{1}{4}$

86435161729. $\frac{1}{3}$

86435161730. $\frac{1}{2}$

**Question Number : 11 Question Id : 86435118380 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

If $q_f$ is the free charge on the capacitor plates and $q_b$ is the bound charge on the dielectric slab of dielectric constant $k$ placed between the capacitor plates, then bound charge $q_b$ can be expressed as :

**Options :**

86435161731. $q_b = q_f\left(1 - \frac{1}{k}\right)$

86435161732. $q_b = q_f\left(1 - \frac{1}{\sqrt{k}}\right)$

86435161733. $q_b = q_f\left(1 + \frac{1}{k}\right)$

86435161734. $q_b = q_f\left(1 + \frac{1}{\sqrt{k}}\right)$

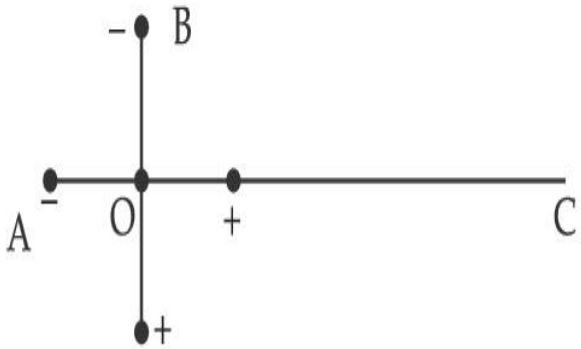
**Question Number : 12 Question Id : 86435118381 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Two ideal electric dipoles A and B, having their dipole moment $p_1$ and $p_2$ respectively are placed on a plane with their centres at O as shown in the figure. At point C on the axis of dipole A, the resultant electric field is making an angle of 37° with the axis.

The ratio of the dipole moment of A and B, $\frac{p_1}{p_2}$ is : (take sin $37° = \frac{3}{5}$ )




**Options :**

86435161735. $\frac{4}{3}$

86435161736. $\frac{3}{2}$

86435161737. $\frac{2}{3}$

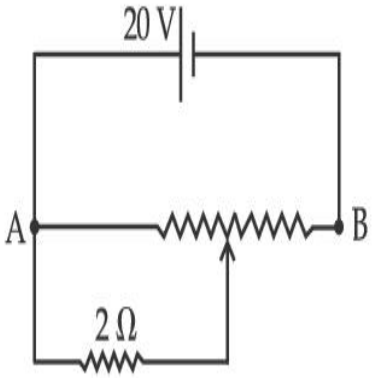
86435161738. $\frac{3}{8}$

**Question Number : 13 Question Id : 86435118382 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

The given potentiometer has its wire of resistance 10 Ω. When the sliding contact is in the middle of the potentiometer wire, the potential drop across 2 Ω resistor is :




**Options :**

86435161739. $10\ \text{V}$

86435161740. $5\ \text{V}$

86435161741. $\frac{40}{9}\ \text{V}$

86435161742. $\frac{40}{11}\ \text{V}$

**Question Number : 14 Question Id : 86435118383 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

Two ions having same mass have charges in the ratio 1 : 2. They are projected normally in a uniform magnetic field with their speeds in the ratio 2 : 3. The ratio of the radii of their circular trajectories is :

**Options :**

86435161743. $4 : 3$

86435161744. $2:3$

86435161745. $3:1$

86435161746. $1:4$

**Question Number : 15 Question Id : 86435118384 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A 10 Ω resistance is connected across 220 V - 50 Hz AC supply. The time taken by the current to change from its maximum value to the rms value is :

**Options :**

86435161747. $2.5\ ms$

86435161748. $1.5\ ms$

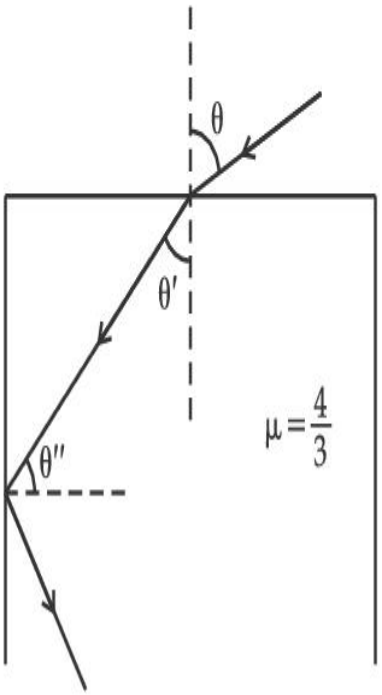
86435161749. $4.5\ ms$

86435161750. $3.0\ ms$

**Question Number : 16 Question Id : 86435118385 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A ray of light entering from air into a denser medium of refractive index $\frac{4}{3}$, as shown in figure. The light ray suffers total internal reflection at the adjacent surface as shown. The maximum value of angle $\theta$ should be equal to :




**Options :**

86435161751. $\sin^{-1}\frac{\sqrt{5}}{3}$

86435161752. $\sin^{-1}\frac{\sqrt{7}}{3}$

86435161753. $\sin^{-1}\frac{\sqrt{7}}{4}$

86435161754. $\sin^{-1}\frac{\sqrt{5}}{4}$

**Question Number : 17 Question Id : 86435118386 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A prism of refractive index μ and angle of prism A is placed in the position of minimum angle of deviation. If minimum angle of deviation is also A, then in terms of refractive index value of A is :

**Options :**

86435161755. $\sin^{-1}\left(\frac{\mu}{2}\right)$

86435161756. $\sin^{-1}\left(\sqrt{\frac{\mu-1}{2}}\right)$

86435161757. $2\cos^{-1}\left(\frac{\mu}{2}\right)$

86435161758. $\cos^{-1}\left(\frac{\mu}{2}\right)$

**Question Number : 18 Question Id : 86435118387 Question Type : MCQ Option Shuffling : Yes**

**Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

When radiation of wavelength λ is incident on a metallic surface, the stopping potential of ejected photoelectrons is 4.8 V. If the same surface is illuminated by radiation of double the previous wavelength, then the stopping potential becomes 1.6 V. The threshold wavelength of the metal is :

**Options :**

86435161759. $2\lambda$

86435161760. $4\ \lambda$

86435161761. $6\ \lambda$

86435161762. $8\ \lambda$

**Question Number : 19 Question Id : 86435118388 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

An electron moving with speed $v$ and a photon moving with speed $c$, have same D-Broglie wavelength. The ratio of kinetic energy of electron to that of photon is :

**Options :**

86435161763. $\frac{2c}{v}$

86435161764. $\frac{v}{2c}$

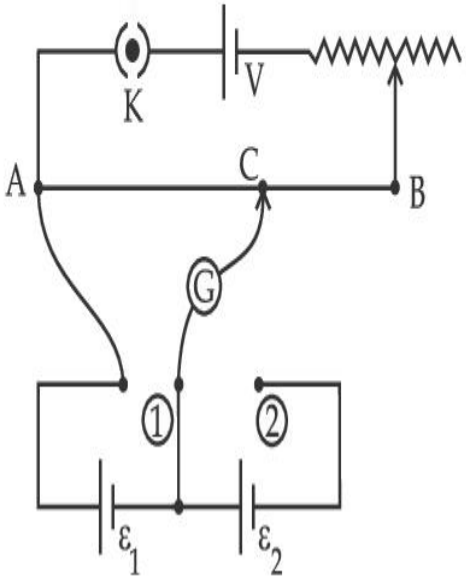
86435161765. $\frac{3c}{v}$

86435161766. $\frac{v}{3c}$

**Question Number : 20 Question Id : 86435118389 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

In the given potentiometer circuit arrangement, the balancing length AC is measured to be 250 cm. When the galvanometer connection is shifted from point (1) to point (2) in the given diagram, the balancing length becomes 400 cm. The ratio of the emf of two cells, $\frac{\varepsilon_1}{\varepsilon_2}$ is :




**Options :**

86435161767. $\frac{8}{5}$

86435161768. $\frac{5}{3}$

86435161769. $\frac{3}{2}$

86435161770. $\frac{4}{3}$

## Physics Section B

**Section Id :** 864351795

| | |
|---|---|
| **Section Number :** | 2 |
| **Section type :** | Online |
| **Mandatory or Optional :** | Mandatory |
| **Number of Questions :** | 10 |
| **Number of Questions to be attempted :** | 5 |
| **Section Marks :** | 20 |
| **Enable Mark as Answered Mark for Review and Clear Response :** | Yes |
| **Sub-Section Number :** | 1 |
| **Sub-Section Id :** | 8643511022 |
| **Question Shuffling Allowed :** | Yes |

**Question Number : 21 Question Id : 86435118390 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A force of $F=(5y+20)\hat{j}$ N acts on a particle. The workdone by this force when the particle is moved from $y=0$ m to $y=10$ m is _____ J.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 22 Question Id : 86435118391 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A solid disc of radius 20 cm and mass 10 kg is rotating with an angular velocity of 600 rpm, about an axis normal to its circular plane and passing through its centre of mass. The retarding torque required to bring the disc at rest in 10 s is _____ $\pi \times 10^{-1}$ Nm.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 23 Question Id : 86435118392 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A system consists of two types of gas molecules A and B having same number density $2\times10^{25}/m^3$. The diameter of A and B are 10 Å and 5 Å respectively. They suffer collision at room temperature. The ratio of average distance covered by the molecule A to that of B between two successive collision is _____ $\times10^{-2}$.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 24 Question Id : 86435118393 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A 16 Ω wire is bend to form a square loop. A 9 V supply having internal resistance of 1 Ω is connected across one of its sides. The potential drop across the diagonals of the square loop is _____ $\times10^{-1}$ V.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

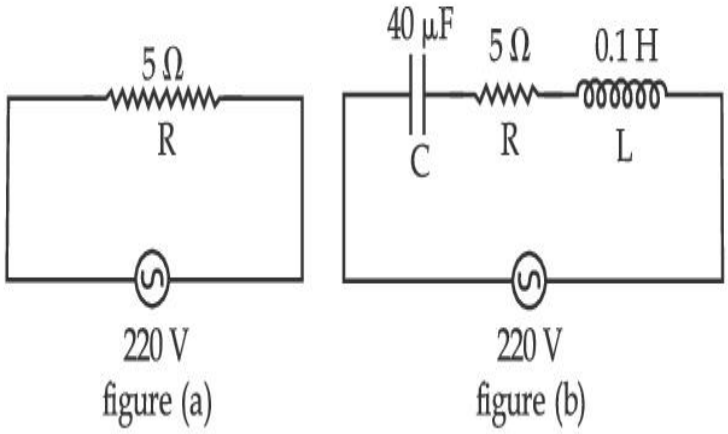
**Possible Answers :**

1

**Question Number : 25 Question Id : 86435118394 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

Two circuits are shown in the figure (a) & (b). At a frequency of _____ rad/s the average power dissipated in one cycle will be same in both the circuits.




**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 26 Question Id : 86435118395 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A light beam of wavelength 500 nm is incident on a metal having work function of 1.25 eV, placed in a magnetic field of intensity B. The electrons emitted perpendicular to the magnetic field B, with maximum kinetic energy are bent into circular arc of radius 30 cm. The value of B is _____ $\times 10^{-7}$ T.

Given $hc = 20 \times 10^{-26}$ J-m, mass of electron $= 9 \times 10^{-31}$ kg

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 27 Question Id : 86435118396 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

The nuclear activity of a radioactive element becomes $\left(\frac{1}{8}\right)^{th}$ of its initial value in 30 years.

The half-life of radioactive element is _____ years.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 28 Question Id : 86435118397 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

From the given data, the amount of energy required to break the nucleus of aluminium $^{27}_{13}Al$ is _____ $x \times 10^{-3}$ J.

Mass of neutron = 1.00866 u

Mass of proton = 1.00726 u

Mass of Aluminium nucleus = 27.18846 u

(Assume 1 u corresponds to $x$ J of energy)

(Round off to the nearest integer)

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 29 Question Id : 86435118398 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

In a semiconductor, the number density of intrinsic charge carriers at 27°C is $1.5 \times 10^{16}/m^3$. If the semiconductor is doped with impurity atom, the hole density increases to $4.5 \times 10^{22}/m^3$. The electron density in the doped semiconductor is _____ $\times 10^9/m^3$.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1

**Question Number : 30 Question Id : 86435118399 Question Type : SA**

**Correct Marks : 4 Wrong Marks : 0**

A message signal of frequency 20 kHz and peak voltage of 20 volt is used to modulate a carrier wave of frequency 1 MHz and peak voltage of 20 volt. The modulation index will be _____.

**Response Type :** Numeric

**Evaluation Required For SA :** Yes

**Show Word Count :** Yes

**Answers Type :** Equal

**Text Areas :** PlainText

**Possible Answers :**

1