PHYSICS

BOOKS - MTG PHYSICS (BENGALI ENGLISH)

QUESTION PAPER 2019

Physics Category I

1. Assume that the earth moves around the sun in a circular orbit of radius R and there

exists a planet which also moves around the sun in a circular orbit with an angular speed twice as large as that of the earth. The radius of the orbit of the planet is

A. $2^{-2/3}R$

B. $2^{2/3}R$

C. $2^{-1/3}R$

D. $\dfrac{R}{\sqrt{2}}$

Answer:

2. A compressive force is applied to a uniform rod of rectangular cross-section so that its length decreases by 1%. If the Poisson's ratio for the material of the rod be 0.2, which of the following statements is correct ? "The volume approximately......."

    A. decreases by 1%

    B. decreases by 0.8%

    C. decreases by 0.6%

    D. increases by 0.2%

Answer:

3. A small spherical body of radius r and density p moves with the terminal velocity v in a fluid of coefficient of viscosity η and density a . What will be the net force on the body ?

A. $\dfrac{4\pi}{3} r^3 (\rho - \sigma) g$

B. $6\pi \eta r v$

C. Zero

D. Infinity

Answer:

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4. Two black bodies A and B have equal surface areas and are maintained at temperatures 27° C and 177° C respectively. What will be the ratio of the thermal energy radiated per second by A to that by B ?

A. $4 : 9$

B. $2:3$

C. $16:81$

D. $27:177$

Answer:

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5. What will be the molar specific heat at constant volume of an ideal gas consisting of rigid diatomic molecules ?

A. $\dfrac{3}{2}R$

B. $\dfrac{5}{2}R$

C. R

D. 3R

Answer:

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6. Consider the given diagram. An ideal gas is contained in a chamber (left) of volume V and is at an absolute temperature T. It is allowed

to rush freely into the right chamber of volume V which is initially vacuum. The whole system is thermally isolated. What will be the final temperature of the system after the equilibrium has been attained ?

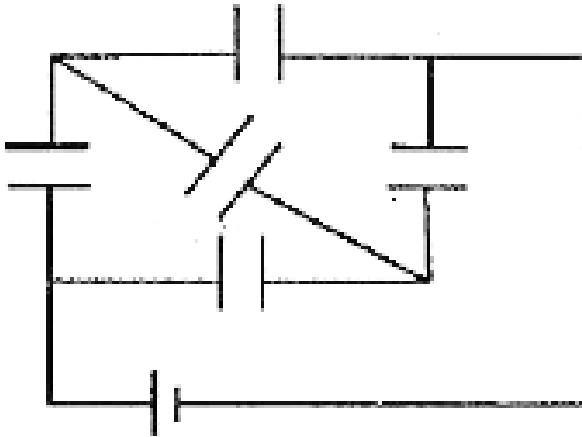| V	V
Ideal gas	Vacuum
(আদর্শ গ্যাস)	(শূন্যস্থান)
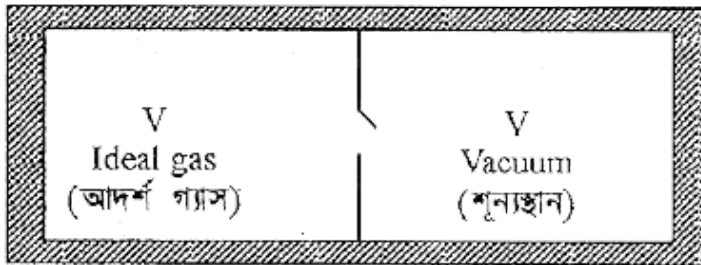
A. T

B. $\dfrac{T}{2}$

C. 2T

D. $\dfrac{T}{4}$

Answer:

7. Five identical capacitors, of capacitance $20\mu F$ each, are connected to a battery of 150 V, in a combination as shown in the diagram.

What is the total amount of charge stored ?

A. $15 \times 10^{-3}C$

B. $12 \times 10^{-3}C$

C. $10 \times 10^{-3}C$

D. $3 \times 10^{-3}C$

Answer:

8. Eleven equal point charges, all of them having a charge +Q, are placed at all the hour positions of a circular clock of radius r, except at the 10 hour position. What is the electric field strength at the centre of the clock ?

A. $\dfrac{Q}{4\pi\varepsilon_0 r^2}$ the centre towards the mark 10

B. $\dfrac{Q}{4\pi\varepsilon_0 r^2}$ towards the centre

C. $\dfrac{Q}{4\pi\varepsilon_0 r^2}$ from the centre towards the mark 6

D. zero

Answer:

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9. A unit negative charge with mass M resides at the midpoint of the straight line of length 2a adjoining two fixed charges of magnitude $+Q$ each if it is given n very small displacement $x(x < < a)$ in a direction perpendicular to the straight line. It will

A. $F \propto x$

B. $F \propto \dfrac{1}{x}$

C. $F \propto x^2$

D. $F \propto \dfrac{1}{x^2}$

Answer:

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10. To which of the following quantities, the radius of the circular path of a charged

particle moving at right angles to a uniform magnetic field is directly proportional ?

A. energy of the particle.

B. magnetic field.

C. charge of the particle.

D. momentum of the particle.

Answer:

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11. An electric current i enters and leaves a uniform circular wire of radius a through diametrically opposite points. A particle carrying a charge q moves along the axis of the circular wire with speed v. What is the magnetic force experienced by the particle when it passes through the centre of the circle ?

A. $qv\dfrac{\mu_0 i}{a}$

B. $qv\dfrac{\mu_0 i}{2a}$

C. $qv\dfrac{\mu_0 i}{2\pi a}$

D. Zero

Answer:

12. A current I is flowing along an infinite, straight wire, in the positive Z-direction and the same current is flowing along a similar parallel wire 5 m apart, in the negative Z-direction. A point P is at a perpendicular distance 3 m from the first wire and 4 m from

the second. What will be magnitude of the

magnetic field $\overrightarrow{B}$ at P?

A. $\dfrac{5}{12}\left(\mu_0 \dfrac{I}{\pi}\right)$

B. $\dfrac{7}{24}\dfrac{\mu_0 I}{\pi}$
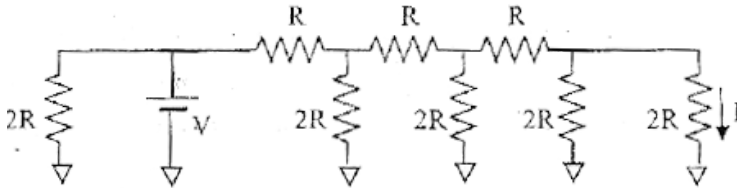
C. $\dfrac{5}{24}\left(\mu_0 \dfrac{I}{\pi}\right)$

D. $\dfrac{25}{288}\left(\mu_0 \dfrac{I}{\pi}\right)$

Answer:

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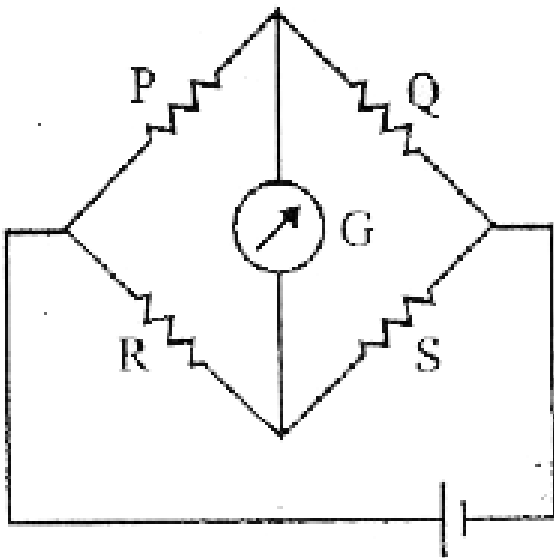
13. What is the current I shown in the given circuit ?

A. $\dfrac{V}{2R}$

B. $\dfrac{V}{R}$

C. $\dfrac{V}{16R}$

D. $\dfrac{V}{8R}$

Answer:

14. When the value of r in the balanced Wheatstone bridge, shown in the figure: is increased from 5Ω to 7Ω the value of S has to be increased by 3Ω in order to maintain the balance. What is the initial value of S ?

A. 2.5Ω

B. 3Ω

C. 5Ω

D. 7.5Ω

Answer:

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15. When a 60 mH inductor and a resistor are connected in series with an AC voltage source, the voltage leads the current by 60°. If the

inductor is replaced by a 0.5 uF capacitor, the voltage lags behind the current by 30°. What is the frequency of the AC supply ?

A. $\dfrac{1}{2\pi} \times 10^4 Hz$

B. $\dfrac{1}{\pi} \times 10^4 Hz$

C. $\dfrac{3}{2\pi} \times 10^4 Hz$

D. $\dfrac{1}{2\pi} \times 10^8 Hz$

Answer:

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16. A point object is placed on the axis of a thin convex lens of focal length 0.05 m at a distance of 0.2 m from the lens and its image is formed on the axis. If the object is now made to oscillate along the axis with a small amplitude of A cm, then what is the amplitude of oscillation of the image ?

[you many assume, $\dfrac{1}{1+x} = 1 - x$, where $x < \ < 1$]

A. $\dfrac{4A}{9} \times 10^{-2} m$

B. $\dfrac{5A}{9} \times 10^{-2} m$

C. $\dfrac{A}{3} \times 10^{-2} m$

D. $\dfrac{A}{9} \times 10^{-2} m$

Answer:

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17. In Young's experiment for the interference of light, the separation between the slits is d and the distance of the screen from the slits is D. If D is increased by 0.5% and d is decreased by 0.3%, then for the light of a given

wavelength, which one of the following is true

?

"The fringe width..........."

A. increases by 0.8%

B. decreases by 0.8%

C. increases by 0.2%
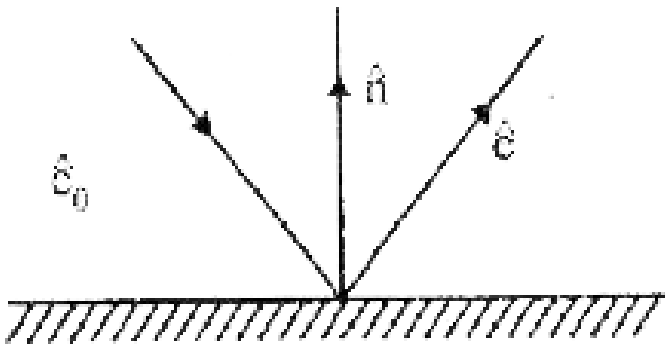
D. decreases by 0.2%

Answer:

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18. A ray of light is reflected by a plane mirror. $\hat{\varepsilon}_0, \hat{e}$ and $\hat{n}$ be the unit vectors along the incident ray, reflected ray and the normal to the reflecting surface respectively. Which of the following gives an expression for $\hat{e}$?

A. $\hat{\varepsilon}_0 + 2(\hat{\varepsilon}_0. \hat{n})\hat{n}$

B. $\hat{\varepsilon}_0 - 2(\hat{\varepsilon}_0. \hat{n})\hat{n}$

C. $\hat{\varepsilon}_0 - (\hat{\varepsilon}_0. \hat{n})\hat{n}$

D. $\hat{\varepsilon}_0 + (\hat{\varepsilon}_0 \cdot \hat{n})\hat{n}$

Answer:

19. A proton and an electron initially at rest are accelerated by the same potential difference. Assuming that a proton is 2000 times heavier than an' electron, what will be the relation between the de Broglie

wavelength of the proton (λ_p) and that of electron (λ_e) ?

A. $\lambda_p = 2000\lambda_e$

B. $\lambda_p = \dfrac{\lambda_e}{2000}$

C. $\lambda_p = 20\sqrt{5}\lambda_e$

D. $\lambda_p = \dfrac{\lambda_e}{20\sqrt{5}}$

Answer:

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20. To which of the following the angular velocity of the electron in the n-th Bohr orbit is proportional ?
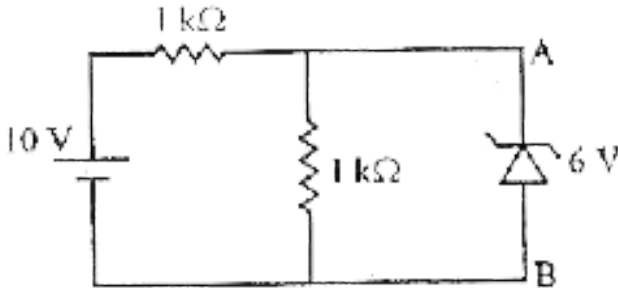
A. n^2

B. $\dfrac{1}{n^2}$

C. $\dfrac{1}{n^{3/2}}$

D. $\dfrac{1}{n^3}$

Answer:

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21. In the circuit shown, what will be the current through the 6v zener ?

A. 6 mA, from A to B

B. 2 mA, from A to B

C. 2 mA, from B to A

D. Zero

Answer:

22. Each of the two inputs A and b can assume values either 0 or 1. Then which of the following will be equal to $\overline{A} . \overline{B}$?

A. $A + B$

B. $\overline{A + B}$

C. $\overline{A . B}$

D. $\overline{A} + \overline{B}$

Answer:

23. The correct dimensional formula for impulse is given by :

A. ML^2T^{-2}

B. MLT^{-1}

C. ML^2T^{-1}

D. MLT^{-2}

Answer:

24. The density of the material of a cube can be estimated by measuring its mass and the length of one of its sides. If the maximum error in the measurement of mass and length are 0.3% and 0.2% respectively, the maximum error in the estimation of the density of the cube is approximately

A. 1.1 %

B. 0.5 %

C. 0.9 %

D. 0.7 %

Answer:

25. Two weights of the mass m_1 and $m_2(>m_1)$ are joined by an inextensible string of negligible mass passing over.a fixed friction-less pulley. The magnitude of the acceleration of the loads is:

A. g

B. $\dfrac{m_2 - m_1}{m_2}g$

C. $\dfrac{m_1}{m_2 + m_1}g$

D. $\dfrac{m_2 - m_1}{m_2 + m_1}g$

Answer:

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26. A body starts from rest, under the action of

an engine working at a constant power and

moves along a straight line. The displacement

S is given as a function of time (t) as:

A. $S = at + bt^2$, a,b are constants

B. $S = bt^2$, b is a constant

C. $S = at^{3/2}$, a is a constant

D. S=at, a is a constant

Answer:

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1. Two identical blocks of ice move in opposite directions with equal speed and collide with each other. What will be the minimum speed required to make both the blocks melt completely, if the initial temperatures of the blocks were -8° C each ? (Specific heat of ice is 2100 $Jkg^{-1}K^{-1}$ and Latent heat of fusion of ice is $3.36 \times 10^5 Jkg^{-1}$)

    A. $840ms^{-1}$
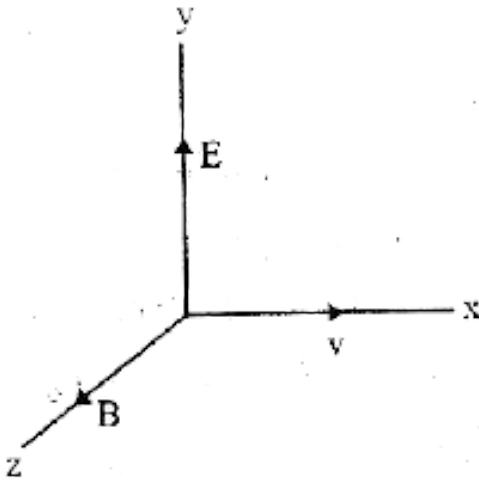
    B. $420ms^{-1}$

C. $8.4ms^{-1}$

D. $84ms^{-1}$

Answer:

2. A particle with charge q moves with a velocity V in a direction perpendicular to the directions of uniform electric and magnetic fields, E and B respectively, which are mutually perpendicular to each other. Which one of the

following gives the condition for which the particle moves undeflected in its original trajectory ?

A. $v = \dfrac{E}{B}$

B. $v = \dfrac{B}{E}$

C. $v = \sqrt{\dfrac{E}{B}}$

D. $v = q\dfrac{B}{E}$

Answer:

3. A parallel plate capacitor in series with a resistance of 100Ω , an inductor of 20 mH and an AC voltage source of variable frequency shows resonance at a frequency of $\dfrac{1250}{\pi}$ Hz: If this capacitor is charged by a DC voltage, source to a voltage 25 V, what amount of charge will be stored in each plate of the capacitor ?

A. $0.2\mu C$

B. 2 mC

C. $0.2mC$

D. 0.2 C

Answer:

4. A horizontal fire hose with a nozzle of cross-sectional area $\dfrac{5}{\sqrt{21}} \times 10^{-3}m^2$ delivers a

cubic metre of water in 10s. What will be the maximum possible increase in the temperature of water while it hits a rigid wall (neglecting the effect of gravity) ?

A. $1°C$

B. $0.1°C$

C. $10°$ C

D. $0.01°$ C

Answer:

1. A projectile thrown with an initial velocity of $10ms^{-1}$ at an angle a with the horizontal, has a range of 5 m . Taking $g = 10ms^{-2}$ and neglecting air resistance, what will be the estimated value of α ?

    A. $15°$

    B. $30°$

    C. $45°$

D. $75°$
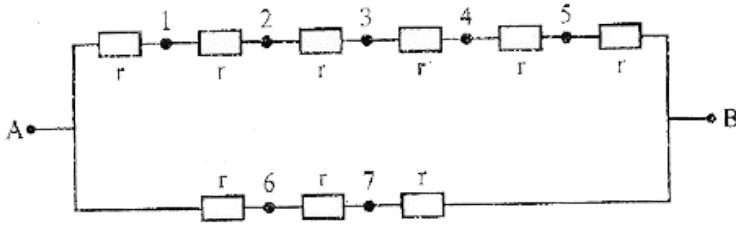
Answer:

2. In the circuit shown in the figure all the resistances are identical and each has the value $r\Omega$. The equivalent resistance of the combination between the points A and B will remain unchanged even when the following pairs of points marked in the figure are

connected through a resistance R.

A. 2 and 6

B. 3 and 6

C. 4 and 7

D. 4 and 6

Answer:

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3. A metallic loop is placed in a uniform magnetic field B with the plane of the loop perpendicular to B. Under which condition(s) given below an emf will be induced in the loop?

"If the loop is...."

moved along the direction of $\vec{B}$

squeezed to a smaller area.

rotated about its axis.

rotated about one of its diameters.

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