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JEE (Main)

PAPER-1 (B.E./B. TECH.)

2023

COMPUTER BASED TEST (CBT)

Memory Based Questions & Solutions

Date: 24 January, 2023 (SHIFT-1) | TIME : (09:00 a.m. to 12:00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: PHYSICS

PHYSICS

1. For equation of wave $y = 0.25 \sin (2x - 4t)$, find velocity of wave. (Here x is in meter, t is in sec. & y is in meter)
(1) 2 m/s (2) 0.5 m/s (3) 2 m/s (4) 4 m/s

Sol. (2)
Compare the equation with $y = a \sin (kx - \omega t)$
$k = 2$, $\omega = 4$
Velocity $= v = \frac{\omega}{k} = \frac{4}{2} = 2$ m/s.

2. For the given circuit find current in 20 Ω, 30 resistance.

(1) 1.2A, 0.2A (2) 1.4A, 0.4A (3) 1.6A, 0.8A (4) 1.8A, 1.2A

Sol. (3)

$R_{eq} = 3\Omega$
$i = \frac{24}{3} = 8A$
$i_{20} = \frac{8 \times 30}{50} = 4.8A$
$i_{30} = \frac{8 \times 20}{50} = 3.2A$

3. Find radius of gyration for uniform solid sphere of mass M and of radius R about the axis PQ, as shown in figure

(1) $\sqrt{\frac{2}{5}}R$ (2) $\sqrt{\frac{7}{5}}R$ (3) $\frac{R}{\sqrt{5}}$ (4) $\sqrt{\frac{3}{5}}R$

Sol. (2)
$I = \frac{2MR^2}{5} + MR^2$
$I = \frac{7}{5}MR^2$
$K = \sqrt{\frac{7}{5}}R$

4. Find radius of gyration for uniform solid cylinder of mass M and of radius R about the axis PQ, as shown in figure

(1) $\sqrt{\frac{3}{2}}R$ (2) $\sqrt{\frac{7}{2}}R$ (3) $\frac{R}{\sqrt{2}}$ (4) $\sqrt{\frac{5}{2}}R$

Sol. (3)
$I = \frac{MR^2}{2} + MR^2$
$I = \frac{3}{2}MR^2$
$K = \sqrt{\frac{3}{2}}R$

5. Calculate the ratio between bandwidth and quality factor for the following circuit.

(1) 2 (2) 1 (3) 3 (4) 4

Sol. (3)
Sol. Band width $= B.W. = \frac{R}{2\pi L}$
Quality factor $= \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{2\pi fCR} = 200$
Band width $= \frac{200}{Quality\ factor} = \frac{R}{2\pi L}$

6. Match the column, and choose the correct option.
(a) Electromagnetic waves (p) 3.0 MHz
(b) AM broadcast band (q) 24 MHz
(c) X ray(soft) (r) 1.5 × 10^{-7} m
(d) Microwave (s) 1.5 × 10^{-9} m
(1) (a-p) (b-r) (c-s) (d-q)
(2) (a-q) (b-p) (c-r) (d-s)
(3) (a-p) (b-q) (c-r) (d-s)
(4) (a-p) (b-q) (c-s) (d-r)

Sol. (3)
Sol. $f = c/\lambda$
$f_1 = \frac{3 \times 10^8}{1.5 \times 10^{-7}} = 2 \times 10^{15}$ Hz
$f_2 = \frac{3 \times 10^8}{1.5 \times 10^{-9}} = 2 \times 10^{17}$ Hz
$f = 3 \times 10^6$ Hz
$f = 24$ MHz
$f = 3.0$ MHz

7. Calculate the resonant frequency of the following circuit.

(1) 2 (2) 1 (3) 3 (4) 4

Sol. (2)
Sol. $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$
$Z = \sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC

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