Resonance®
Educating for better tomorrow

JEE (Main)

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

2022

COMPUTER BASED TEST (CBT)

Memory Based Questions & Solutions

Date: 25 June, 2022 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: PHYSICS

Resonance Eduventures Ltd.
Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222
To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in | CIN : U80302RJ2007PLC024029
Toll Free : 1800 258 5555 7340010333 facebook.com/ResonanceEdu twitter.com/ResonanceEdu www.youtube.com/resowatch blog.resonance.ac.in

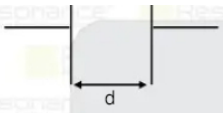
PART : PHYSICS

1. A metallic plate having thickness d/2 is placed between parallel plate capacitor of plate separation d. Find ratio of its new capacitance to initial capacitance :

(1) 8 (2) 6 (3) 4 (4) 2

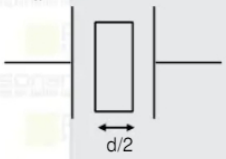
Ans. **(4)**

Sol. Initial



$C = \frac{\epsilon_0 A}{d}$

Final



Final

$C' = \frac{\epsilon_0 A}{d - d/2} = \frac{2\epsilon_0 A}{d}$

$\frac{C'}{C} = 2$

2. In YDSE, the intensity at the screen due to each slit are in the ratio of $\frac{4}{1}$. If the ratio of $\frac{(I)_{max} + (I)_{min}}{(I)_{max} - (I)_{min}}$ is $\frac{5}{x}$ then write the value of x.

(1) 2 (2) 4 (3) 6 (4) 8

Ans. **(2)**

Sol. $\frac{I_1}{I_2} = \frac{4}{1} \Rightarrow \frac{A_1}{A_2} = \frac{2}{1}$

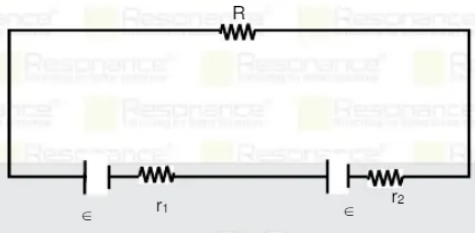
$\frac{(A)_{max}}{(A)_{min}} = \frac{2+1}{2-1} = \frac{3}{1}$

$\frac{(I)_{max}}{(I)_{min}} = \left(\frac{3}{1}\right)^2 = \frac{9}{1}$

$\frac{(I)_{max} + (I)_{min}}{(I)_{max} - (I)_{min}} = \frac{9+1}{9-1} = \frac{10}{8} = \frac{5}{4}$

So, x = 4

3. If Potential difference between the terminal of the second battery is zero, then the value of R will be equal to : ($r_1 > r_2$)



(1) $r_1 + r_2$ (2) $r_1 - r_2$ (3) $\sqrt{r_1 r_2}$ (4) $\frac{r_1^2}{r_2}$

Ans. **(2)**

Sol. $i = \frac{2\epsilon}{r_1 + r_2 + R}$

$\Delta V_2 = \epsilon - ir_2 = 0$

$\varepsilon = \frac{2\varepsilon}{r + r_2 + R} \times r_2$

$R = r_1 - r_2$

4. If degree of freedom of an ideal gas is f then the ratio of C_P/C_V will be :

(1) 1 + f/2 (2) 1 + 2/f (3) 1 – f/2 (4) 1 + 3/f

Ans. **(2)**

Sol. $C_P/C_V = r = 1 + 2/f$

5. The value of R depends on x and y as given by $R = ax^3 . y^{1/2}$ if $\Delta x/x = 0.02\%$ and $\Delta y/y = 0.04\%$, here a is constant, find maximum percentage error in $\Delta R/R$:

(1) 0.05 (2) 0.08 (3) 0.1 (4) 0.5

Ans. **(2)**

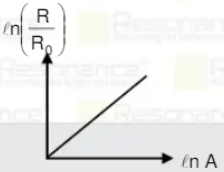
Sol. $R = ax^3y^{1/2}$

$$\left|\frac{\Delta R}{R}\right|_{max.} \times 100 = 3\left(\frac{\Delta x}{x}\times 100\right) + \frac{1}{2}\left(\frac{\Delta y}{y}\right)\times 100$$

$$= 3.(0.02) + \frac{1}{2}\times(.04)$$

$$= 0.06 + 0.02 = 0.08\%$$

6. For various nuclei, the graph of $\log\left(\frac{R}{R_0}\right)$ v/s log A is plotted, where R = radius of nucleus and A = mass number of the nucleus. The slope of the graph will be



(1) 3 (2) $\frac{1}{3}$ (3) $\frac{2}{3}$ (4) $\frac{3}{2}$

Ans. **(2)**

Sol. $R = R_0A^{1/3}$

$$\frac{R}{R_0} = A^{1/3} \quad \Rightarrow \quad \log\left(\frac{R}{R_0}\right) = \frac{1}{3}\log(A)$$

$y = mx$

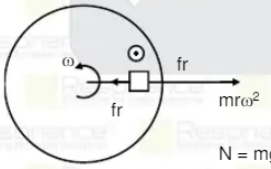
slope = $\frac{1}{3}$

7. A small block is placed on a horizontal rotating disc, w.r.t vertical axis passing centre of disc, at constant angular velocity w. then find distance of block from centre of disc if disc doesn't slip.

(1) $\frac{\mu g}{2\omega^2}$ (2) $\frac{2\mu g}{\omega^2}$ (3) $\frac{4\mu g}{2\omega^2}$ (4) $\frac{\mu g}{\omega^2}$

Ans. **(4)**

Sol. From FBD



fro circular motion

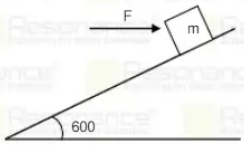
$f = m\omega^2 r$

$\mu N = m\omega^2 r$

$\mu mg = m\omega^2 r$

$\frac{\mu g}{\omega^2} = \boxed{r = \frac{\mu g}{\omega^2}}$

8. A block of mass 200g is placed on smooth inclined plane as shown as figure .

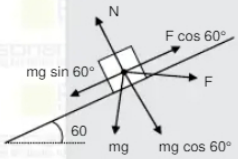


Find minimum force to keep the block stationary on the surface is $\sqrt{x}$ N, then x will be :

(1) 16 (2) 14 (3) 12 (4) 10

Ans. **(3)**

Sol.



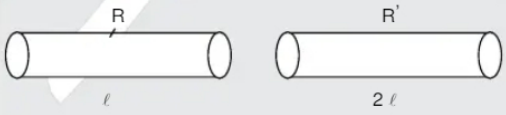
A long surface

$F \cos 60° = mg \sin 60°$

$F = mg \tan 60°$

$= 200 \times 10 \times \sqrt{3} \times 10^{-3} = 2\sqrt{3} = \sqrt{12}$ N

9. A cylindrical wire is stretched to double of its initial length. Find % change as its resistance :



(1) 100 (2) 200 (3) 300 (4) 400

Ans. **(3)**

Sol.

$R' = n^2 R$

$R' = 4R$

% change $= \left(\frac{R'-R}{R}\right) \times 100 = \left(\frac{4R-R}{R}\right) \times 100 = 300\%$.

10. Mass and radius of each bodies are respectively M and R.

I_1 = Moment of inertial of a solid cylinder about its central axis

I_2 = Moment of inertial of a disc about its diameter

I_3 = Moment of inertial of a ring about its diameter

I_4 = Moment of inertial of a solid sphere about its central axis

If $2(I_1 + I_2) + I_3 = xI_4$, write the value of x

(1) 3 (2) 4 (3) 5 (4) 8

Ans. **(3)**

Sol. $2\left[\frac{MR^2}{2}+\frac{MR^2}{4}\right]+\frac{MR^2}{2}$

$2MR^2 = x\left[\frac{2}{5}MR^2\right]$

$x = 5$

11. 27 liquid drops, each of them charged to a potential of V, are combining to form a single drop. Find the potential of the new drop

(1) 3V (2) 9V (3) 27 V (4) v/9

Ans. **(2)**

Sol.

$R = (27)^{1/3} r = 3r$

$V = \frac{KQ}{R} = \frac{K(27q)}{3r} = 9 \times v \Rightarrow 9v$

12. A turn of radius r is banked for the vehicles going at a speed of v. If radius of road is 75 m then speed of vehicle is 30 m/s. What will be the speed (in m/s) of vehicle when radius of road is 48 m?

(1) 12 (2) 24 (3) 36 (4) 48

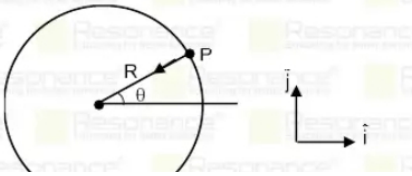
Ans. **(2)**

Sol. $\tan\theta = \frac{v^2}{Rg}$, then $v \propto \sqrt{r}$

$\frac{v_2}{v_1} = \frac{\sqrt{r_2}}{\sqrt{r_1}} = \sqrt{\frac{48}{75}}$

$v_2 = \frac{4}{5} \times 30 = 24$ m/s

13. A point P moves with constant speed v in counter-clockwise direction on a circular path of radius R as shown in the figure. The acceleration of 'P' at polar position (R, θ)

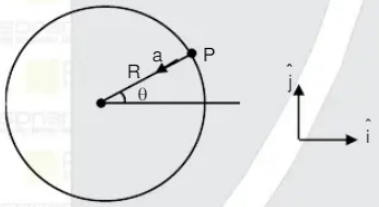


(1) $\frac{v^2}{R}\cos\theta\hat{i}-\frac{v^2}{R}\sin\theta\hat{j}$ (2) $-\frac{v^2}{R}\cos\theta\hat{i}-\frac{v^2}{R}\sin\theta\hat{j}$

(3) $-\frac{v^2}{R}\cos\theta\hat{i}+\frac{v^2}{R}\sin\theta\hat{j}$ (4) $\frac{v^2}{R}\cos\theta\hat{i}+\frac{v^2}{R}\sin\theta\hat{j}$

Ans. **(2)**

Sol.



$a = \frac{v^2}{R}$

$\vec{a} = a\cos\theta(-\hat{i}) + a\sin\theta(-\hat{j})$

$-\frac{v^2}{R}\cos\theta\hat{i}-\frac{v^2}{R}\sin\theta\hat{j}$

14. Speed of light in a medium is $v = 2 \times 10^8$. Then permittivity of this medium will be : (given that μ_r = 1for this medium)

(1) 9/4 (2) 7/4 (3) 5/4 (4) 3/4

Ans. **(1)**

Sol. $\frac{1}{\sqrt{\mu_\varepsilon}} = 2\times10^8 = \frac{1}{\sqrt{\mu_r\varepsilon_r}\sqrt{\mu_0\varepsilon_0}} = \frac{3\times10^8}{\sqrt{\varepsilon_r}}$

$\varepsilon_r = 9/4$

15. Threshold frequency for a metal is 2×10^6 Hz. Minimum value of frequency of light to produce photo electric effect will be –

(1) 2×10^6 Hz (2) 4×10^6 Hz (3) 10^6 Hz (4) None of these

Ans. **(1)**

Sol. $KE = h\nu - h\nu_{th}$

For minimum frequency KE = 0

$\nu h = h\nu_{th}$

$\nu = \nu_{th}$

16. The magnetic field inside a solenoid is B if number of terns is reduced to half and current flowing in solenoid is doubled. Find the new magnetic field inside solenoid :

(1) B/2 (2) B (3) 2B (4) 4B

Ans. **(2)**

Sol. $B = \mu_0\left(\frac{N}{\ell}\right)I$ .....(i)

$N' = \frac{N}{2}$ $I` = 2I$

$B' = \mu_0\left(\frac{N/2}{\ell}\right).2I$

$B` = B$

17. In AC circuit supply voltage is v = 200sin100t, C = 400 μF, L = $\frac{250}{3}$ mH and R = 100 Ω. Phase angle between voltage and current will be :

(1) tanϕ = 0.17 (2) tanϕ = 0.33 (3) tanϕ = 0.25 (4) tanϕ = 0.50

Ans. **(1)**

Sol. $X_C = \frac{1}{\omega C} = \frac{1}{100\times 400\times 10^{-6}} = 25\,\Omega$

$X_L = \omega L = 100 \times \frac{250}{3} \times 10^{-3} = \frac{25}{3}\,\Omega$

$X = X_C - X_L$

$= 25 - \frac{25}{3} = \frac{50}{3}\,\Omega$

$\tan\phi = \frac{X}{R} = \frac{50/3}{100} = \frac{1}{6}$

$\tan\phi = \frac{1}{6} = 0.17$

18. Two particle are projected with same speed V at angle θ_1 & θ_2. Here $\theta_1 + \theta_2 = 90°$. If height & range of first particle is H_1 and R_1 and for second particle H_2 and R_2 .

Statement-I : $R_1 = R_2 = 4\sqrt{H_1H_2}$

Statement-II : $H_1H_2 = \frac{\mu^2\sin^2\theta}{2g}.\frac{\mu^2\cos^2\theta}{2g}$

(1) Statement-1 is True, Statement-2 is True (2) Statement-1 is False, Statement-2 is True

(3) Statement-1 is True, Statement-2 is False (4) Statement-1 is False, Statement-2 is False.

Ans. **(1)**

Sol. $R_1 = \frac{\mu^2\sin 2\theta_1}{g} = R_2 = \frac{\mu^2\sin 2\theta_2}{g}$

$H_1 = \frac{\mu^2\sin^2\theta_1}{2g} = H_2 = \frac{\mu^2\cos^2\theta_1}{2g}$

$H_1H_2 = \frac{\mu^4\sin^2\theta\cos^2\theta}{2^2g^2}$.

19. For metal cube, linear expansion coefficient is $\propto$, if temperature of cube is increased by $\Delta\theta$ then % change in volume of cube :

(1) $300 \propto \Delta\theta$ (2) $200 \propto \Delta\theta$ (3) $200 \propto \Delta\theta$ (4) $3 \propto \Delta\theta$

Ans. **(1)**

Sol. $\Delta v = v_0\, R\Delta\theta$

$\frac{\Delta v}{v_0} = r\Delta\theta$ $\because$ $r = 3\alpha$

$\frac{\Delta v}{v_0} = 3 \propto \Delta\theta$

$\frac{\Delta v}{v_0}\% = 300 \propto \Delta\theta$.

20. Two particle A and B moving along same straight line. Position of particle A and B are given by $X_A = 2t - \alpha t^3$ and $X_B = t + \beta t^3$. At what time the velocities of both particles will be same.

(1) $\frac{1}{\sqrt{(\alpha+\beta)}}$ (2) $\frac{1}{\sqrt{3(\alpha+\beta)}}$ (3) $\frac{1}{\sqrt{3(\alpha-\beta)}}$ (4) $\frac{1}{\sqrt{(\alpha-\beta)}}$

Ans. **(2)**

Sol. $V_A = \frac{dX_A}{dt} = 2 - 3\alpha t^2$

$V_B = \frac{dX_B}{dt} = 1 + 3\beta t^2$

so $V_A = V_B$

$2 - 3\alpha t^2 = 1 + 3\beta t^2$

$3(\alpha + \beta)\, t^2 = 1$

$t = \frac{1}{\sqrt{3(\alpha + \beta)}}$

21. Proton, neutron, electron and α-particle are projected with same kinetic energy. de-broglie wavelengths of these particles are λ_p, λ_n, λ_e and λ_α, then choose correct option:

(1) $\lambda_e < \lambda_P = \lambda_N < \lambda_\alpha$ (2) $\lambda_e = \lambda_P > \lambda_N > \lambda_\alpha$

(3) $\lambda_e > \lambda_P = \lambda_N > \lambda_\alpha$ (4 $\lambda_e > \lambda_P > \lambda_N = \lambda_\alpha$

Ans. **(3)**

22. A copper block of mass 80g is placed on ice cube at 0°C (specific heat 80 cal/g). If initial temperature of copper is 100°C. Find amount of water formed during cooling of ice block. (Latent heat of ice is L = 80 cal/g, specific heat of copper 0.1 cal/g-k) :

(1) 10 g (2) 20 g (3) 30 g (4) 40 g

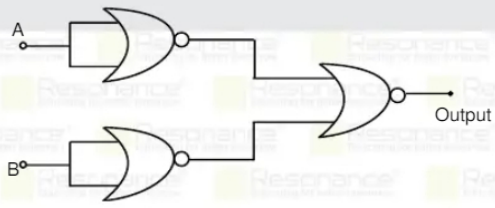
Ans. **(1)**

Sol. Heat given by block = heat received by ice.

M.S. (T – O) = M_{ice}.L

$\therefore \quad M_{ice} = \frac{MST}{L} = \frac{100 \times 0.1 \times 80}{80} = 10\,g$

23. This combination of logic gates will behave like



(1) AND Gate (2) OR Gate (3) NAND Gate (4) NOT Gate

Ans. **(1)**

Sol.

Not Gate

A A

A

Output

B

B B

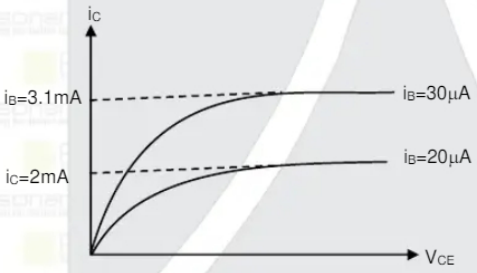
Not Gate

Output = A + B

= A.B

= A. B

24. The output characteristic curve for a transistor is shown below :



If the input resistance and output resistance are respectively 10kΩ and 50 kΩ, then the voltage gain will be :

(1) 500 (2) 550 (3) 600 (4) 650

Ans. **(2)**

Sol. $\beta_{AC} = \frac{\Delta i_C}{\Delta i_B} = \frac{(3.1-2)\times10^{-3}}{(30-20)\times10^{-6}} = 110$

$A_v = \beta_{AC} = \frac{R_{out}}{R_{in}} = (110)\left(\frac{500\times10^3}{10\times10^3}\right) = 550.$