PHYSICS

1. (a)

Mean value= $\frac{90+91+95+92}{4}$ = 92 sec

mean absolute error = $\frac{2+1+3+0}{4}$ = 1.5 sec

Reported main time = 92 $\pm$ 2 sec

2. (b)

The 1 distance will be either $\left(\frac{R}{\sqrt{2}}\right)$ or $\left(\frac{R}{\sqrt{2}}+a\right)$

Therefore $\vec{L}$ = mv $\left(\frac{R}{\sqrt{2}}-a\right)\hat{k}$ will never be possible

3. (c)

Total loss of energy = mgh = 2 mg

we during slide (energy equation)

mg = $\frac{\mu mg\cos\theta}{\sin\theta} \Rightarrow \mu = \frac{1}{2\sqrt{3}} \approx 0.29$

during horizontal motion (energy equation)

mg = μ mgx $\Rightarrow$ x = $\frac{1}{\mu} = \frac{1}{0.29} \approx 3.5$ m

4. (d)

w/d = mgh×1000 = 9.8×10^{μ} J

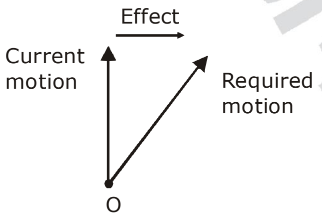
Energy / kg = 20% of 3.8 ×10^7J = 0.76×10^7J

Fat burnt = $\frac{9.8\times10^4}{0.76\times10^7}$ = 12.89×10^{-3} kg

5. (b)

The roller with try to move along the equidistance line from AB and CD

$\therefore$ it will move towards right



6. (d)

$v_0 = \sqrt{gr}$ $v_e = \sqrt{2gr}$

$\therefore$ increase required = $\sqrt{2gr}-\sqrt{gr} = \sqrt{gr}\left(\sqrt{2}-1\right)$

7. (a)

Using aligation median method

To = $\frac{12\times20+4\times40}{12+4} = \frac{400}{16}$ = 25°C

Now $\frac{\Delta T}{T} = \frac{1}{2}\alpha\Delta\theta$

$\frac{12}{60\times60\times24} = \frac{1}{2}\times15\times\alpha$

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$\Rightarrow \alpha = \dfrac{1}{60 \times 60 + 15} = 1.85 \times 10^{-5}/°C$

8. (b)

PV^n = constant, this process is polytripic process

$c = C_v \dfrac{\gamma - n}{1 - n}$; $\gamma = \dfrac{C_p}{C_v}$; From equation (1)

$c - cn = rC_v - nC_v$

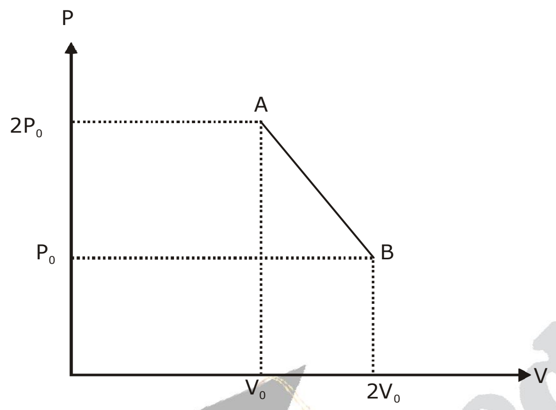
$n (c - C_v) = \gamma C_v$

$n (c - C_v) = c - \gamma C_v$

$n (c - C_v) = c - \dfrac{C_p}{C_v}$

$\because \gamma = \dfrac{C_p}{C_v}$; $n = \dfrac{C - Cp}{C - C_v}$

9. (a)



The graph is a stright line ; p= mv+c, where m is slope.

Point A and B should satisfy the above equation

$2P_0 = mV_0 + C$....... (i); $P_0 = m2V_0 + C$....... (ii)

after solving equation (i) and (ii), we get

$c = 3P_0$ and $m = \dfrac{-P_0}{V_0}$

Now, P = mv + c; and for ideal gas

pv = nRT; (mv+c) v = nRT;

$mv^2 + cv = nRT$ .... (iii)

for max temp

$2mv + c = nR \dfrac{dT}{dv}$; when $\dfrac{dT}{dv} = 0 \Rightarrow$; $v = \dfrac{-C}{2m}$

after putting the values of c and m, we get $v = \dfrac{3V_0}{2}$

i.e. T is maximum when $V = \dfrac{3V_0}{2}$

from (iii)

$$T_{max} = \frac{1}{nR}\left[\frac{-P_0}{V^0} \times \frac{9V_0 2}{4} + 3P_0 \times \frac{3V_0}{2}\right]$$

$$T_{max} = \frac{9PV_0}{4nR}$$

10. (d)

$v = \omega\sqrt{A^2 - x^2}$ .... (i)

at $x = \frac{2A}{3}$

$v = \omega\sqrt{A^2 - \frac{4A^2}{9}} \Rightarrow v = \frac{\omega A}{3}\sqrt{5}$

the, velocity is imreased 3 times

$v_1 = 3v = \omega A\sqrt{5}$

from (i)

$v_1^2 = \omega^2\left(A_1^2 - x^2\right) \Rightarrow \text{at } x = \frac{2A}{3}$

$\omega^2 A^2 5 = \omega^2\left(A_1^2 - \frac{4A^2}{9}\right) \Rightarrow A_1 = \frac{7A}{3}$

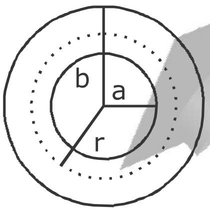
11. (c)

$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{\mu x g}{x}} = \sqrt{xg}$

$\frac{dx}{dt} = \sqrt{xg} \Rightarrow \int \frac{dx}{xg} = \int_0^t dt$

$2\sqrt{\frac{x}{g}} = t \Rightarrow t = 2\sqrt{\frac{20}{10}} = 2\sqrt{2}$ sec

12. (a)



Making a Gaussian surface at a distance from centre

$q = \int_a^r \rho dv = \int_a^r \frac{A}{r} 4\pi r^2 dr$

$q = 2\pi(r^2 - a^2)$

total charge enclosed by the gaussian surface

$q_1 = 2\pi\left(r^2 - a^2\right) + Q$

from gauss formula

$E.4\pi r^2 = \frac{q_1}{\varepsilon_0}$

$E.4\pi r^2 = \frac{2\pi(r^2 - a^2) + Q}{\varepsilon_0}$

$E = \frac{2\pi A\left(r^2 - a^2\right) + Q}{4\pi r^2 \varepsilon_0}$

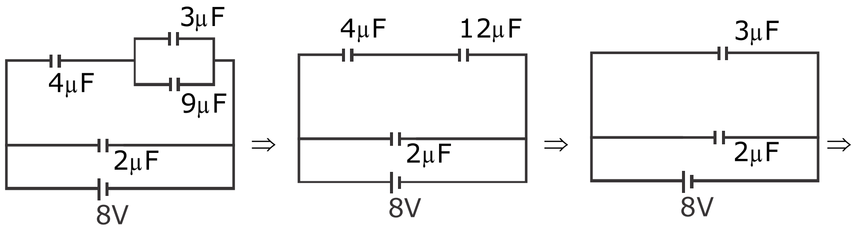
since E is same at a and b

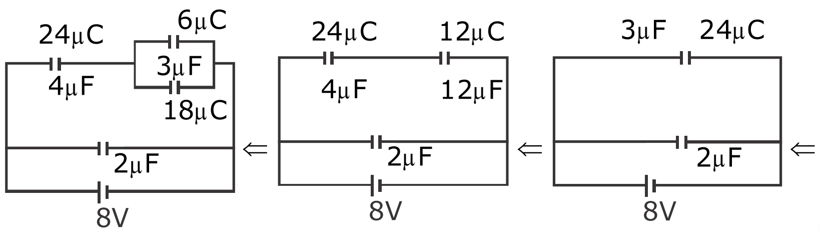
$$\frac{Q}{4\pi\varepsilon_0 a^2} = \frac{2\pi A\left(r^2 - a^2\right) + Q}{4\pi\varepsilon_0 a^2}$$

after solving we get

$$A = \frac{Q}{2\pi a^2}$$

13. (c)





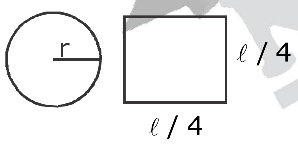
$\therefore$ Total change = (24 + 18) μC = 42 μC

$$E = \frac{1}{4\pi E_0} \cdot \frac{Q}{r^2} = \frac{9 \times 10^9 \times 42 \times 10^{-6}}{(30)^2} = 420\ \mu / C.$$

14. (c)

Cu is metal so at room temperature α will be small and positive.
Si is semiconductor at room temperature α will be high and negative.
$\therefore$ Linear increase for Cu and eaxaponential decrease for Si.

15. (d)



$$\ell = 2\pi r \Rightarrow r = \frac{\ell}{2\pi}$$

$$\Rightarrow r = \frac{\ell}{2\pi}$$

Magnetic field at the centre of circle

$$B_A = \frac{\mu_0 I}{2r}$$

$$B_A = \frac{\mu_0 I \pi}{\ell}$$

Magnetic field at the centre of square

$$B_B = \frac{2\mu_0 I}{\pi a^2}\ \sqrt{2a^2}\ \left[a = \frac{\ell}{4}\right]$$

$$B_B = \frac{8\sqrt{2}\mu_o I}{8\sqrt{2}}$$

$$\frac{B_A}{B_B} = \frac{\pi^2}{8\sqrt{2}}$$

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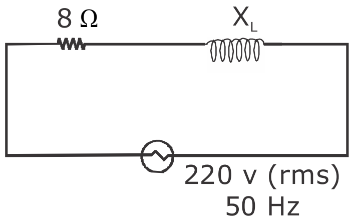
16. (d)

Hysterists loss is the area enclosed by the curve and area is minimum for graph (B)

17. (d)

Resistance of arc lamp

$$R = \frac{V}{I} \Rightarrow R = \frac{80}{10} \Rightarrow R = 8\Omega$$



$$Z = \sqrt{(8)^2 + X_L^{\,2}}$$

$$Z = \sqrt{(8)^2 + (WL)^2}$$

$$V = I\,Z \Rightarrow 220 = 10\sqrt{64 + (50)^2 L^2} \Rightarrow L = 0.65\text{ H}$$

18. (a)

For bigger frequency, energy will also be bigger so the increasing order of energy is Radiowave. Yellow light, Blue light, X-ray.

19. (c)

$$m = \frac{h_i}{h_o} \Rightarrow hi = m \times ho = 20 \text{ times taller.}$$

20. (c)

Geometrical spread = a

$$\text{Diffraction spread} = \left(\frac{\lambda}{2a}\right)L = \frac{\lambda}{2a}L$$

$$\text{Sum (b)} = a + \frac{\lambda L}{2a}$$

For b to be minimum

$$\frac{db}{da} = 0 \Rightarrow 1 - \frac{\lambda L}{2a^2} = 0 \Rightarrow a = \sqrt{\frac{\lambda L}{2}}$$

$$\text{and } b_{min} = \sqrt{\frac{\lambda L}{2}} + \sqrt{\frac{\lambda L}{2}} = \sqrt{2\lambda L}$$

No answer is correct.

21. (a)

$$\frac{h_C}{\lambda} = \phi + \frac{1}{2}mv^2$$

$$\text{now, } \frac{4}{3}\frac{h_C}{\lambda} = \phi + \frac{1}{2}mv'^2$$

$$\frac{4}{3}\left[\phi + \frac{1}{2}mv^2\right] = \phi + \frac{1}{2}mv'^2$$

$$\therefore \frac{1}{2}mv^2 = \frac{\phi}{3} + \frac{1}{2}mv^2\,\frac{4}{3}.\frac{1}{2}mv^2$$

$$v'^2 = \frac{2\phi}{3m} + \frac{4v^2}{3} \Rightarrow v' = \sqrt{\frac{2\phi}{3m} + \frac{4}{3}v^2}$$

$$\therefore v' > \sqrt{\frac{4}{3}}v$$

22. (d)

In 80 minutes

A $\rightarrow$ 4 half lives $\rightarrow \frac{15}{16}$ decay

B $\rightarrow$ 2 half lives $\rightarrow \frac{3}{4}$ decay

Required ratio = $\frac{15}{16} : \frac{3}{4} = 5 : 4$

23. (c)

0 + 0 + 0 + 0 = 0
1 + 0 + 0 + 0 = 1
0 + 1 + 0 + 0 = 1
Which is only satisfying by OR gate

24. (a)

In amplitude modulation the amplitude of light frequency carrier wave is made to vary in proportion to the amplitude of the audio signal

25. (b)

Zero error = – 5 divisions
Reading = 0.5 + 25 divisions
correct reading = 0.5 + 25 div + 5 div = 0.5 + 30 div

1 div = $\frac{0.5}{50}$ = 0.01 mm

$\therefore$ correct reading = (0.5 + 30 × 0.01) = 0.30 mm

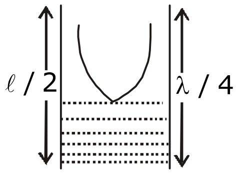
26. (d)

For open pipe

I = $\ell = \frac{\lambda}{4} + \frac{\lambda}{4} \Rightarrow \ell = \frac{\lambda}{2} \Rightarrow \lambda = 2\ell$

f = $\frac{\vartheta}{2\ell}$ ....(i)

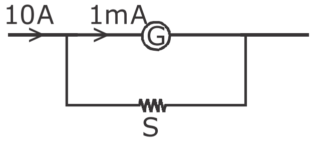
when it is dipped in water



$\frac{\ell}{2} = \frac{\lambda}{4} \Rightarrow \ell = \frac{\lambda}{2}$

which is same, so frequency will also be same

27. (a)



G = 100 Ω
i_g = 1 mA = 1 × 10^{-3} A
S = ?
i = 10A
from formula
$i_g.G = (i - i_g).S$
$1 \times 10^{-3} \times 100 = (10 - 1 \times 10^{-3})\, S$
S = 0.01 – 2.

28. (a)

$A + \delta = i + e \rightarrow A = i + e - \delta = 74°$

Let δ = 40° be minimum deviation.

$$\mu = \frac{\sin\left(\frac{\delta m + A}{2}\right)}{\sin A/2} = \frac{\sin 57°}{\sin 37°} \approx 1.39$$

$\therefore$ μ will surely be less than 1.5.

29. (a)

The graphs are of simple diode, Zener diode, solar diode and light dependent resistance respectively.

30. (b), (d)

We know that $\beta = \frac{\alpha}{1-\alpha}$

So $\frac{1}{\alpha} = \frac{1}{\beta} + 1$ and $\alpha = \frac{\beta}{1+\beta}$ are correct and remaining are incorrect.

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