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AI24BTECH11002 - K. Akshay Teja

13) Identify which one is a first-order phase transition?
    a) A liquid to gas transition at its critical temperature
    b) A liquid to gas transition close to its triple point
    c) A paramagnetic to ferromagnetic transition in the absence of a magnetic field
    d) A metal to superconductor transition in the absence of a magnetic field
14) Group I lists some physical phenomena while Group II gives some physical parameters. Match the phenomena with the corresponding parameters:

	Group I		**Group II**
P.	Doppler Broadening	1.	Moment of inertia
Q.	Natural Broadening	2.	Refractive index
R.	Rotational spectrum	3.	Lifetime of the energy level
S.	Total internal reflection	4.	Pressure

    a) P-4, Q-3, R-1, S-2
    b) P-3, Q-2, R-1, S-4
    c) P-2, Q-3, R-4, S-1
    d) P-1, Q-4, R-2, S-3

15) The separation between the first Stokes and corresponding anti-Stokes lines of the rotational Raman spectrum in terms of the rotational constant, B is

    a) 2B
    b) 4B
    c) 6B
    d) 12B

16) A superconducting ring is cooled in the presence of a magnetic field below its critical temperature (T_c). The total magnetic flux that passes through the ring is

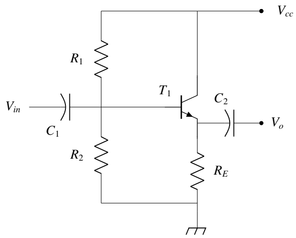
    a) zero
    b) n$\frac{h}{2e}$
    c) $\frac{nh}{4\pi e}$
    d) $\frac{ne^2}{hc}$

17) In a cubic crystal, atoms of mass M_1 lie on one set of planes and atoms of mass M_2 lie on planes interleaved between those of the first set. If C is the force constant between nearest neighbor planes, the frequency of lattice vibrations for the optical phonon branch with wavevector $k = 0$ is

    a) $\sqrt{2C\left(\frac{1}{M_1} + \frac{1}{M_2}\right)}$
    b) $\sqrt{C\left(\frac{1}{2M_1} + \frac{1}{M_2}\right)}$
    c) $\sqrt{C\left(\frac{1}{M_1} + \frac{1}{2M_2}\right)}$
    d) 0

18) In the quark model, which one of the following represents a proton? This means there are

    a) udd
    b) uud
    c) $a\bar{b}$
    d) $c\bar{e}$



19) The circuit shown above

a) is a common-emitter amplifier
b) uses a pop transistor
c) is an oscillator
d) has a voltage gain less than one

20) Consider a nucleus with N neutrons and Z protons. If m_n, m_p, and BE represent the mass of the neutron, the mass of the proton, and the binding energy of the nucleus respectively, and c is the velocity of light in free space, the mass of the nucleus is given by

a) $Nm_n + Zm_p$
b) $Nm_p + Zm_n$
c) $Nm_n + Zm_p + \frac{BE}{c^2}$
d) $Nm_p + Zm_n + \frac{BE}{c^2}$

21) The magnetic field $\left(in\, A\, m^{-1}\right)$ inside a long solid cylindrical conductor of radius $a = 0.1\,\text{m}$ is $\vec{H} = \frac{10^4}{r}\left[\frac{1}{\alpha^2}\sin(\alpha r) - \frac{r}{\alpha}\cos(\alpha r)\right]\hat{\phi}$ where $\alpha = \frac{\pi}{2a}$. What is the total current (in A) in the conductor?

a) $\frac{\pi}{2a}$
b) $\frac{800}{\pi}$
c) $\frac{400}{\pi}$
d) $\frac{300}{\pi}$

22) Which one of the following current densities, $\vec{J}$, can generate the magnetic vector potential $\vec{A} = \left(y^2\hat{i} + x^2\hat{j}\right)$?

a) $\frac{2}{\mu_0}\left(x\hat{i} + y\hat{j}\right)$
b) $-\frac{2}{\mu_0}\left(\hat{i} + \hat{j}\right)$
c) $\frac{2}{\mu_0}\left(\hat{i} - \hat{j}\right)$
d) $\frac{2}{\mu_0}\left(x\hat{i} - y\hat{j}\right)$

23) The value of the integral $\int_C \frac{e^z}{z^2-3z+2}\,dz$ where the contour C is the circle $|z| = \frac{3}{2}$ is

a) $2\pi ie$
b) πie
c) $-2\pi ie$
d) $-\pi ie$

24) In a non-conducting medium characterized by $\epsilon = \epsilon_0$, $\mu = \mu_0$, and conductivity $\sigma = 0$, the electric field $\left(in\, V\, m^{-1}\right)$ is given by $\vec{E} = 20\sin\left[10^8 t - kz\right]\hat{j}$. The magnetic field, $\vec{H}$ $\left(in\, A\, m^{-1}\right)$, is given by

a) $20k\cos\left[10^8 t - kz\right]\hat{i}$
b) $\frac{20k}{10^8\mu_0}\sin\left[10^8 t - kz\right]\hat{j}$
c) $-\frac{20k}{10^8\mu_0}\sin\left[10^8 t - kz\right]\hat{i}$
d) $-20k\cos\left[10^8 t - kz\right]\hat{j}$