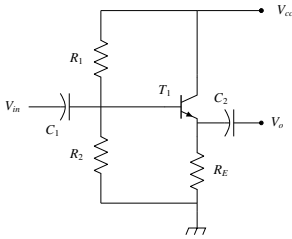


- 1) Identify which one is a first-order phase transition?
- A liquid to gas transition at its critical temperature
 - A liquid to gas transition close to its triple point
 - A paramagnetic to ferromagnetic transition in the absence of a magnetic field
 - A metal to superconductor transition in the absence of a magnetic field
- 2) 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

- P-4, Q-3, R-1, S-2
 - P-3, Q-2, R-1, S-4
 - P-2, Q-3, R-4, S-1
 - P-1, Q-4, R-2, S-3
- 3) The separation between the first Stokes and corresponding anti-Stokes lines of the rotational Raman spectrum in terms of the rotational constant, B is
- 2B
 - 4B
 - 6B
 - 12B
- 4) 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
- zero
 - $n \frac{h}{2e}$
 - $\frac{nh}{4\pi e}$
 - $\frac{ne^2}{hc}$
- 5) 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
- $\sqrt{2C \left(\frac{1}{M_1} + \frac{1}{M_2} \right)}$
 - $\sqrt{C \left(\frac{1}{2M_1} + \frac{1}{M_2} \right)}$
 - $\sqrt{C \left(\frac{1}{M_1} + \frac{1}{2M_2} \right)}$
 - 0
- 6) In the quark model, which one of the following represents a proton? This means there are
- udd
 - uud
 - $a\bar{b}$
 - $c\bar{e}$



7)

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
- 8) 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) $Nm_p + Zm_n + \frac{BE}{c^2}$
- 9) The magnetic field $(in A m^{-1})$ inside a long solid cylindrical conductor of radius $a = 0.1$ m is $\vec{H} = \frac{10^4}{r} \left[\frac{1}{a^2} \sin(\alpha r) - \frac{r}{a} \cos(\alpha r) \right] \hat{\phi}$ 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) $\frac{300}{\pi}$
- 10) Which one of the following current densities, \vec{J} , can generate the magnetic vector potential $\vec{A} = (y^2\hat{i} + x^2\hat{j})$?
- a) $\frac{2}{\mu_0} (x\hat{i} + y\hat{j})$
b) $-\frac{2}{\mu_0} (\hat{i} + \hat{j})$
c) $\frac{2}{\mu_0} (\hat{i} - \hat{j})$
d) $\frac{2}{\mu_0} (x\hat{i} - y\hat{j})$
- 11) 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) $-\pi ie$
- 12) In a non-conducting medium characterized by $\epsilon = \epsilon_0$, $\mu = \mu_0$, and conductivity $\sigma = 0$, the electric field $(in V m^{-1})$ is given by $\vec{E} = 20 \sin [10^8 t - kz] \hat{j}$. The magnetic field, \vec{H} $(in A m^{-1})$, is given by
- a) $20k \cos [10^8 t - kz] \hat{i}$
b) $\frac{20k}{10^8 \mu_0} \sin [10^8 t - kz] \hat{j}$
c) $-\frac{20k}{10^8 \mu_0} \sin [10^8 t - kz] \hat{i}$
d) $-20k \cos [10^8 t - kz] \hat{j}$