

Name _____

25 March, 1993

347K SECOND HOUR EXAM

Answer the following questions as directed. For multiple choice questions choose the **single best** answer.

- 1) Pleochroism in gems is caused by
 - a) diffraction.
 - b) dispersion.
 - c) absorption of different wavelengths of light in different direction.
 - d) the presence of more than one chromophore.
 - e) the absence of an optic axis.

- 2) The amount of bending light undergoes when passing through a gem or mineral depends on
 - a) the angle at which it enters.
 - b) the refractive index of the gem or mineral.
 - c) the wavelength (color) of the light.
 - d) all of the above
 - e) b and c

- 3) Dispersion is
 - a) a phenomenon that produces play-of-color.
 - b) an optical property that can be measured with a refractometer.
 - c) related to the difference in the speed of red and blue light in a gem or mineral.
 - d) something that only occurs in anisotropic materials.
 - e) c and d

- 4) A polariscope tests for
 - a) dispersion.
 - b) diffraction.
 - c) refractive index.
 - d) the presence of chromophores.
 - e) none of the above

- 5) A refractometer can be used to measure
 - a) refractive index.
 - b) birefringence.
 - c) optic sign.
 - d) pleochroism.
 - e) a, b and c

- 6) A dichroscope is used to check for
 - a) play-of-color
 - b) pleochroism
 - c) asterism
 - d) dispersion
 - e) birefringence

- 7) A mineral's critical angle is the angle at which
- light exiting the mineral is internally reflected.
 - light entering the mineral is refracted to 40° .
 - light exiting the mineral is refracted parallel to the surface of the mineral.
 - light exiting the mineral is refracted away from the normal.
 - none of the above.
- 8) The refractive index of a substance describes
- how strongly light is bent by the substance.
 - whether a substance can polarize light.
 - whether a substance can split light into two plane polarized rays.
 - the amount of diffraction occurring within a substance.
 - all of the above.
- 9) Optical anisotropic minerals differ from isotropic minerals by
- having low critical angles.
 - being able to polarize light.
 - having high critical angles.
 - being fluorescent in ultraviolet light.
 - none of the above.
- 10) Light within a gemstone that strikes a facet at an angle less than the critical angle of the gem will
- exit the gem.
 - be internally reflected.
 - be refracted parallel to the facet.
 - be split into two plane polarized rays.
 - none of the above
- 11) Light that travels through an anisotropic material is always
- split into 2 rays
 - polarized
 - doubly refracted
 - diffracted
 - none of the above
- 12) Light that travels through an isotropic material is always
- split into 2 rays
 - polarized
 - doubly refracted
 - diffracted
 - none of the above
- 13) A gem that looks black every 90° of rotation in a polariscope must be
- anisotropic
 - isotropic
 - monoclinic or triclinic
 - hexagonal or tetragonal
 - none of the above

- 14) An optic axis is defined as a unique direction in a mineral along which light traveling
- a) will be split into two rays
 - b) will be polarized into two directions
 - c) will pass through without being split or polarized
 - d) will be most strongly absorbed
 - e) none of the above
- 15) A mineral that is trichroic must
- a) be isotropic
 - b) be isometric (cubic).
 - c) be triclinic.
 - d) in some orientations blink from dark to light when rotated in a polariscope.
 - e) none of the above.
- 16) A pleochroic mineral must always be
- a) isotropic.
 - b) anisotropic.
 - c) hexagonal.
 - d) tetragonal.
 - e) none of the above.
- 17) A gem that shows two distinct shadow edges on a refractometer must always be
- a) pleochroic.
 - b) isotropic.
 - c) anisotropic.
 - d) uniaxial.
 - e) none of the above.
- 18) Double refraction is visible in some gems as
- a) dispersion.
 - b) a doubling of pavilion facet junctions when viewed through the table.
 - c) oriented inclusions.
 - d) total internal reflection
 - e) none of the above
- 19) A gem that is dichroic will
- a) have one or two optic axes.
 - b) have more than one refractive index.
 - c) be anisotropic.
 - d) be a member of the hexagonal, tetragonal, monoclinic, triclinic or orthorhombic crystal system.
 - e) all of the above.
- 20) A transparent material will only refract light if
- a) it is anisotropic
 - b) it has a birefringence
 - c) it can polarize light
 - d) the light enters at less than a 90° angle to the normal
 - e) all of the above

- 21) The shadow edge of the extraordinary ray in a refractometer can
- move as the gem is rotated.
 - be less than the shadow edge of the ordinary ray.
 - be greater than the shadow edge of the ordinary ray.
 - overlap the shadow edge of the ordinary ray if the birefringence is low.
 - all of the above.
- 22) The flashes of color that are characteristic of a diamond's brilliance are caused by
- birefringence
 - anisotropism
 - dispersion
 - double refraction
 - total internal reflection
- 23) Dull, lifeless, gemstones that show little brilliance are sometimes a consequence of
- culet angles that are
- 1 or 2° greater than the critical angle for the gem material.
 - less than the critical angle for the gem material.
 - equal to the normal.
 - less than the reflective angle for incoming light through the table.
 - too shallow for a properly cut crown.
- 24) Internal reflection within a gemstone occurs when light strikes a facet at
- greater than the critical angle
 - less than the critical angle
 - the critical angle
 - an angle parallel to the normal
 - parallel to the optic axis
- 25) Pleochroism is possible in gems of the
- hexagonal system
 - triclinic system
 - monoclinic system
 - tetragonal system
 - all of the above

Answer the following questions True or False.

- 26) ___ Minerals of the isometric (cubic) crystal system are always optically isotropic.
- 27) ___ A gem that has a different refractive index depending on how it is oriented on the polariscope must be isometric.
- 28) ___ A gemstone with a high critical angle will appear more brilliant than one with a low critical angle, all other factors being equal.
- 29) ___ To attain maximum return of light from a gem's pavilion facets, they must be cut so the culet angle is 1 or 2° less than the critical angle for the material.
- 30) ___ The ordinary and extraordinary rays in a uniaxial mineral are plane polarized.
- 31) ___ The c axis in an isometric (cubic) gem is the direction along which light traveling will not show double refraction.

- 32) ____ A refractometer can be used to measure refractive indices of any polished gem or mineral.
- 33) ____ A ruby has been faceted so its optic axis is perpendicular to the table facet. When placed table down in a polariscope and rotated about its optic axis, it will remain dark when rotated.
- 34) ____ Uniaxial minerals with positive (+) optic signs have extraordinary rays that travel slower than ordinary rays.
- 35) ____ Minerals that have high critical angles have low refractive indices.
- 36) ____ Minerals that are hexagonal have a single optic axis, have two refractive indices, can be dichroic, and are anisotropic.
- 37) ____ Gems of minerals with high R.I.s will be more brilliant than gems of minerals with low R.I.'s, all other factors being equal.
- 38) ____ Because both diamond and glass are isometric, an easy way to tell them apart is by testing them in a polariscope.
- 39) __ An optically positive mineral must have a birefringence.
- 40) __ Light travels faster in gems with higher R.I.s than in gems with lower R.I.s.