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 minerals **critical angle** is the angle at which
   a) light exiting the mineral is internally reflected.
   b) light entering the mineral is refracted to 40°.
   c) light exiting the mineral is refracted parallel to the surface of the mineral.
   d) light exiting the mineral is refracted away from the normal.
   e) none of the above.

8) The refractive index of a substance describes
   a) how strongly light is bent by the substance.
   b) whether a substance can polarize light.
   c) whether a substance can split light into two plane polarized rays.
   d) the amount of diffraction occurring within a substance.
   e) all of the above.

9) Optical anisotropic minerals differ from isotropic minerals by
   a) having low critical angles.
   b) being able to polarize light.
   c) having high critical angles.
   d) being fluorescent in ultraviolet light.
   e) 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
    a) exit the gem.
    b) be internally reflected.
    c) be refracted parallel to the facet.
    d) be split into two plane polarized rays.
    e) none of the above

11) Light that travels through an **anisotropic** material is always
    a) split into 2 rays
    b) polarized
    c) doubley refracted
    d) diffracted
    e) none of the above

12) Light that travels through an **isotropic** material is always
    a) split into 2 rays
    b) polarized
    c) doubley refracted
    d) diffracted
    e) none of the above

13) A gem that looks black every 90° of rotation in a polariscope must be
    a) anisotropic
    b) isotropic
    c) monoclinic or triclinic
    d) hexagonal or tetragonal
    e) 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
   a) move as the gem is rotated.
   b) be less than the shadow edge of the ordinary ray.
   c) be greater than the shadow edge of the ordinary ray.
   d) overlap the shadow edge of the ordinary ray if the birefringence is low.
   e) all of the above.

22) The flashes of color that are characteristic of a diamonds brilliance are caused by
   a) birefringence
   b) anisotropism
   c) dispersion
   d) double refraction
   e) total internal reflection

23) Dull, lifeless, gemstones that show little brilliance are sometimes a consequence of
   culet angles that are
   a) 1 or 2° greater than the critical angle for the gem material.
   b) less than the critical angle for the gem material.
   c) equal to the normal.
   d) less than the reflective angle for incoming light through the table.
   e) to shallow for a properly cut crown.

24) Internal reflection within a gemstone occurs when light strikes a facet at
   a) greater than the critical angle
   b) less than the critical angle
   c) the critical angle
   d) an angle parallel to the normal
   e) parallel to the optic axis

25) Pleochroism is possible in gems of the
   a) hexagonal system
   b) triclinic system
   c) monoclinic system
   d) tetragonal system
   e) 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 gems 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.