Chapter 40

1. For cell proliferation, a somatic cell undergoes:

a. synthesis

b. mitosis

c. metaphase

d. meiosis

2. Hydrogen peroxide can be the end result of:

a. radiolysis of oxygen

b. protein synthesis

c. radiolysis of water

d. cell proliferation

3. If a high dose of radiation is delivered to the patient continuously over a longer period

of time, but at a slower dose rate, it is said to be:

1. prophased
2. fractionated
3. radiosensitized
4. protracted

4. During which phase of cell division can damage to chromosomes be visibly observed:

a. interphase

b. metaphase

c. prophase

d. anaphase

e. they cannot be observed

5. An increase in can cause a cell to become more radiosensitive:

a. age

b. protein

c. oxygen

d. water

6. Which organelles in the human cell actually synthesize proteins:

a. lysosomes

b. mitochondria

c. ribosomes

d. messenger RNA

7. Which of the following cells is most radiosensitive?

a. lymphocytes

b. nerve cells

c. osteoblasts

d. muscle cells

8. When an atom is ionized, there is a change in its binding properties:

a. mechanical

b. chemical

c. kinetic

d. potential

e nuclear

9. The amount of energy deposited by radiation into a material per unit path length is

referred to as the:

1. RBE
2. DNA
3. TEL
4. LET
5. GSD

10. When radiation exposure is fractionated:

a. the LET is changed

b. there is more direct effect

c. the is less biological effect

d. it is given continuously over a longer period of time

11. Which type of dose-effect curve implies that if the radiation dose is doubled, the

biological effect will be exactly doubled?

1. sigmoidal
2. linear quadratic
3. quadratic
4. linear

12. The most likely dose-response curve for deterministic effects at high doses is the:

a. supralinear

b. sigmoidal

c. quadratic

d. linear

13. Which of the following types of chromosome damage is **not** visible under a

microscope:

1. translocations
2. inversions
3. dicentric chromosomes
4. acentric chromosomes

e. point lesions

14. According to the law of Bergonie and Tribondeau, which cells are most sensitive to

the effects of radiation?

1. cells that do not divide
2. cells that are less highly differentiated
3. cells that are more specialized in structure and function
4. cells that divide very slowly

15. The genetic code consists of a sequence of found in the DNA molecule:

a. sugars

b. phosphates

c. amino acids

d. nitrogenous bases

16. Each set of three nitrogenous bases composes a single in the genetic code:

a. codon

b. autosome

c. amino acid

d. protein

e. rung

17. Which type of ribonucleic acid is able to cross the nuclear membrane out into the

cytoplasm of the cell?

a. tRNA

b. DNA

c. sRNA

d. mRNA

e. sugar phosphate

18. Transfer RNA (tRNA):

a. is found only in the nucleus

b. is attached to a specific amino acid

c. causes DNA in the nucleus to split

d. is only found outside of cells

19. How many pairs of chromosomes does a normal human cell contain?

a. 32

b. 36

c. 23

d. 64

20. Which phase of the cell’s life cycle occurs after G1 but before G2:

a. synthesis (S)

b. interphase (I)

c. anaphase (A)

d. telophase (T)

e. meiosis

21. Which of the following is the most accurate description of target theory:

a. radiation seeks out the most sensitive targets in a cell

b. radiation tends to avoid the most sensitive targets in a cell

c. the entire cell is a sensitive target

d. There are regions of cells that are more radiosensitive than other regions, which

may be struck by accident

22. The indirect effect has occurred when:

a. radiation strikes a DNA molecule and severs one of the strands

b. radiation interacts with water to form free radicals

c. radiation interacts with water to form bound radicals

d. radiation interacts with mitochondria

23. For complex human cells, a cell survival curve:

a. cannot be drawn

b. has a shoulder region and a straight line region

c. consists only of a straight line region

d. is usually plotted on a linear scale

e. does not show the effects of dose rate

24. Radiation that has an RBE of 5:

a. has 5 times the biological effect compared to a reference radiation

b. has 1/5 the biological effect compared to a reference radiation

c. requires 5 rem to result in acute radiation syndrome

d. has no LET

25. Meiosis consists of:

a. a reduction division only

b. a reduction division followed by a replication division

c. a replication division followed by a reduction division

d. a replication division only

26. The multi-target, single hit theory explains the:

a. formation of free radicals

b. straight line portion of the cell survival curve

c. indirect effect

d. shoulder portion of the cell survival curve

27. Typical radiation levels from diagnostic radiology represents only a small risk to the

individual, but a significant risk to the population. Its effects are therefore

classified as:

1. non-linear
2. non-statistical
3. deterministic
4. stochastic

28. High LET radiation usually also has:

a. a high RBE

b. an RBE of 1

c. an RBE of zero

d. no relationship to RBE

29. Which of the following types of chromosome aberrations is most harmful?

a. a chromatid deletion

b. a dicentric

c. a chromatid break

d. a point mutation

30. Chromosome aberrations can:

*1. lead to cell death*

*2. result in abnormal cell metabolism*

*3. occur in genetic cells*

a. 1 & 2

b. 2 only

c. 2 & 3

d. 1, 2 & 3

31. In the normal human karyotype, there are:

a. 23 individual chromosomes

b. 44 autosomes

c. 46 autosomes

d. none of the above

32. The reason that a fractionated dose is less biologically effective than an equal single

dose of radiation is because of:

1. reduced LET
2. reduced OER
3. recovery and repair
4. increased GSD

e. increased RBE

33. Which of the following would be an appropriate unit for measuring linear energy

transfer (LET)?

1. gray
2. kV/rad
3. kV/µm3
4. sievert
5. gray/mA

34. Which of the following has the highest LET:

a. alpha particles

b. gamma rays

c. protons

d. neutrons

35. Relative biological effectiveness (RBE) is:

a. a quantification of the resistance of tissue to radiation damage

b. about 2.0 for diagnostic x-rays

c. equal to 1.0 for orthovoltage x-rays

d. increases and x-ray energy increases

36. The oxygen enhancement effect is primarily related to:

a. direct hits

b. indirect hits

c. multiple hits

d. multiple targets

37. Low-LET radiations are primarily associated with:

a. single-strand breaks in the DNA

b. double-strand breaks in the DNA

c. direct damage

d. high quality factors

38. Which of the following is the most severe form of radiation damage to the DNA:

a. a point lesion

b. main chain scission

c. change of a base in a “rung”

39. The breaking down of macromolecules into water and carbon dioxide is called;

a. anabolism

b. catabolism

c. metabolism

d. homeostasis

40. The nucleolus, in particular, contains:

a. DNA

b. RNA

c. proteins

d. mitochondria

41. The very first step in any response to radiation exposure is always:

a. covalent bonding

b. ionic bonding

c. ionization

d. main chain scission

e. rung breakage

42. For a cell survival graph, the best measure of the radiosensitivity of the cells is the:

a. height of the shoulder of the curve

b. right-to-left position of the shoulder of the curve

c. height of the body of the curve

d. slope steepness of the body of the curve

43. Which of the following most accurately lists the **initial** products when radiation

interacts with water:

a. OH\* and H\*

b. HOH+ and e-

c. OH\* and e-

d. H2O and e-

44. Which of the following does **not** belong with the other three:

a. high RBE

b. low kVp

c. low LET

d. low HVL

45. Linear energy transfer (LET) is an expression of radiation:

a. quality

b. quantity

c. dose

d. response

46. Which of the following radiation effects would certainly lead to rapid death of the

individual cell?

1. a point lesion
2. rupture of the cell membrane
3. hydrolysis
4. a single-strand break

47. After a low radiation dose, most cellular damage resulting in **late** total body effects

occurs because of:

1. cross-linking
2. reduced viscosity
3. point lesions
4. hydrolysis

48. In the DNA, which of the following nitrogenous bases binds with guanine?

a. adenine

b. thymine

c. cytosine

d. phosphene

49. Within the blood, which of the following cells would be the first to respond to a radiation exposure?

a. lymphocytes

b. erythrocytes

c. thrombocytes

d. granulocytes

50. Which of the following pairs are the most radiosensitive cells in the human body?

a. granulocytes and lymphocytes

b. granulocytes and oogonia

c. spermatogonia and oogonia

d. spermatogonia and lymphocytes

51. Which of the following chromosome aberrations would not be obvious under a

microscope without using a karyotype for comparison?

1. isochromatid fragments
2. dicentric chromosomes
3. ring chromosomes
4. translocations

52. Genetic cell division takes place through the process of:

* 1. mitosis
  2. meiosis
  3. interphase
  4. symbiosis

53. Radiation would have less effect upon a cell if given:

a. over a shorter period of time

b. all at once

c. over a longer period of time

d. along with water

54. In organisms, inheritance is the term used to describe the transfer of information

from:

* 1. the cell nucleus to the cytoplasm of the cell
  2. somatic cell nuclei to progeny cells
  3. germ cells to future generations of individuals
  4. progeny to the previous generation of cells

55. The part of the cell cycle that occurs between replications is:

1. prophase
2. terrophase
3. anaphase
4. interphase

56. Which of the following lists the stages of mitosis in their proper order?

1. metaphase, anaphase, telophase, prophase
2. anaphase, metaphase, prophase, telophase
3. prophase, metaphase, anaphase, telophase
4. telophase, anaphase, metaphase, prophase

57. Which of the following is **not** a somatic cell?

1. osteocyte
2. ova
3. leukocyte
4. neuron

58. Which of the following components of a cell is a network of passageways for the

transport of materials?

1. endoplasmic reticulum
2. mitochondria
3. lysosome
4. ribosome

59. Which of the following components of a cell rids the cell of metabolic waste products?

1. Mitochondria
2. Nucleus
3. Lysosome
4. ribosome

60. In which components of a cell are the blueprints or the genetic code for the function

of the cell?

1. Nucleus
2. endoplasmic reticulum
3. ribosome
4. cytoplasm

61. The sections of a chromosome that contain genetic information necessary to construct

a characteristic, such as eye color, in an organism, are called:

1. germs
2. nucleoli
3. freons
4. genes

62. When radiation deposits energy into the **cytoplasm** of a cell, which theory describes

the mechanism by which damage occurs to the cell?

* 1. indirect hit theory
  2. direct hit theory
  3. random interaction theory
  4. potential free radical theory

63. In order to be conservative about radiation exposure, DELs are based upon what type of assumed dose response curve?

a. linear, threshold

b. non-linear, threshold

c. linear, non-threshold

d. non-linear, non-threshold

64. Most damage to the body from radiation exposure results from the:

a. direct effect

b. indirect effect

c. target effect

d. threshold effect

65. Which of the following is the most radiosensitive tissue:

a. nerve tissue

b. alimentary tract tissue

c. muscular tissue

d. cardiovascular tissue

66. The most radiosensitive phase of a cell’s life cycle is during:

a. Meiosis

b. Mitosis

c. G1

d. Late S phase

67. The most radiation-resistant phase of a cell’s life cycle is:

a. metaphase

b. anaphase

c. mid- to late-S phase

d. early G1 phase

68. Which of the following is NOT part of mitosis:

a. prophase

b. metaphase

c. telophase

d. anaphase

e. all of these are part of mitosis

69. Radiation damage to tissues is amplified by increases in:

a. oxygen enhancement ratio

b. linear energy transfer

c. quality factor for the radiation

d. none of the above

e. all of the above

70. Which of the following blood cells is the **least** radiosensitive?

a. mature erythrocyte

b. mature leukocyte

c. immature leukocyte

d. immature thrombocyte

71. In the life cycle of the cell, when comparing the G1 and G2 phases:

a. they both have the same amount of DNA present

b. there is twice the DNA in G1 as in G2

c. there is twice the DNA in G2 as in G1

d. they both last about the same time

72. Which of the following would be the most sensitive to radiation exposure?

a. osteum

b. osteocyst

c. osteoblast

d. osteoclast

73. When human cells are irradiated, their response appears to follow which theory of

cellular damage?

1. single target, single hit
2. single target, multiple hits
3. multiple targets, single hit
4. multiple targets, multiple hits

74. The law of Bergonie and Tribondeau states that:

a. metabolic activity results in less radiosensitivity

b. the older a cell is, the more radiosensitive it is

c. radiosensitivity increases with the rate of cell proliferation

d. radiosensitivity increases with hypoxia (reduced oxygen)

75. Which of the following is most likely to be lethal to a human cell?

a. a point mutation on DNA

b. a frame-shift mutation on RNA

c. a free radical created in a lysosome

d. an ion created in a mitochondrium

76. The linear energy transfer of an x-ray or gamma photon is low because of its:

a. low energy

b. high penetration

c. negative charge

d. low mass

77. The interpretation of a linear, non-threshold dose curve is that radiation damage is

directly proportional to dose, and that:

1. only high doses cause damage
2. any dose may cause damage
3. damage occurs only after a minimum dose
4. none of the above

78. The indirect hit theory for DNA damage is based upon within the cytoplasm of

the cell:

1. protraction
2. fractionation
3. synthesis
4. hydrolysis

79. Translocations, inversions, deletions and duplications are all chromosome effects that

would require:

1. single-point lesions
2. double-strand breaks
3. direct hits
4. dicentric alleles

80. A “map” of the chromosomes, laying them all out in order, is called a(n):

a. photochronograph

b. chromogram

c. karyotype

d. allele plot

81. Visible chromosome aberrations begin to occur at dose levels as low as:

a. 50 mSv

b. 100 mSv

c. 250 mSv

d. 1000 mSv (1 Sv)

82. A “free radical” is:

a. a positive ion

b. a negative ion

c. an acid

d. an isotope

e. any atom with an unpaired electron in the outermost shell

83. Which of the following is most likely to cause a frameshift mutation from a double-

strand break in the DNA:

1. x-rays
2. gamma rays
3. beta particles
4. alpha particles

84. About what percentage of genetic mutations that occur are harmful to the individual

organism?

1. 99%
2. 87%
3. 75%
4. 37%

85. A dose of several hundred gray can cause a cell to necrotize and die within a few days

after exposure, prior to the next attempt at cell division. This type of cell death is

called:

1. Instant cell death
2. Interphase cell death
3. Reproductive cell death
4. Mitotic cell death

86. *Mitotic* cell death causes:

a. immediate, severe changes in cell structure

b. decreased mitochondrial output, darkening of the nucleus, and necrosis

c. non-viability of the two daughter cells at the time of the next cell division

d. early death of daughter cells after the next cell division

87. Which of the following occurs at a threshold dose above 1000 Gray:

a. Instant cell death

b. Interphase cell death

c. Reproductive cell death

d. Mitotic cell death

88. Which of the following would be considered a physical dose modifying factor

(rather than a biological factor)?

a. Presence of oxygen

b. Age

c. Protraction

d. Vitamin K

89. Which of the following would be categorized as a biological dose-modifying

factor?

a. fractionation

b. OER

c. linear energy transfer

d. dose rate

e. x-ray beam geometry