1) Which transcription factor is essential for osteoblast differentiation?
A) NF-κB
B) RUNX2
C) MyoD
D) SOX9
Answer: B

2) The primary function of osteoprotegerin (OPG) is to:
A) Stimulate osteoclasts
B) Bind M-CSF
C) Inhibit RANKL-RANK interaction
D) Activate osteoblast apoptosis
Answer: C

3) During endochondral ossification, the first site of bone formation is:
A) Epiphysis
B) Periosteum
C) Primary ossification center
D) Articular cartilage
Answer: C

4) Which zone of the epiphyseal plate shows columnar chondrocytes?
A) Resting zone
B) Proliferation zone
C) Calcification zone
D) Ossification zone
Answer: B

5) Osteoclasts are derived from:
A) Mesenchymal stem cells
B) Neural crest cells
C) Hematopoietic monocyte lineage
D) Fibroblasts
Answer: C

6) Increased PTH chronically leads to:
A) Bone formation
B) Increased OPG
C) Bone resorption
D) Cartilage hypertrophy
Answer: C

7) Which collagen type predominates in bone matrix?
A) Type I
B) Type II
C) Type III
D) Type IV
Answer: A

8) The organic component of bone matrix is mainly:
A) Hydroxyapatite

B) Calcium carbonate
C) Osteoid
D) Fluoride
Answer: C

9) Intramembranous ossification primarily forms:
A) Femur
B) Vertebrae
C) Skull flat bones
D) Phalanges
Answer: C

10) Rickets is primarily due to deficiency of:
A) Vitamin A
B) Vitamin D
C) Vitamin K
D) Iron
Answer: B

11) The lacunae in bone contain:
A) Osteoclasts
B) Chondrocytes
C) Osteocytes
D) Fibroblasts
Answer: C

12) Haversian canals contain:
A) Only nerves
B) Blood vessels and nerves
C) Cartilage
D) Fat cells
Answer: B

13) The periosteum is absent at:
A) Diaphysis
B) Metaphysis
C) Articular surfaces
D) Shaft
Answer: C

14) Osteomalacia differs from osteoporosis because:
A) Less mineralization
B) Less bone mass only
C) Increased osteoblasts
D) More OPG
Answer: A

15) Calcitonin primarily:
A) Activates osteoclasts
B) Inhibits osteoclast activity

C) Stimulates RANKL
D) Decreases calcium excretion
Answer: B

16) The inorganic bone matrix is mainly:
A) Collagen
B) Proteoglycan
C) Hydroxyapatite
D) Elastin
Answer: C

17) Secondary ossification centers appear in:
A) Diaphysis
B) Epiphysis
C) Periosteum
D) Tendon
Answer: B

18) Which hormone increases RANKL expression?
A) Estrogen
B) PTH
C) Calcitonin
D) Insulin
Answer: B

19) Estrogen deficiency leads to:
A) Increased OPG
B) Decreased osteoclasts
C) Increased bone resorption
D) Increased mineralization
Answer: C

20) The Volkmann canals are oriented:
A) Longitudinal
B) Parallel to osteons
C) Transversely
D) Circularly
Answer: C

21) The resting zone of growth plate contains:
A) Hypertrophic cells
B) Mitotic cells
C) Small inactive chondrocytes
D) Osteoblasts
Answer: C

22) Which factor promotes osteoclast differentiation?
A) OPG
B) RANKL
C) Collagen I

D) Calcitonin
Answer: B

23) Osteoid is secreted by:
A) Osteoclasts
B) Osteocytes
C) Osteoblasts
D) Macrophages
Answer: C

24) The strongest region of long bone is:
A) Epiphysis
B) Metaphysis
C) Diaphysis
D) Growth plate
Answer: C

25) Which vitamin is essential for γ-carboxylation of osteocalcin?
A) Vitamin C
B) Vitamin D
C) Vitamin K
D) Vitamin E
Answer: C

26) Woven bone is characterized by:
A) Organized lamellae
B) Random collagen fibers
C) Low cellularity
D) Absence of osteocytes
Answer: B

27) Compact bone is mainly composed of:
A) Trabeculae
B) Osteons
C) Cartilage
D) Fat
Answer: B

28) The major stimulus for bone remodeling is:
A) Mechanical stress
B) Low glucose
C) High sodium
D) Hyperkalemia
Answer: A

29) In osteoporosis, bone density is:
A) Increased
B) Normal but weak
C) Decreased
D) Calcified excessively

Answer: C

30) Which pathway is targeted by Denosumab?
A) Wnt pathway
B) RANK/RANKL pathway
C) Collagen synthesis
D) Calcitonin receptor
Answer: B