UMST – Human Development Answer Key (Weeks 1–3)

Correct options with explanations for all questions.

Q1. *Week 1 – Fertilization*

Fertilization most commonly occurs in which specific part of the female reproductive tract?

	A. Infundibulum of the uterine tube
✔	**B. Ampulla of the uterine tube**
	C. Isthmus of the uterine tube
	D. Uterine cavity

Explanation: The ampulla of the uterine tube is the most common site of fertilization due to its favorable environment for capacitated sperm and the oocyte.

Q2. *Week 1 – Fertilization*

Which statement best describes sperm capacitation?

	A. Fusion of the sperm and oocyte plasma membranes
	B. Exocytosis of acrosomal enzymes
✔	**C. Removal of seminal plasma proteins from the sperm head within the female tract**
	D. Completion of meiosis II by the oocyte

Explanation: Capacitation is a functional maturation in the female tract that removes glycoproteins and stabilizing factors from the sperm head, increasing motility and enabling the acrosome reaction.

Q3. *Week 1 – Fertilization*

During the acrosomal reaction, enzymes released primarily facilitate penetration of which structure?

	A. Oolemma (oocyte plasma membrane)
✔	**B. Corona radiata and zona pellucida**
	C. Perivitelline space only
	D. Cumulus oophorus only

Explanation: Hyaluronidase and acrosin help traverse the corona radiata and digest a path through the zona pellucida via ZP3-mediated binding.

Q4. *Week 1 – Fertilization*

The cortical reaction triggered at fertilization functions chiefly to:

	A. Activate the acrosomal reaction
✔	**B. Prevent polyspermy by modifying the zona pellucida**
	C. Induce trophoblast differentiation

	D. Promote blastocoel formation

Explanation: Cortical granule exocytosis hardens and modifies the zona pellucida (zona reaction), blocking additional sperm binding and entry.

Q5. *Week 1 – Fertilization*

Zygote formation is defined by:

	A. Entry of the sperm into the perivitelline space
	B. Completion of oocyte meiosis I
✔	**C. Fusion of male and female pronuclei restoring diploidy**
	D. Shedding of the zona pellucida

Explanation: Fusion of pronuclei establishes a diploid genome, forming the zygote.

Q6. *Week 1 – Cleavage*

Cleavage divisions typically begin approximately how long after fertilization?

	A. 6 hours
	B. 12 hours
✔	**C. 24 hours**
	D. 72 hours

Explanation: The first cleavage division usually begins around 24 hours after fertilization.

Q7. *Week 1 – Cleavage*

Compaction during early cleavage primarily results in:

	A. Formation of the blastocoel
✔	**B. Increased cell adhesion and polarization of outer cells**
	C. Immediate implantation
	D. Completion of gastrulation

Explanation: Compaction increases cell–cell adhesion; outer cells polarize and set up trophoblast vs embryoblast lineages.

Q8. *Week 1 – Morula*

The morula (≈16–32 cells) typically reaches the uterine cavity around:

	A. Day 2
✔	**B. Day 3–4**
	C. Day 5–6
	D. Day 7–8

Explanation: Around day 3–4, the morula reaches the uterine cavity while still enclosed by the zona pellucida.

Q9. *Week 1 – Blastocyst*

Which component is correctly matched with its major fate?

	A. Embryoblast → maternal component of placenta
	B. Trophoblast → embryo proper
	C. Blastocoel → amniotic cavity
✔	**D. Trophoblast → major fetal component of placenta**

Explanation: Trophoblast forms the major fetal part of the placenta; the embryoblast forms the embryo proper; blastocoel is the blastocyst cavity.

Q10. *Week 1 – Blastocyst/Implantation*

Shedding of the zona pellucida ('hatching') is essential primarily because it:

	A. Triggers meiosis II completion
	B. Prevents premature implantation in the uterine tube
✔	**C. Allows the blastocyst to expand and adhere to the endometrium**
	D. Induces cytotrophoblast mitosis to stop

Explanation: Hatching permits expansion and direct interaction with endometrium for implantation.

Q11. *Week 1 – Implantation*

Implantation of the blastocyst typically begins approximately:

	A. Day 2 after fertilization
	B. Day 4 after fertilization
✔	**C. Day 6–7 after fertilization**
	D. Day 10–12 after fertilization

Explanation: Attachment and penetration begin around day 6–7 post-fertilization.

Q12. *Week 1 – Implantation*

Which statement about trophoblast differentiation is TRUE?

	A. Cytotrophoblast is multinucleated and invasive.
	B. Syncytiotrophoblast is mitotically active.
✔	**C. Cytotrophoblast is mitotically active; syncytiotrophoblast is invasive and secretes hCG.**
	D. Neither layer proliferates during implantation.

Explanation: Cytotrophoblast divides and contributes to invasive, multinucleated syncytiotrophoblast which also produces hCG.

Q13. *Week 1 – Implantation*

Initial adhesion of the blastocyst to the endometrium is mediated in part by:

✔	**A. Integrins and extracellular matrix molecules**
	B. Gap junctions only
	C. Desmosomes only
	D. Primary cilia

Explanation: Integrins and ECM proteins (e.g., fibronectin, laminin) aid adhesion to a receptive endometrium.

Q14. *Week 1 – Clinical (Ectopic)*

Which is a recognized risk factor for tubal ectopic pregnancy?

	A. Endometriosis limited to the uterus
✔	**B. Pelvic inflammatory disease (PID)**
	C. Late menarche
	D. Nulliparity

Explanation: PID can scar uterine tubes, impairing transport and increasing tubal implantation risk.

Q15. *Week 1 – Clinical (Ectopic)*

A patient presents with lower abdominal pain, amenorrhea, and vaginal bleeding. Which diagnosis should be high on your differential?

	A. Incomplete abortion
✔	**B. Ectopic pregnancy**
	C. Molar pregnancy
	D. Pelvic organ prolapse

Explanation: The classic triad suggests ectopic pregnancy until proven otherwise.

Q16. *Week 1 – Clinical (Twinning)*

Dizygotic (fraternal) twins result from:

	A. Division of a single zygote at the 2-cell stage
✔	**B. Fertilization of two separate oocytes by two different sperm**
	C. Division of the inner cell mass only
	D. Failure of the zona pellucida to shed

Explanation: Dizygotic twins arise from two separate fertilizations and usually are dichorionic–diamniotic.

Q17. *Week 1 – Clinical (Twinning)*

Monozygotic twins that split during the first 3 days after fertilization most commonly are:

	A. Monochorionic–monoamniotic
✔	**B. Dichorionic–diamniotic**
	C. Monochorionic–diamniotic
	D. Conjoined

Explanation: Early splitting at morula stage yields dichorionic–diamniotic twins.

Q18. *Week 1 – Clinical (Twinning)*

If monozygotic twinning occurs between days 4–8, the most likely membranes are:

	A. Dichorionic–diamniotic
✔	**B. Monochorionic–diamniotic**
	C. Monochorionic–monoamniotic
	D. No membranes

Explanation: Splitting after trophoblast forms but before the amnion typically gives monochorionic–diamniotic twins.

Q19. *Week 1 – Clinical (Twinning)*

Splitting of the embryonic disc after day 8 increases the likelihood of:

	A. Dichorionic–diamniotic twins
	B. Monochorionic–diamniotic twins
✔	**C. Monochorionic–monoamniotic twins and (if very late) conjoined twins**
	D. Complete absence of placenta

Explanation: Late splitting after amnion formation yields monochorionic–monoamniotic; after ~day 13 may produce conjoined twins.

Q20. *Week 1 – Implantation/Protection*

An important function of the intact zona pellucida during tubal transport is to:

	A. Promote hCG secretion
✔	**B. Prevent premature implantation in the uterine tube**
	C. Induce formation of the blastocoel
	D. Block the cortical reaction

Explanation: The zona prevents adhesion to tubal epithelium, avoiding tubal implantation.

Q21. *Week 2 – Implantation*

During implantation, which trophoblastic layer is invasive and responsible for eroding maternal capillaries to form lacunae?

	A. Cytotrophoblast
✔	**B. Syncytiotrophoblast**
	C. Epiblast
	D. Hypoblast

Explanation: Syncytiotrophoblast is multinucleated, invasive, and erodes maternal vessels forming lacunae; cytotrophoblast is mitotically active but not invasive.

Q22. *Week 2 – Decidual Reaction*

The decidual reaction observed in the endometrial stroma during implantation primarily results in:

	A. Proliferation of syncytiotrophoblast
✔	**B. Accumulation of glycogen and lipids in stromal cells**
	C. Formation of the amniotic cavity
	D. Differentiation of the notochord

Explanation: Endometrial stromal cells swell and store glycogen and lipids, providing early nutrition to the embryo.

Q23. *Week 2 – Bilaminar Disc*

The bilaminar germ disc consists of:

	A. Epiblast and trophoblast
✔	**B. Epiblast and hypoblast**
	C. Hypoblast and cytotrophoblast
	D. Amnioblasts and hypoblast

Explanation: By the second week, the embryonic disc is bilaminar: epiblast (dorsal) and hypoblast (ventral).

Q24. *Week 2 – Cavities*

Which cavity develops above the epiblast and is lined by amnioblasts?

	A. Chorionic cavity
✔	**B. Amniotic cavity**
	C. Primary yolk sac
	D. Secondary yolk sac

Explanation: The amniotic cavity forms over the epiblast and is lined by amnioblasts.

Q25. *Week 2 – Extraembryonic Mesoderm*

The chorionic cavity arises within which tissue?

✔	**A. Extraembryonic mesoderm**
	B. Paraxial mesoderm
	C. Intermediate mesoderm
	D. Endoderm

Explanation: Spaces appear in the extraembryonic mesoderm and coalesce to form the chorionic cavity.

Q26. *Clinical – Ectopic*

A 27-year-old with a history of pelvic inflammatory disease presents with amenorrhea, lower abdominal pain, and spotting. β-hCG is positive, ultrasound shows no intrauterine gestation. Most likely diagnosis?

	A. Normal early pregnancy
✔	**B. Ectopic pregnancy**
	C. Molar pregnancy
	D. Corpus luteum cyst

Explanation: PID is a risk factor for tubal implantation; absence of intrauterine pregnancy with positive β-hCG suggests ectopic pregnancy.

Q27. *Week 2 – Yolk Sacs*

The primary yolk sac is replaced by the secondary yolk sac when:

	A. Extraembryonic mesoderm forms
✔	**B. Hypoblast migrates to form a new lining**
	C. Amniotic cavity closes
	D. Primitive streak forms

Explanation: Hypoblast cell migration creates the exocoelomic membrane (primary yolk sac) and later remodels into the secondary yolk sac.

Q28. *Week 2 – Connecting Stalk*

The connecting stalk, which later becomes the umbilical cord, traverses which cavity?

	A. Amniotic cavity
✔	**B. Chorionic cavity**
	C. Pericardial cavity
	D. Yolk sac lumen

Explanation: The chorionic cavity surrounds the amnion and yolk sac, leaving the embryo attached via the connecting stalk.

Q29. *Week 3 – Gastrulation*

A researcher blocks cell migration through the primitive streak in a model organism. Which layer is most directly affected first?

	A. Ectoderm formation
	B. Endoderm formation by hypoblast cells
✔	**C. Endoderm formation by epiblast cells displacing hypoblast**
	D. Neural crest formation

Explanation: First ingressing epiblast cells replace the hypoblast to form definitive endoderm; subsequent ingress forms intraembryonic mesoderm.

Q30. *Week 3 – Primitive Streak*

The primitive node is located:

✔	**A. At the cranial end of the primitive streak**
	B. At the caudal end of the primitive streak
	C. Within the hypoblast
	D. In the extraembryonic mesoderm

Explanation: The primitive node caps the cranial end of the primitive streak and contains the primitive pit.

Q31. *Week 3 – Notochord*

A key role of the notochord is to:

	A. Form the vertebral bodies
✔	**B. Induce overlying ectoderm to form neural plate**
	C. Generate amniotic fluid
	D. Differentiate into the heart tube

Explanation: Notochordal signaling induces neurulation in the overlying ectoderm; remnants contribute to the nucleus pulposus.

Q32. *Axes – Left–Right*

Defects in ciliary motion at the primitive node most directly disrupt which axis establishment?

	A. Cranial–caudal
	B. Dorsal–ventral
✔	**C. Left–right**
	D. Proximal–distal

Explanation: Left–right asymmetry is influenced by nodal cilia generating directional fluid flow and asymmetric signaling.

Q33. *Week 4 – Folding*

Lateral folding of the embryo primarily results in:

	A. Positioning of the heart tube cranially
✔	**B. Closure of the ventral body wall and formation of a cylindrical body**
	C. Formation of the primitive streak
	D. Formation of the amniotic cavity

Explanation: Lateral folding brings body walls ventrally, closing the ventral body wall and forming the primitive gut tube.

Q34. *Germ Layers – Ectoderm*

Which structure is a derivative of surface ectoderm?

	A. Dermis of back
✔	**B. Epidermis**
	C. Adrenal medulla
	D. Endothelial cells

Explanation: Surface ectoderm forms the epidermis; adrenal medulla is neural crest derived; back dermis is paraxial mesoderm.

Q35. *Germ Layers – Mesoderm*

Paraxial mesoderm gives rise to:

	A. Renal tubules
	B. Cardiac muscle only
✔	**C. Somites that form skeletal muscle and much of the axial skeleton**
	D. Limb nerves

Explanation: Paraxial mesoderm segments into somites → sclerotome (axial skeleton), myotome (skeletal muscle), dermatome (dermis).

Q36. *Germ Layers – Endoderm*

A definitive endoderm derivative is:

✔	**A. Hepatocytes**
	B. Melanocytes
	C. Microglia
	D. Vertebral cartilage

Explanation: Endoderm forms epithelial components of the GI tract and organs such as the liver (hepatocytes).

Q37. *Clinical – Teratogens*

A 22-year-old unknowingly consumes high-dose isotretinoin (retinoic acid) during early pregnancy. The embryo is most vulnerable to major structural defects during:

	A. First 2 weeks
✔	**B. Weeks 3–8**
	C. Weeks 9–12
	D. Third trimester

Explanation: Organogenesis (weeks 3–8) is the critical period for teratogen-induced malformations.

Q38. *Clinical – Abnormal Implantation*

Placenta accreta spectrum is most closely associated with:

✔	**A. Excess trophoblast invasion into the myometrium**
	B. Lack of lacunar network formation
	C. Failure of primitive streak regression
	D. Defective amniotic membrane

Explanation: Accreta spectrum involves abnormally deep trophoblast invasion due to defective decidua basalis, from accreta to percreta.

Q39. *Clinical – Primitive Streak*

Sacrococcygeal teratoma arises from:

	A. Defects in lateral folding
✔	**B. Persistent pluripotent cells of the primitive streak at the caudal end**
	C. Abnormal notochord signaling
	D. Failure of neural tube closure

Explanation: SCT is derived from remnants of the primitive streak containing pluripotent cells at the caudal region.

Q40. *Clinical – Gastrulation*

A teratogen impairs epiblast cell ingression through the primitive streak. Which tissue is most directly reduced?

	A. Surface ectoderm
✔	**B. Intraembryonic mesoderm**
	C. Extraembryonic mesoderm only
	D. Chorionic trophoblast

Explanation: Ingressing epiblast cells form intraembryonic mesoderm; impairment reduces mesoderm-derived tissues.