



ANSWER BOOK

# Gametes and fertilisation: from two cells to a blastocyst

Cell cycles, reproduction and development · Unit B06

Edexcel A Topic 3

8 questions · 25 marks

NAVY EDITION

---

**SECTION A** · Short, 1 to 2 marks

- A1** **B1** fertilisation takes place in the oviduct, also accepted as the fallopian tube or egg tube. **B1** implantation takes place in the endometrium, the lining of the uterus. [2]
- 

---

**SECTION B** · Standard, 3 to 5 marks

- B1** **B1** the sperm binds to a complementary receptor on the zona pellucida. **B1** the acrosome membrane fuses with the sperm cell surface membrane and hydrolytic enzymes are released by exocytosis, which digest a path through the zona pellucida. **B1** the sperm cell surface membrane fuses with the egg cell surface membrane and the sperm nucleus enters the cytoplasm of the egg. **B1** the egg completes meiosis II, releasing the second polar body, and the two haploid nuclei fuse to give a diploid zygote nucleus. [4]
- B2** **B1** sperm production is continuous from puberty, whereas egg production begins before birth, is then arrested, and one cell is usually completed in each cycle. **B1** cytokinesis is equal in spermatogenesis, whereas in oogenesis it is unequal, so one daughter cell keeps almost all the cytoplasm. **B1** one primary spermatocyte gives four functional gametes, whereas one primary oocyte gives one functional gamete and two or three polar bodies. **B1** meiosis is completed before a sperm is released, whereas in the egg the second meiotic division is completed only if a sperm fuses with it. [4]
- B3** **B1** fusion of the sperm and egg membranes raises the calcium ion concentration in the cytoplasm of the egg, which causes the cortical granules to fuse with the cell surface membrane. **B1** their contents are released by exocytosis into the space between the cell surface membrane and the zona pellucida. **A1** these contents alter the sperm receptors on the zona pellucida and harden it, so no further sperm can bind to it or pass through it. [3]
- B4** **B1** each gamete carries one haploid set of chromosomes, so the cell formed contains three sets, 69 chromosomes in a human, instead of two sets. **B1** every gene is then present in three copies rather than two, so the balance of gene products is disturbed throughout development; mitosis itself can still copy and divide three sets. **A1** the embryo and the placenta develop abnormally and development stops at an early stage. [3]
- B5** **B1** the mitochondria are the site of aerobic respiration, which releases ATP. **B1** ATP is required for the movement of the tail, which is the only means by which the sperm moves. **B1** a greater distance requires movement for longer, so a greater rate of ATP release is needed and more mitochondria supply it. [3]
-

- B6** **B1** the zygote divides by mitosis while travelling along the oviduct, in divisions called cleavage, with no growth between them, so the total size does not increase. **B1** a solid ball of cells called a morula forms by about day four, and by about day five a fluid-filled cavity has formed and it is a blastocyst with an inner cell mass. **B1** the blastocyst leaves the zona pellucida and implants in the endometrium, the lining of the uterus, about six or seven days after fertilisation. [3]
- 
- B7** **M1** radius = 110 divided by 2 = 55  $\mu\text{m}$ . **M1**  $V = \frac{4}{3} \times \pi \times 55^3$ . **A1**  $7.0 \times 10^5 \mu\text{m}^3$ ; accept 696 910  $\mu\text{m}^3$  correctly rounded. [3]
-