Section Three: Extended Answers

Question 28

(a)

✓ the hypothalamus is connected by blood vessels to the anterior lobe of the pituitary.
✓ the hypothalamus produces releasing and inhibiting factors which stimulate or inhibit the release of hormones from the anterior lobe of the pituitary, e.g. TSHRF.
✓ the hypothalamus sends nerve impulses down nerve fibres to the posterior lobe of the pituitary.
✓ these impulses stimulate the release of ADH or OT which are produced in the hypothalamus and stored at the end of the nerve fibres in the posterior lobe of the pituitary.

(b) **Anterior Lobe of the Pituitary (ALP)**

HORMONE	TARGET/S	EFFECT ON TARGET
FSH	✓ ovary follicle ✓ testis	✓ stimulates development of follicle ✓ stimulates sperm production
LH	✓ mature follicle ✓ testis	✓ stimulates ovulation and maintains corpus luteum ✓ stimulates testosterone production
TSH	✓ thyroid gland	✓ stimulates production and release of thyroxine
GH	✓ all cells , primarily bone	✓ stimulates protein synthesis and therefore growth
ACTH	✓ adrenal cortex	✓ secretion of cortisol
PRL	✓ mammary glands	✓ milk production

and the Posterior Lobe of the Pituitary(PLP)

HORMONE	TARGET	FUNCTION
OT	✓ muscles of uterus ✓ mammary glands	✓ contractions during child birth ✓ milk release
ADH	✓ kidney nephrons (specifically the distal convoluted tubules and collecting ducts)	✓ tubules and ducts become more permeable to water – more water is reabsorbed

(To score full marks student must do each of the 8 hormones and must include more than one point on at least one hormone–example for FSH, LH or OT).

(c)

✓ (i) hyperthyroidism: over secretion of thyroxine from thyroid glands.
✓ symptoms: high metabolic rate, sweating, rapid irregular heartbeat, nervousness, loss in weight.
✓ (ii) hypothyroidism ; under secretion of thyroxine.
✓ symptoms: low metabolic rate, lethargy, mental sluggishness. In infants may result in mental retardation, short stature.

(d) hypothyroidism in adults is often caused by the undersecretion of thyroxine.
✓ to treat this problem patient is required to ingest a synthetic form of thyroxine.
✓ the amount required, usually taken orally each day, depends on the severity of the condition.

Question 30

(a)

- ✓ blood sugar is the main source of energy for all the body's living cells.
- ✓ it is an essential requirement for brain cells which cannot use other food sources for energy.
- ✓ it is used in both aerobic and anaerobic respiration.
- ✓ the blood sugar level (BSL) is maintained within limits mainly by the antagonistic hormones insulin and glucagon

- ✓ insulin is released by beta cells in the islets of Langerhan in the pancreas
- ✓ glucagon is released by alpha cells in the islets of Langerhan
- ✓ when the blood sugar level is too high, insulin is released and reduces blood sugar level
- ✓ by stimulating liver cells and muscles to convert glucose to glycogen (glycogenesis)
- ✓ by causing cell membranes to become more permeable to glucose
- ✓ by stimulating glucose metabolism in cells
- ✓ by promoting protein synthesis which uses glucose as an energy source
- ✓ when the blood sugar level is too low glucagon increases blood sugar levels
- ✓ by stimulating the breakdown of glycogen to glucose (glycogenolysis) in the liver and muscle cells
- ✓ by stimulating gluconeogenesis, the conversion of amino acids and glycerol to glucose in the liver

(b)

- ✓ an increased core temperature is detected by thermoreceptors in the hypothalamus
- ✓ these convey messages to the modulator (cells nearby in the hypothalamus) which process the information
- ✓ the modulator sends nerve impulses to the sweat glands and to the blood vessels of the skin(effectors)
- ✓ the sweat evaporates, cooling the skin and the underlying blood in capillaries close to the skin surface
- ✓ the arterioles in the skin dilate so that more blood flows through them
- ✓ more blood flowing close to the surface loses a greater quantity of heat through radiation and conduction to the cooler atmosphere
- ✓ this mechanism also lowers the blood's temperature and therefore the body's core temperature
- ✓ if the temperature of the body remains higher than normal for a longer period of time, the hypothalamus releases less TSHRF
- ✓ which in turn causes the anterior lobe of the pituitary to release less TSH
- ✓ which causes the thyroid gland to release less thyroxine
- ✓ this reduces the body's rate of metabolism and therefore reduces the body's heat production and core temperature.

(c)

- ✓ during strenuous exercise the skeletal muscles require more oxygen and nutrient for respiration to provide the necessary energy
- ✓ less blood is needed by organs such as the intestines and kidneys
- ✓ a greater flow of blood is directed towards the skeletal muscles as a result of the dilation of arteries which service them (under the control of the autonomic N S)

Question 32

(a)

- ✓ specific resistance refers to the body's ability to fight particular pathogens (and not others)
- ✓ for example a person may have a specific resistance to the bacterium that causes tetanus but no specific resistance to the bacterium that causes meningitis
- ✓ non specific resistance refers to the general barriers that the body has to resist invasion by most pathogens
- ✓ e.g. 1 the skin is impervious to most bacteria and viruses, it is a non-specific barrier which keeps most pathogens out of the body.
- ✓ e.g. 2 the stomach is highly acidic (pH~2) - most living organisms are destroyed by such acidic conditions.
- ✓ e.g. 3 large white blood cells called macrophages engulf or phagocytose most pathogens to which they are exposed (they are non-specific)

(b)

- ✓ both B cells and T cells provide specific resistance.
- ✓ there are many types of B cells and T cells, each attacks a specific pathogen.
- ✓ B cells and T cells both develop memory cells as they deal with their particular target pathogen
- ✓ the B and T cells which are produced as memory cells provide a quicker and stronger response to a second attack by that same pathogen
- ✓ both B and T cells originate in the red bone marrow
- ✓ both are involved in the immune response
- ✓ T cells provide immunity from bacterial and viral pathogens which have entered cells (intracellular infections)and also fungi, protozoa and cancer.
- ✓ B cells provide immunity to bacteria, viruses and toxins which are outside cells (extracellular)
- ✓ on exposure to pathogens (or their products) both B and T cells enlarge, divide and form clones of themselves
- ✓ most of the cloned B cells form plasma cells
- ✓ plasma cells produce antibodies (chemicals which attack the invading pathogen or neutralise its toxins).
- ✓ some cloned cells remain as memory cells and attack subsequent invasions by the same pathogen – more quickly and with greater numbers
- ✓ most of the cloned T cells formed (killer T cells) either migrate towards the pathogen
- ✓ then attach to their antigens and destroy them
- ✓ or secrete chemicals which attract macrophages or stimulate macrophage activity or chemicals that stimulate other lymphocytes
- ✓ as with B cells, some cloned T cells remain as memory cells and are ready to respond more quickly and strongly to a second infection by the same pathogen.

(Note to student: must include at least four similarities and ar least four differences).

(c)

- ✓ antibodies may combine within a foreign antigen (e.g. the coating on outside of a pathogen) or a toxin produced by the pathogen or the whole virus
- ✓ some antibodies puncture the cell walls of bacteria causing them to lyse
- ✓ some antibodies combine chemically with toxins effectively neutralising poisons
- ✓ some attach to viruses preventing their invasion of cells
- ✓ some attach to bacteria so that they form clumps which are easily phagocytosed by macrophages
- ✓ some may dissolve antigens making them insoluble so that they can be more easily phagocytosed.