

M507 – Health effects of hazardous substances – Revision questions

Section 4 – Basic human biology and target organs

1. What are the three main areas of the respiratory system? What defence mechanisms are in each?
(Pages 23 and 24)
 - Naso-pharynx region
 - Nose, mouth and throat
 - Nasal hairs, moist mucous membrane, cilia, sneezing, coughing
 - Tracheo-bronchiole region
 - Trachea, bronchi and bronchioles
 - Moist mucous membranes, cilia (muco-ciliary escalator)
 - Alveolar region (gas-exchange region)
 - Alveoli
 - Phagocytic cells (macrophage cells) – dissolve / engulf the particle and remove via muco-ciliary escalator or lymphatic system
2. What sizes (aerodynamic diameters) of particles deposit in each area of the respiratory system?
(Page 25 and 26)
 - 10 to 100 micron – nose and nasal cavity
 - 5 to 30 micron – throat, larger bronchioles
 - 1 to 5 (10) micron – smaller bronchioles, alveoli
 - Less than 1 micron – tend to be exhaled directly
3. In industrial hygiene, what are the two particle size fractions that are commonly used? What size ranges do they cover?
(Page 27)
 - Respirable – 0 to 10 micron
 - Inhalable (or inspirable) – 0 to 100 micron
4. What is the main factor that affects where irritant gases affect the respiratory system? (Give examples).
(Pages 28 and 29)
 - Water solubility – high solubility gases (e.g. ammonia, hydrogen chloride, formaldehyde) mainly affect the upper respiratory tract, low solubility gases (e.g. phosgene, nitrogen dioxide) mainly affect the deep lung.
5. What do you understand by the terms ‘benign pneumoconiosis’ and ‘fibrotic pneumoconiosis’?
(Pages 29 and 30)
 - Pneumoconiosis – accumulation of dust in the lungs

- Fibrotic pneumoconiosis – caused when the macrophage cells are unable to engulf or remove the dust particles (e.g. crystalline silica, asbestos). The macrophage cells die, release chemicals that cause a scarring or fibrosis of the lungs
- Benign pneumoconiosis – dust (e.g. iron, tin) deposited in the lungs does not cause damage to the alveoli or lead to fibrosis.

6. Name four types of respiratory sensitisation. Give an example of a substance that may cause each type.

(Pages 31 and 32)

- Rhinitis – allergic reaction that affects the nose, throat and eyes – pollen, organic dusts
- Occupational asthma – inflammation and allergic constriction of the bronchi and bronchioles – isocyanates, solder fume, latex, animal proteins
- Extrinsic allergic alveolitis – inflammation of terminal bronchioles and alveoli – mould, fungal spores, dried animal proteins
- Byssinosis – airways obstruction – cotton

7. What are the three main layers of the skin?

(Pages 32 and 33)

- Epidermis – outer layer – barrier to water and water soluble substances
- Dermis – connective tissue that includes blood vessels, hair follicles, sweat glands etc.
- Hypodermis – (sub-cutaneous layer) – contains fat cells

8. What factors increase the likelihood of chemicals permeating the skin?

(Page 34)

- Damage to the skin – cuts, abrasions, pre-existing skin disease
- Warm, moist skin
- Degreased skin
- Substances kept in contact with skin (e.g. under gloves)
- Lipid soluble substances can permeate through intact skin

9. What conditions may be caused by exposure of the skin to hazardous substances?

(Pages 34 to 36)

- Dermatitis – inflammation of the skin
- Irritant contact dermatitis – acids, alkalis, detergents etc
- Allergic contact dermatitis – nickel, epoxy resins, latex etc
- Folliculitis – oils, greases etc
- Ulceration of the skin – hexavalent chromium etc
- Skin cancer – PAH's, coal tar, soot, asphalt, UV light etc

10. Describe the main mechanisms by which the correct functioning of the nervous system may be affected by hazardous substances.

(Pages 38 and 39)

- Structural damage to the neuron
 - Lead damages myelin sheath, n-hexane damages axon and myelin sheath, mercury damages sensory nerves, organo-metallics affect the brain
- Functional damage to the nerves
 - Organic solvents cause swelling of myelin sheath – impair conduction of nerve signals, organo-chlorine pesticides affect normal travel of nerve impulses
- Interference with impulse transmission across the synapse
 - Organo-phosphorous pesticides cause excessive transmission of nerve signals

11. What conditions may be caused by exposure of the skin to hazardous substances?

(Pages 41 to 42)

- Haemolysis – breakdown of the red blood cells – (arsine, stibine)
- Carboxyhaemoglobin formation – (carbon monoxide)
- Methaemoglobin formation – (aromatic amines)
- Anaemia – reduced haemoglobin levels – (lead, benzene)
- Leukaemia – abnormal white blood cells produced – (benzene)

12. Why is the liver at particular risk of damage from hazardous substances? What conditions may be caused?

(Pages 42 to 44)

- Main site for biotransformation in body – liver at risk from hazardous substance and any toxic metabolites
 - Receives high blood flow from hepatic artery
 - First organ to receive blood from digestive tract
- Fat accumulation in the liver – (alcohol, organic solvents)
- Cirrhosis – build up of fibrous tissues in liver – (alcohol, organic solvents)
- Liver cancer – (arsenic, vinyl chloride monomer, organic solvents)

13. Why are the kidneys at particular risk of damage from hazardous substances? What conditions may be caused?

(Pages 45 and 46)

- Receive high blood flow
- Re-absorption of water concentrates toxins in the tubules
- Acute renal failure – may occur when urine production is reduced e.g. tubules blocked by damaged red blood cells – (arsine, stibine)
- Chronic kidney damage – (cadmium, mercury, lead, halogenated hydrocarbons)