

General Physiology

Section 1

- 1 Regarding cellular components:
 - a) peroxisomes are larger than lysosomes
 - b) pH of lysosomes is higher than the rest of the cytoplasm
 - c) microfilaments are hollow
 - d) myosin 1 molecules are characteristically found in muscle cells
 - e) microfilaments are made up of actin

- 2 $\text{Na}^+ - \text{K}^+$ -ATPase is an example of a/an:
 - a) symport
 - b) uniport
 - c) biport
 - d) antiport
 - e) airport

- 3 Which decreases $\text{Na}^+ - \text{K}^+$ -ATPase pump activity?
 - a) thyroid hormones
 - b) dopamine
 - c) G-actin
 - d) intracellular sodium
 - e) insulin

- 4 Given that a person weighs 60kg and their haematocrit is 40%, their total blood volume is:
 - a) 6L
 - b) 5L
 - c) 4L
 - d) 3L
 - e) cannot be calculated with the given information

- 5 What percentage of body weight is plasma?
 - a) 2%
 - b) 5%
 - c) 8%
 - d) 15%
 - e) 20%

- 6 ECF volume can be estimated using:
- inulin
 - D₂O
 - Evan's blue
 - radioactive chromium
 - iron isotopes
- 7 The number of molecules in a mole is:
- 1×10^{26}
 - 6×10^{26}
 - 4×10^{26}
 - 1×10^{23}
 - 6×10^{23}
- 8 The molecular mass of a substance is expressed in:
- moles
 - Daltons
 - equivalents
 - osmoles
 - grams
- 9 Regarding mitochondria:
- genome inheritance is strictly maternal
 - the citric acid cycle occurs at the outer membrane
 - the space between the two membranes is called the matrix
 - the mutation rate for mitochondrial DNA is less than for nuclear DNA
 - invaginations of the outer membrane are called cristae
- 10 Which volume of distribution is evaluated with which substance?
- plasma – D₂O
 - RBC volume – ⁵¹Cr
 - ECF – Evans Blue
 - Interstitial fluid – Inulin
 - ICF – mannitol
- 11 Which is correct?
- blood volume is 8% total body weight
 - 2/3 total body weight is ECF
 - 75% of ECF is blood plasma
 - water content of lean tissue is 25%
 - total body water increases with increasing age

- 12 For mitochondria, which is TRUE?
a) NADH-DH, 5DH, bc, cox synthesise ATP
b) the matrix is between the inner and outer mitochondrial DNA
c) mitochondrial DNA is not transmitted paternally
d) 99% of mitochondrial proteins are encoded by mitochondrial DNA
e) ATP synthetase is powered by an electron gradient
- 13 Which is TRUE?
a) the cytoskeleton is composed of hydroxyapatites
b) the mitotic spindle is composed of actin microtubules
c) myosin is the most abundant protein in cells
d) colchicine stabilises microtubules preventing organelle movement
e) actin-myosin interaction allows cells to move
- 14 For the genome, which is TRUE?
a) the human genome encodes 3×10^9 genes
b) adenine binds to cytosine and guanine to thymine
c) uracil replaces thymine in RNA
d) 3% of DNA are introns
e) haploid DNA in germ cells is single stranded
- 15 For transmembrane movement, which is TRUE?
a) exocytosis requires Ca^{2+} and energy
b) Na^+ - K^+ -ATPase is an example of facilitated diffusion
c) amiloride activates epithelial Na^+ channels
d) clathrin is essential for vesicle exocytosis
e) water can only enter cells via water channels
- 16 For the Erlanger and Gasser classification, which is TRUE?
a) Sunday morning syndrome mainly affects C fibres
b) local anaesthetics primarily affect A fibres
c) preganglionic autonomic fibres are type B
d) C fibres have the largest diameter
e) B fibres are the least susceptible to hypoxia
- 17 For the glial cells, which is TRUE?
a) one schwann cell can myelinate up to 40 neurons
b) oligodendocytes are the scavenger cells of the CNS
c) microglia are the scavenger cells of the PNS
d) there are up to three glial cells per neuron in the nervous system
e) protoplasmic astrocytes are found in grey matter

- 18 For cardiac muscle, which is FALSE?
- a) HERG really is the acronym for human ether-a-go-go related gene
 - b) intercolated discs are calcified structures within cardiac muscle cells
 - c) resting membrane potential is -90mV
 - d) cardiac muscle requires continuous supply of O₂ to function
 - e) cardiac muscle action potential time decreases with increasing heart rate
- 19 For neurotransmitters, which is TRUE?
- a) acetylcholine is synthesised by true cholinesterase
 - b) atropine blocks muscarinic cholinergic receptors
 - c) catecholamines are formed from VMA (vanillylmandelic acid)
 - d) adrenaline has a higher affinity for α rather than β adrenergic receptors
 - e) dopamine is formed by COMT from tryptophan

General Physiology

Section 1 – Answers

1	E
2	D
3	B
4	B
5	B
6	A
7	E
8	B
9	A
10	B
11	A
12	C
13	E
14	C
15	A
16	C
17	E
18	B
19	B

Section 2

- 1 Regarding body water, which is FALSE?
 - a) 1/3 total body weight is **extra** and 2/3 **intra** cellular
 - b) 60% of body weight is water
 - c) plasma is 8% and total blood 10%, of body weight
 - d) of extracellular fluid, 25% is vascular, 75% extravascular
 - e) interstitial fluid is 15% of body weight

- 2 Chemical composition, which is TRUE?
 - a) pH is the negative natural logarithm of $[H^+]$
 - b) pH 5 to pH 6 involves tenfold increase in $[H^+]$
 - c) pH remains 7.4 +/- 0.05 in ECF, stabilised by buffer
 - d) H_2O and $CO_2 \rightleftharpoons H_2CO_3 \rightleftharpoons H^+$ and HCO_3^- , adding H^+ shifts the equilibrium to the right, while adding ??? shifts it to the left
 - e) the Donnan effect does not contribute significantly to the balance of electrolyte between intra and extra vascular compartment

- 3 Nerve fibres, which is FALSE?
 - a) 70% of energy requirement of nerves is used in maintaining polarity across the recytlemina by action of Na-K ATPase
 - b) metabolic rate of nerves doubles in max action
 - c) "C" type fibres are non-myelinated and include some of the sympathetic preganglionic fibres
 - d) "A" and "B" fibres are all myelinated
 - e) effects of local anaesthetic are maximal in "C" fibres

- 4 Regarding skeletal muscle, which is FALSE?
 - a) metabolic rate of muscle may increase 100 times in maximal activity
 - b) muscle cells can be excited chemically, mechanically and electrically, to produce action potentials in the cell membrane
 - c) actin is a myosin-binding protein which is a molecular motor, converting ATP energy to monomers
 - d) mitochondria are packed in between myofibrils
 - e) T tubules occur over the junction of I and A bands

- 5 More on muscles; which is TRUE?
- a) skeletal muscle cells act as syncytium, though intercellular communications
 - b) some skeletal muscles are not subject to voluntary control
 - c) smooth muscle contains regularly discharging pacemaker
 - d) a variant of smooth muscle is found in the eye, which resembles skeletal muscle
 - e) cardiac muscle does not contain regular striation
- 6 More on muscles; which is FALSE?
- a) T tubules are extensions of extracellular space
 - b) "cisternae" of SR are in contact with T-tubules
 - c) myosin molecules combine to form thick filaments while actin, tropomyosin, and the troponins form thin filaments
 - d) an individual muscle cell is a myofibril, containing myofilaments
 - e) the sarcolemma transmits action potentials
- 7 In muscle contraction, which is TRUE?
- a) only contraction is energy requiring, not relaxing
 - b) sequestering of Ca^{2+} causes separation of actin-myosin bands and muscle relaxation
 - c) ATPase clefts are on the tips of the myosin heads
 - d) ryanodine receptors are voltage gated Ca^{2+} channels
 - e) Troponin T inhibits the interaction of actin and myosin
- 8 Action potentials:
- a) travel along neurons at a set velocity
 - b) are only seen in neurons
 - c) are generated initially by action of K^+ voltage gated channels
 - d) result from variation in Na^+ and K^+ membrane permeability
 - e) are unidirectional impulses
- 9 The $Na^+ K^+$ ATPase pump:
- a) utilises ATP to pump out 2 Na^+ ions for every 3 K^+ ions
 - b) activity is altered by insulin, aldosterone and thyroid hormones
 - c) is only found in muscle and nervous tissue
 - d) is made of α , β , and δ subunits
 - e) ATP binds to the α subunit causing a protein configuration change

- 10 Which is TRUE?
- a) active transport is the major method for transport of glucose into cells
 - b) facilitated diffusion utilises ATP to transport ions against their chemical or electrical gradients
 - c) an example of an active transporter is the $K^+ H^+$ ATPase found in the gastric mucosa
 - d) the $H^+ K^+$ ATPase is an example of an electrogenic pump
 - e) none of the above
- 11 The golgi apparatus, which is TRUE?
- a) is found only in secretory cells
 - b) vesicles containing newly synthesised proteins bind to trans side of the apparatus
 - c) constitutive pathway of cell secretion is responsible for further processing and storage of proteins
 - d) is responsible for glycosylation of proteins
 - e) none of the above
- 12 With respect to protein synthesis:
- a) each amino acid found in human protein has its own individual single transfer RNA
 - b) pre mRNA processing occurs in the cytoplasm prior to binding to ribosomes on the endoplasmic retic???
 - c) each gene has regulatory, promoter, coding and non coding regions which are all transcribed into pre mRNA
 - d) introns no recognised physiological function
 - e) the promoter site of a gene is the site where RNA polymerase binds
- 13 Which is TRUE?
- a) polymerase chain reaction may be used to repair damaged DNA
 - b) restriction fragment length polymorphism detects differences in DNA sequences between different individuals
 - c) protein encoding genes make up only 15% of the human genome
 - d) the only difference between DNA and RNA is the substitution of uracil for thymine
 - e) the haploid human genome is made up of 3×10^6 base pairs
- 14 Action potentials in skeletal muscle:
- a) travel along muscle fibres at varying rates
 - b) have larger refractory periods compared to nerves
 - c) causes uptake of Ca^{++} into sarcoplasmic reticulum
 - d) results in sustained contraction of muscle fibres

- 15 Regarding membrane potential:
- a) it is only found in nervous tissue
 - b) Na^+/K^+ pump does not contribute to the membrane potential
 - c) its magnitude does not change from tissue to tissue
 - d) the membrane potential is negative inside in relation to the outside
 - e) it is mainly caused by leaking Na^+/K^+ channels
- 16 Gamma amino butyric acid:
- a) is an excitatory mediator in the brain
 - b) it is formed by decarboxylation of glutamates
 - c) there are three different classes of GABA receptors
 - d) it is mostly excreted unchanged in the urine
 - e) is the main mediator in glutamate metabolism
- 17 Substance P:
- a) is a carbohydrate
 - b) is a polypeptide found in intestine and nervous tissue
 - c) is a beta II amino acid residue mainly found in the liver
 - d) it is not involved in the neuroendocrine system
 - e) it is a lipid
- 18 Opioid peptides:
- a) are not formed from precursors
 - b) morphine is an example of opioid peptides
 - c) they form the opioid receptors in the brain
 - d) are mainly found in the brain and gastrointestinal
 - e) they are excreted unchanged almost always
- 19 Regarding the autonomic nervous system:
- a) does not have a reflex arc like somatic nervous system
 - b) dopamine is the main transmitter
 - c) cholinergic division of the autonomic nervous system increases activity of the intestinal musculature and increases gastric secretion
 - d) norepinephrine is metabolised by pseudocholinesterase
 - e) it is not involved with visceral sensation
- 20 With respect to blood volume:
- a) the greater proportion is present in the arterial system
 - b) the pulmonary vessels contain 50%
 - c) the systemic capillaries and arterioles contain 7%
 - d) the heart contains 20%
 - e) the aorta contains 20%

- 21 Blood pressure:
- a) fluctuates in the aorta between 180 and 20mmHg
 - b) is approaching 0mmHg at the right atrium
 - c) is half in the pulmonary arteries of that in the aorta
 - d) is greater in large veins than the vena cava
 - e) drops significantly at capillary level
- 22 With respect to blood flow:
- a) during laminar flow, blood moves at greater velocity adjacent to the vessel wall
 - b) turbulent flow can occur in long straight vessels
 - c) during turbulent flow, there is less resistance to flow
 - d) the tendency for turbulent flow increases inversely with the velocity of blood flow
 - e) turbulent flow does not normally occur in the aorta
- 23 As a percentage of total blood volume, which of the following values are CORRECT?
- a) 40% is in the pulmonary circulation
 - b) 13% is in the systemic arteries
 - c) 20% is in the systemic arterioles and capillaries
 - d) 30% is in the veins
 - e) none of the above are correct
- 24 Which is NOT correct about reflex mechanisms acting on the circulation?
- a) the baroreceptors in the carotid bodies are stimulated when blood pressure increases
 - b) the Bainbridge reflex causes increase in heart rate
 - c) the Cushing reflex is a special central nervous system ischaemic response resulting from increased intracranial pressure
 - d) the maximum firing per change in pressure of the carotid baroreceptors occurs at a mean arterial pressure of 90mmHg
 - e) the glossopharyngeal nerve is involved in baroreceptor reflex system
- 25 When the cholinergic vagal fibres to nodal tissues are stimulated:
- a) the membrane becomes hyper-polarised
 - b) the slope of the pre-potential is decreased
 - c) acetylcholine decreases conductance to Ca^{++} via muscarinic receptors
 - d) acetylcholine increases the permeability of nodal tissues to K^+ via muscarinic receptors
 - e) all of the above are true

- 26 Heart rate is accelerated by:
- a) decreased activity of baroreceptors in the left ventricle
 - b) increased activity of baroreceptors in the pulmonary circulation
 - c) increased intracranial pressure
 - d) expiration
 - e) increased activity of baroreceptors in the arteries
- 27 Regarding the physical characteristics of the circulation:
- a) arterioles have a strong muscular wall but can close completely
 - b) the arterial system contains the greatest volume of blood at any given time
 - c) the aorta has a greater total cross sectional area than the venae cavae
 - d) velocity is directly proportional to the cross sectional area of the blood vessel
 - e) Reynold's number represents a measure of laminar blood flow
- 28 Regarding a coronary blood flow:
- a) systolic blood flow in subendocardial arteries is greater than in the epicardial
 - b) less than 50% of oxygen is removed during passage when in the resting state
 - c) the coronary circulation is well supplied by parasympathetic vasodilatory fibres
 - d) sympathetic vasoconstrictory fibres predominate in epicardial vessels
 - e) none of the above
- 29 Active transport of Na^+/K^+ accounts for what percentage of energy utilised in cells and neurons?
- a) 20% cells, 50% neurons
 - b) 24% cells, 50% neurons
 - c) 24% cells, 70% neurons
 - d) 30% cells, 70% neurons
 - e) 30% cells, 90% neurons
- 30 Human DNA – what proportion codes for proteins?
- a) 3%
 - b) 13%
 - c) 23%
 - d) 33%
 - e) 53%

- 31 Comparing nerve fibre types – which is FALSE?
a) C fibres are most susceptible to local anaesthetic
b) A fibres are least susceptible to local anaesthetic
c) B fibres are found preganglionic – autonomic
d) $A\delta$ fibres transmit motor to muscle spindles
e) some C fibres transmit postganglionic sympathetic impulses
- 32 Nicotinic receptors, which is FALSE?
a) are found on sympathetic ganglia
b) are found at the neuromuscular junction
c) are activated by ACh
d) cause activation of a G protein and \uparrow cAMP
e) cause influx of Na^+ via open Na^+ channels
- 33 Serotonin is noted in all but:
a) sexual behaviour
b) obesity
c) platelet aggregation
d) mood
e) vomiting
- 34 With respect to the ascending pathways of sensation within the spinal cord:
a) the ??? columns connect with the medial branches (crosses midline)
b) the central spinothalamic tract carries pain/temp fibres
c) the lateral spinothalamic tract has small fibres medially
d) gracile fasciculus contains fibres from thoracic and cervical nerves
e) proprioception is transmitted in the lateral spinothalamic tract
- 35 With respect to the EEG and brain wave activity – which is FALSE?
a) the α rhythm (adults) has a frequency of 18-30/second
b) infants have a faster β rhythm than adults
c) the frequency of the α rhythm can be decreased with hypoglycaemia, hypothermia and increased ???
d) young adult – 25% sleep is REM sleep
e) REM sleep is characterised by no muscle tone, but increased extraocular movement
- 36 Which of the following decreases basal metabolic rate?
a) recent ingestion of food
b) stress
c) increased thyroid hormones
d) sleep
e) lactation

- 37 Which of the following is an example of a low energy phosphate compound:
a) creatine phosphate
b) UTP
c) acetyl CoA
d) glucose-6 phosphate
e) ATP
- 38 Creatinuria occurs in measurable amounts in all but:
a) women during and after pregnancy and occasionally in non-pregnant women
b) normal men
c) starvation
d) thyrotoxicosis
e) poorly controlled diabetes mellitus
- 39 Plasma lipids and lipid transport:
a) apoprotein B₄₈ occurs in VLDL
b) apoprotein B₁₀₀ and apoprotein C occurs in chylomicrons
c) lecithin cholesterol acyltransferase is responsible for transferring cholesterol esters from HDL to...
d) chylomicron remnants travel from the intestine within lymphatic fluid in the thoracic duct
e) one half of all LDL molecules is taken up by macrophages and other cells by means other than the LDL receptor
- 40 Adrenal insufficiency may cause all but which of the following?
a) inability to excrete a water load
b) personality changes
c) sodium loss with circulatory insufficiency
d) hypoglycaemia in the presence of fasting
e) leukocytosis
- 41 Hyperaldosteronism:
a) causes low plasmic Na⁺ and high H⁺
b) retains acid H⁺ ions and can cause acidosis
c) doesn't cause oedema due to the escape phenomenon
d) may cause hypocalcaemic nephropathy
e) may be caused by high sodium intake
- 42 Bone:
a) osteoblasts are multinucleate
b) osteoclasts attach to bone via integrins
c) compact bone makes up 60% of a long bone
d) osteoblasts secrete large quantities of type IV collagen and other bone matrix proteins
e) oestrogens inhibit osteoblasts and stimulate osteoclasts

- 43 Daily water turnover in the gastrointestinal tract:
- the stomach contributes about 2500ml resorption
 - jejunum resorbs 1300ml of the water
 - the colon absorbs the bulk of the water load
 - the ??? toxin causes adenyl cyclase therefore \uparrow cAMP and \uparrow Cl^- secretion, \downarrow ???
 - stool balance (average) is 500ml
- 44 Functional anatomy of the kidney – which is TRUE?
- 5 million nephrons in each human kidney
 - pores in terrestrial kidneys are 170-190nm in diameter
 - mesangial cells are located between the basal lumina and podocytes
 - glomerular membrane permits passage of small (???) neutral substances
 - proximal tubule is 100nm long
- 45 Functional anatomy of the kidney – which is FALSE?
- total length of the nephrons ranges from 45-65mm
 - the macula densa is ??? tubular epithelium of the collecting duct
 - juxtaglomerular cells are found in the walls of the afferent arteriole
 - intercalated cells are involved in acid secretion and bicarbonate transport
 - total glomerular capillary endothelium across which filtration occurs, is 0.8m^2
- 46 Regulation of renal blood flow – which is FALSE?
- angiotensin II constricts the afferent arteriole and efferent arteriole
 - noradrenaline constricts intertubular arteries and afferent arterioles
 - dopamine causes vasodilation in renal vessels and natriuresis
 - ACh – renal vasodilation
 - prostaglandins increase blood flow to the cortex and decrease it in the medulla
- 47 All but which of the following cause contraction of the mesangial cells?
- endothelins
 - angiotensin II
 - ADH
 - noradrenaline
 - cAMP
- 48 All but which of the following are involved in the movement of Na^+/Cl^- across the apical membrane of the proximal tubules?
- $\text{Na}^+ / 2\text{Cl}^- / \text{K}^+$ co-transporter (CT)
 - $\text{Na}^+ /$ glucose CT
 - $\text{Na}^+ / \text{P}^{???$ CT
 - $\text{Cl}^- /$ base exchanges
 - Na^+ / H^+ exchanges

Section 2

Answers

1	C	25	E
2	C	26	A
3	C	27	A
4	C	28	D
5	D	29	C
6	D	30	A
7	B	31	D
8	D	32	D
9	B	33	A
10	C	34	A
11	E	35	B
12	E	36	D
13	B	37	D
14	B	38	B
15	D	39	C
16	B	40	E
17	B	41	C
18	D	42	B
19	C	43	D
20	C	44	D
21	B	45	B
22	B	46	A
23	B	47	E
24	A	48	A

Section 3

- 1 B nerve fibres:
 - a) provide motor supply to intrafusal muscle fibres
 - b) are usually the first fibres affected by local anaesthetics
 - c) are 12-20µm in diameter
 - d) are unmyelinated
 - e) provide pre-ganglionic autonomic supply

- 2 Ionic:
 - a) movement across an impermeable membrane occurs due to an osmotic gradient
 - b) equilibrium potential can be determined using the Nernst equation
 - c) movement across the capillary wall is not affected by the Donnan effect
 - d) valency determines osmotic effect in an ideal solution
 - e) forms of weak acids cross cell membranes easily

- 3 Steroid hormones:
 - a) open ion channels in cell membrane
 - b) act via cytoplasmic or nuclear receptors
 - c) increase intracellular cAMP
 - d) increase tyrosine kinase activity of transmembrane receptors
 - e) act via a serpentine receptor

- 4 Cardiac muscle fibres:
 - a) develop tetany only at very high stimulation frequencies
 - b) develop less tension when stretched due to decreased actin-myosin overlap
 - c) can derive only 5% of basal caloric requirement from fat
 - d) have a T-system located at the A-I junctions
 - e) remain absolutely refractory until the membrane potential repolarises to -50mV
 - f) may contain a human ether-a-go-go gene which is associated with uncontrollable Irish dancing when subjected to ether

- 5 Glomeruli:
 - a) minimally filters protein, so plasma protein concentration is not altered
 - b) are supplied by an extensive anastomotic arterial network
 - c) lie distal to the juxtaglomerular apparatus
 - d) each receive approximately 20-25% of resting cardiac output
 - e) do not filter appreciable albumin since membrane pores are too small

- 6 The distal tubule:
- absorbs most of the filtered sodium ions in the presence of aldosterone
 - absorbs glucose in the normal state
 - absorbs most of the filtered water in the presence of ADH
 - secretes hydrogen via secondary active transport
 - is almost entirely impermeable to urea
- 7 Regarding vitamin D metabolism:
- 25-hydroxycholecalciferol is converted to 1,25-dihydroxycholecalciferol in the distal convoluted tubule of the kidney
 - 1,25-dihydroxycholecalciferol receptors can be found in skin
 - when calcium levels are high, 24,25-dihydroxycholecalciferol levels are also high
 - transport in plasma is by binding to haemoglobin
 - formation of 25-hydroxycholecalciferol is tightly regulated
- 8 Regarding protein metabolism:
- NH_4^+ is formed by reductive deamination of amino acids
 - most of the body's urea is formed in the kidney
 - phosphorylcreatine is formed in the liver
 - creatinuria occurs normally in children
 - purines and pyrimidines are mainly sourced from dietary intake
- 9 Regarding blood flow:
- total cross-sectional area of capillaries is 1000 times that of the aorta
 - the recoil effect producing continuous forward flow in the arterial system is called the Poisevill-Hagen effect
 - 20% of the circulating blood is in the capillaries
 - average central venous pressure is 10.6mmHg
 - venicular dilation is a cause of oedema
- 10 With respect to nerve fibre types:
- the speed on conduction is inversely proportional to the diameter of the fibre
 - C fibres are more susceptible to local anaesthetics than A fibres
 - $A\delta$ fibres are concerned primarily with somatic motor function
 - pain may be relayed by all fibre types
 - $A\alpha$ fibres are efferent only
- 11 Excitatory amino acids in the brain are:
- glutamine and GABA
 - GABA and glycine
 - glutamate and glycine
 - glycine and aspartate
 - glutamate and aspartate

- 12 The opioid δ receptor is involved in:
- a) analgesia
 - b) respiratory depression
 - c) miosis
 - d) dependence
 - e) all of the above
- 13 In visceral smooth muscle:
- a) calcium for contraction is released from sarcoplasmic reticulum
 - b) membrane potential has a resting value of -90mV
 - c) the excitation contraction coupling time is rapid ($<10\text{ms}$)
 - d) muscle contracts when stretched in absence of innervation
 - e) binding of acetylcholine to nicotinic receptors increases calcium influx
- 14 Inhibitory post synaptic potentials involve:
- a) localised increase in membrane permeability to Na
 - b) localised decrease in membrane permeability to Cl
 - c) localised increase in membrane permeability to PO_4
 - d) localised increase in membrane permeability to Cl
 - e) localised decrease in membrane permeability to K
- 15 In skeletal muscle relaxation:
- a) there is a spread of depolarisation along T-tubules
 - b) calcium is released from troponin
 - c) there is increased Na and K conduction in the end plate membranes
 - d) a resting membrane potential of -65mV is finally reached
 - e) Mg has a crucial role
- 16 Regarding synapses:
- a) the synaptic cleft is $30\text{-}50\text{nm}$ wide
 - b) transmitters are released from synaptic knobs secondary to Na trigger
 - c) amount of transmitter released is proportional to Ca efflux
 - d) ach is present in granulated vesicles in synaptic knob
 - e) the EPSP is caused by Na influx
- 17 Which of the following is an inhibitory neurotransmitter?
- a) gallamine
 - b) acetylcholine
 - c) glutamate
 - d) glycine
 - e) aspartate

- 18 Given an Hb of 140g/L, how many mLs of O₂ is carried in 1L of 100% saturated blood
- 5mL
 - 100mL
 - 200mL
 - 500mL
 - 1L
- 19 Substances metabolised by the lung include the following EXCEPT:
- serotonin
 - noradrenaline
 - acetylcholine
 - glutamic acid
 - bradykinin
- 20 Substances synthesised by the lung include all the following EXCEPT:
- arachidonic acid
 - histamine
 - kallikrein
 - angiotensin I
 - surfactant
- 21 Compliance is:
- increased in pulmonary oedema
 - increased in collapsed lungs
 - decreased with age
 - the change in pressure per unit change in lung volume
 - increased in emphysema
- 22 In a healthy person in standard conditions with a PO₂ of 60mmHg, which is the correct Hb saturation
- 75%
 - 90%
 - 95%
 - 57%
 - 85%
- 23 Pulmonary compliance:
- is decreased in emphysema
 - is defined as the change in pressure per unit change in volume
 - compliance is slightly greater when measured during the deflation than when measured during inflation
 - is increased by pulmonary fibrosis
 - is independent of lung volume

- 24 With regard to pulmonary function:
- tidal volume is the volume of each maximal inspiration
 - residual volume is the volume remaining at the end of passive expiration
 - residual volume can be measured directly
 - vital capacity is equivalent to the total of inspiratory reserve volume, tidal volume and expiratory reserve volume
 - tidal volume is measured by single breath nitrogen technique
- 25 Exposure to altitude:
- shifts the O_2 -Hb dissociation curve to the right due to alkalosis
 - is associated with an increase in RBC 2,3-DPG
 - is associated with a decrease in P50
 - is associated with a respiratory acidosis
 - has no effect on erythropoietin secretion
- 26 Heart rate is accelerated by:
- grief
 - increased baroreceptor activity
 - increased atrial stretch receptor activity
 - expiration
 - a direct effect of angiotensin
- 27 Vagal stimulation of SA node:
- leads to increased conductance of calcium into the cell
 - leads to increased conductance of K into the cell
 - leads to raised intracellular cAMP
 - decreases the slope of the prepotential of the SA node
 - inhibits the B1 receptor directly
- 28 The ejection fraction represents:
- % of blood remaining in the ventricle following systole
 - % of atrial volume ejected into the ventricles with atrial systole
 - aortic blood flow
 - % of ventricular volume ejected with each stroke
 - left ventricular pressure
- 29 The C wave of the jugular venous pressure corresponds to:
- atrial systole
 - rise in atrial pressure prior to tricuspid opening
 - aortic valve snapping shut
 - bulging of the tricuspid valve into the atrium
 - atrial diastole

- 30 Regarding cardiac output, which one of the following is INCORRECT?
- a) resting cardiac output correlates with body surface area
 - b) cardiac output is not affected by moderate changes in environmental temperature
 - c) heterometric regulation is changing contractility of the heart independent of length
 - d) the output per minute per square metre of body surface is the cardiac index
 - e) cardiac output is not affected by sleep
- 31 The rate of pacemaker cells in the heart can be slowed by all of the following EXCEPT:
- a) more negative diastolic potential
 - b) reduction of the slope of diastolic depolarisation
 - c) more positive threshold potential
 - d) prolongation of action potential
 - e) increased phase 4 depolarisation slope
- 32 Concerning the Islets of Langerhans:
- a) the B cells make up 90% of the islets
 - b) the D cells secrete pancreatic polypeptide
 - c) beef insulin is structurally more like human insulin than pork insulin is
 - d) the release of insulin involves depolarisation of the cell membrane causing opening of calcium channels
 - e) hyperkalaemia increases the secretion of insulin
- 33 In the thyroid gland:
- a) passage of iodide from the thyroid cells into the colloid is an active process
 - b) RT_3 is inert
 - c) most T_4 is metabolised to T_3
 - d) thyroglobulin is formed in the colloid
 - e) thyroxine binding globulin has the highest capacity to bind thyroid hormones in the plasma
- 34 The effects of thyroid hormones include all of the following EXCEPT:
- a) increased activity of Na/K ATPase
 - b) increased nitrogen excretion
 - c) increased levels of catecholamines
 - d) increased carbohydrate absorption from the gut
 - e) increased alpha myosin heavy chains in cardiac muscle fibres

- 35 Concerning insulin:
- a) alpha adrenergic stimulation inhibits insulin secretion
 - b) theophylline inhibits insulin secretion
 - c) insulin has a half-life of about 30 minutes in the circulation
 - d) insulin inhibits K uptake into muscle and adipose cells
 - e) somatostatin stimulates insulin secretion
- 36 Actions of glucocorticoids include all of the following EXCEPT:
- a) gluconeogenesis in the liver
 - b) maintenance of myocardial contractility
 - c) inhibition of glucose uptake by muscle and adipose tissue
 - d) "permissive" effect on angiotensin II
 - e) decrease in vascular resistance
- 37 Concerning calcium metabolism:
- a) the net effect of parathyroid hormone is to decrease serum phosphate
 - b) vitamin D decreases renal excretion of both Ca and PO_4
 - c) calcitonin is secreted by parathyroid chief cells
 - d) insulin decreases bone formation
 - e) thyroid hormones decrease calcium excretion in urine
- 38 Which of the following is true of the renin angiotensin system:
- a) renin causes release of aldosterone
 - b) increased Na reabsorption at the macula densa causes increased renin secretion
 - c) angiotensinogen is converted to angiotensin I in the lungs
 - d) prostaglandins increase the secretion of renin
 - e) oestrogens decrease production of angiotensinogen
- 39 Concerning vasopressin:
- a) diabetes insipidus is characterised by polydipsia and polyuria
 - b) secretion of vasopressin is stimulated by alcohol
 - c) surgical stress inhibits secretion of vasopressin
 - d) preprooxyphysia is the precursor of vasopressin
 - e) vasopressin is absent in hippopotamuses
- 40 Which of the following is true concerning temperature regulation:
- a) vaporisation of sweat accounts for 70% of heat loss
 - b) increased TSH is an important response to cold
 - c) anterior hypothalamic stimulation causes shivering
 - d) bacterial toxin act on the OVLT to produce fever
 - e) none of the above

- 41 With respect to thirst, which of the following is TRUE?
- a) angiotensin II acts on the supraoptic nucleus to stimulate thirst
 - b) drinking and vasopressin secretion are regulated in much the same way
 - c) dry mucous membranes stimulate thirst via the hypothalamus
 - d) secretion of oxytocin causes thirst due to its similarity to vasopressin
 - e) ACE inhibitors decrease thirst in response to hypovolaemia by decreasing angiotensin II
- 42 Which of the following is TRUE concerning the heart?
- a) increased volume work produces an increase in O_2 consumption than increased pressure work
 - b) cardiac work is the product of heart rate and stroke volume
 - c) the heart in its rested state, gains 60% of its caloric requirements from fat
 - d) the work of the left ventricle is twice that of the right, due to higher pressures in the systemic circulation
 - e) increased preload has a greater effect on O_2 consumption of the heart, than increased afterload

Section 3

Answers

- 1 E
- 2 B
- 3 B
- 4 E
- 5 C
- 6 E
- 7 B
- 8 D
- 9 A
- 10 No answer
- 11 No answer
- 12 No answer
- 13 No answer
- 14 No answer
- 15 No answer
- 16 No answer
- 17 No answer
- 18 No answer
- 19 No answer
- 20 No answer
- 21 No answer
- 22 No answer
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- 26 No answer
- 27 No answer
- 28 No answer
- 29 No answer
- 30 No answer
- 31 No answer
- 32 No answer
- 33 No answer
- 34 No answer
- 35 No answer
- 36 No answer
- 37 No answer
- 38 No answer
- 39 No answer
- 40 No answer
- 41 No answer
- 42 No answer

Section 4

- 1 Which pattern of laboratory findings in the table below is most consistent with a diagnosis of diabetes insipidus?

	24 Hr Urine Volume	Ketones	Glucose	Protein
a)	4.0	+	0	0
b)	6.2	2+	4+	0
c)	1.6	0	0	4+
d)	6.4	0	0	0
e)	5.0	0	0	3+

- 2 Angiotensin II causes:
- greater constriction of efferent than afferent arterioles
 - greater constriction of afferent than efferent arterioles
 - constriction of afferent arterioles only
 - constriction of efferent arterioles only
 - has no effect on arteriolar constriction
- 3 With regard to tuboglomerular feedback:
- the GFR increases when flow through the distal tubule increases
 - the macula densa on the afferent arteriole is the sensor
 - the afferent arteriole is constricted by thromboxane A₂
 - it is designed to maintain Na⁺ reabsorption
 - it does not operate in individual nephrons
- 4 With respect to the counter current system:
- the loops of Henle act as counter current exchangers
 - solute diffuses out of vessels conducting blood towards the cortex
 - water diffuses out of ascending vessels
 - water diffuses into the collecting ducts
 - counter current exchange is passive and can operate even if counter current multiplication ceases
- 5 Renal autoregulation of GFR helps prevent large fluctuations in GFR despite wide variations in arterial blood pressure. With regard to autoregulation, which is TRUE?
- the macula densa cells sense change in afferent arteriolar pressure
 - falling GFR results in a feedback to decrease efferent arteriolar pressure
 - falling GFR results in an increase in renin secretion from macula densa cells
 - decreased macula densa concentration of NaCl results in dilation of afferent arterioles
 - decreased GFR decreases NaCl reabsorption in the ascending loop of Henle

- 6 What is the clearance of a substance when its concentration in plasma is 1mg/ml, its concentration in urine is 10mg/ml and the urine flow is 2ml/min
- 2ml/min
 - 10ml/min
 - 20ml/min
 - 200ml/min
 - clearance cannot be determined from the information given
- 7 Regarding the proximal tubule, the following statements are true EXCEPT:
- Na is co-transported out of the tubule with glucose
 - Na is actively transported into the intercellular spaces by Na-K ATPase
 - the cells are characterised by a brush border and tight junctions
 - vasopressin increases the permeability to water by causing the rapid insertion of water channels into the luminal membrane
 - water moves passively out of the tubule along osmotic gradients
- 8 With regard to the effect of hormones on renal tubules, which is CORRECT?
- aldosterone increases K reabsorption from the distal tubule
 - angiotensin II increases H⁺ secretion from the proximal tubules
 - ADH increases water reabsorption in the proximal tubule
 - atrial natriuretic peptide decreases Na⁺ reabsorption from the proximal tubules
 - parathyroid hormone increases phosphate reabsorption
- 9 The thin ascending loop of Henle is:
- relatively permeable to water
 - relatively impermeable to Na⁺
 - permeable to both water and Na⁺
 - relatively impermeable to water
 - relatively impermeable to both water and Na⁺
- 10 Action potential initiation in the sinoatrial and atrioventricular nodes results from:
- Na⁺ influx
 - K⁺ influx
 - Ca⁺⁺ influx
 - Na⁺ and Ca⁺⁺ influx
 - increased K⁺ conductance
- 11 Regarding isometric ventricular contraction:
- it occurs late in diastole
 - ventricular filling occurs
 - intraventricular pressure remains constant during this phase
 - it ends when the AV valve close
 - it ends when the AV valve open

- 12 Local vasoconstriction results from:
- increased potassium concentration
 - increased magnesium concentration
 - increased sodium concentration
 - decrease in pH
 - increased calcium concentration
- 13 In compensated low output cardiac failure:
- venous resistance is decreased
 - cardiac contractility is increased
 - mean systemic filling pressure is decreased
 - right atrial pressure is decreased
 - venous return is decreased
- 14 With regard to ascending to high altitudes:
- there is a linear decrease in inspired oxygen pressures with increasing altitude
 - the partial pressure of water vapour in moist inspired air decreases with P_{iO_2}
 - at 19,200m, barometric pressure = 47mmHg, P_{iO_2} then is approx 9mmHg
 - at peak at Mt Everest, barometric pressure = 380mmHg, P_{iO_2} is approx 70mmHg
 - in permanent residents of the Andes, arterial and venous PO_2 is half normal levels
- 15 A 28-year-old lady has taken an overdose of sedatives causing her to hypoventilate. Given that her arterial PCO_2 is now doubled to 80mmHg, which of the following is most likely to be correct, given that she is breathing room air at normal barometric pressures?
- arterial PO_2 will be approximately 70mmHg
 - arterial PO_2 will be approximately 35mmHg
 - arterial Hb O_2 saturation will be approximately 50%
 - arterial Hb O_2 saturation will be approximately 80%
 - arterial Hb O_2 saturation will be approximately 27%
- 16 Which of the following has the greatest effect on the ability of the blood to transport O_2 ?
- the capacity of the blood to dissolve O_2
 - the amount of Hb in the blood
 - the pH of the plasma
 - the CO_2 content of red blood cells
 - the temperature of the blood

- 17 The Haldane effect describes:
- the shift to the right of the O_2 dissociation curve caused by increased PCO_2
 - the enhanced loading of CO_2 in the presence of deoxygenated Hb
 - the shift of chloride ions into red blood cells to balance HCO_3^- shift from those cells
 - the action of carbonic anhydrase on carbonic acid
 - none of the above
- 18 With regard to CO_2 carriage in the blood:
- dissolved CO_2 has an insignificant role in the carriage of CO_2 in the blood
 - HCO_3^- production is fast in plasma
 - ionic dissociation of carbonic acid in the red cell is fast without an enzyme
 - the CO_2 concentration in blood is independent of the saturation of haemoglobin with oxygen
 - the majority of CO_2 is carried in the blood in the forms of dissolved CO_2 and carbamino-compounds
- 19 Substances cleared from the circulation by the lungs include all the following EXCEPT:
- angiotensin II
 - serotonin
 - leukotrienes
 - bradykinin
 - prostaglandin
- 20 With regard to the normal Hb-ox-y-en dissociation curve, which is the most likely to be CORRECT?
- when arterial $PO_2 = 60\text{mmHg}$, Hb saturation is $\sim 80\%$
 - when arterial $PO_2 = 40\text{mmHg}$, Hb saturation is $\sim 75\%$
 - when arterial $PO_2 = 30\text{mmHg}$, Hb saturation is $\sim 40\%$
 - acidosis shifts the curve to the left
 - decreased PCO_2 shifts the curve to the right
- 21 Increased lung compliance is associated with:
- increasing age
 - increasing pulmonary venous pressure
 - high expanding pressures
 - interstitial fibrosis
 - low lung volumes associated with hypoventilation

- 22 The following physiological events that occur in the body are listed in random sequence:
- decreased CSF pH
 - increased PaCO₂
 - increased CSF PCO₂
 - stimulation of medullary chemoreceptors
 - increased PACO₂

What is the usual sequence?

- a, b, c, d, e
 - d, a, c, b, e,
 - c, d, e, b, a,
 - e, b, c, a, d,
 - e, c, b, d, a
- 23 In relation to acid base balance in the body:
- respiratory compensation in metabolic alkalosis is limited by carotid and aortic chemoreceptor response
 - HCO₃ concentration will decrease in compensated respiratory acidosis
 - the rate of renal H⁺ secretion is not affected by PCO₂ in respiratory acidosis
 - chloride excretion is decreased in respiratory acidosis
 - hepatic glutamine synthesis is decreased in chronic metabolic acidosis
- 24 The action potential of a neuron:
- is initiated by efflux of Na⁺
 - is terminated by efflux of K⁺
 - declines in amplitude as it moves along the axon
 - results in transient reversal of the concentration gradient of Na⁺ across the cell membrane
 - is not associated with any net movement of Na⁺ or K⁺ across the cell membrane
- 25 The functions of tropomyosin in skeletal muscle include:
- releasing Ca⁺⁺ after an action potential
 - sliding on actin to produce shortening
 - binding to myosin during contraction
 - acting as a "relaxing protein" at rest by covering up the sites where myosin binds to actin
 - generating ATP which passes to the contractile mechanism
- 26 Regarding the autonomic nervous system:
- does not have a reflex like somatic nervous system
 - has dopamine as the main transmitter
 - has cholinergic division which increases activity of the intestinal musculature and increases gastric secretion
 - neurotransmitter noradrenaline is metabolised by pseudocholinesterase
 - is not involved with visceral sensation

- 27 Lymph flow is:
- an average 500ml/hr into the circulation
 - proportional to interstitial fluid pressure
 - increased with decreased interstitial fluid protein
 - decreased with contraction of muscles
 - decreased with elevated capillary pressure
- 28 Regarding the intracellular fluid, which is NOT CORRECT?
- it accounts for 40% of body weight
 - its volume can be estimated using radio-active inulin
 - it contains more protein (in mg/L water) than extracellular fluid
 - the composition of intracellular fluid varies with the nature and function of the cell
 - all of the above are true
- 29 Regarding extracellular volume maintenance:
- control of sodium balance is the major mechanism maintaining ECF volume
 - a rise in ECF volume stimulates vasopressin secretion
 - osmotic stimuli over-ride volume stimuli in the regulation of vasopressin secretion
 - vasopressin causes Na^+ retention by the kidney
 - angiotensin II inhibits aldosterone secretion
- 30 Regarding renal compensation in respiratory acidosis and alkalosis:
- the rate of HCO_3^- reabsorption is inversely proportional to the arterial PCO_2
 - in respiratory acidosis, HCO_3^- reabsorption is reduced
 - changes in plasma chloride concentration are proportional to HCO_3^- concentration
 - in respiratory alkalosis, renal H^+ secretion is increased
 - HCO_3^- reabsorption depends upon the rate of H^+ secretion by the renal tubular cells
- 31 Regarding calcium metabolism:
- approximately 60% of filtered calcium is reabsorbed by the kidney
 - absorption of calcium in the gastrointestinal tract is mainly by passive diffusion
 - the extent of Ca^{++} binding by plasma proteins is inversely proportionate to the plasma protein level
 - levels of 1,25-dihydroxycholecalciferol fall in the presence of increased plasma Ca^{++}
 - the majority of calcium present in bone is readily exchangeable

- 32 Toxins that increase the cyclic AMP content of the intestinal mucosa cause diarrhoea because they:
- a) increase Cl^- secretion into the intestinal lumen
 - b) increase Na^+ absorption in the small intestine
 - c) increase K^+ secretion into the colon
 - d) increase Na^+/K^+ co-transport K^+ secretion into the colon
 - e) none of the above
- 33 Which of the following is NOT synthesised in post-ganglionic sympathetic neurons:
- a) L-dopa
 - b) dopamine
 - c) noradrenaline
 - d) adrenaline
 - e) acetylcholine

Section 4

Answers

- | | |
|----|----|
| 1 | D |
| 2 | A |
| 3 | C |
| 4 | B |
| 5 | ? |
| 6 | C |
| 7 | D |
| 8 | B |
| 9 | D |
| 10 | C |
| 11 | E |
| 12 | E |
| 13 | D |
| 14 | D |
| 15 | D |
| 16 | B |
| 17 | B |
| 18 | C |
| 19 | A |
| 20 | B |
| 21 | A |
| 22 | D |
| 23 | A |
| 24 | B |
| 25 | D |
| 26 | C |
| 27 | B |
| 28 | B |
| 29 | A |
| 30 | E |
| 31 | D |
| 32 | A |
| 33 | ?C |