Questions 1- 3
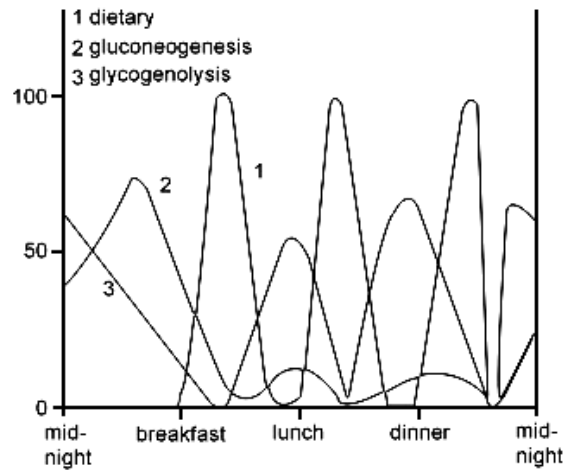

Figure 1

The sources of blood glucose in a human body during a normal day of 24 hours are shown in the above figure. Glucose is primarily derived from glycogenolysis occurring between meals. Glucose is chiefly sourced from the dietary intake for few hours following the principal meals of the day. Late at night, gluconeogenesis becomes the predominant source of glucose.

1   Glycogenolysis decreases after midnight because

A	gluconeogenesis takes place.	**B**	muscle glycogen is converted to glucose.
C	hepatic glycogen is depleted.	**D**	energy consumption is less after mid night.

2   The early morning glucose supply in the blood is provided by which of the following?

A	Diet	**B**	Glycogenolysis
C	Gluconeogenesis	**D**	Both B and C

3   The maximum contribution of blood glucose from gluconeogenesis occurs during which of the following time periods?

A	At midnight	**B**	After lunch
C	Before breakfast	**D**	Before dinner

Question 4

Regulation of blood glucose level is tightly controlled by feedback mechanisms in the body. Insulin is released from beta cells in the pancreas in response to the consumption of food. As glucose levels drop during fasting, the pancreas secretes glucagon from alpha cells that release glucose from body stores.
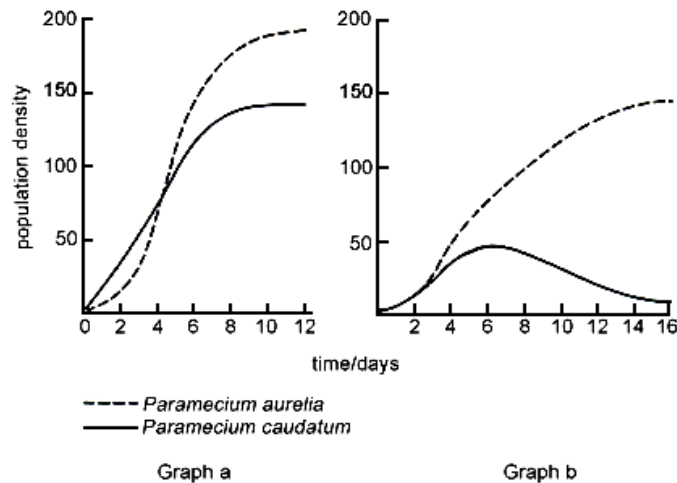
4   Thirty minutes after eating a large sweet meal including cake and candy, which of the following blood levels would be expected?

A	Low Glucose, low Insulin	**B**	High Glucose, low Insulin
C	Low Glucose, high Insulin	**D**	High Glucose, high Insulin

Unit 3

Questions 5-9

Figure 1

The population growth of two species of *Paramecium* is shown in the graphs above. Graph '*a*' shows the growth of both species when cultured separately, while graph '*b*' shows the growth of both *Paramecium* species cultured together. When the two species of *Paramecium* are cultured together, *Paramecium aurelia* has a competitive advantage over *Paramecium caudatum*. When the two species are grown separately, the growth of both species achieves a stationary phase after a certain interval of time.

5 When grown together, the population of *Paramecium caudatam* starts decreasing after

A	7 days.	**B**	6 days.
C	16 days.	**D**	8 days.

6 When both species of *Paramecium* are grown together, *Paramecium caudatum* shows a stationary phase of growth, after the

A	6th day.	**B**	12th day.
C	3rd day.	**D**	8th day.

7 Which of the following takes the longest time to achieve the stationary phase?

A *P. aurelia* when grown separately.
B *P. caudatum* when grown together with *P. aurelia.*
C *P. aurelia* when grown together with *P. caudatum.*
D *P. caudatum* when grown separately.

8 Which of the following statements regarding the growth of *Paramecium* species is correct?

A Both the *Paramecium* species achieve a stationary phase whether grown separately or together.
B When grown separately, the population densities of each *Paramecium* species are the same after the 4th

day.
C   When grown together, neither of the *Paramecium* species will become extinct.
D   Both B and C

9   The competitive threat in *Paramecium* species when grown together is most likely due to a competition for

A	temperature.	**B**	oxygen.
C	nutrients.	**D**	both A and B.

Unit 4

Questions 10-13

Figure 1

10   Vasoconstriction in the blood vessels induced by angiotensin II raises the arterial pressure by increasing the

A	blood flow.	**B**	diameter of the Lumen of blood vessels.
C	peripheral resistance.	**D**	capillary hydrostatic pressure.

11   All of the following have enzymatic action in the renin-angiotensin pathway shown *EXCEPT*

A	angiotensinogen.	**B**	angiotensin converting enzyme.
C	angiotensinase.	**D**	renin.

12   Angiotensin II uses all of the following means in order to increase arterial pressure *EXCEPT*

A	water retention.	**B**	prevention of natriuresis.
C	arteriolar constriction.	**D**	dieresis.

13 ACE inhibitors are the drugs that inhibit the angiotensin-converting enzyme. Which of the following statements regarding this is true?

    A   It increases renal retention of salt and decreases arterial pressure.
    B   It decreases arterial pressure and increases the concentration of angiotensin I.
    C   It increases arterial pressure and decreases vasoconstrictions.
    D   It decreases renal retention of salt and increases arterial pressure.

Questions 14-17

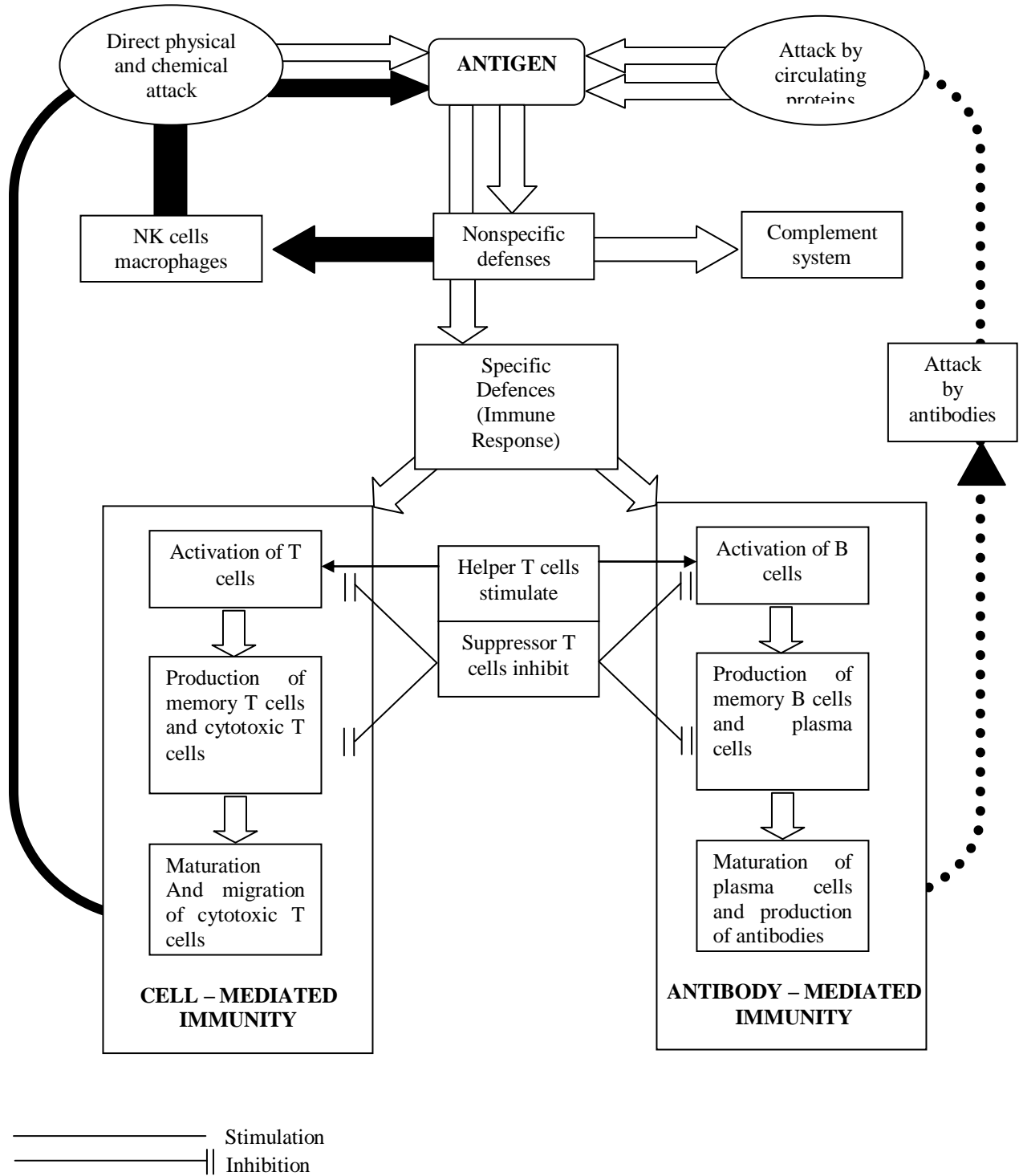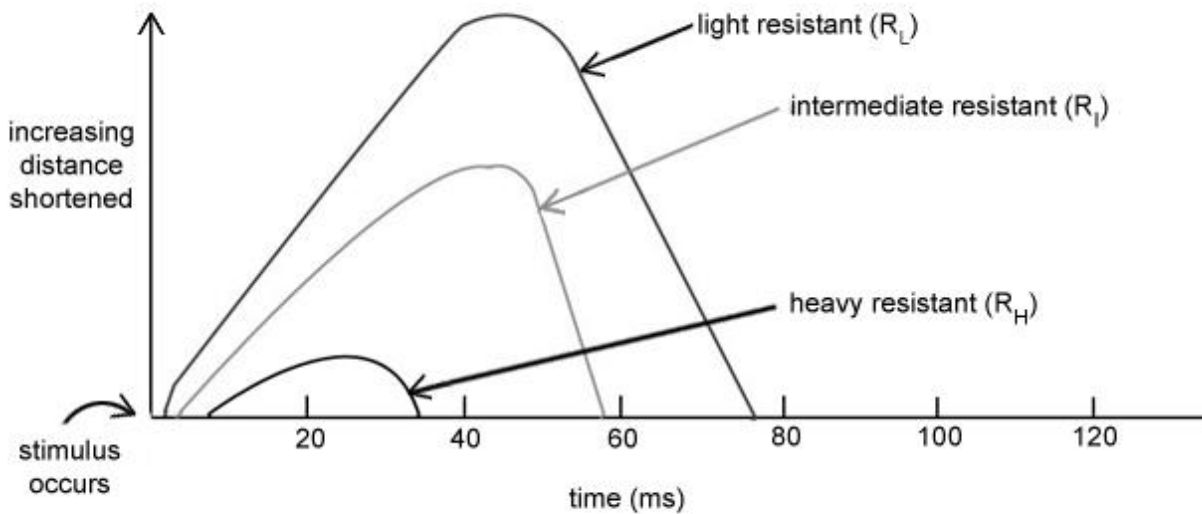The following diagram summarises an integrated response by the immune system.

Figure 1

14   What is not an immune response to an antigen?

A   Activation of T cells.   **B**   Activation of B cells.
C   Activation of NK cells and macrophages.   **D**   None of the above are immune responses.

15   What happens in the early stages of bacterial infection before antigen processing?

A   NK cells migrate into the infected area.
B   Neutrophils migrate into the infected area.
C T_S, T_C and T_H cells destroy the invading bacteria in a non-specific response.
D   A and B are both correct.

16   What causes the production of memory T cells and memory B cells?

A T_S cells.
B T_H cells stimulating the complement system.
C   Activation of T cells and B cells.
D   NK cells and macrophages.

17   What is the difference between specific and non-specific responses?

A   Specific defences protect against threats on an individual basis.
B   Specific defences stop pathogens invading the body.
C   Specific defences are present at birth.
D   Specific defences cannot distinguish between one pathogen or another.

Unit 6

Questions 18-20

You cannot lift a heavy object as quickly as a light object. The resistance and the speed of contraction are inversely related.
If the resistance is less, then the tension produced in the muscle will shorten. Muscle tension, which increases gradually, must exceed the resistance before muscle shortening will occur.
For any muscle, there is an optimal balance of speed and tension for any given resistance.

Speed of contraction and resistance

Figure 1

Original length of muscles is retained after contraction. Opposing muscle contractions, elastic forces and gravity play a major role in this. The heavier the resistance, the longer it takes for the muscle to begin to shorten and the less muscle is used.

18   Why can you lift a light object more quickly than a heavy object?

   A   The heavier the resistance, the longer it takes for movement to begin.
   B   The resistance and speed of contraction are directly proportional.
   C   Muscle tension must not exceed tension before any rapid shortening can occur.
   D   The resistance must be greater than the tension produced to involve a rapid shortening of muscle tissue.

19   What causes a muscle fibre to return to its original length?

   A   Opposing muscle contractions   **B**   Elasticity
   C   Muscle tone   **D**   Both A and B

20   Why can muscle contraction shorten further with a lighter resistance?

   A   It takes longer and less muscle is used.
   B   More muscle is used in a greater amount of time.
   C   Muscle contraction and gravity easily overcome the elastic forces in the muscle.
   D   Light intermediate and heavy resistance can both shorten the same maximum distance.

Questions 21-28

pulmonary circulation - 9%

pulmonary artery

pulmonary vein

aorta

superior
vena cava

heart - 7%

arteries - 13%

systemic
vessels

inferior
vena cava

arteries
and
capillaries - 7%

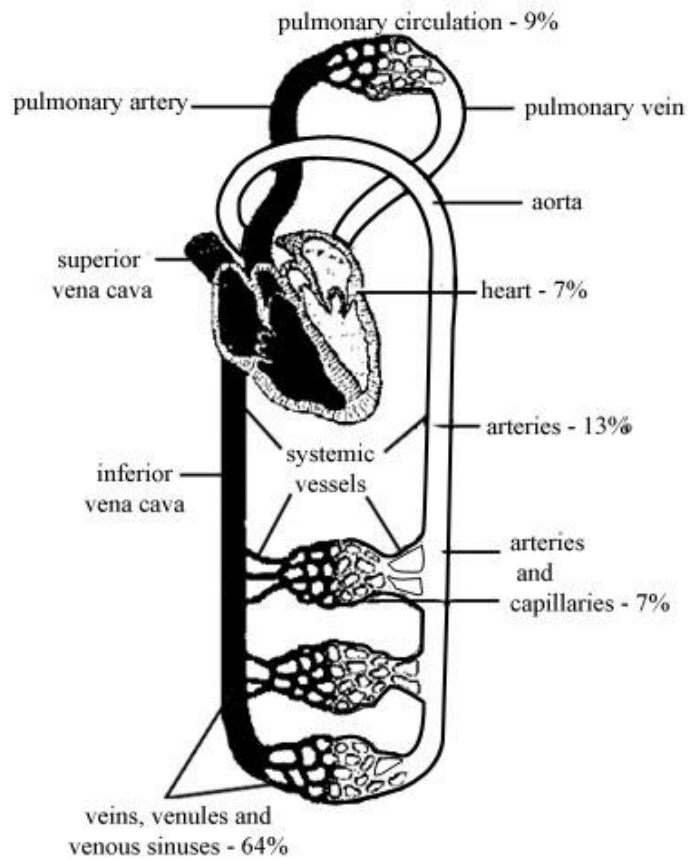veins, venules and
venous sinuses - 64%

Figure 1

The above diagram represents the pathway of systemic circulation and the blood vessels involved in it.

The chart below shows the dimensions of the different types of blood vessels.

Vessel	D (cm)	A (cm^2)	P (mm Hg)	v (cm/s)
Aorta	2.5	2.5	100	33
Small Arteries	0.5	20	100	30
Arterioles	3×10^{-3}	40	85	15
Capillaries	6×10^{-4}	2500	30	0.03
Venules	2×10^{-3}	250	10	0.5
Small veins	0.5	80	10	2
Venae Cavae	3.0	8	2	20

Use this information to answer the following questions:

21 Of the following generalizations applicable to the capillaries, choose the one that is incorrect.

    A Capillaries are the narrow blood vessels but have the largest cross-sectional area.

B Being the narrowest cross-section, the velocity of blood through the capillaries is the lowest because individual blood cells take time to squeeze through the narrow segments.

C The velocity of blood flow through the capillaries is lowest because of a sharp drop in pressure when the blood reaches the capillary from the previous segment arterioles.

D The increased transit time for the capillaries allows adequate time for the exchange of nutrients and gases.

22 Select the most correct response for the statement below.
As the blood leaves the capillaries and enters the venules, its speed increases measurably because of the following factors:

A the diameter of venules being larger than capillaries results in an automatic increase in the blood's velocity as the friction affecting the flow of blood is reduced dramatically.

B as the cross-sectional area of venules drop sharply, blood has to speed up in order to maintain flow rates.

C as blood leaves the capillaries, it tends to speed up because of the pumping effect of the right side of the heart leads to a negative suction that speeds up the blood flow.

D none of the above explanations is the correct reason.

23 Comparing the 2 diagrams the net drop in blood pressure as the blood runs a complete course through a systemic circulation circuit in mm of Hg is roughly

A 86. **B** 94.
C 98. **D** 100.

24 The forward flow of blood in the systemic circuit is maintained by the cardiac muscles pumping against the resistance of various segments of the systemic circulation. From the table find the segment that offers maximum peripheral resistance to cause the sharpest drop in blood pressure.

A Aorta to arterioles **B** Arterioles to capillaries
C Capillaries to vena cava **D** Venules to vena cava

25 Blood in the pulmonary veins differs from that found in all other veins. Which of the following statements provides the correct reason for this?

A Blood from the pulmonary veins does not flow into the heart.
B Blood in the pulmonary vein contains a higher percentage of sugar.
C Blood in the pulmonary veins is highly oxygenated.
D Blood in the pulmonary veins is under lower pressure.

26 Arterial walls are generally thicker and contain more elastic tissue than do veins. Based on the chart above, the best explanation for this is

A arteries have to withstand more pressure and increased blood velocity.
B arteries regulate blood pressure by constricting and relaxing.
C both A and B.
D none of the statements provide the reason for the statement.

27 Based on the chart above, the velocity of blood flow is

A in direct proportion to the total cross-sectional area of the blood vessels.
B slower in the arteries than in the capillaries since arteries have a relatively large diameter.
C slower in the veins than in the capillaries since veins have a large diameter.
D slowest in the capillaries since the total cross-sectional area is the greatest.

28 Two blood vessels, A and B, have diameters of 3 cm and 1.5 cm, respectively. Assuming that same volume of blood is flowing through both A and B, which of the following statements is correct regarding the blood pressure in the vessels?

    A   The pressure in vessel A will be greater than in vessel B.
    B   The pressure will be equal in both A and B.
    C   The pressure in vessel B will be greater than in vessel A.
    D   None of the above statements are correct.

Unit 8

Questions 29- 34

As a complete system, the amount of blood that flows through the circulatory system is in terms of the pressure difference between the arteries and the veins times the quantity referred to as the total peripheral resistance. Poiseuille's Law relates the rate at which blood flows through a small blood vessel (Q) depends upon the difference in blood pressure at the two ends (P), the radius (r) and the length (L) of the artery, and the viscosity (η) of the blood.

Vessel resistance (R) is directly proportional to the length (L) of the vessel, the (η) of the blood, and inversely proportional to the radius raised to the fourth power (r^4):

$$R \propto \frac{\eta \cdot L}{r^4}$$

If the above expression for resistance is combined with the equation describing the relationship between flow, pressure and resistance (F=ΔP/R), then:

$$F \propto \frac{\Delta P \cdot r^4}{\eta \cdot L}$$

This relationship is known as **Poiseuille's equation**.

29 Due to mucosal swelling, the radius of a bronchial tube has been reduced to one half of its original size. Before the swelling occurred, the gas flowed at a rate of 16 mL s^{-1}. What will be the flow rate through the bronchial tube after swelling ?

    A   14 mL s^{-1}.   **B**   16 mL s^{-1}.
    C   1 mL s^{-1}.   **D**   None of the above.

30 Athereosclerosis is a condition in which blood flow is hampered by an obstructed or narrowed blood vessel. Angioplasty is the technique of mechanically widening the blood vessel. Based on Poiseullie's law, the principle behind angioplasty can be stated as:

    A   It decreases blood flow by increasing the radius of blood vessel.
    B   It increases blood flow by slightly increasing the radius of a vessel.
    C   It increases blood flow by increasing the length of the blood vessel.
    D   It decreases blood flow by increasing the length of the blood vessel.

31 The flow rate of water through a uniform capillary of length L, radius R, is found to be 0.4 mL s^{-1}. Assuming, Poiseuille's law holds,

i) What is the flow rate if the length was doubled (with R unchanged)? and
ii) What is the flow rate if the radius was halved (with L having its original value)?

    A   0.200 mL s^{-1} and 0.025 mL s^{-1}.   **B**   0.025 mL s^{-1} and 0.200 mL s^{-1}.
    C   1.00 mL s^{-1} and 16.0 mL s^{-1}.   **D**   16.0 mL s^{-1} and 1.00 mL s^{-1}.

32 Poiseullie's equation is derived from the following assumptions:

i)   The fluid is in steady state. When the flow changes with time, this law is violated.
ii)   The flow is laminar.
iii)   The fluid is viscous.

In the case of blood flow through the heart, Poiseullie's law is not completely valid. This is because

A   all three assumptions mentioned above are not satisfied.
B   the flow is not laminar.
C   the heart beats periodically.
D   both A and C.

33 In large arteries, if the velocity of blood becomes too high and viscosity becomes too low, turbulence will occur. Based on Poiseullie's equation, what will be the effect of turbulence on blood flow?

A   Blood flow will increase greatly.
B   Blood flow will decrease.
C   Poiseullie's law is not be applicable to this situation.
D   Poiseullie's law is applicable to this situation

34 In terms of the human body, Poiseullie's law does not strictly apply as the expected outcomes applicable to the variables in the equation are rarely achieved in practice. Select the incorrect response that highlights the reasons why Poiseullie's law does not apply to an invivo system (in the human body).

A   Blood viscosity changes very little in human body, except in the course of diseases.
B   Blood vessel lengths do not undergo much change and are not a significant factor.
C   The radius of big blood vessels do not change much and the flow is not altered significantly.
D   Radius of small peripheral blood vessels like small arterioles change rapidly and are one of the major determinants of resistance to blood flow.

Questions 35-38

liver and gallbladder
bile secretion and ejection
gastrin release
food in stomach
increased acid production
(inhibition)
chyme in duodenum release of gastric inhibitory peptide (GIP)
cholecystokinin release (CCK)
endocrine
exocrine
hormones stimulate enzyme secretion
pancreas
insulin released
vasoactive intestinal peptide release - dilates capillaries (VIP)
materials enter jejunum
nutrients absorbed
tissue utilies nutrients

N.B. Chyme also in the duodenum release secretin.
This then produces alkaline buffers in the pancreas

The diagram shows the activities of the major digestive tract hormones. These hormones are:

Cholecystokinin CCK
Gastric inhibitory peptide, GIP
Vaso intestinal peptide, VIP
Gastrin
Secretin

35 What two hormones affect increased acid production and motility in the stomach?

A	GIP, VIP	**B**	CCK, secretin
C	GIP, CCK	**D**	CCK, VIP

36 Bile released from the gallbladder occurs following the release of which hormone?

A	VIP	**B**	GIP
C	CCK	**D**	Gastrin

37 The dilation of intestinal capillaries is caused by what stimulus and hormone?

    A   Chyme arriving in the duodenum, VIP   **B**   Vagus nerve stimulation, CCK
    C   Large quantities of facts and glucose, GIP   **D**   Partially digested proteins, VIP

38 Identify the correct pathway for the release of insulin.

    A   Chyme arrives in the duodenum-cholecystokinin released-insulin released.
    B   Chyme arrives in the duodenum-gastrin released-insulin released.
    C   Cholecystokinin released-stimulates gall bladder-insulin released.
    D   Chyme arrives in the duodenum-GIP released-insulin released.

Unit 10

Questions 39-40

In the Graph above, the metabolic rate of various mammals is calculated with per gram body mass using the logarithmic coordinates. As respiration is directly involved with the metabolic activities, the metabolic rate can be calculated by measuring the oxygen consumption.

39 Which of the following mammals has the highest metabolic rate?

    A   Wild fox   **B**   Adult male human
    C   Guinea pig   **D**   Horse

40 Which of the following mammals have metabolic rate of 900 mm^3 of oxygen per gm per hour?

    A   Rabbit   **B**   Mouse
    C   Rat   **D**   None of the these