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Measurement

CM01 [ackmo] As ambient temperature increases, heat loss increases by:

A. Radiation
B. Convection
C. Conduction
D. Evaporation
E. Vasodilatation
F. None of the above

Alternative versions of the stem:

- In hot climates, most heat is lost by:
- As ambient temperature increases above body temperature, the greatest % heat is lost by:
- In operating room, increased contribution of heat loss from:

(see also CM04 which may also be a version of this question)

CM02 [af] All are ways of measuring O2 in a gas mixture EXCEPT:

A. Paramagnetic analyser
B. Clark electrode
C. Infrared absorption - need more than one molecule
D. Mass spectroscopy
E. None of the above

CM03 [aefhk] With regard to oxygen:

A. The only gas that can reignite a glowing splint N2o
B. Causes pulmonary (?oxygen toxicity/?hypertension) at less than 100 kPa???maybe correct
C. Some CNS toxicity occurs at 100 kPa (? or: < 100kPa) needs 2ATM
D. Medical grade is 95% pure 99.9
E. Produced commercially by hydrolysis of water fractional distillation of air
F. May result in the reduction of alveolar lung volume if given at an FIO2 of 1.0

CM04 [cdhlr] A naked 70kg man in a theatre at 20C will lose most heat by:

A. Conduction to air molecules next to the patient
B. Conduction to the table
C. Radiation to OT equipment and walls
D. Convection
E. None of the above

CM05 [ci] A pulse oximetry reading is underestimated by:

A. Methaemoglobinaemia tendancy towards 85%
B. Carboxyhaemoglobinaemia similar at 660 ∴ overestimates
C. Foetal haemoglobin similar absortion at 660 & 940nm to HbA
D. Sickle cell anaemia no effect
Also remembered as:

CM06 [c] With respect to one mole each of CO2 and N2O, which is **untrue**?

A. Same weight
B. Same density Density is mass per volume. Equal volumes of gas, at the same temperature and pressure, contain the same number of molecules (Avagadro's Law). One mole of each gas will have the same mass, and the same volume(22.4L STPD if ideal) and so therefore the same density.
C. Same viscosity = measure of resistance of a fluid to deform under shear stress. is always indivdual to diff fluids
D. Same volume at STP
(Note: Both have MW of 44, so one mole of each will weigh 44G)

CM08 [dh] At an altitude of 5,500m (barometric pressure 380mmHg), assuming a normal pCO2 of 40mmHg, pAO2 will be:

A. 20mmHg
B. 30mmHg
C. 40mmHg
D. 50mmHg
E. 60mmHg
(see also RE29)

CM09 [d] According to the Hagen-Pouseille Law:

A. Flow varies inversely with resistance

B. Viscosity varies inversely with length
C. ?

CM10 [d] Turbulence is more likely with:

A. Small tube diameter
B. High density fluid
C. ?Increased/decreased length of tube no effect
D. ?Increased/decreased viscosity decreased
E. None of the above

CM11 [dfh] Pneumotachograph:

A. Can be used to measure peak airflow
B. Measures velocity and not flow measures pressure difference to determine flow
C. Is accurate at all flow rates inaccurate above certain flow velocity
D. Variable orifice flowmeter fixed
E. Can be used to measure volume if flow is integrated with respect to time
F. Unaffected by temperature heated gauze offsets this problem

It is based on the Hagen-Poiseuille Equation (in laminar flow, flow is proportional to pressure drop)

The gasses pass through a gauze screen / capillary network, with pressure transducers on either side of the screen.

The screen:

- maintains laminar flow
- Provides a fixed resistance that results in a pressure drop proportional to flow
- Can be heated to provide a constant temperature (constant viscosity and density) and to prevent moisture accumulation.

The pressure difference is transduced into an electrical signal by means of a pressure transducer.

Once a certain flow velocity is exceeded, turbulences appear (Re increases) - this makes the pneumotachograph inaccurate. Anaesthetic gases will alter viscosity, and provide a potential source of error.

CM12 [fhimn] Cardiac output measurement is most accurate with which method?

A. Direct Fick
B. Radionuclide angiocardiography
C. Gated pooling
D. LV angiogram
E. Transthoracic echocardiography
F. Thermodilution
(See also CM16)

Mar 02 version: Cardiac Output is best measured by:

A. Direct Fick
B. Gated radionuclear
C. Echocardiography
D. ?
E. ?

CM13 [f] Impedance:

A. Increases as the frequency of an AC current increases across a capacitor
B. Decreases as the frequency of an AC current increases across an inductor
C. Is constant across a resistor
D. All of the above
E. None of the above

CM13b Alt version:

As the frequency of an alternating current increases:

A. Impedance increases in a resistor
B. Impedance increases in a capacitor
C. Impedance increases in an inductor
D. All of the above
E. None of the above

CM13c [g] Impedance as AC frequency increases:

A. In a resistor - no change
B. In a capacitance - increases
C. In an inductor - decreases
D. All of the above

E. None of the above

1. Impedance generalises the concept of Resistance to AC circuits.(ref Wiki)
2. In a Resistor, the Impedance equals the resistance.
3. Across a Capacitor, Impedance is inversely proportional to the frequency of the AC current.
4. Across an Inductor, the Impedance is directly proportional to the frequency of the AC current.

CM14 [f] Oxygen manufacture:

A. Hydrolysis of water
B. ?? 95% pure 99.5% pure (0.4% argon)
C. ?

Fractional distillation: Air is compressed to 5 ATM and cooled to -181 celsius using reverse heat exchangers. A two stage distillation process yields 99.5% pure oxygen

Oxygen concentrators: zeolite mesh. Max conc reached is 95% with 5% argon

CM15 [f] According to Fick's law, diffusion is related:

A. Directly to thickness
B. Inversely to concentration gradient
C. Inversely to surface area
D. Inversely thickness
E. ?

CM16 [gi] Stroke volume is most accurately measured with:

A. Thermodilution
B. Thoracic bioimpedance
C. Doppler
D. Electromagneto-. . ? . .
E. Echocardiography TOE

CM17 [gk] When indocyanine green is used to measure hepatic blood flow, levels are taken from:

A. Hepatic vein & portal vein
B. Hepatic artery & portal vein
C. Radial artery & hepatic vein
D. Hepatic artery & hepatic vein
E. Radial artery & right atrium

CM18 [fj] Specific heat capacity of which of the following is the highest?

A. Stored whole blood
B. Red blood cells blood = lowest liquid
C. Muscle tissue
D. Water
E. Air lowest

July 00 version: The specific heat capacity is greatest in:

A. Packed red blood cells
B. Whole blood
C. Water
D. Saline?

CM20 [hk] Solubility of gases in blood (?at 37C):

A. O2 > CO2 > N2
B. N2O > CO2
C. CO2 > N2 > O2
D. . . (etc)
E. N20 < 02)

For BLOOD
Blood:gas solubility coefficients - N20 > CO2 > 02 > N2

Apr 2001 version: Regarding the solubility of gases in PLASMA

A Nitrous oxide is less soluble than carbon dioxide
B Carbon dioxide is less soluble than oxygen
C Carbon dioxide is less soluble than Nitrogen
D Nitrous oxide is less soluble than oxygen
E Nitrous oxide is less soluble than Nitrogen
F Oxygen is less soluble than Nitrogen

For plasma
Water:gas solubility coefficients - CO2 > N2O > 02 > N2

CM21 Renumbered as a version of CM05

CM22 [j] In a patient with pulmonary obstruction addition of helium to the inspired mixture:

A. Density is not altered

B. Flammability of mixtur is increased

C. Viscosity is minimally altered

D. Rotameter would not need to be recalibrated

E. Decreased O2 transfer

F. Solubility of oxygen is decreased

CM23 [j] For washout curve described by ?? y = y0 . e-k T/[illegible]

A. After 2 time constants 13.5% remains

B. 50% of substance remaining after 1 time constant

C. After 6 times constants y = e

D. After 2 half lives 90% has been removed

E. After 1 half life 37% remains

Time constant is the time taken for a negative exponential process to reach zero if it continued at its initial rate of change. One time constant equals:

- 0.37 of original amount
- half-life/ln2
- half-life/0.693
- volume/flow
- compliance*resistance

CM24 [j] Hagen-Poiseuille relationship:

A. ?? laminar flow
B. ?? turbulent flow
C. ?

There is no equation/law governing turbulent flow, however turbulent flow is proportional to:

- the square root of pressure gradient
- 1/length
- radius squared
- 1/ density of fluid

CM25 [k] Pulmonary artery catheter can be used for:

A. PCWP > LAP
B. Aplying Fick's principle, can be used to measure cardiac output
C. ?
D. ?
E. ?

A Pulmonary Artery Cathether is used for monitoring/measuring:

1. Pulmonary Artery Pressures.
2. Mixed Venous Oxygen Saturations and Blood Gas Analysis.
3. Temperature.
4. Pulmonary Artery Occlusion Pressure $\propto$ LVEDP $\propto$ LVEDV.
5. Cardiac Output by Thermodilution.

CM26 [l] An apparatus whereby an external voltage is applied to a silver/silver chloride anode and a platinum cathode would be best used to measure

A. Oxygen content
B. Oxygen partial pressure
C. Carbon dioxide content
D. Carbon dioxide partial pressure
E. pH
(This was Q50 on Jul 01 paper)

CM27 [l] For laminar flow:

A. Decreased by increased pressure
B. Influenced by viscosity
C. Influenced by density

D. Proprtional to length to 4th power

E. ?

CM28 [l] Carbon dioxide dissolved in blood follows which law?

A. Charles law
B. Avogadro's law
C. Henry's law
D. Dalton's law
E. Boyles law

Henry's Law deals with gases dissolved in solution. When the system is at equilibrium, the law states:

Amount of gas dissolved (mmol/l) = k x partial pressure of gas above solution (mmHg) where k is a solubility constant of the gas in the liquid phase, and its value for CO2 is 0.03 mmol/l.mmHg

- **Boyle's Law** states that at a constant temperature, the volume of a given mass of gas varies inversely with the absolute pressure. This is often expressed as: $P_1V_1 = P_2V_2$
- **Dalton's Law** states that for gases that are in a mixture, each gas exerts a pressure equal to the pressure it would exert if it alone occupied the volume. This pressure is referred to as "the partial pressure of that gas".

The sum of the partial pressures of all the gases present is equal to the total gas pressure.

- **Avogadro's Law** states that equal volumes of gases at the same temperatures and pressure contain equal numbers of molecules.
- **Charles' law** states that at constant pressure, the volume of a given mass of gas varies directly with the absolute temperature.

CM29 [l] Electroencephalogram (EEG):

A. Reticular activating system

B. Limbic system

C. Thalamus

D. Cortex

E. ?

CM30 [nop] Which of following does not utilises change in electrical resistance (wording?)

A.. *something about wire*

B. Strain gauge

C. Katharometer

D. Bourdon gauge Bourdon gauge measures pressure through mechanical unfurling of a gas-filled coil

E. Thermocouple

CM32 [q] Which combination of pulmonary artery catheter values is consistent with cardiogenic shock ?

A. High PCWP, low CI, high SVR SVR = MAP - RAP x 79.9/CO ∴
B. Low EF, high PCWP, low MAP PA catheter does not mention EF ∴ less right
C. High EF, low PCWP, low MAP

cardiogenic shock is characterised by:

- an increased HR,
- an increased SVR,
- a reduced SV, CO, CI,
- systemic hypotension (defined for cardiogenic shock as SBP<90mmHg for more than 30 min)
- an elevated PAOP (=PCWP)
- and metabolic acidosis

CM32b [r] Features of Cardiogenic shock CO PCWP Peripheral vessels

A decrease increase v.constriction
B decrease decrease v.constriction
C increase increase v.dilation
D decrease increase v.dilation
E increase decrease v.dilation

CM33 [q] When estimating LVEDV from PCWP, all of the following are assumptions except :

A. Normal Mitral valve overestimates LVEDV if there is abnormal mitral valve (MR or MS)

B. Normal LV compliance underestimates LVEDV if the LV is noncompliant

C. Normal airway pressures Measured PCWP overestimates LVEDV if there is increased PEEP (or airway pressure)

D. Normal LV systolic function does not interfere with end diastolic point in p-v loop

CM34 [qr] The attenuation of ultrasound is NOT affected by :

A. Frequency

B. Velocity

C. The number of interfaces

D. Wavelength

E. Type of tissue

CM35 [r] Which is the derived SI unit for pressure measurement?

A. mmHg
B. cmH2O
C. atm
D. torr
E. pascal

CM36 Which of the following is NOT a base SI unit?

A. metre
B. ampere
C. candela (*A unit for luminosity - how bright! or NOT!*)
D. kelvin
E. Newton

CM37 Which is true regarding the Clarke electrode?

A. Has a Ag/AgCl cathode and a platinum anode. Ag/AgCl anode
B. Can measure pO2 in both gas and blood sample.
C. Uses a 0.6 amp polarising current. 0.6V
D. Is accurate despite changing temperature. must be 37deg
E. Is calibrated using a special electrical device. standardised gas mixtures

CM38 [Jul09] [Mar10] [Jul10] Regarding Raman scattering:

A. The wavelength remains unchanged
B. It is a form of mass spectroscopy
C. ?... the emitted photon has the same wavelength
D. Only occurs with ?monoatomic molecule -OR- Can only be used to measure one gas at a time
E. Can be used to measure the concentration of a gas

CM39 Jul10 ECG R wave in V1 compared to V5

A. Bigger than
B. Smaller than
C. Proportional to
D. Not related

E. ?

CM40 [Feb12] Henry's law states:

A. The amount of gas dissolved is directly proportional to the partial pressure of the gases above it.
B. ?
C. ?
D. ?
E. ?