Section 1 – Questions

Physics and Clinical Measurement Questions

Q 1. With respect to damping

A. Damping does not apply to electrical devices
B. Damping affects the step response of the system
C. Underdamping results in overestimation
D. Overdamping results in overestimation
E. Critical damping refers to the fastest steady state reading of the system with no oscillation

Q 2. Concerning the gas laws

A. Boyle's law refers to the relationship between temperature and pressure of a gas
B. Temperature is measured on the absolute temperature scale
C. Temperature is a constant in Charles' law
D. Boyle's law states that at a constant volume, pressure varies with temperature
E. The gas laws are only true for air

Q 3. The critical temperature of a gas is that

A. Below which it solidifies
B. Above which it will not liquefy despite increased pressure
C. At which it sublimes
D. At which it liquefies if pressure is decreased
E. At which kinetic energy is zero

Q 4. The following are correct SI Units

A. The unit of energy is newton
B. The unit of power is watt
C. The unit of frequency is hertz
D. The unit of mass is gram
E. The unit of length is metre

Q 5. The peak expiratory flow rate (PEFR)

A. In normal adults is often more than 500 l/min
B. Can be measured by a pneumotachograph
C. Can be measured by the Wright's peak flow meter
D. Increases with age
E. Can be improved by training

Q 6. The amount of gas dissolved in a liquid

A. Increases as the temperature of the liquid increases
B. Is proportional to the pressure of the gas in contact with the liquid
C. Is influenced by the presence of other dissolved gases
D. Exerts the same 'tension' as the partial pressure of the gas in contact with the liquid at equilibrium
E. Is proportional to the molecular weight of the gas

Q 7. The laminar flow of a gas through a tube is

A. Proportional to the square root of the pressure drop along the tube
B. Proportional to the length of the tube
C. Proportional to the fourth power of the diameter
D. Inversely proportional to the square of the viscosity of the gas
E. Inversely proportional to the square root of the density of the gas

Q 8. A thermistor

A. Is a type of transducer
B. Comprises a junction of dissimilar metals
C. Is used for electrical measurement of temperature
D. Can be used in a Wheatstone bridge circuit
E. Is very delicate

Q 9. The following are derived SI units

A. pascal
B. hertz
C. joule

D. newton
E. coulomb

Q 10. When five 2 V batteries are joined in series across a resistance of 1 megaohm the current flowing in the circuit is

A. 0.2 A
B. 0.01 mA
C. 0.001 A
D. 0.00001 A
E. 0.005 mA

Q 11. Critical temperature is

A. The temperature at which a liquid will change into a vapour without heat being required
B. The temperature above which a gas cannot be liquefied by pressure
C. The temperature at which latent heat of vapourisation becomes maximal
D. The temperature at which latent heat of vapourisation becomes zero
E. The temperature above which a substance cannot exist in a liquid state

Q 12. Vapour concentration in a breathing system may be monitored by

A. Infrared gas analysis
B. Ultraviolet gas analysis
C. Paramagnetism
D. Mass spectrometry
E. Gas chromatography

Q 13. Pressure gauges on anaesthetic machines

A. Are calibrated in newtons
B. Control flow rate
C. Can be used to measure gas flow
D. Work on the principle of the Bourdon gauge
E. Reduce high to low pressure

Q 14. The following affect turbulent flow

A. Length of tube
B. Radius of tube
C. Drop in pressure
D. Density of fluid
E. Viscosity of fluid

Q 15. Latent heat of vapourisation

A. Is lower at high temperatures
B. Is the energy required to change a liquid to a vapour without a change in temperature
C. Is zero at the critical temperature
D. SI units are joule/kg
E. Is responsible for the majority of heat loss from the respiratory tract

Q 16. Surgical diathermy

A. Requires a large plate area
B. Uses a sinusoidal waveform
C. Requires the plate to be sited over an area with good blood supply
D. Operates at frequencies below 400 kHz
E. Always requires an earth

Q 17. With respect to humidifiers

A. Ideal droplet size is one micron diameter
B. There may be a risk of scalding
C. The Bernoulli effect may be employed
D. Water baths are more efficient than nebulisers
E. Infection may be introduced

Q 18. Boyle's law relates to

A. Ideal gases only
B. Pressure and volume
C. Constant temperature
D. Boyle's bottle
E. An inverse relationship between pressure and volume

Q 19. Cooling during surgery can be decreased by

A. Ambient theatre temperature of 20°C
B. Space blankets
C. Warmed intravenous fluids
D. Phenothiazines
E. Humidified gases

Q 20. One mole of a gas

A. Occupies 22.4 l at room temperature
B. Has the same volume for any gas
C. Contains Avogadro's number of molecules
D. May be liquefied by compression if above critical temperature
E. Is one gram molecular weight

Q 21. A rise in temperature

A. Increases liquid vapourisation
B. Can be measured by a Bourdon gauge
C. Increases the amount of gas dissolved in a liquid
D. Moves the oxyhaemoglobin saturation curve to the left
E. Is related to saturated vapour pressure (SVP)

Q 22. The rate of gas diffusion through a membrane is directly proportional to

A. Pressure
B. Membrane surface area
C. Membrane thickness
D. Gas molecular weight
E. Gas solubility

Q 23. A thermistor

A. Demonstrates the Seebeck effect
B. Shows a linear relationship between resistance and temperature
C. Has a resistance that changes with time
D. Exhibits hysteresis
E. Has a negative temperature coefficient of resistance

Q 24. Pressure

A. Relates force to area
B. Relates flow to area
C. Can be measured by a column of fluid
D. SI unit is newtons per square metre
E. Is the force acting per unit mass

Q 25. The following are fundamental SI units

A. Degree Celsius
B. Candela
C. Metre per second
D. Ampere
E. Mole

Q 26. Concerning pulse oximetry

A. Oxyhaemoglobin and deoxyhaemoglobin light absorption is equal at the isobestic point of 660 nm
B. Measurements are accurate in the presence of carboxyhaemoglobin
C. Measurements are accurate in the presence of high levels of bilirubin
D. Measurements are accurate in the presence of pigmented skin
E. Saturation of venous blood may be recorded

Q 27. Surgical diathermy

A. Commonly delivers 1 kW of power
B. Operates at frequencies around 10 kHz
C. Requires good contact of the indifferent electrode
D. May be unipolar or bipolar
E. May be safely used on patients having cardiac pacemakers

Q 28. With respect to electrical equipment

A. Double insulated equipment can be used in wet areas
B. Class 1 equipment is double insulated
C. The patient should be connected to earth
D. Class 2 equipment is fully earthed
E. Class 3 equipment is low voltage

Q 29. With respect to humidity

A. Absolute humidity is independent of temperature
B. Relative humidity is independent of temperature
C. Relative humidity in the operating theatre should exceed 50%
D. Humidity may be measured by electrical transducers
E. Regnault's hygrometer uses a hair

Q 30. Doppler ultrasound

A. Uses transducer crystals to transmit and receive ultrasound
B. Transducers may be placed directly on the skin
C. Can be used to measure blood pressure
D. Is unaffected by movement
E. Measurements are affected by diathermy

Q 31. When gas flows through a tube

A. Laminar flow implies that flow is smooth and parallel to the wave of the tube
B. With laminar flow, resistance is inversely proportional to the diameter of the tube
C. Above the critical flow rate, turbulent flow results
D. At a restriction, sharp curve or valve, turbulent flow develops
E. When turbulent flow develops, flow is inversely proportional to the square of the gas density

Q 32. Regarding biological signals

A. EEG signals have a voltage of 50 mV
B. EEG signals have frequencies up to 60 Hz
C. ECG signals have voltages of 0.1–500 mV
D. EMG signals may extend up to 1 kHz
E. Signal-to-noise ratio is the ratio of noise amplitude to signal amplitude expressed in decibels

Q 33. With respect to the measurement of gas flow

A. The rotating bobbin is an example of a constant orifice device
B. The Fleisch pneumotachograph is an example of a variable orifice flowmeter

C. Gases which have the same density will give similar readings in a rotating bobbin flowmeter at high flows
D. If a bobbin does not spin, the reading will be inaccurate
E. At the narrowest part of a Venturi, the pressure of gas will fall

Q 34. The following are true of an ideal gas

A. The volume of a given mass of gas at a given pressure is inversely proportional to its temperature
B. At constant temperature, the volume of a given mass of gas is directly proportional to its pressure
C. At absolute zero, the volume of a gas would be one volume percent
D. At a given temperature and pressure, one mole of any gas occupies the same volume as one mole of any other gas
E. The ideal Gas law is a combination of Boyle's and Charles' laws

Q 35. Humidity

A. Expressed in absolute units, relates the amount of water present to the maximum amount possible at that temperature
B. Expressed in absolute units, is the mass of water in unit volume of gas at standard temperature and pressure
C. Is a measure of the total water content in the gas, both vapour and droplets
D. Expressed in relative units, compares the humidity at ambient temperature to that at absolute zero
E. In the lungs is usually 95–100% of the maximum possible

Q 36. Sources of error in arterial pressure monitoring include

A. Air bubbles
B. Rigid catheters
C. Blood clots
D. Lack of a zero point
E. Transducers with a high frequency response