Society of Mechanical Ventilation

1) C

The alveolar gas equation is expressed as: $\mathbf{PAO_2 = FIO_2(P_B\text{-}P_{H20}) - PaCO_2/RQ}$
FIO_2: Fraction inspired oxygen, PB: atmospheric barometric pressure at sea level (760 mmHg), PH_2O: barometric pressure of water (47 mmHg), $PaCO_2$: partial pressure of arterial carbon dioxide, RQ: respiratory quotient (0.8)

2) C

Using the above equation, The PAO_2 with FiO2 0.21 at sea level is 101 mmHg, assuming normal A-a gradient of 10, the expected PaO2 is about 90

Estimated A-a gradient = 2.5 X (0.25 X Age)

3) D

Using the above equation, the PAO2 = 650 mmHg, the PaO_2 is 450 mmHg, so difference is very wide of 200 mmHg indicating abnormal physiology.

4) D

As the PaCO2 decrease, the PAO_2 will increase and vice versa
50/0.8 – 30/0.8 = 25 mmHg

5) D

According to the PCO_2 equation, $\mathbf{PaCO_2 = VCO_2 \ X\ 0.863 / Valv}$
= 268 X 0.863 /3.9
= 59.3

6) B

According to the Bohr's equation. The dead space VD

$$\frac{V_d}{V_t} = \frac{P_a\mathrm{CO_2} - P_e\mathrm{CO_2}}{P_a\mathrm{CO_2}}$$

VD = 500 X (50-40) / 50

7) B

According to the Winter's formula: the expected $PaCO_2 = 1.5 \text{ X } (HCO3) + 8 \pm 2$
$= 21 - 25$

The measured PaCO2 is higher than expected and thus pointing to hypoventilation (respiratory acidosis), if number is less than 21 then hyperventilation (respiratory alkalosis).

8) B

The oxygen content formula: **$CaO_2 = [(1.34 \text{ x } Hgb \text{ x } SaO_2) + (0.003 \text{ x } PaO_2)$**

9) B

Oxygen delivery: $DO_2 = CO \text{ X } CaO_2$
$= 2.5 \text{ X } 11.5$
$= 278$ ml/min

10) C

Mechanical power of ventilator = VE X (Peak pressure + PEEP + Flow/6) / 20
VE: minute ventilation
$= 9 \text{ X } (30 + 8 + 8.3) / 20$
$= 20.83$

Mechanical power is highly related to VILI (Ventilator Induced Lung Injury)