

FORMULAS

Respiratory Coach

Ideal Body Weight

Females $[105 + 5 (\text{inches} - 60)] / 2.2$

Males $[106 + 6 (\text{inches} - 60)] / 2.2$

Respiratory Coach

Females $45.5 + 2.3 (\text{inches} - 60)$

Males $50 + 2.3 (\text{inches} - 60)$

Ideal Body Weight

What is the ideal body weight for a 76 year old female that is 5 feet and 2 inches tall?

Respiratory Coach

You are taking care of a 45 year old male (5'11") in the ED who presents with dyspnea and...

Ideal Body Weight

You are taking care of a 45 year old female (163 cm) in the ED who presents with...

Respiratory Coach

Ventilation

Respiratory Coach

Minute Ventilation

$$V_e = V_t \times RR$$

$$V_t = V_e / RR$$

Respiratory Coach

$$RR = V_e / V_t$$

Minute Ventilation

Your patient is breathing 16 breaths per minute at an average tidal volume of 450 mL. What is their minute ventilation?

Respiratory Coach

Minute Ventilation

Your patient is receiving a minute ventilation of 8.4 LPM with a set breath rate of 20 bpm. What is the set tidal volume?

Respiratory Coach

Minute Ventilation

Your patient has an average tidal volume of .350L with a total minute volume of 10.5L. What is their breathing frequency?

Respiratory Coach

Arterial to End Tidal Gradient

$$P(a-et)CO_2 = PaCO_2 - EtCO_2$$

Respiratory Coach

Arterial to End Tidal Gradient

Your patient is receiving mechanical ventilation with settings below. Arterial blood gas results and other monitoring tools are listed below. What is the patients P(a-et)CO₂?

Respiratory Coach

Mode	VC-AC
Vt	420 mL
RR	20 bpm
PEEP	7 cmH ₂ O
FiO ₂	.50

pH	7.35
PaCO ₂	42 mmHg
PaO ₂	72 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
BP	124/76 mmHg
Temp	98.6 F
ETCO ₂	28 mmHg
ICP	16 mmHg

Dead Space

Dead space = (PaCO₂ - PetCO₂) / PaCO₂

Respiratory Coach

Dead Space

Considering the information below. What is the patient's percent dead space?

Respiratory Coach

Mode	VC-AC
Vt	420 mL
RR	20 bpm
PEEP	7 cmH2O
FiO2	.50

pH	7.35
PaCO2	42 mmHg
PaO2	72 mmHg
HCO3	24 mEq/L
SaO2	94%

HR	94 bpm
BP	124/76 mmHg
Temp	98.6 F
ETCO2	28 mmHg
ICP	16 mmHg

Dead Space

Considering the information below. What is the patient's percent dead space?

Respiratory Coach

Mode	VC-AC
Vt	420 mL
RR	20 bpm
PEEP	7 cmH2O
FiO2	.50

pH	7.35
PaCO2	47 mmHg
PaO2	72 mmHg
HCO3	24 mEq/L
SaO2	94%

HR	94 bpm
BP	124/76 mmHg
Temp	98.6 F
ETCO2	14 mmHg
ICP	16 mmHg

Dead Space

Considering the information below. How much of the set tidal volume is NOT participating with gas exchange?

Respiratory Coach

Mode	VC-AC
Vt	420 mL
RR	20 bpm
PEEP	7 cmH2O
FiO2	.50

pH	7.35
PaCO2	47 mmHg
PaO2	72 mmHg
HCO3	24 mEq/L
SaO2	94%

HR	94 bpm
BP	124/76 mmHg
Temp	98.6 F
ETCO2	14 mmHg
ICP	16 mmHg

Oxygenation

Respiratory Coach

Alveolar Air Equation

$$PAO_2 = [(P_b - P_{H_2O}) \times F_{iO_2}] - (P_aCO_2 / RQ)$$

Respiratory Coach

Alveolar Air Equation

Considering the information below for a patient breathing room air at sea level. What is the patient's alveolar partial pressure of oxygen?

pH	7.35
PaCO ₂	47 mmHg
PaO ₂	72 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

Alveolar Air Equation

Considering the information below for a patient on a 50% venturi mask at sea level. What is the patient's PAO₂?

pH	7.35
PaCO ₂	38 mmHg
PaO ₂	92 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

Respiratory Coach

Alveolar to Arterial Gradient

$$P(A-a)O_2 = PAO_2 - PaO_2$$

Respiratory Coach

Alveolar to Arterial Gradient

Considering the information below for a patient breathing room air at sea level. What is the patient's alveolar to arterial oxygen gradient?

pH	7.35
PaCO ₂	47 mmHg
PaO ₂	72 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

Alveolar to Arterial Gradient

Considering the information below for a patient on a 50% venturi mask at sea level. What is the patient's P(A-a)O₂?

pH	7.35
PaCO ₂	38 mmHg
PaO ₂	92 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

Arterial to Alveolar Ratio

$$a/A = PaO_2 / PAO_2$$

Respiratory Coach

Arterial to Alveolar Ratio

Considering the information below for a patient breathing room air at sea level. What is the patient's arterial to alveolar oxygen ratio?

pH	7.35
PaCO ₂	47 mmHg
PaO ₂	72 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

Arterial to Alveolar Ratio

Considering the information below for a patient on a 50% venturi mask at sea level. What is the patient's a/A ratio?

pH	7.35
PaCO ₂	38 mmHg
PaO ₂	92 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

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P/F Ratio

$$P/F \text{ Ratio} = PaO_2 / FiO_2$$

Respiratory Coach

P/F Ratio

Considering the information below for a patient breathing room air at sea level. What is the patient's PaO₂ to FiO₂ ratio?

pH	7.35
PaCO ₂	47 mmHg
PaO ₂	72 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

P/F Ratio

Considering the information below for a patient on a 50% venturi mask at sea level. What is the patient's P/F ratio?

pH	7.35
PaCO ₂	38 mmHg
PaO ₂	92 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%

HR	94 bpm
RR	18 bpm
Temp	98.6 F
MAP	84 mmHg
SpO ₂	95%

Oxygenation

Compare the oxygenation of the following two patients.

PaO ₂	70 mmHg
PaCO ₂	40 mmHg
FiO ₂	.40
PAO ₂	
P(A-a)O ₂	
a/A ratio	
P/F ratio	

PaO ₂	90 mmHg
PaCO ₂	40 mmHg
FiO ₂	1.0
PAO ₂	
P(A-a)O ₂	
a/A ratio	
P/F ratio	

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Total Arterial Oxygen Content

$$CaO_2 = (Hgb \times 1.34 \times SaO_2) + (PaO_2 \times .003)$$

Respiratory Coach

Total Arterial Oxygen Content

Calculate and compare the total O₂ content for the following two scenarios:

pH	7.35
PaCO ₂	38 mmHg
PaO ₂	112 mmHg
HCO ₃	24 mEq/L
SaO ₂	94%
Hgb	6 g/dL

pH	7.35
PaCO ₂	50 mmHg
PaO ₂	62 mmHg
HCO ₃	34 mEq/L
SaO ₂	94%
Hgb	18 g/dL

Respiratory Coach

Total Venous Oxygen Content

$$CvO_2 = (Hgb \times 1.34 \times SvO_2) + (PvO_2 \times .003)$$

	ABG	VBG
pH	7.41	7.33
PCO ₂	40	46
PO ₂	90	30
HCO ₃	24	24
Hgb	14	14
SaO ₂	100%	58%

Respiratory Coach

Arterial to Venous Oxygen Content Gradient

$$C(a-v)O_2 = CaO_2 - CvO_2$$

Respiratory Coach

Arterial to Venous Oxygen Content Gradient

Using the information below calculate and compare the patient's $C(a-v)O_2$ with the next example.

	ABG	VBG
pH	7.41	7.33
PCO ₂	40	46
PO ₂	90	45
HCO ₃	24	24
Hgb	14	14
SaO ₂	100%	75%

Arterial to Venous Oxygen Content Gradient

Using the information below calculate and compare the patient's C(a-v)O₂ with the prior example.

	ABG	VBG
pH	7.41	7.33
PCO ₂	40	46
PO ₂	90	30
HCO ₃	24	24
Hgb	14	14
SaO ₂	100%	55%

Mechanical Ventilation

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Tidal Volume

Initial Vt = IBW X 6-8 mL

Respiratory Coach

Tidal Volume

Which of the following is an appropriate initial tidal volume for a male patient that is 242 lbs, 5'8" tall.

Respiratory Coach

- a. 375 mL c. 575 mL
b. 430 mL d. 750 mL

Tidal Volume

Which of the following is an appropriate initial tidal volume for a female patient that is 5'4" tall.

Respiratory Coach

- a. 350 mL c. 500 mL
b. 475 mL d. 650 mL

Desired PaCO₂

$$\text{Desired RR} = \frac{\text{Known RR} \times \text{Known PaCO}_2}{\text{Desired PaCO}_2}$$

Respiratory Coach

$$\text{Desired Vt} = \frac{\text{Known Vt} \times \text{Known PaCO}_2}{\text{Desired PaCO}_2}$$

Desired PaCO₂

Considering the information below, what is best respiratory rate to achieve a PaCO₂ of 40 mmHg?

pH	7.31	Mode	CMV
PaCO ₂	56 mmHg	RR	12
PaO ₂	92 mmHg	Vt	420 mL
HCO ₃	24 mEq/L	FiO ₂	.5
SaO ₂	94%	PEEP	5 cmH ₂ O

Desired PaCO₂

Considering the information below, what is best tidal volume to achieve a PaCO₂ of 40 mmHg?

pH	7.31	Mode	CMV
PaCO ₂	56 mmHg	RR	16
PaO ₂	92 mmHg	Vt	320 mL
HCO ₃	24 mEq/L	FiO ₂	.5
SaO ₂	94%	PEEP	5 cmH ₂ O

Desired PaO2

$$\text{Desired FiO}_2 = \frac{\text{Known FiO}_2 \times \text{Desired PaO}_2}{\text{Known PaO}_2}$$

Respiratory Coach

$$*P/F = P/F$$

Desired PaO2

Considering the information below, what is best FiO2 to achieve a PaO2 of 80 mmHg?

pH	7.37
PaCO2	44 mmHg
PaO2	52 mmHg
HCO3	24 mEq/L
SaO2	94%

Mode	CMV
RR	16
Vt	320 mL
FiO2	.3
PEEP	5 cmH2O

Dynamic Compliance

$$C_{\text{dyn}} = V_t / (\text{PIP} - \text{PEEP})$$

Respiratory Coach

Dynamic Compliance

Considering the information below, what is the patient's dynamic compliance?

Mode	CMV
RR	16
Vt	320 mL
FiO2	.3
PEEP	5 cmH2O
Flow	60 LPM

Peak	36 cmH2O
Plateau	24 cmH2O
Mean	19 cmH2O
HR	104
MAP	90 mmHg

Static Compliance

$$C_{stat} = V_t / (P_{plat} - PEEP)$$

Respiratory Coach

Static Compliance

Considering the information below, what is the patient's static compliance?

Mode	CMV
RR	16
Vt	320 mL
FiO2	.3
PEEP	5 cmH2O
Flow	60 LPM

Peak	36 cmH2O
Plateau	24 cmH2O
Mean	19 cmH2O
HR	104
MAP	90 mmHg

Respiratory Coach

Airway Resistance

$$R_{aw} = (PIP - P_{plat}) / \text{Flow (lps)}$$

Respiratory Coach

Airway Resistance

Considering the information below, what is the patient's airway resistance?

Mode	CMV
RR	16
Vt	320 mL
FiO2	.3
PEEP	5 cmH2O
Flow	60 LPM

Peak	36 cmH2O
Plateau	24 cmH2O
Mean	19 cmH2O
HR	104
MAP	90 mmHg

Airway Resistance

Compare the previous data with the following patient values, in regards to compliance and resistance.

Mode	CMV
RR	16
Vt	320 mL
FiO2	.3
PEEP	5 cmH2O
Flow	60 LPM

Peak	39 cmH2O
Plateau	36 cmH2O
Mean	24 cmH2O
HR	104
MAP	90 mmHg

Total Cycle Time

TCT = Inspiratory Time + Expiratory Time

Respiratory Coach

$$\text{TCT} = 60 \text{ seconds} / \text{RR}$$

Total Cycle Time

If a patient has a respiratory rate/frequency of 20 breaths per minute, what is their total cycle time?

Respiratory Coach

How does that compare to a respiratory rate of 12 breaths per minute?

Inspiratory Time

$$T_{\text{insp}} = V_t / \text{Flow (lps)}$$

Respiratory Coach

Inspiratory Time

A patient has a respiratory rate/frequency of 20 bpm, V_t of 450 mL, and a flow of 40 lpm. What is their inspiratory time?

Respiratory Coach

What effect would increasing flow to 60 lpm have on inspiratory time?

Expiratory Time

$$T_{exp} = TCT - T_{insp}$$

Respiratory Coach

Expiratory Time

A patient has a respiratory rate/frequency of 20 bpm, V_t of 450 mL, and a flow of 50 lpm. What is their expiratory time?

Respiratory Coach

What effect would increasing frequency to 24 bpm have on expiratory time?

I:E Ratio

$$\text{I:E Ratio} = \frac{T_{\text{insp}}}{T_{\text{insp}}} : \frac{T_{\text{exp}}}{T_{\text{insp}}}$$

Respiratory Coach

I:E Ratio

A patient has a respiratory rate/frequency of 15 bpm, V_t of 400 mL, and a flow of 60 lpm. What is their I:E ratio?

Respiratory Coach

Compare these results with the next 2 slides.

I:E Ratio

A patient has a respiratory rate/frequency of 20 bpm, V_t of 400 mL, and a flow of 60 lpm. What is their I:E ratio?

Respiratory Coach

Compare these results with the next.

I:E Ratio

A patient has a respiratory rate/frequency of 15 bpm, V_t of 400 mL, and a flow of 40 lpm. What is their I:E ratio?

Respiratory Coach

Suction Catheter Size

Catheter size = (ETT size X 3) / 2

Respiratory Coach

Suction Catheter Size

A patient is receiving mechanical ventilation via an 7.5 ETT. What is the appropriate size suction catheter to facilitate secretion clearance?

Respiratory Coach

Rapid Shallow Breathing Index

$$\mathbf{RSBI = RR / Vt (L)}$$

Respiratory Coach

Rapid Shallow Breathing Index

Consider the following patient data for a patient during assessment of potential liberation from mechanical ventilation.

Spont RR	15 bpm
Spont Ve	6.8 LPM
Spont Vt	

Respiratory Coach

Compare these findings with the next example.

Rapid Shallow Breathing Index

Consider the following patient data for a patient during assessment of potential liberation from mechanical ventilation.

Spont RR	27 bpm
Spont Ve	5.5 LPM
Spont Vt	

Respiratory Coach

Compare these findings with the prior example.

Cuff Leak

$$\text{Cuff leak} = \frac{(\text{Exh Vt w/cuff up} - \text{Exh Vt w/cuff down})}{\text{Exh Vt w/cuff up}}$$

Respiratory Coach

$$*\text{Cuff leak} = (\text{Up} - \text{Down}) / \text{Up}$$

Cuff Leak

Upon assessment for extubation, the RT performs a cuff leak assessment and observes a 435 mL exhaled Vt with the cuff deflated. With the cuff inflated exhaled Vt was 450 mL. What should be recommended?

Respiratory Coach

Cuff Leak

Upon assessment for extubation, the RT performs a cuff leak assessment and observes a 105 mL exhaled V_t with the cuff deflated. With the cuff inflated exhaled V_t was 450 mL. What should be recommended?

Respiratory Coach

Gas Therapy

Respiratory Coach

Approximate FiO₂ with NC

$$\text{FiO}_2 = 20 + (4 \times \text{Set flow})$$

Respiratory Coach

Approximate FiO₂ with NC

A patient wearing a nasal cannula at 4 lpm is receiving approximately what FiO₂?

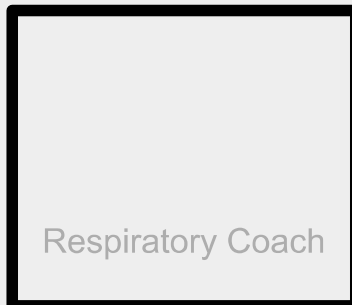
Respiratory Coach

Total Flow

Total Flow = Total parts X Set flow (lpm)

Respiratory Coach

Magic Box



Total Flow

Total Flow = Total parts X Set flow (lpm)

Respiratory Coach

Total Flow

What is the total flow for a patient receiving heated aerosol via a 40% tracheostomy collar set on 10 lpm?

Respiratory Coach

Cylinder Duration

E cylinder = (PSI X .28) / Flow (lpm)

H cylinder = (PSI X 3.14) / Flow (lpm)

Respiratory Coach

Cylinder Duration

How long will an E cylinder (1750 psi) last if the patient is on a NRB at 12 lpm?

Respiratory Coach

Compare to the next example.

Cylinder Duration

How long will an H cylinder (1750 psi) last if the patient is on a NRB at 12 lpm?

Respiratory Coach

Compare to the prior example.

Heliox

Actual flow = Conversion factor X Set flow (lpm)

$$80/20 = 1.8$$

$$70/30 = 1.6$$

Respiratory Coach

$$60/40 = 1.4$$

Heliox

What is the actual flow being delivered to the patient when delivering 80/20 heliox at 12 lpm with an oxygen calibrated flow meter?

Respiratory Coach

Cardiac Monitoring

Respiratory Coach

Cardiac Output

$$CO = SV \times HR$$

$$SV = CO / HR$$

Respiratory Coach

$$HR = CO / SV$$

Cardiac Output

Consider a patient with a heart rate of 65 bpm and a stroke volume of 90 mL. What is their cardiac output?

Respiratory Coach

Compare with the next example.

Cardiac Output

Consider a patient with a heart rate of 110 bpm and a stroke volume of 53 mL. What is their cardiac output?

Respiratory Coach

Compare with the prior example.

Mean Arterial Pressure

$$\text{MAP} = [\text{Systolic} + (\text{Diastolic} \times 2)] / 3$$

Respiratory Coach

Mean Arterial Pressure

What is the mean arterial pressure (MAP) for a patient with a blood pressure of 118/67 mmHg?

Respiratory Coach

Pulmonary Vascular Resistance

$$\text{PVR} = (\text{PAP} - \text{PCWP}) / \text{CO}$$

Respiratory Coach

Pulmonary Vascular Resistance

Considering the following hemodynamic values. What is the patient's pulmonary vascular resistance?

CVP	5 mmHg
PAP	25 mmHg
PCWP	7 mmHg
MAP	80 mmHg
QT	5 LPM

Respiratory Coach

Pulmonary Vascular Resistance

Considering the following hemodynamic values. What is the patient's pulmonary vascular resistance?

CVP	5 mmHg
PAP	15 mmHg
PCWP	7 mmHg
MAP	80 mmHg
QT	7 LPM

Respiratory Coach

Systemic Vascular Resistance

$$SVR = (MAP - CVP) / CO$$

Respiratory Coach

Systemic Vascular Resistance

Considering the following hemodynamic values. What is the patient's pulmonary vascular resistance?

CVP	2 mmHg
PAP	15 mmHg
PCWP	7 mmHg
MAP	80 mmHg
QT	4 LPM

Respiratory Coach

Systemic Vascular Resistance

Considering the following hemodynamic values. What is the patient's pulmonary vascular resistance?

CVP	5 mmHg
PAP	15 mmHg
PCWP	7 mmHg
MAP	90 mmHg
QT	7 LPM

Respiratory Coach

Pulmonary Function

Respiratory Coach

FEV1%

$$\text{FEV1\%} = \text{FEV1} / \text{FVC}$$

Respiratory Coach

FEV1%

Considering the following PFT values.
What is the patient's FEV1%?

	Actual	Pred
FVC (L)	2.9	4.4
FEV1 (L)	1.6	3.7
RV (L)	3.1	2.1
TLC (L)	8.0	6.2
DLCOcorr	11.6	32.2

Respiratory Coach

Compare with the next example.

FEV1%

Considering the following PFT values.
What is the patient's FEV1%?

	Actual	Pred
FVC (L)	1.8	4.4
FEV1 (L)	1.6	3.7
RV (L)	.87	2.1
TLC (L)	2.9	6.2
DLCOcorr	15.6	32.2

Respiratory Coach

Compare with the prior example.

Reversibility

$$\text{Reversibility} = \frac{(\text{Post FVC} - \text{Pre FVC})}{\text{Pre FVC}}$$

Respiratory Coach

Reversibility

Considering the following PFT values.
Assess the reversibility of the airway
obstruction.

Respiratory Coach

	Pre-BD	Pred	Post-BD
FVC (L)	2.9	4.4	3.7
FEV1 (L)	1.6	3.7	2.8

Compare with the next example.

Reversibility

Considering the following PFT values.
Assess the reversibility of the airway
obstruction.

Respiratory Coach

	Pre-BD	Pred	Post-BD
FVC (L)	2.9	4.4	3.19
FEV1 (L)	1.6	3.7	1.74

Compare with the prior example.