TARGET JIPMER MAY 2017 (Supplement)

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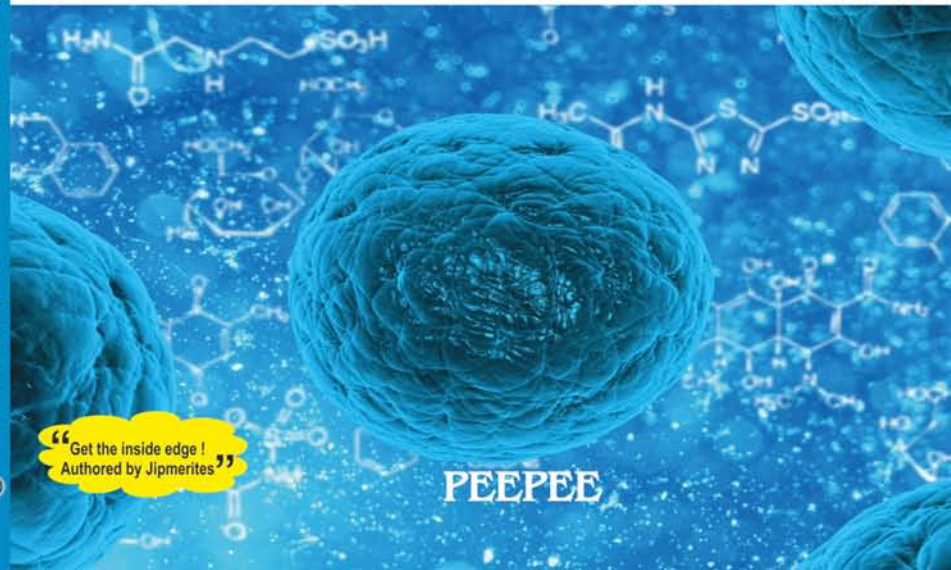


JIPMER–MAY 2017

ANATOMY

1. Fate of 6th aortic arch:

(a) Arch of aorta in between left common carotid artery and left subclavian artery
(b) Ductus arteriosus
(c) Right brachiocephalic
(d) Left subclavian artery

Explanation:

Aortic arch	Develops into
1st Aortic arch	***Maxillary artery****
2nd Aortic arch	***Hyoid artery**** ***Stapedial artery****
3rd Aortic arch	***Common carotid artery**** ***Proximal part of internal carotid and external carotid artery***
4th Aortic arch	**Left side:** ***Arch of aorta*** in between left common carotid artery and left subclavian artery **Right side:** Right ***subclavian artery***
5th Aortic arch	Disappear completely
6th Aortic arch	**Proximal part** – ***Pulmonary artery**** **Distal part disappear** on the **right side** but persist on the ***left side*** as ***ductus arteriosus****

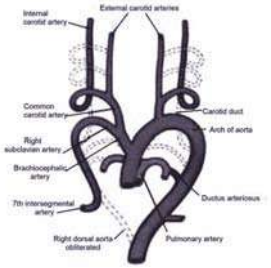


Fig: Development of aortic arches

Ans: (b) Ductus arteriosus

Ref: *Langman's Medical Embryology, 9th Edition, Page 255–259*

2. Which of the following is the site of cerebellar input?

(a) Inferior olivary nuclei
(b) Vestibular nuclei
(c) Globose and emboliform nuclei
(d) Dentate nucleus

Explanation:

The Afferent Cerebellar Pathways

Pathway	Function	Origin	Destination
Corticopontocerebellar	Conveys control from cerebral cortex	Frontal, parietal, temporal, and occipital lobes (cerebral ***cortex***)	Via ***pontine nuclei*** and mossy fibers to ***cerebellar*** cortex
Cerebro-olivocerebellar	Conveys control from cerebral cortex	Frontal, parietal, temporal, and occipital lobes (***cerebral*** cortex)	Via ***inferior olivary nuclei*** and climbing fibers to ***cerebellar*** cortex
Cerebroreticulocerebellar	Conveys control from cerebral cortex	Sensorimotor areas (***cerebral*** cortex)	Via ***reticular formation***
Anterior spinocerebellar	Conveys information from muscles and joints	***Muscle spindles, tendon organs, and joint receptors***	Via mossy fibers to ***cerebellar cortex***
Posterior spinocerebellar	Conveys information from muscles and joints	***Muscle spindles, tendon organs, and joint receptors***	Via mossy fibers to ***cerebellar cortex***
Cuneocerebellar	Conveys information from muscles and joints of upper limb	***Muscle spindles, tendon organs, and joint receptors (from upper limb)***	Via mossy fibers to ***cerebellar cortex***
Vestibular nerve	Conveys information of head position and movement	***Utricle, saccule, and semicircular canals***	Via mossy fibers to ***cerebellar flocculonodular lobe***
Other afferents	Conveys information from midbrain	Red nucleus, tectum	Cerebellar cortex

The Efferent Cerebellar Pathways

Pathway	Function	Origin	Destination
Globose-emboliform-rubral	Influences ipsilateral motor activity	***Globose and emboliform nuclei***	To contralateral ***red nucleus***, then via crossed rubrospinal tract to ipsilateral motor neurons in spinal cord
Dentothalamic	Influences ipsilateral motor activity	***Dentate nucleus***	To contralateral ***ventrolateral nucleus of thalamus***, then to contralateral motor cerebral cortex; corticospinal tract crosses midline and controls ipsilateral motor neurons in spinal cord
Fastigial vestibular	Influences ipsilateral extensor muscle tone	***Fastigial nucleus***	Mainly to ipsilateral and to contralateral ***lateral vestibular nuclei***; vestibulospinal tract to ipsilateral motor neurons in spinal cord
Fastigial reticular	Influences ipsilateral muscle tone	***Fastigial nucleus***	To neurons of ***reticular formation***; reticulospinal tract to ipsilateral motor neurons to spinal cord
Note: Each cerebellar hemisphere influences the voluntary muscle tone on the same side of the body			

Ans: (a) Inferior olivary nuclei

Ref: *Clinical Neuroanatomy, Richard S. Snell, 7th Edition, 2010, Page 237–243*

3. Gross dissected specimen of hand is shown. Identify this structure in Black circle.

(a) Deep palmar arch
(b) Superficial palmar arch
(c) Radial artery
(d) Ulnar artery

Explanation:

- In this image based question, the circle was marked on the ulnar artery just distal to the flexor reticulam. So it is **Superficial branch of the ulnar artery** not the superficial palmar arch. Superficial ulnar artery not in the option, so **ulnar artery** is the correct answer.

More details about ulnar artery in the hand:

- Ulnar artery enters the palm of hand by passing **superficial to the flexor retinaculum or passing through *Guyon's canal*** [fibers of the flexor retinaculum split to form a tunnel to the passage of ulnar nerve and artery] accompanied by the ulnar artery
- In front of the flexor retinaculum and lateral to the pisiform the ulnar artery continues as ***superficial ulnar artery*** after giving deep branch
- ***Superficial branch*** of ulnar artery ***anastomose with superficial palmar branch of the radial artery or arteria radialis indicis or arteria princeps pollicis*** and forms ***superficial palmar arch.***
- **Branches of superficial palmar arch:**
  - ***Three common palmar digital arteries*** - aries from the convexity of the superficial palmar arch.
  - Each common palmar digital artery divides into two ***proper palmar digital arteries*** and supplies the contiguous sides of medial four fingers.
- **Deep branch of the ulnar artery** (accompanies with deep branch of ulnar nerve) joins the **radial artery** to complete the **deep palmar arch.**
- Branches of deep palmar arch:
  - ***Three palmar metacarpal arteries*** - which join the common palmar digital arteries from the superficial palmar arch
  - ***Three perforating branches***–which pass posteriorly between the heads of origin of the dorsal interossei to anastomose with the dorsal metacarpal arteries from the dorsal carpel arch.

EXTRA EDGE:

Look for thumb or little finger in the shape.

- Along the side of **thumb:**
  - **Nerve**-Median nerve*
  - **Artery**-Radial artery* of its branches.
- Along the side of **little finger**
  - **Nerve**-Ulnar nerva
  - **Artery**-Ulnar artery

Ans: (d) Ulnar artery

Ref: *Gray's Anatomy, The Anatomical Basis of Clinical Practice, 41st Edition, 2016, Page 889 and 890*

4. Gross dissected specimen of forearm and hand is shown. Identify the structure in Black circle.

(a) Digital branch of radial nerve
(b) Anterior introsseous nerve
(c) Digital branch of ulnar nerve
(d) Median nerve

Explanation:

- In this image based question, the circle is marked on the median nerve just distal to the origin of recurrent branch

More details about median nerve in the hand:

- Median nerve enters the palm of hand by passing ***deep to the flexor retinaculam*** (carpel tunnel)
- ***Branches*** of median nerve in the hand:

Recurrent branch (Motor)	Supply the ***thenar muscles**** • Flexor pollicis brevis • Abductor pollicis brevis • Opponens pollicis
Palmar digital branches (Motor and sensory)	• Supply the ***First and second lumbricals*** • Innervates the skin of ***lateral 3½ fingers*** of palmar aspect of hand

- After giving the recurrent branch the median nerve divides into ***2 proper palmar digital nerves*** and ***2 Common palmar digital nerves*** The 2 proper palmar digital nerves runs along the ulnar side of thumb and radial side of index finger respectively.
- Each common palmar digital nerves divides **into 2 proper palmar digital nerves** which supplies the adjacent sides of index, middle finger and ring finger respectively.
- Palmar digital nerves also gives ***vasomotor*** (blood vessels) and ***sudomotor*** (sweat glands) ***branches*** to lateral 3½ fingers of hand.

Ans: (d) Median nerve

Ref: *Gray's Anatomy, The Anatomical Basis of Clinical Practice, 41st Edition, 2016, Page 891*

5. Sixth pharyngeal arch gives rise to:

(a) Sternohyoid
(b) Cricothyroid
(c) Cricoarytenoid
(d) Stylopharyngeus

Explanation:

Mesodermal derivatives of the pharyngeal arches and their innervation

Pharyngeal Arch	Nerve	Artery	Muscles	Skeleton
1 arch [mandibular] (maxillary and mandibular processes)	**V. Trigeminal:** (maxillary and mandibular divisions)	Maxillary	**Mastication** (temporal, Masseter, medial and lateral pterygoids), **mylohyoid, anterior belly of digastric, tensor veli palatinii and tensor tympani**	Premaxilla, maxilla, zygomatic bone, part of temporal bone, **Meckel's cartilage,** Mandible, **malleus, incus**, anterior ligament of malleus and sphenomandibular ligament

Contd.

Contd.

2 arch [Hyloid]	**VII. Facial**	Hyoid and stapedial	**Facial expression** (buccinators, Auricularis, Frontalis, Platysma, orbicularis oris, orbicularis oculi), **posterior belly of digastric, stylohyoid and stapedius**	**Stapes, styloid process,** stylohyoid ligament, lesser horn and upper portion of body of K\RLGERQH
3 arch	**IX. Glossopharyngeal**	Common carotid artery, proximal (1st part) of internal carotid artery amd External carotid artery	***Stylopharyngeus***	Greater horn and lower portion of body of ***hyoid bone***
4 arch	**X. Vagus** Superior laryngeal branch	Left side: Arch of aorta Right side: Right subclavian artery	***Cricothyroid, levator veli palatinii and constrictors muscles of pharynx***	***Thyroid cartilage, epiglottis and cuneiform cartilage***
5 arch	Disappears			
6 arch	**X. Vagus** Recurrent laryngeal branch	Right and left pulmonary artery Left side: Distal part persist as ductus arteriosus	***All intrinsic muscles of larynx*** except cricothyroid	***Cricoid, arytenoid, corniculate, and tracheal cartilages***

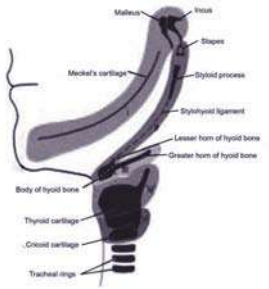


Fig: Mesodermal derivatives of the pharyngeal arches

Ans: (c) Cricoarytenoid

Ref: *Langman's Medical Embryology, 9th Edition, Page 366-372*

6. During surgery, which of the following anatomical landmark is closely associated with geniculate ganglion?

(a) Pyramid
(b) Short process of incus
(c) Processes cochleariformis
(d) Oval window

Explanation:

- The complex course of facial nerve through the middle ear is due to its development from ***facioacoustic primordium*** which gives rise to **VII and VIII nerves*.**

- To reach the ***second pharyngeal arch mesoderm*** the main trunk of facial nerve courses through the middle ear.

Surgical landmark of facial nerve during middle ear and mastoid surgery

Processes cochleariformis	It demarcates the ***geniculate ganglion***
Cog	It is a bony spur, projecting from the tegmen anterior to the ***head of malleus.*** It is the ***landmark for geniculate ganglion***
Oval window	Facial nerve lies ***above*** the oval window niche
Lateral semicircular canal	Facial nerve lies ***below*** the lateral semicircular canal
Short process of incus	Facial nerve lies ***medial*** to the short process of incus at the level of aditus
Pyramid	Facial nerve runs ***behind*** the pyramid and post tympanic sulcus
Tympanomastoid suture	Vertical or the mastoid segment facial nerve runs ***behind*** this suture
Digastric ridge	Facial nerve leaves the mastoid at the ***anterior end*** of this ridge
Stylomastoid foramen	Facial nerve ***exits*** through this foramen

Surgical landmark of facial nerve during parotid surgery

Tragal point	Facial nerve located ***1 cm deep and inferior*** to this point
Tympanomastoid suture	Facial nerve lies **6-8 mm deep** to this suture
Styloid process	Facial nerve crosses ***lateral to styloid*** process
Posterior belly of digastric muscle	Facial nerve is situated ***between digastric groove and styloid*** process
Retromandibular vein	Facial nerve passes ***Superficial*** to it

Ans: (c) Processes cochleariformis

Ref: *Snapshots in Ear, Nose and Throat, Head and Neck Surgery, Santosh Kumar Swain, 1st Edition, 2016, Page 195 and 196*

7. A patient presented with pustule over the dorsum of nose and upper lip. Which is the most direct route of spread of this infection to cavernous sinus?

(a) Angular vein to ophthalmic vein to cavernous sinus
(b) Dorsal nasal vein to maxillary vein to cavernous sinus
(c) Facial vein to pterygoid plexus to cavernous sinus
(d) Palatine vein to ophthalmic vein to cavernous sinus

Explanation:

- Dorsum of nose and upper lip is ***dangerous area of face*****;** this area is drained by **facial vein** and its **tributaries.**

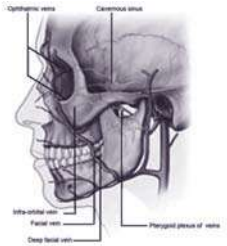


Fig: Communications of facial vein with the cavernous sinus

PHYSIOLOGY

1. Deglutitive inhibition:

(a) Wave of inhibition preceding peristalsis
(b) Inhibition occurs simultaneously with peristalsis
(c) Inhibition occurs after peristalsis
(d) Wave of stimulation preceding peristalsis

Explanation:

Deglutitive inhibition

- **Definition:** A **second swallow,** initiated while an **earlier peristaltic contraction is still progressing** in the striated muscles of esophagus, causing rapid and complete inhibition of the contraction induced by the first swallow.
- It happens secondary to **hyperpolarization** of the circular smooth muscle
- It is mediated through **nonadrenergic, noncholinergic** neurons in the **myenteric plexus**LQ*,WUDFW

Deglutition

- It is the process of swallowing
- It refers to the passage of food from the oral cavity in to the stomach.
- It comprises three stages namely:
  1. Oral phase - voluntary.
  2. Pharyngeal phase - involuntary.
  3. Esophageal phase - involuntary.

Motility events in the esophagus

- During the esophageal phase, food bolus is pushed from esophagus to the stomach by peristalsis.
- Two types of sphincters are seen in esophagus namely:
  - **Upper esophageal sphincter:**
    - Formed by the cricopharyngeal muscle
    - It is normally contracted tonically and opens only during swallowing
  - **Upper esophageal sphincter:**
    - Also called as cardiac sphincter
    - Its main function is to prevent regurgitation of gastric contents into esophagus.

Ans: (b) Inhibition occurs simultaneously with peristalsis

Ref: *Yamada's Textbook of Gastroenterology, 5th Edition, Page 194*

2. PO_2 (in mm Hg) in skeletal muscle during exercise:

(a) 3 (b) 10 (c) 20 (d) 30

Explanation:

- PO_2(in mm Hg) in skeletal muscle during exercise can be as low as **1 to 3 mm Hg*.**
- This is mainly due to the **compression of blood vessels** supplying the **muscle** during muscle contrac-WLRQ
- Fortunately, **myoglobin** in the muscle acts as a reservoir for O_2 and enhances its diffusion during exercise.

Skeletal muscle blood flow during exercise:

- All rest, skeletal muscle receives blood flow of **2-4mL/100g/min.** But during exercise the value increase by more than **20 times – 80 mL/100 g/min.**
- This increase is mainly because of:
  - Accumulation of **local metabolites** that causes vasodilation
  - Opening up of **new capillaries** during exercise

Redistribution of blood flow in the body

- Tremendous increases in skeletal muscle flow is made possible by **redistribution of blood flow**
- **Sympathetic, nor adrenergic vasoconstriction** occurs in two important vascular beds:
  - **Renal circulation*.**
  - **Splenic blood flow*.**
- Vasoconstriction in Renal and Splanchnic system diverts their blood to the exercising muscle.
- **Cutaneous blood**flow **increases** during sustained activities to **dissipate the heat** generated during exercise.
- **coronary blood flow increases** by more than **four times** than **normal*.**
- **Cerebral blood flow** remains largely **unchanged.**

Ans: (a) 3 mm Hg

Ref: *West Respiratory Physiology, 9th Edition, Page 91*

3. A man weighing 70 kg has a hematocrit of 45%. What would be his approximate plasma volume?

(a) 2310 ml (b) 2695 ml (c) 2890 ml (d) 3080 ml

Explanation:

- Average blood volume account for **8% of body weight.**
- So, here for 70 Kg man, Blood volume is **5.6 Litres (70 × 8/100).**
- **Blood Volume = Plasma volume/1-Hematocrit.**
- So, **Plasma volume = Blood volume × (1-hematocrit).**
- Here, plasma volume = 5.6* (1-0.45) =**3080 ml.**

<table>
<tr><td colspan="3">Total Body Water (60% of body weight), 42 liters</td></tr>
<tr><td>Intracellular fluid</td><td colspan="2">Extracellular fluid</td></tr>
<tr><td rowspan="3">2/3rd of TBW,LH 40% body weight (28 liters)</td><td colspan="2">1/3rd of TBW,LH 20% body weight (14 liters)</td></tr>
<tr><td>Interstitial Fluid</td><td>Plasma</td></tr>
<tr><td>75% or 3/4th of ECF or 15% of body weight (10.5 liters)</td><td>25% or 1/4th of ECF Or 5% of body weight (3.5 liters)</td></tr>
</table>

Ans: (d) 3080 ml

Ref: *Ganong Review of Medical Physiology, 21st Edition, Page 2*

4. A patient who underwent extensive bowel resection is on total parenteral nutrition (TPN) for 1 month. Endoscopy done after one month reveals defuse gastric mucosal atrophy. Which enzyme deficiencies are most likely responsible for gastric mucosal atrophy in this patient?

(a) Gastrin and Ghrelin (b) Secretin and CCK
(c) Gastrin and CCK (d) Gastrin and Secretin

Explanation:

Gastrin

- Produced by **G cells** in the **antral portion** of the gastric mucosa
- Three forms – **G 34, G 17 and G 14** gastrins
- **G 17** is the principal form*
- Acts via **CCK-B receptor*.**
- **Stimuli** that increase gastrin secretion:
  - **Peptides*.**
  - **Amino acids**(Phenylalanine, tryptophan)
  - Gastric distension
  - **Gastrin releasing peptide*.**
  - Calcium.
  - Epinephrine.
- Stimuli that decrease gastrin secretion:
  - Acid

- **Somatostatin*.**
- **Secretin*.**
- **GIP.**
- **VIP.**
- **Glucagon.**
- Calcitonin

- **Actions:**
  - Stimulation of **gastric acid and pepsin secretion.**
  - Stimulation of the growth of the mucosa of GI tract **(Trophic action*).**

Cholecystokinin

- Secreted by **I cells** in the **mucosa** of the **upper small intestine*.**
- Also found in **nerves** in the **distal ileum, colon and brain.**
- Acts via **CCK-A receptor*.**
- **Functions** of CCK:
  - Gut-stimulation of **pancreatic enzyme secretion.**
  - **Contraction** of the **gallbladder*.**
  - **Relaxation** of the **sphincter of Oddi.**
  - Brain-regulation of **food intake.**
  - Production of **anxiety** and **analgesia.**
- **Other actions:**
  - Augments the action of **secretin.**
  - **Inhibits gastric emptying.**
  - Exerts a **trophic** effect on the **pancreas.**
  - Increases the **synthesis** of **enterokinase.**
- Releasing factors that activate CCK secretion:
  - CCK - releasing peptide (intestinal mucosa).
  - Monitor peptide (Pancreas)
- **Stimuli that increase CCK secretion:**
  - Peptides and amino acids.
  - Fatty acids (more than 10 carbon atoms).

Ans: (c) Gastrin and CCK

Ref: *Yamada's Textbook of Gastroenterology, 5th Edition, Page 284*

5. Direction of sound is differentiated by:

(a) Auditory cortex (b) Medial geniculate body
(c) Lateral geniculate body (d) Inferior colliculus

Explanation:

Central auditory pathway

- Auditory pathway can be easily remembered with the help of a very familiar mnemonic **"E COLI MA".**

Structure	Characteristics
Eighth nerve	• Carries the afferent auditory information
Cochlear nuclei	• 95% of fibres in cochlear nuclei are myelinated fibres that receives input from inner hair cells • Small number (5%) of unmyelinated fibres receives input from outer hair cells
Superior **O**livary nucleus	• Receives information from both the ears (bilateral) • Helps in localization of sound and the direction from which the sound comes • Also send efferent to outer hair cells in the form of **olivocochlear bundle** modulates the sensitivity of these hair cells and blocks background noise
Lateral lemniscus	• Project auditory information to inferior colliculus
Inferior colliculus	• All auditory pathways ascending through the brainstem converge in inferior colliculi • Helps in localization of sound and the direction from which the sound comes

Contd.

Contd.

Medial geniculate body	• Thalamic nuclei for hearing • Project to auditory cortex
Auditory cortex	• Location – Superior temporal gyrus of the temporal lobe • Also called as **Heschl gyrus** • Tonotopic organization – Low tones are represented anterolaterally and high tones postero-medially • **Planum temporale –** Part of auditory cortex involved in language related auditory processing. It is larger in the left hemisphere.

Ans: (d) Inferior colliculus

Ref: *Kandel, Principle of Neural Sciences, 5th Edition, Page 697*

6. A 60-year-old patient, known case of Hypertension for the past 25 years underwent renal artery doppler which showed narrowing and turbulence in right renal artery. If the diameter of lumen is reduced by 50%, how much blood flow will be reduced?

(a) 1/4th (b) 1/8th (c) 1/16th (d) 1/32nd

Explanation:

Blood flow (F)

- Blood flow (F) inside vessel depends on:
  - **Pressure difference** (P_A - P_B) - Directly related*
  - **Viscosity of the fluid** (η) - Inversely related*
    - Viscosity is a measure of fluid's resistance to flow.
    - A fluid with low viscosity flows easily such fluids are called **Newtonian fluid**. Example is **water*.**
    - A fluid with high viscosity flows resist motion. Such fluids are called: Non-Newtonian fluid Example is **blood*.**
    - **Fahraeus-Lindqvist effect–** This effect is seen mainly in **capillaries** where RBCs flow in the center which leaves cell free plasma near the vessel wall. So, the viscosity change per unit change in hematocrit is much less in capillaries.
  - **Radius of the vessel** (r^4) - directly related
  - **Length of the vessel** (L) - inversley related
- Inter-relation of these factors are expressed in **Poiseuille-Hagen formula** which is:

$$F = (P_A - P_B) * \pi r^4 / 8 \eta L)$$

- According to the above formula, blood flow is directly proportional to the **fourth power of radius*.**
- So, if the radius is **halved,** then blood flow decreases by **2^4 times** which is 16 times*.

Ans: (c) 1/16th

Ref: *Ganong, 25th Edition, Page 573*

7. PCO_2 at alveoli and expired air is 40 and 30 mm Hg respectively. Calculate dead space to tidal volume ratio.

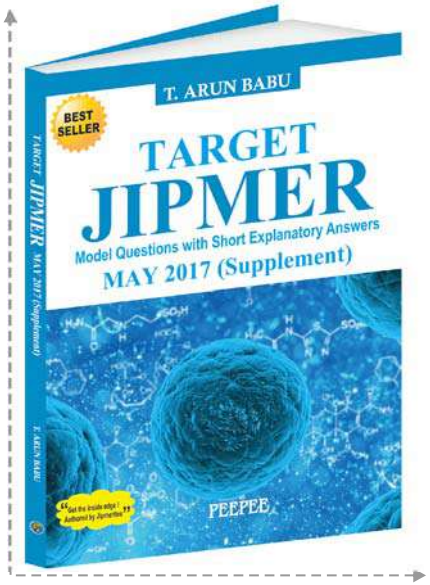
DEFG

Explanation:

- **Dead space** to **tidal volume** ratio is calculated by **PCO_2** of **alveolar air** – **PCO_2 of expired air/PCO_2** of **alveolar air.** This equation is called **Bohr's equation.**

$$\text{Dead space to tidal volume ratio} = \frac{PCO_2 \text{ of alveolar air} - PCO_2 \text{ of expired air}}{PCO_2 \text{ of alveolar air}}$$

- So, Here it is **40 – 30/40,** that comes around **0.25.**



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PREVIEW

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