Syllabus	
Topic	Intracranial pressure and cerebral spinal fluid physiology

a)

Complete the following blanks regarding cerebrospinal fluid (CSF) flow. (5 marks)

Site of CSF production: ……

CSF then flows to …….. through ……

It then flows to …….. through ……..

It flows through to the subarachnoid space through:

1. ……..
2. ……..

Absorption takes place at ……

b)

List 3 functions of CSF (3 marks)

1. .....
2. .....
3. .....

c)

List 2 symptoms and 2 signs of an acute rise in intracranial pressure (4 marks)

<u>Symptoms</u>

1. .....
2. .....

<u>Signs</u>

1. .....
2. .....

d)

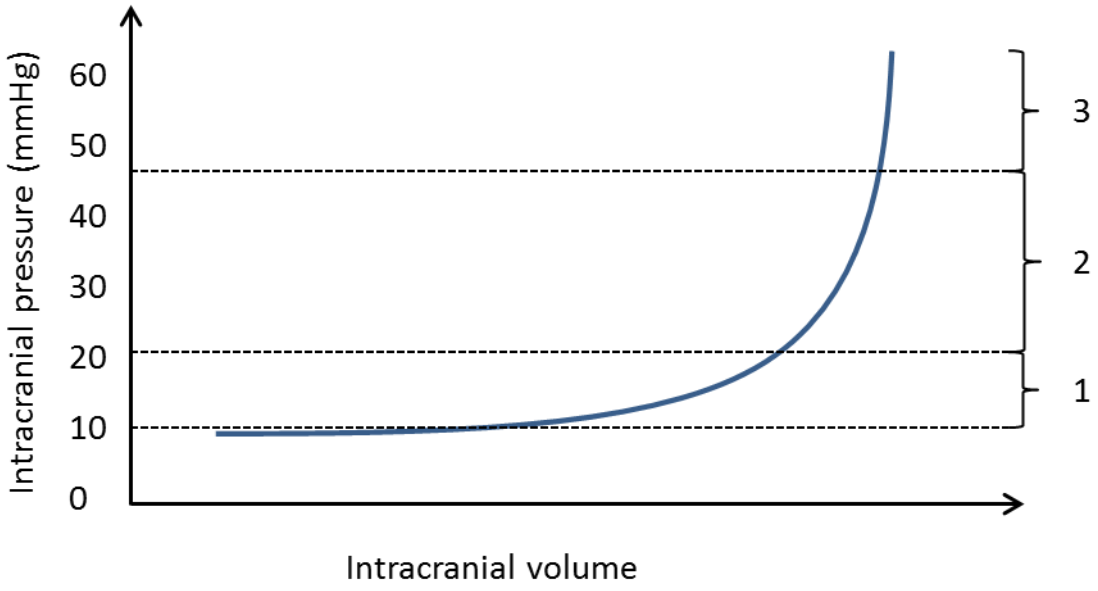
The skull is a rigid container of constant volume, with three main 'compartments'. With this is mind, what is the Monro-Kelly doctrine? (1 mark)

……

……

e)

Below is a curve demonstrating the intracranial volume-pressure relationship. State what is happening at areas labelled 1, 2 and 3. (3 marks)



1. ……

2. ……

3. ……

f)

A patient is admitted to ICU after a head injury. The mean arterial pressure is 75mmHg and CVP is 8mmHg. Assuming the ICP is within normal limits, what is the cerebral perfusion pressure (CPP)? (1 mark)

……

g)

List three ways in which the volume of the 'blood' compartment of the skull can be reduced to prevent ICP rise. (3 marks)

1. .....
2. .....
3. .....

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Q	Answer	Mark	Guidance
a)	• Ependymal cells of choroid plexus (accept either) • **Third ventricle** through the **foramina of Monro** (need both for 1 mark) • **Fourth ventricle** through the **aqueduct of Sylvius** (accept cerebral aqueduct) (need both for 1 mark) • Through **foramina of Luschka and Magendie** (need both for 1 mark) • Arachnoid granulations	1 1 1 1 1	At any one time there is ~150ml of CSF. 500ml is produced/day. Long and thin, the aqueduct is prone to becoming blocked. These are located at the superior sagittal sinus
b)	• Buoyancy • Protection • CSF displacement to compensate for increases in ICP (i.e. 'spatial compensation') • Acid-base regulation for control of respiration • Clearing waste	Any 3	The low specific gravity of CSF reduces the effective weight of the brain from 1.4kg to 47g. Fluid buffer acts as a shock absorber from some forms of mechanical injury. Displacement of CSF into the spinal canal is an important compensatory mechanism when ICP is raised to reduce intracranial CSF volume. CSF is a critical part of the brain's lymphatic system.
c)	<u>Symptoms:</u> • Headache • Vomiting • Blurred vision/diplopia/visual disturbance <u>Signs:</u> • Papilloedema • Seizures	Any 2 Any 2	• Usually bursting, throbbing, early-morning. Exacerbated by sneezing, coughing, lying flat, straining • Usually in absence of nausea • As a result of papilloedema/ocular palsies

	• Decreased GCS • Bradycardia and hypertension • Fixed dilated pupils • Respiratory irregularity		This is Cushing's reflex (plus high pulse pressure for triad)
d)	This states that any increase in volume of one of its compartments must be compensated for by a reduction in volume of another if a rise in intracranial pressure is to be avoided	1	
e)	1. Compensation 2. Focal ischaemia 3. Global ischaemia	1 1 1	Initially a rise in the volume of one intracranial compartment is compensated for to maintain ICP <20 mmHg. However, when these limited compensatory mechanisms are exhausted, ICP rises rapidly, causing focal ischaemia (ICP 20-45mmHg). This is followed by global ischaemia (ICP >45mmHg).
f)	• Accept 57-62mmHg	1	CPP = MAP – (ICP + CVP) Assume normal ICP is 5-10mmHg
g)	• Avoid tight tube ties • Head-up tilt (15-30 degree) • Paralyse to reduce valsava/coughing • Treat seizures with anticonvulsants • Avoid excessive PEEP/peak airway pressures • Maintain PaO_2 >13 kPa • Aim $PaCO_2$ 4.5-5.0 kPa • Adequate sedation • Avoid pyrexia • (Evacuate clot)	Any 3	To reduce the 'blood' compartment, you can look at it as: • Optimising venous drainage • Avoiding excessive arterial flow (i.e. by reducing CBF and $CMRO_2$) Nb. there is much debate about the target PaO_2 after traumatic brain injury – AAGBI say >13kPa

References:

1) Tameen A, Krovvidi H. Cerebral physiology. CEACCP (2013) 13(4)113-118 https://academic.oup.com/bjaed/article/13/4/113/345118