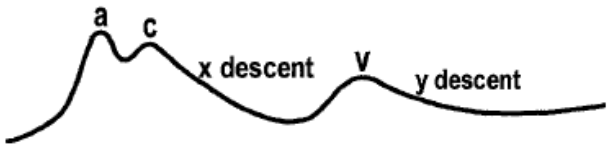
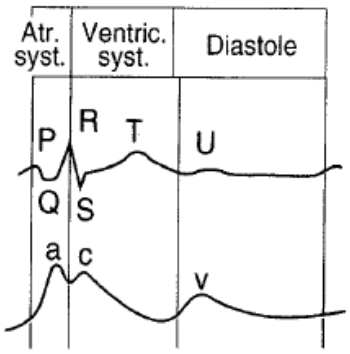
Physiology week 8 - Cardiovascular (electrical) VIVAs

TOPIC: The Cardiac Cycle _____ **NUMBER:** _____ 4b

OPENING QUESTION	Describe the mechanical events that occur during the cardiac cycle	**PROMPTS**	**COMMENTS**
POINTS REQUIRED	1 Diastole-slow filling, decreasing in rate	Start during diastole	7/9 to pass
	2 Atrial systole		
	3 Closure of mitral and tricuspid valves		
	4 Isovolumetric Ventricular contraction		
	5 Opening of pulmonary and aortic valves		
	6 Ventricular ejection		
	7 Protodiastole		
	8 Isovolumetric relaxation		
	9 Opening of AV valves and commencement of diastole		
SECOND QUESTION	When do the heart sounds occur?		
POINTS REQUIRED	1		Name valves to pass
	2		
	3		
	4		
	5		
	6		
	7		

TOPIC	QUESTION	ESSENTIAL KNOWLEDGE
Cardiac cycle	Describe the phases of the cardiac cycle.	Atrial systole; Isovolumetric ventricular contraction; Ventricular contraction; Isovolumetric ventricular relaxation; Ventricular filling.
	Relate the aortic pressure to the phases of the cardiac cycle	Require that they can either draw the curve or describe the change in pressure in the aorta, including the points at which the aortic valve opens and closes.

Please draw and label a diagram of the jugular venous pressure wave.		Shape with 2 peaks a and v waves
Explain the origins of the fluctuations in this wave.	• The 'a' wave is due to atrial systole as some blood regurgitates into the great veins when the atria contract and venous inflow. • The 'c' wave is the transmitted rise in atrial pressure produced by the bulging of the tricuspid valve into the atria during isovolumetric ventricular contraction. • The 'x' descent is due to increased atrial volume consequent upon the tricuspid valve ring being pulled distally during ventricular emptying. • The 'v' wave mirrors the rise in atrial pressure before the tricuspid valve opens during diastole. • The 'y' descent is due to emptying of the atrium after the tricuspid valve opens during diastole.	a and v wave
How does the ECG relate to the jugular venous pressure wave?		Line up with phases - a/c wave with QRS - v wave with / after T wave

How does the ECG relate to the ventricular muscle action potential?	**Upstroke on QRS** Plateau occupies QT interval **Repolarisation at T wave**

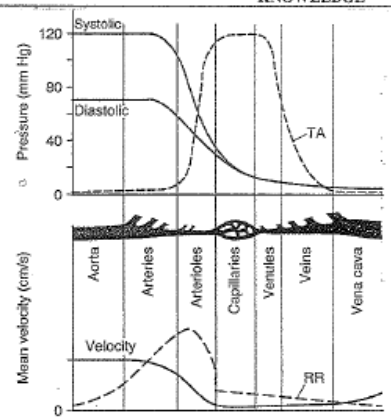
TOPIC: Factors affecting myocardial contractility **NUMBER:** 1

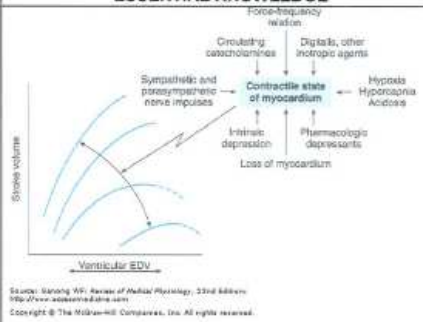
OPENING QUESTION	How does stroke volume relate to end diastolic volume in the heart?	**PROMPTS**	**COMMENTS**
POINTS REQUIRED	Draw diagram of SV vs EDV Energy of contraction is proportional to the initial length of the muscle fibre.	Prompt: can you describe the Frank Starling law?	Need to describe the relationship to pass.
SECOND QUESTION (if needed)	What factors affect the myocardial contractility?		
POINTS REQUIRED	Neural – symp / parasym, catecholamines, drugs eg digoxin, negative ionotropes, hypoxia, acidosis, temperature, ischemia, muscle mass		Need to mention symp / parasympathetic & 2 more to pass.

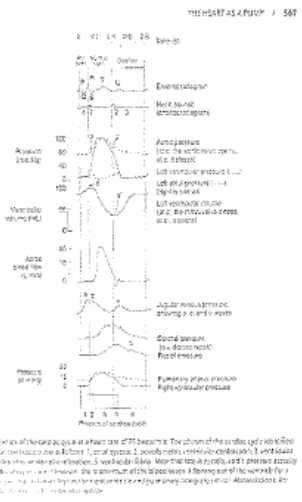
TOPIC	QUESTION	ESSENTIAL KNOWLEDGE	
Question 1: Isovolumetric contraction and relaxation Ganong 565-8	In the heart: i) Describe the pressure and volume changes in the ventricles at the onset of systole. Prompt: describe the events that occur around the isovolumetric relaxation phase of systole. ii) Describe the pressure and volume changes in the ventricles at the onset of diastole Prompt: describe the events that occur around the isovolumetric relaxation phase of diastole iii) Additional / offer as an option if candidate struggles with the question: Can you draw the pressure-volume loop of the left ventricle?	i) At the start of **systole mitral and tricuspid valves close**. Ventricular muscle initially shortens very little and pressure rises sharply. AV valves bulge into atria causing a small but sharp rise in atrial/venous pressure. **Isovolumetric contraction** lasts about 0.05 secs until left pressure exceeds aorta (80mmHg), right pressure exceeds pulmonary artery (10mmHg) and so **aortic and pulmonary valves open.** ii) When the momentum of ejected blood is overcome by arterial pressure the **aortic and pulmonary valves close** (setting up transient vibrations). Ventricular pressures drop rapidly until they fall below atrial pressures – **isovolumetric relaxation**. Then **AV valves open** to start ventricular filling. iii) Pressure-volume loop.P566	Core k

TOPIC: Effects of hyper/hypokalaemia on ECG _____ NUMBER: _____

OPENING QUESTION	**Please draw a normal ECG tracing, showing the durations of the major intervals**	**COMMENTS**
POINTS REQUIRED	1. **correct shape**	All
	2. **times** PR 0.16 QRS 0.12 QT 0.4	
PROMPTS		
SECOND QUESTION (if needed)	**How does the ECG change with hyperkalaemia?**	
POINTS REQUIRED	1. progression	
	2 Initial **tall peaked T waves**. Intervals normal K 7.0	At least 3
	3. later **no atrial activity, QRS broad/slurred**	
	4 **ventricular arrhythmias** then fibres eventually unexcitable, sine wave appearance	
PROMPTS		
THIRD QUESTION (if needed)	**How does it change with hypokalaemia?**	
POINTS REQUIRED	1. **long PR**, ST depression, inverted T,	Both required
	2. **U wave**	
PROMPTS		

QUESTION	KNOWLEDGE	PASS CRITERIA
1. a) Please draw a diagram of the changes in systolic and diastolic pressure as blood flows through the systemic circulation. -suggest: pressure on y-axis, and label the various parts of the systemic circulation on the x-axis. 1 b) How does the total cross-sectional area of vessels change through the systemic circulation?	 **FIGURE 32–27 Diagram of the changes in pressure and velocity as blood flows through the systemic circulation.** TA, total cross-sectional area of the vessels, which increases from 4.5 cm^2 in the aorta to 4500 cm^2 in the capillaries (Table 32–9). RR, relative resistance, which is highest in the arterioles. *w of Medical* TA = total cross-sectional area of vessels RR = relative resistance (highest in arterioles) • pressure falls very slightly in large and medium-sized arteries because resistance to flow is small • pressure falls rapidly in small arteries and arterioles, which are main sites of peripheral resistance against which heart pumps • magnitude of pressure drop along arterioles varies depending on whether constricted or dilated 1. small pressure change in large and medium-sized arteries 2. rapid fall in pressure in small arteries and arterioles 3. mean pressure at end of arterioles is 30-38mmHg 4. Pulse pressure 5mmHg at ends of arterioles TA – maximal in capillaries and venules (about 10 x that in arterioles)	Need to pass: 1. Correct shape of pressure diagram 2. Rapid fall in pressure in arterioles 3. TA is maximal in capillaries, and venules

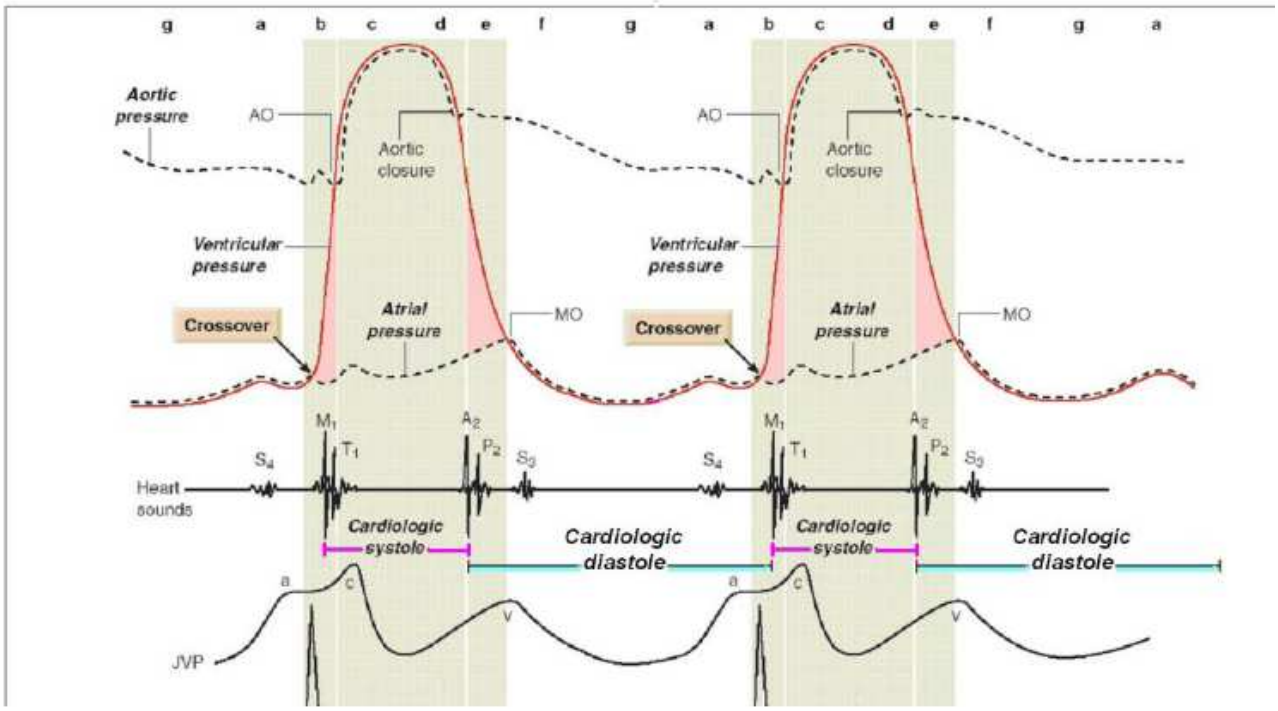
TOPIC	QUESTION	ESSENTIAL KNOWLEDGE	NOTES
Question 1: a) b)	**Draw Frank Starling curve.** **List the factors that alter contractility**	 	1. Sympathetic nerves moves up & left, 2. Parasympathetic nerves move down and right; 3. Force frequency relationships, postextrasystolic potentiation (Ca2+mediated 4. Catechols (via beta 1 and cAMP), digitalis (via Na/K ATPase block) and inotropes increase 5. Hypoxia, hypercarbia, acidosis, quinidine, procainamide, barbs etc depress MC 6. Intrinsic depression with CHF, AMI **Must label FS curve, and 2up /2 down**

TOPIC	QUESTION	ESSENTIAL KNOWLEDGE	NOTES
Question 1:	**On this sheet of paper, please draw an ECG trace and, below this, identify the 5 phases of the cardiac (contractile) cycle**	1. Atrial systole 2. Isovolumetric ventricular contraction 3. Ventricular ejection 4. Isovolumetric ventricular relaxation 5. Ventricular filling	4/5
	On this sheet of paper, please draw an ECG trace and, below this, demonstrate the left ventricular volume trace. Please give approximate volume values on the y-axis.		1. The end-diastolic ventricular volume is approx. 130ml 2. The end-systolic ventricular volume is approx. 50ml [thus about 80ml is ejected by each ventricle per contraction, at rest and the ejection fraction (the percent of the EDV that is ejected with each contraction) is about 65%.

TOPIC: The cardiac cycle.

OPENING QUESTION	Define the cardiac cycle.	**PROMPTS**	**COMMEN**
POINTS REQUIRED	One complete sequence of ventricular systole & diastole		
SECOND QUESTION	What are its phases?	Please draw on the paper provided if it helps.	
POINTS REQUIRED	These are defined wrt the **ventricle**	How are the phases defined?	
	Phase 1 ***Atrial systole*** Additional blood propelled into ventricles (70% of ventricular filling is ***passive).***		
	Phase 2 ***Isovolumetric contraction of ventricles*** – lasts about 0.05s – until pressures exceed aortic/pulmonary artery pressures and the aortic and pulmonary valves open. AV valves bulge, causing rise in atrial pressure.		
	Phase 3 ***Ventricular ejection*** - rapid initially then slows. Peak left ventricular pressure 120mmHg. Peak right ventricular pressure 25mmHg. 70-90ml ejected (end diastolic ventricular volume 130ml – therefore 50ml left) – ejection fraction 65%		
	Early diastole Ventricular pressure drop rapidly – protodiastole – lasts 0.04s. Eventually momentum of propelled blood overcome and aortic and pulmonary valves close.		

	Phase 4 ***Isovolumetric relaxation.*** Isometric relaxation ends when ventricular pressure falls below atrial pressure and the AV valves open permitting the ventricles to fill.	
	Phase 5 ***Late diastole Ventricular filling.*** Blood passively fills atria and ventricles. Filling is rapid initially. Rate of filling declines as chambers fill and cusps of AV valves drift closed.	



TOPIC: The Frank Starling Law

OPENING QUESTION	What is the Frank Starling Law?	**PROMPTS**	**C**
POINTS REQUIRED	1. Any of the following will do: • The greater the diastolic filling, the greater the amount of blood pumped into the aorta • Or, within normal limits the heart pumps all the blood that comes to it! • Or, energy of contraction is proportional to initial length of the cardiac muscle fibre		
	2. This is just within normal limits though.		
SECOND QUESTION	Please draw and label the normal Starling curve		
POINTS REQUIRED	1. The graph below.		
	2. X-axis = LV's EDV [**end** diastolic volume] [total LV vol is permissible]		
	3. Y axis is LV's SV [stroke volume][total LV pressure is permissible]		
	4. Descending limb is only in pathological hearts [because that's a vicious cycle due to fibres literally pulling apart!]		
THIRD QUESTION	What can push the curve up/down?	I.E. what can increase or decrease the heart's intrinsic contractility?	
POINTS REQUIRED	1. Up: exogenous eg digoxin, autonomic NS stimulus		
	2. Down: endogenous disease eg MI [lose myocardium], exogenous eg hypoxia, acidosis