GCE

Biology A

H420/01: Biological processes

Advanced GCE

Mark Scheme for June 2019

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
	Wavy underlined words must be present or similar-meaning words must be present in answer to score a mark.
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Marking Annotations

Annotation	Use
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
I	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
NBOD	Benefit of the doubt not given
	Tick
^	Omission Mark
BP	Blank Page
L1	Level 1 answer in Level of Response question
L2	Level 2 answer in Level of Response question
L3	Level 3 answer in Level of Response question

Subject-specific Marking Instructions

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1			C ✓	1	
2			A ✓	1	
3			A ✓	1	
4			C ✓	1	
5			D ✓	1	
6			A ✓	1	
7			B ✓	1	
8			D ✓	1	
9			B ✓	1	
10			B ✓ **ALLOW** A	1	
11			D ✓	1	
12			C ✓ **ALLOW** A	1	
13			D ✓	1	
14			D ✓	1	
15			B ✓	1	
			Total	15	

<table>
<tr><th colspan="3">Question</th><th colspan="2">Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>16</td><td>(a)</td><td>(i)</td><td>1

2
3

4

5

6
7</td><td>similar increase and decrease (in pressure) , between 0 to 0.15s / to 0.15s / to point X ✓

steeper / faster, rise / fall , in ventricle (pressure) ✓
bigger , increase / decrease , in ventricle (pressure) ✓

idea that at approximately 0.15s atrial (pressure) has , (small) rise and fall / AW , but ventricular is increasing ✓

idea that from approximately 0.3s ventricular pressure decreases but atrial pressure still increasing ✓

from 0.5s no change in pressure(s) in both ✓
comparative figures with units ✓</td><td>4 max</td><td>ALLOW changes in pressure are the same , between 0 to 0.15s / to point X / to 0.15s

ALLOW ORA for atrium
ALLOW ORA for atrium
NOTE: MPs 2 and/or 3 may be implied using comparative figures

<table>
<tr><th>Time (s)</th><th>LA (kPa)</th><th>LV (kPa)</th></tr>
<tr><td>0</td><td>0.2</td><td>0.2</td></tr>
<tr><td>0.08</td><td>1.5</td><td>1.0</td></tr>
<tr><td>0.15</td><td>0.2</td><td>0.2</td></tr>
<tr><td>0.30</td><td>0.8</td><td>16.0</td></tr>
<tr><td>0.50</td><td>0.2</td><td>0.2</td></tr>
</table>

For MP7 units must be mentioned once
Figures must show change in pressure in kPa

ALLOW +/- 0.5 throughout for pressure

e.g. at 0.15s ventricle pressure goes from 0.2 kPa to 16kPa but atrial has ‘blip’ from 0.2 to 0.8 and back down = MP4 and MP7

e.g. ventricular pressure has big increase from 0.2kPa to 16kPa but atrial only goes to 0.8kPa = MP3 and MP7</td></tr>
<tr><td></td><td>(a)</td><td>(ii)</td><td colspan="2">86 bpm ✓</td><td>1</td><td>Unit must be given
ALLOW beats per minute</td></tr>
</table>

	(a)	**(iii)**	45 (%) ✓✓	**2**	**IGNORE** + or – **ALLOW for 1 max** 44 or 46 If answer incorrect or not given to 2 sig.figs: **ALLOW for 1 max** 5 ÷11 x 100 **OR** 45.45 **OR** 45.5
	(a)	**(iv)**	atrioventricular ✓	**1**	**ALLOW** bicuspid / mitral **IGNORE** AV **DO NOT ALLOW** tricuspid
	(b)		type / vigour / intensity / AW , of exercise ✓ muscle mass / bone density / fitness / height / build / proportion of body fat / BMI ✓ age ✓ (environmental) temperature ✓ brand / make / type , of smart watch ✓ reference to , exercise / rest , before experiment ✓ named , health / lifestyle , condition ✓	**3 max**	***List Rule*** *If all **three** prompt lines used and more than one variable is on prompt line mark the **first** one on each line.* *If only **one** or **two** lines used but there is more than one variable listed mark the first three variables given.* **IGNORE** repeats / replicates / amount of exercise **IGNORE** mass **IGNORE** gender **DO NOT ALLOW** body temperature **ALLOW** same smart watch e.g. asthma e.g. smoking e.g. drugs / anabolic steroids **IGNORE** diet / healthy unqualified / alcohol
	(c)		mitochondria / mitochondrion	**1**	
			Total	**12**	

Question			Answer		Marks	Guidance
17	(a)		1	(gibberellin is) a chemical messenger ✓	3 max	**IGNORE** functions of gibberellin **ALLOW** cell-signalling molecule
			2	produced in one part of plant but has effects in another part / AW✓		
			3	affects activity / AW , of target , cells / tissues ✓		e.g. causes activity of target cells to be altered e.g. causes response in target cells
			4	long-lasting / acts over long period of time ✓		
			5	wide-spread effect ✓		

	(b)	**(i)**	***x*** (horizontal) axis labelled **volume of gibberellin applied (x10^{-3} cm^3 kg^{-1} day^{-1})** **AND** ***y*** (vertical) axis labelled **rate of internodal length increase (mm day^{-1})** ✓ linear scale on both axes **AND** at least 50% of area covered ✓ line graph **AND** points plotted accurately to ±1 small square ✓ suitable curved line of best fit drawn ✓	**4**	<table><tr><th>Volume of gibberellin applied (10^{-3} cm^3 kg^{-1} day^{-1})</th><th>Rate of increase of internodal length (mm day^{-1})</th></tr><tr><td>0.0</td><td>1</td></tr><tr><td>0.2</td><td>1</td></tr><tr><td>0.4</td><td>2</td></tr><tr><td>0.6</td><td>4</td></tr><tr><td>0.9</td><td>22</td></tr><tr><td>1.2</td><td>47</td></tr><tr><td>1.4</td><td>48</td></tr><tr><td>1.8</td><td>49</td></tr><tr><td>1.9</td><td>50</td></tr><tr><td>2.0</td><td>50</td></tr></table>**IGNORE** extrapolations Units **must** be given for both axes **ALLOW** solidus i.e. / for brackets () **NOTE** () or / should be seen at least once **NOTE** non-linear *x* axis data **ALLOW** one error in plotting **ALLOW ECF** if non-linear scale used **DO NOT ALLOW** ruled lines between points

<table>
<tr><td></td><td>(b)</td><td>(ii)</td><td>Any one from
seed germination
flowering in long-day plants
cellular , transcription / translation
prevents leaf abscission
aids stomatal opening
promotes fruit development
promotes , activity of amylase / hydrolysis of starch ✓</td><td>1 max</td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>non-reducing , sugars / disaccharides ✓</td><td>1</td><td>ALLOW sucrose / cellulose / vitamins
IGNORE minerals / ions / fibre</td></tr>
<tr><td></td><td>(c)</td><td>(ii)</td><td>
<table>
<tr><th>Test tube</th><th>Observations</th><th>Conclusion</th></tr>
<tr><td>1</td><td>(pale) purple / lilac / violet / mauve</td><td>Protein present</td></tr>
<tr><td>2</td><td>Yellow colour</td><td>reducing sugar (present)</td></tr>
<tr><td>3</td><td>Pale brown colour</td><td>no / very little , starch (present)</td></tr>
<tr><td>4</td><td>(turns) white / cloudy / milky
OR
(forms white) suspension / emulsion</td><td>Fat present</td></tr>
<tr><td>5</td><td><u>pink</u></td><td>Glucose content small (15 mg dl^{-1})</td></tr>
</table>
✓ ✓
</td><td>2</td><td>1 mark per correct column

IGNORE monosaccharides

DO NOT ALLOW precipitate

IGNORE any qualifications / shades of colour</td></tr>
</table>

	(c)	**(iii)**	(result using colorimeter will be) quantitative **OR** not subjective / less affected by human error / no bias ✓	**1**	**IGNORE** accurate / valid **ALLOW** is objective
			Total	**12**	

18 (a)*

Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

Once the level is located, award the higher or lower mark.

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

- **The science content determines the level.**
- **The communication statement determines the mark within a level.**

Level 3 (5–6 marks)
Full and detailed comparison of the circulatory systems of a fish and mammal.

There is a well-developed comparison including a range of features. The information presented is relevant and clearly explained.

Level 2 (3–4 marks)

Detailed comparison of the circulatory systems of a fish and mammal.

There is a reasonable attempt at comparison including a small range of features. The information presented is mostly relevant and clearly explained.

Level 1 (1–2 marks)

6

Indicative scientific points may include…
As this is a comparison BOTH fish and mammals must be mentioned
Similarities

- Both are closed systems / blood in blood vessels
- Both have a heart
- Both carry oxygen using haemoglobin
- Both have arteries / veins / capillaries

Differences:

Fish	Mammal
Single circulation / blood though heart once	Double circulation / blood through heart twice Pulmonary and systemic circulations
One atrium and 1 ventricle / 2 chambers (in heart) / no septum in heart	Two atria and 2 ventricles / 4 chambers (in heart) / heart has a septum

			Some correct comparison of the circulatory systems of a fish and mammal. *The information is basic and communicated in an unstructured way. The information is supported by limited explanations which may be unclear.* **0 marks** No response or no response worthy of credit.			<table><tr><td>Blood passes through 2 sets of capillaries (before returning to heart)</td><td>Blood passes through 1 set of capillaries (before returning to heart)</td></tr><tr><td>Blood pressure is lower (to organs)</td><td>Blood maintained at higher pressure</td></tr><tr><td></td><td>2 circulations with different pressures / can have high pressure in systemic circulation</td></tr><tr><td>Less efficient at transporting / supplying oxygen to tissues</td><td>More efficient at transporting / supplying oxygen to tissues</td></tr><tr><td>(Fulfils needs) as fish are 'cold blooded' / have a low oxygen demand / low metabolic rate</td><td>(Fulfils needs) as mammals need to maintain a constant body temperature / have a high oxygen demand / high metabolic rate</td></tr></table>
	(b)		secreted into / travels in , blood ✓ binds to receptors on (skin) cell (surface) ✓ detail of response inside cell(s) ✓	**2 max**		**ALLOW** transport medium / AW for blood **ALLOW** specific binding sites for receptors e.g. activates G protein e.g. causes formation of a secondary messenger e.g. enzyme / phosphorylation , cascade

	(c)		carbon dioxide / CO_2 , forms , carbonic acid / H_2CO_3 **OR** carbonic acid / H_2CO_3 , dissociates into H^+ (and HCO_3^-) ✓ haemocyanin , acts as a buffer / associates with (excess) H^+ ✓ H^+ / low pH , causes change in (tertiary) structure of haemocyanin ✓	**2 max**	**ALLOW** hydrogen ions / H ions throughout for H^+ **IGNORE** cannot bind to oxygen / reduced affinity for oxygen **IGNORE** Bohr effect **If 2 MPs awarded give max 1** if haemoglobin instead of haemocyanin written **ALLOW** equation e.g. CO_2 (+ H_2O) → H_2CO_3 **OR** e.g. H_2CO_3 → H^+ (+ HCO^{3-}) **DO NOT ALLOW** hydrogen / H atoms / molecules
			Total	**10**	

Question			Answer		Marks	Guidance
19	(a)		have , thin wall / valves , so will , distend / bulge ✓ large lumen / wide , as contains , large volume of / slow-moving , blood ✓ found closer to the , surface / skin , than arteries ✓		3	**ALLOW** ORA e.g. arteries are found further away from surface than veins
	(b)		**1** (skin has) large surface area for absorption ✓ **2** (skin has) many / network of , capillaries ✓ **3** (steroids are) lipid-soluble / non-polar ✓ **4** (so) can cross phospholipid bilayer ✓ **5** muscles are close to the skin (surface) so short diffusion , pathway / distance ✓		2 max	**ALLOW** can cross , cell surface / plasma , membranes

	(c)	**(i)**	(any number in range) 180 to 279 ✓✓✓	**3**	**ALLOW ANY number between 180 and 279 for 3 marks** **IGNORE +/-** **If incorrect response:** **ALLOW for 2 marks** number testing positive in 1988 – number testing positive in 1991 e.g. 799 - 546 **OR** e.g. (1.7 ÷ 100) x 47000 – (0.65 ÷ 100) x 84000 **ALLOW for 1 mark** Calculation of number of samples testing positive in EITHER 1988 or 1991 e.g. (1.7 ÷ 100) x 47000 **OR** e.g. 1.7% of 46000 **ALLOW** for % testosterone + / - 0.02% **ALLOW** for number of urine samples +/- 1000

Year	% containing testosterone	No of urine samples	Number of positive tests
1988	1.7	46000	782
1991	0.65	85000	553

			Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. **The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. **The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. **In summary:** • **The science content determines the level.** • **The communication statement determines the mark within a level.**			
	(c)	**(ii)***	**Level 3 (5–6 marks)** Full and detailed evaluation including reference to factors that both support and contradict the statement, as well as reference to the issues of validity which affect the data. *There is a well-developed argument including a good range of evidence. The information presented is relevant and clearly explained.* **Level 2 (3–4 marks)** Detailed evaluation including reference to at least one factor that supports and one that does not support the statement. *There is a reasonable attempt at evaluation including a small range of evidence. The information presented is mostly relevant and clearly explained.*	**6**		**Indicative scientific points may include…** ***Evidence in support of the statement:*** • General trend : reduction in % samples with testosterone from start to end of test • From 1988 to 1991, % samples with testosterone decreased as test numbers increased • Increase in number of tests carried out over time • More testing shows , more awareness / scrutiny / acts as deterrent ***Evidence against the statement:*** • From 1986 to 1988 there was an increase in % tests with testosterone / number of positive tests • Correlation does not show causation • More tests but more athletes competing • After 1991 / in 1992 and 1993 there was an increase in % tests with testosterone / number of positive tests • Fewer samples with testosterone is not the same as less incidence of abuse

			Level 1 (1–2 marks) Evaluation is attempted including reference to a factor that supports **or** contradicts the statement, **or** refers to an issue of validity which affect the data. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence which may be unclear.* **0 marks** No response or no response worthy of credit.			• No clear pattern / trend in positive samples • From 1986 to 1994 the number of positive tests increases ***Issues of validity with data:*** • Only a limited / short time was studied or only valid for the time studied • Other steroids used and not detected • Other drugs mask testosterone levels • Testosterone levels may vary naturally in the population (AW) • No details provided for the method used / modern technology may have improved the sensitivity of the test over time • No detail of a control group • Security of testing / cheating / corruption / bribery • Not turning up for testing / times of testing • Reference to significance of data • No statistical tests / SD bars / range bars • Could be same sport being tested or different sports • Could be same athletes repeatedly tested or different athletes
			Total	**14**		

Question				Answer	Marks	Guidance
20	(a)	(i)	1	contains non-protein groups ✓	3 max	**ALLOW** ions / molecules for groups **ALLOW** non-polypeptide for non-protein
			2	has prosthetic group ✓		
			3	(prosthetic group) is , iron / Fe , ion ✓		**ALLOW** Fe^{2+} / Fe^{3+} for iron ion
			4	(prosthetic group) is attached by , covalent bonds / ionic interactions / hydrogen bonds ✓		**e.g. has non-protein prosthetic group = 2 marks**
	(a)	(ii)	1	proteins / contain polypeptide chain(s) ✓	2 max	**Mark as continuous prose** **IGNORE** subunit **IGNORE** ref to structure / amino acids / bonds
			2	contain , cysteine / sulphur (atoms) ✓		
			3	have prosthetic group(s) / are conjugated (proteins) ✓		**ALLOW two** marks for conjugated protein
			4	contain iron ions ✓		
	(a)	(iii)	1	haemoglobin , is a larger molecule / has greater molecular mass / has more amino acids ✓	2 max	**Mark as continuous prose** **ALLOW ORA** for rubredoxin **ALLOW** longer polypeptide chain(s)
			2	haemoglobin has , quaternary structure / more than one polypeptide chain ✓		**IGNORE** subunit **ALLOW** rubredoxin , does not have quaternary structure / only has one polypeptide chain **ALLOW** haemoglobin has , four / two alpha and two beta , polypeptide chains **DO NOT ALLOW** haemoglobin has , one / two / three , polypeptide chains
			3	haemoglobin has , more than one / four , prosthetic groups / iron ions ✓		**ALLOW** rubredoxin only has one prosthetic group
			4	haemoglobin contains haem (groups) ✓		**ALLOW ORA** for rubredoxin **ALLOW** haemoglobin doesn't contain sulphur in its , prosthetic group / haem

	(b)	**(i)**	264 / 263.932 / 263.93 / 263.9 (nm^3) ✓✓✓	**3**	**ALLOW 2 max** for the following if answer is incorrect **1 mark** for $9.04 \times 10^{-4} \times 4500$ **1 mark** for 268 - 4.068
	(b)	**(ii)**	hydrophobic regions / R groups , on inside (of molecule / protein) **AND** hydrophilic regions / R groups , on outside (of molecule / protein) ✓	**1**	**BOTH required for one mark** **ALLOW e.g.** hydrophobic regions point inwards and hydrophilic regions face outwards **DO NOT ALLOW** hydrophobic tails / hydrophilic heads
			Total	**11**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>21</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>Hormone produced</th><th>Functions of hormone</th></tr>
<tr><td>adrenaline</td><td>TWO functions from list in guidance</td></tr>
<tr><td>noradrenaline</td><td>increases heart rate, increases blood pressure, widens pupils.</td></tr>
<tr><td>androgens</td><td>help regulate sexual characteristics and cell growth.</td></tr>
<tr><td>glucocorticoids / cortisol / corticosterone</td><td>regulation of metabolism</td></tr>
<tr><td>✓</td><td>✓</td></tr>
</table>
</td><td>2</td><td>1 mark per correct column

ALLOW adrenaline for noradrenaline in column one

ALLOW for functions any two of the following:

• increases heart rate
• increases blood glucose concentration
• increases blood flow to muscles
• increases glycogenolysis
• causes pupils to dilate
• decreases blood flow to gut
• increases blood pressure
• dilation of bronchioles
• increases air flow to alveoli
• increases breathing rate</td></tr>
<tr><td></td><td>(a)</td><td>(ii)</td><td>B
AND
(adrenal) medulla ✓</td><td>1</td><td>BOTH required for one mark</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Z THEN X ✓

Y ✓</td><td>2</td><td>Order MUST be Z, X then Y for two marks</td></tr>
</table>

	(b)	**(ii)**	large single peaks present ✓ small wavy line between peaks with at least three waves between any two peaks ✓	**2**	**0 marks** if just a wavy line drawn with no peaks
	(b)	**(iii)**	increased stroke volume / AW ✓ increased volume of ventricle (chamber) ✓ increased , thickness / strength , of heart <u>muscle</u> ✓	**2**	 **ALLOW** myocardium for muscle
			Total	**9**	

Question			Answer	Marks	Guidance
22	(a)		**A** RuBP / ribulose bisphosphate ✓ **B** triose phosphate / TP ✓ **C** fatty acid(s) ✓ **D** amino acid(s) ✓	4	**Mark first response on each line** **IGNORE** biphosphate **IGNORE** named fatty acids / triglycerides / fats **IGNORE** named amino acids **ALLOW** polypeptide / protein
	(b)	(i)	*independent variable* temperature ✓ *dependent variable* concentration of oxygen ✓ *control variable* species / type of pondweed **OR** mass of pondweed **OR** light intensity / distance of light source from beaker **OR** time in water bath / equilibration time / time intervals **OR** volume of (distilled) water **OR** mass of $NaHCO_3$ ✓	3	**NOTE: 1 max for control variable** **IGNORE quoted figures** **ALLOW** *P. pusillus* for pondweed **ALLOW** wavelength of light
	(b)	(ii)	pH ✓ concentration of CO_2 ✓ age of pondweed ✓ size / surface area / number , of leaves ✓	1 max	**IGNORE** reference to equipment **ALLOW** *P. pusillus* for pondweed

	(c)		***descriptions*** **D1** increasing temperature increases , O_2 concentration / rate of photosynthesis ✓ **D2** at each temperature rate of , oxygen production / photosynthesis , is constant ✓ ***explanations*** **E1** oxygen is a product of , photosynthesis / photolysis / light-dependent reactions ✓ **E2** temperature acts as a <u>limiting factor</u> ✓ **E3** no other (named) factor was limiting ✓ **E4** increasing temperature increases , kinetic energy of molecules / rate of enzyme reactions ✓	**3 max**	**ALLOW** ORA for decreasing temperature ***2 max for explanations*** **ALLOW** e.g. light intensity / CO_2 concentration **ALLOW** e.g. increases , ESC / EPC , formation e.g. increases number of successful collisions **ALLOW** KE for kinetic energy **ALLOW** ORA for decreasing temperature
	(d)	**(i)**	*accurate because:* does not require , photons / light <u>energy</u> ✓ *inaccurate because:* needs , ATP / reduced NADP , produced in light-dependent stage ✓	**2**	**IGNORE** can occur in the dark **ALLOW** variations of reduced NADP e.g.NADPH
	(d)	**(ii)**	ribulose <u>bis</u>phosphate carboxylase / RuBisCO ✓	**1**	**ALLOW** RUBISCO / rubisco
	(e)	**(i)**	(auxin causes) apical dominance ✓	**1**	

	(e)	**(ii)**	rooting , powder / solutions ✓ micropropagation / tissue culture ✓ weed killers / herbicides ✓ production of seedless fruit ✓ preventing abscission ✓ promotes fruit ripening ✓	**2 max**	***List Rule*** *If **both** prompt lines used and more than one response is on prompt line mark the **first** one on each line.* *If only **one** line used but there is more than one response listed mark the first two given.* **ALLOW** rooting hormone **IGNORE** to take cuttings **ALLOW** parthenocarpy **ALLOW** prevents leaf / fruit , drop
			Total	**17**	

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