Biological Rhythms – Mark Scheme

Q1.

Please note that the AOs for the new AQA Specification (Sept 2015 onwards) have changed. Under the new Specification the following system of AOs applies:

- AO1 knowledge and understanding
- AO2 application (of psychological knowledge)
- AO3 evaluation, analysis, interpretation.

Although the essential content for this mark scheme remains the same, mark schemes for the new AQA Specification (Sept 2015 onwards) take a different format as follows:

- A single set of numbered levels (formerly bands) to cover all skills
- Content appears as a bulleted list
- No IDA expectation in A Level essays, however, credit for references to issues, debates and approaches where relevant.

AO1 = 4

Candidates need to outline an example of one or more examples of ultradian biological rhythms ie rhythms that have a cycle length of more than one cycle every 24 hours. The most accessible example is the alternation between REM and NREM sleep during the night. For marks in the top band candidates should provide some details of this alternation, such as the number of REM episodes per night, the link with stage 2 NREM, or the distinctive characteristics of each sleep type. Other examples of ultradian rhythms include meal patterns in humans and other animals and variations in locomotor activity in rats. Again, for marks in the top band detail beyond a simple outline is necessary.

Description of the stages of sleep without reference to the ultradian rhythm can gain a maximum of 1 mark.

Straightforward definitions are not credit-worthy. However, candidates who provide an incorrect definition of an ultradian rhythm but present an appropriate outline may earn marks across the scale.

AO1 Mark Bands
4 marks Sound Knowledge and understanding are accurate and well detailed. Organisation and structure of the answer are coherent.
3 marks Reasonable Knowledge and understanding are generally accurate and reasonably detailed. Organisation and structure of the answer are reasonably coherent.
2 marks Basic Knowledge and understanding are basic/relatively superficial. Organisation and structure of the answer are basic.
1 mark Rudimentary Knowledge and understanding are rudimentary and may be very brief, muddled and/or

inaccurate. Lacks organisation and structure.
0 marks No creditworthy material.

Q2.

AO1 = 4

Circadian rhythms have a 24 hour periodicity, and include the sleep / waking cycle and body temperature. Candidates are likely to outline the sleep-waking cycle. Besides correctly identifying the rhythm, an outline might include reference to the role of endogenous body clocks and external zeitgebers such as light. However any material relevant to the sleep-waking cycle would be credit-worthy. This section should be marked bearing in mind time constraints.

AO1 Mark bands	
4 marks	Outline is reasonably thorough, accurate and coherent
3 – 2 marks	Outline is limited, generally accurate and reasonably coherent
1 mark	Outline is weak and muddled
0 marks	No creditworthy material

Q3.

[AO2 = 4]

Level	Marks	Description
2	3 – 4	Knowledge of the role of endogenous pacemakers and exogenous zeitgebers and how they interact to affect the normal sleep-wake cycle is clear and mostly accurate. The material is used appropriately to explain Sam's experiences / symptoms. The answer is generally coherent with effective use of specialist terminology.
1	1 – 2	Some knowledge of the role of endogenous pacemakers and exogenous zeitgebers in the sleep-wake cycle is evident. The material is not always linked explicitly or effectively to Sam's experiences / symptoms. The answer lacks accuracy and detail. Use of specialist terminology is either absent or inappropriate.
	0	No relevant content.

Content:

- endogenous pacemakers – internal biological rhythms

- exogenous zeitgebers – external factors, eg light
- moving to night shift means pacemakers try to impose inbuilt rhythm of sleep, but are now out of synchrony with the zeitgeber of light
- disruption of biological rhythms has been shown to lead to disrupted sleep patterns, increased anxiety and decreased alertness and vigilance.

Q4.

(a) **[AO2 = 3]**

3 marks for the correct answer given to two significant figures: 8.4 (even if no correct workings are shown).

2 marks for correct answer not given to two significant figures, e.g. 8.35714, 8.3571, 8.357, 8.36 or 8.

1 mark if incorrect answer is provided but all workings are correct.

Correct workings:

9 + 8 + 8.5 + 7 + 7.5 + 10.5 + 8 = 58.5

58.5/7 = 8.35714286

Answer = 8.4 hours

3

(b) **[AO2 = 2]**

2 marks for one elaborated reason why the mean is the most appropriate measure of central tendency for this set of data.

1 mark for a limited reason why the mean is the most appropriate measure of central tendency for this set of data.

Possible reasons:

- there are no extreme values (not skewed) so distortion will not be a problem with this data set
- the mean takes into account / uses all the data so is more representative of the data than other measures
- data is time and is therefore interval data.

Credit other relevant points.

2

[5]

Q5.

[AO3 = 4]

Level	Marks	Description
2	3 – 4	Explanation of problem and way of dealing with it is clear and mostly appropriate. The answer is generally coherent

		with effective use of specialist terminology.
1	1 – 2	Some explanation of problem and/or appropriate way of dealing with it. The answer lacks accuracy and detail. Use of specialist terminology absent or inappropriate.
	0	No relevant content.

Possible content:

- Problem – random sampling; the 3 pm group might simply have been better at maths than the 3 am group. The solution would be a matched pairs (matched on maths ability) or repeated measures design.
- Problem – use of different maths tests, with no evidence that they were matched for difficulty. The solution would be to use the same set of maths problems if a matched pairs design was used.
- Individual differences due to independent groups design so use repeated measures but would need different but equivalent tests and counterbalancing.
- Other issues, such as individual differences in biological rhythms ('owls' versus 'larks') confounding results. Such answers should be marked on their merits – is the problem plausible and is the solution sensible?

Q6.

[AO1 = 3 AO2 = 2 AO3 = 3]

Level	Mark	Description
4	7-8	Knowledge of research into exogenous zeitgebers is accurate with some detail. Application to Julia's baby is effective. Discussion is effective. Minor detail and / or expansion of argument is sometimes lacking. The answer is clear, coherent and focused. Specialist terminology is used effectively.
3	5-6	Knowledge of research into exogenous zeitgebers is evident but there are occasional inaccuracies / omissions. Application and / or discussion is mostly effective. The answer is mostly clear and organised but occasionally lacks focus. Specialist terminology is used appropriately.
2	3-4	Limited knowledge of research into exogenous zeitgebers is present. Focus is mainly on description. Any discussion / application is of limited effectiveness. The answer lacks clarity, accuracy and organisation in places. Specialist terminology is used inappropriately on occasions.
1	1-2	Knowledge of research into exogenous zeitgebers is very limited. Discussion / application is limited, poorly focused or absent. The answer as a whole lacks clarity, has many inaccuracies and is poorly organised. Specialist terminology is either absent or inappropriately used.

	0	No relevant content.

Possible content:

- external cues act as zeitgebers (Klein and Wegmann)
- these cues may influence / entrain biological rhythms (endogenous pacemakers)
- light suppresses the production of melatonin from the pineal gland which influences people's sleep / wake cycle
- knowledge of relevant studies.

Possible application:

- Julia should try to keep her baby in the dark at night (e.g. shutting curtains and keeping lights off) but expose her baby to light in the day time (e.g. keep curtains open, go outside)
- Julia should use social cues, e.g. ensuring verbal communication, eye contact and feeding are only in the day time.

Possible discussion:

- use of research to provide support for the importance of light as a zeitgeber, e.g. Vetter et al. (2011), Burgess et al. (2003), Campbell and Murphy (1998)
- use of research to provide evidence against the importance of social cues as a zeitgeber, e.g. Lughton Miles et al. (1977)
- discussion of methodological issues is only creditworthy if the implications are linked to the stem
- discussion for and against the role of light as an exogenous zeitgeber
- counterarguments, e.g. the role of endogenous pacemakers – biological clock

Credit other relevant material.
Note: Application should be sensible and reasoned

[8]

Q7.

Marks for this question: AO1 = 6, AO3 = 10

Level	Marks	Description
4	13 – 16	Knowledge is accurate and generally well detailed. Discussion / evaluation / application is thorough and effective. The answer is clear, coherent and focused. Specialist terminology is used effectively. Minor detail and / or expansion of argument sometimes lacking.
3	9 – 12	Knowledge is evident. There are occasional inaccuracies. Discussion / evaluation / application is apparent and mostly effective. The answer is mostly clear and organised. Specialist terminology is mostly used effectively. Lacks focus in places.
2	5 – 8	Some knowledge is present. Focus is mainly on description. Any discussion / evaluation / application is only partly effective. The answer lacks clarity, accuracy

		and organisation in places. Specialist terminology is used inappropriately on occasions.
1	1 – 4	Knowledge is limited. Discussion / evaluation / application is limited, poorly focused or absent. The answer as a whole lacks clarity, has many inaccuracies and is poorly organised. Specialist terminology either absent or inappropriately used.
	0	No relevant content.

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AO1

The term 'research' refers to both theory / explanations and studies.

Students are likely to focus on research studies into shift work and jet lag, although other examples, such as seasonal affective disorder, could also be relevant if presented in the context of the disruption of biological rhythms. Effects of disrupting biological rhythms through shift work and jet lag can be behavioural (e.g. lowered productivity), psychological (e.g. tiredness, depression, anxiety), or physiological (e.g. increased vulnerability to heart disease and cancer). For each of these and for both shift work and jet lag there are many accessible research studies.
More anecdotal answers that simply describe effects of disrupting biological rhythms without reference to research studies may earn very limited credit as the description is based on research. This includes reference to real world events such as Chernobyl and Three Mile Island.

Some candidates may begin by outlining the mechanisms behind the disruptive effects, such as the dislocation of endogenous pacemakers and external zeitgebers i.e. outlining an *explanation* for the effects of disrupting biological rhythms.

AO3

Commentary might include the implications of findings for our understanding of the mechanisms of the effects of disruption, and application of findings to reduce the impact of disruption e.g. by changes to shift work patterns, or by adjusting behaviour when crossing time zones. For full credit such applications should be linked to mechanisms / explanations. Treatments for jet lag e.g. melatonin, would be creditable as long as there is an explicit link to biological rhythms e.g. via the role of melatonin in biological clocks.

Use of the findings of relevant research studies is an accessible source of credit, where used to support or contradict our understanding of the mechanisms.

Credit also discussion of practical applications of findings. Some convincing studies show that modifying shift work patterns can have significant beneficial effects on behaviour and health. Other relevant discussion may include reductionism and the nature / nurture debate.

Q8.

Marks for this question: AO1 = 6, AO3 = 10

Level	Marks	Description
4	13 – 16	Knowledge is accurate and generally well detailed. Discussion / evaluation / application is thorough and effective. The answer is clear, coherent and focused. Specialist terminology is used effectively. Minor detail and / or expansion of argument sometimes lacking.
3	9 – 12	Knowledge is evident. There are occasional inaccuracies. Discussion / evaluation / application is apparent and mostly effective. The answer is mostly clear and organised. Specialist terminology is mostly used effectively. Lacks focus in places.
2	5 – 8	Some knowledge is present. Focus is mainly on description. Any discussion / evaluation / application is only partly effective. The answer lacks clarity, accuracy and organisation in places. Specialist terminology is used inappropriately on occasions.
1	1 – 4	Knowledge is limited. Discussion / evaluation / application is limited, poorly focused or absent. The answer as a whole lacks clarity, has many inaccuracies and is poorly organised. Specialist terminology either absent or inappropriately used.
	0	No relevant content.

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AO1

The emphasis in this question is in the 'role' of endogenous pacemakers. Endogenous pacemakers (EP) and exogenous zeitgebers interact in the control and fine tuning of biological rhythms. An effective approach to marks would be to describe examples of endogenous pacemakers, such as the suprachiasmatic nucleus (SCN), pineal gland and melatonin release. There are other pacemakers in the brain, eg for body temperature, although answers focusing on the SCN and pineal may receive marks across the scale. A further route to marks would be to describe the mechanisms underlying the interaction between EPs and exogenous zeitgebers such as light.

AO3

It is likely that research evidence will provide the major source of discussion on this question. There are many studies supporting a role for EPs in the control of biological rhythms, and how they interact with exogenous zeitgebers; these include Siffre's original isolation study and subsequent similar work, experiments on infradian rhythms, and even research on non-human animals (eg hamsters) and plants could be made directly relevant to this question.

The effects of disrupting biological rhythms can also provide evidence directly relevant to the question. Interpretation and evaluation of research evidence should distinguish the quality of answers, with better candidates able to describe accurately how findings support the role of EPs in the control of biological rhythms.
Also relevant would be methodological evaluation of research evidence, although this would only be effective if the implications for findings are clear and application of scientific ideas and evidence eg the implications of findings on the disruption of biological rhythms and possible remedies for shift work and jet lag.

Issues that could be relevant in the context of the role of endogenous pacemakers in the control of biological rhythms: biological approach, evolutionary: use of animals in research, reductionism, free will / determinism, ethics.

Q9.

Marks for this question: AO1 = 6, AO3 = 10

Level	Marks	Description
4	13 – 16	Knowledge is accurate and generally well detailed. Discussion / evaluation / application is thorough and effective. The answer is clear, coherent and focused. Specialist terminology is used effectively. Minor detail and / or expansion of argument sometimes lacking.
3	9 – 12	Knowledge is evident. There are occasional inaccuracies. Discussion / evaluation / application is apparent and mostly effective. The answer is mostly clear and organised. Specialist terminology is mostly used effectively. Lacks focus in places.
2	5 – 8	Some knowledge is present. Focus is mainly on description. Any discussion / evaluation / application is only partly effective. The answer lacks clarity, accuracy and organisation in places. Specialist terminology is used inappropriately on occasions.
1	1 – 4	Knowledge is limited. Discussion / evaluation / application is limited, poorly focused or absent. The answer as a whole lacks clarity, has many inaccuracies and is poorly organised. Specialist terminology either absent or inappropriately used.
	0	No relevant content.

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AO1

Award credit for knowledge of relevant biological rhythms: circadian, infradian and ultradian, and for knowledge of factors which might affect these rhythms eg endogenous pacemakers and exogenous zeitgebers. Candidates will show

knowledge of a range of different consequences, such as the effects of shift work and jet lag, and, although unlikely knowledge of circadian sleep disorders.

Credit knowledge of non-human animal studies and sleep deprivation as explicitly linked to the consequences of disrupting biological rhythms.

AO3

An effective route to discussion/evaluation marks would be methodological evaluation of research and field studies as relevant to the consequences. A second route would be commentary on the implications of findings eg what modifications to shift work have been shown to alleviate its effects? Does our knowledge of the mechanisms behind jet lag suggest possible ways of minimising its effects? Accurate explanations of why/how disrupting biological rhythms has such effects ie the roles of endogenous pacemakers and exogenous zeitgebers, would qualify as extended commentary.

Examiners should be sensitive to depth / breadth trade-offs in answers that cover several consequences or examples of disruption.

Further relevant discussion points might broader approaches eg biological, general issues related the research eg reductionism; ethical issues; applications of psychological research eg to the alteration of shift work patterns.