Learning Objectives

**Issues to Consider**

As a consequence of today's 24/7 culture, sleep deprivation has been classed as an epidemic of modern society and so is very thought-provoking. In this chapter, we will consider the nature of biological rhythms and the consequences of disrupting them. Next, we will examine the theories of sleep and try to answer why sleep is necessary—is it to restore the body or to ensure survival? The effects of sleep deprivation will be examined as evidence to support the theories. We will also consider how sleep changes across the lifespan, as well as sleep disorders such as somnambulism and insomnia.

On completion of this topic you should be familiar with the following.

*Use this list of learning objectives as a revision checklist. Cross-reference the objectives with the Specification.*

**Biological rhythms**

- Describe research studies into circadian rhythms (about a day, 24 hours), e.g. the sleep–wake cycle, and include the role of endogenous (the biological clock, including the role of the SCN and pineal gland) and exogenous (zeitgebers, i.e. time givers such as light) factors.
- Describe research studies into infradian rhythms (greater than 24 hours), e.g. the menstrual cycle, and include the role of pheromones.
- Describe research studies into ultradian rhythms (less than 24 hours), e.g. the stages and cycles of sleep.
- Assess the consequences of disrupting biological rhythms through jet lag and shiftwork.

**Sleep states**

- Outline the nature of sleep including the stages and cycle of this ultradian rhythm and the role of neurotransmitters in this rhythm.
- Critically consider the restoration theory of sleep, e.g. Oswald (1980) suggested that NREM sleep repairs the body and REM sleep repairs the brain; Horne (1988) distinguished between core (stage 4 and REM) and optional sleep (stages 1–3).
- Critically consider evolutionary explanations of sleep, which suggest that sleep has an adaptive function as it increases survival potential. For example, Meddis (1975) considered a safety function and Siegal (2005) suggested energy conservation in his hibernation theory.
- Relate sleep deprivation to the theories, e.g. research on sleep deprivation supports the restoration theory and, given that it can be fatal, suggests that it is necessary for survival, thus supporting a restoration and an evolutionary function.
- Outline and evaluate lifespan changes in sleep using evidence that documents variations in sleep from birth to adulthood to the elderly.
Disorders of sleep

- Discuss explanations of sleep disorders such as primary and secondary insomnia.
- Critically consider research into the factors affecting insomnia.
- Describe other sleep disorders, such as narcolepsy and sleepwalking, and assess the research into each one.
Biological Rhythms

For details, see Eysenck’s A2 Level Psychology (pages 20–42).

**FIND OUT FOR YOURSELF:** You probably know if you are a “morning” or an “evening” person, but you can do a simple test to confirm this at: http://news.bbc.co.uk/1/hi/programmes/breakfast/3703940.stm

OR read the characteristics below to see which type you are.

**The Night Owl**
- Shows “morning syndrome”, i.e. awakens as day goes on, not feeling human until after 11am.
- Goes to bed late—midnight or later.
- Wakes as late as possible in the morning.
- Feels “ill” if have to get up at 6am.
- Feels tired during day due to too little sleep.

**The Morning Lark**
- Doesn’t show “morning syndrome”.
- Tends to wake early—before 7am.
- Struggles to stay up late.
- Can fall asleep fast if goes to bed early, e.g. 9pm.

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**How much sleep do we need?**

Fill in the blanks.

Most people can function on _____ hours’ sleep per night, but we’re really at our best on around ______ hours’ sleep per night. It is likely that our evolutionary past designed our bodies to need one long continuous sleep at night and around a 1½-hour nap during the day. Just ensure this nap is before 6pm and not during one of your classes and your sleep pattern will be optimal!

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**A Circadian Rhythm: The Sleep–Wake Cycle**

Fill in the blanks.

A circadian rhythm repeats in a cycle of once every _______ hours. Mammals possess about 100 circadian rhythms. The 24-hour sl______–w_______ cycle is a good example of a circadian rhythm because it clearly illustrates that circadian rhythms depend on an interaction of phy________al and psy________al processes. The fact that we maintain a fairly consistent sleep pattern suggests an internal mechanism, the biological cl____k. However, this can be overridden by psychological factors, e.g. anxiety can disrupt the sleep pattern.
Endogenous factors: The biological clock

Fill in the blanks.
The suprachiasmatic nucleus (SCN, a small group of cells in the hypothalamus) is the pa_____ker of the biological clock. The SCN generates its own biological rhythm due to protein synthesis. It is connected to the optic chiasm and so receives input about the amount of li__t, which also influences the rhythm. The pineal gland is linked to the SCN by a neural pat____y and electrical stimulation of this causes it to release melatonin; when light levels are low high amounts of m________n are released. Melatonin is a hormone that induces sleep because it enhances production of the neur________er serotonin and this causes the ner________s system to slow down, brain activity consequently falls, and sleep begins.

The physiological processes of the biological clock can be summarised as:

Organise the following into the correct order in the flow diagram.

- enhances the production of serotonin
- optic chiasm in the eye
- stimulates pineal gland
- produces melatonin
- low light
- brain activity falls → sleep
- stimulates SCN

Why is the sleep–wake cycle 24 hours long?

Fill in the blanks.
This is mainly due to the above endogenous factors (in-built biological mechanisms), as is supported by the following research studies that demonstrate the influence of a bio__________l clock. However, there is research evidence supporting the influence of exogenous factors (zei__________s), which involve external processes.
### RESEARCH EVIDENCE FOR ENDOGENOUS FACTORS

*Summarise the research evidence below.*

<table>
<thead>
<tr>
<th>Study</th>
<th>Evidence</th>
<th>Support for Endogenous Factors</th>
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</thead>
<tbody>
<tr>
<td>Siffre’s (1975) “cave study”</td>
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<td>Miles et al.’s (1977) study of a blind man</td>
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<tr>
<td>Morgan’s (1995) “hamster studies”</td>
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</tbody>
</table>

### RESEARCH EVIDENCE AGAINST ENDOGENOUS FACTORS AND FOR EXOGENOUS FACTORS OR ZEITGEBERS

*Summarise the research evidence below.*

<table>
<thead>
<tr>
<th>Study</th>
<th>Evidence</th>
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</tbody>
</table>
**Other endogenous clocks**

Ψ **The temperature and cognitive vigilance cycles.** What does Klein and Armitage’s (1979) research reveal about these?

Ψ **Cognitive alertness.** When is peak performance usually achieved?

**EVALUATION**

*Summarise the evaluation points below.*

Ψ **Generalisability.** Why do the case studies and Morgan’s (1995) research on hamsters lack generalisability?
An Infradian Rhythm: The Menstrual Cycle

Fill in the blanks.

An infradian rhythm repeats in a cycle of greater than 24 hours. For example, the menstrual cycle occurs every _______ days, although this is subject to great individual variation and so can repeat from 20–60 days. It is controlled by the hormones oe__________n and pro__________ne, which are released by the en__________e glands. The hormones cause the release of the egg and engorging of the lining of the womb 2 weeks after ovulation. If the egg is not fertilised the lining is shed and so menstruation is the outcome of a cycle of activity that prepares the body for conception. Menstruation is an end________us mechanism as it is controlled mainly by internal biological factors (the hormones) but exogenous factors (external cues) can also affect the rhythm.
### Research Evidence

*Summarise the research evidence below.*

**Ψ McClintock’s (1971) “synchronised menstrual cycles” study.** How did they synchronise?

**Ψ Russell et al.’s (1980) “female pheromones” study.** Explain the process of armpit to upper lip!

**Ψ The “male pheromones” study.** Why do these speed up the menstrual cycle?

### Evaluation

*Summarise the evaluation points below.*

**Ψ Synchronisation is adaptive.** How does this account for the origin of this mechanism?

**Ψ Objective evidence.** Why is the evidence objective?
An Ultradian Rhythm: The Stages and Cycles of Sleep

**Fill in the blanks.**

An ultradian rhythm repeats in a cycle of less than 24 hours. The stages and cycles of sleep are ultradian rhythms as the cycles occur approximately every 90 minutes and the stages occur within these cycles. Sleep is not an unconscious state but there is a loss of consciousness.

**The five stages of sleep: The sleep escalator**

*Starting on the top step with the first stage of sleep, place the letters of the following stages onto the correct steps of the escalator.*

(a) **Lasts approximately 30 minutes.** This stage is also known as slow-wave sleep (SWS) because of the long, slow delta waves of the EEG. The EOG and EMG show very little activity. This is deep sleep and so it is hard to wake somebody from. Other physiological activity includes body temperature, heart rate, and blood pressure dropping to their lowest point and growth hormones are secreted. It is also the stage when sleepwalking, sleep-talking, and “night terrors” (a nightmare where the individual appears wide awake but is asleep) can occur.

(b) **Lasts approximately 15 minutes.** The body relaxes and the individual feels drowsy. The EEG activity is characterised by alpha waves that have a frequency of 8–12 cycles per second (cps or Hz). The EOG indicates slow rolling eye movements and the EMG shows reductions in muscle tension. Heart rate and temperature also fall. A hypnogogic state may occur during the transition from wakefulness to sleep in which hallucinations may be experienced, e.g. the feeling of falling. As this is the lightest stage of sleep we are easily awakened and may feel as if we have been jolted awake.
(c) **Lasts approximately 10 minutes in the first cycle and builds up to an hour by the fourth and fifth cycles.** The EEG activity is characterised by beta waves (13–30 Hz), which also occur during a relaxed waking state and this high level of brain activity is linked to dreaming. This stage is known as REM sleep because of the rapid eye movements and has also been called paradoxical sleep because the EEG readings show that the brain is very active, whilst the EMG readings show that the body is paralysed. Consequently it is the hardest stage to wake somebody from. This paralysis is for a good reason because REM sleep is when most (but not all) dreaming occurs and so the paralysis prevents us from acting out our dreams.

(d) **Lasts approximately 15 minutes.** The EEG activity is characterised by long, slow delta waves (1–5 Hz) with some sleep spindles. The EOG and EMG are the same as stage 2.

(e) **Lasts approximately 20 minutes.** The EEG activity is characterised by larger and slower theta waves (4–8 Hz) and high frequency sleep spindles called K-complexes (12–14 Hz), which are our responses to external stimuli (e.g. noise) and internal stimuli. The EOG shows little eye movement and the EMG shows the muscles are relaxed. It is still easy to be awakened.

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**The cycles of sleep: Up and down the sleep escalator**

Correctly identify and label the cycles.

<table>
<thead>
<tr>
<th>1st cycle</th>
<th>2nd cycle</th>
<th>3rd cycle</th>
<th>4th cycle</th>
<th>5th cycle</th>
</tr>
</thead>
</table>

- Enter at stage 2 for 70 minutes and then enter REM sleep (stage 5) for approximately an hour.
- Begin at stage 2, which lasts for about 20 minutes, then descend through stage 3 to the deep sleep of stage 4, which lasts approximately 30 minutes. Then ascend through stages 3 and 2. REM sleep (stage 5) completes the cycle and lasts for about 10 minutes.
- Enter at stage 2 followed by REM (stage 5). This is known as the emergent cycle because we may awake from either stage. We are more likely to remember our dream if we awake in stage 5 and can experience a hypnogogic state and so recall vivid visual images as we awake.
- Enter at stage 2 and spend about an hour in this stage. Next we miss the descent of the sleep escalator by going straight into REM sleep (stage 5) for approximately 40 minutes.
- Go down the sleep escalator from stage 1 to 4; then ascend through stage 3 and then stage 2. Stage 5 or REM sleep follows this and lasts for approximately 10 minutes.

- How many cycles do we average per night?
- In which cycles does deep (SWS) occur?
- How does REM sleep change during the course of the night?
Fill in the blanks.
As we descend the sleep escalator into deep sleep the brain (EEG) waves become l_________ and s_________.

RESEARCH EVIDENCE

Summarise the research evidence below.
Ψ Electroencephalograms (EEGs), electro-oculograms (EOGs), and electromyograms (EMGs). What does each of these measure?

Ψ Self-report measures. Why is this measure used?

EVALUATION

Below are some evaluative points. However, these are limited because they do not fully explain the weaknesses. The evaluation is elaborated upon in the next section.
Ψ Objective evidence. The EEG, EOG, and EMG provide objective measures of the physiology of sleep, and have greatly advanced our understanding.
Ψ Artificiality of the sleep laboratory. A significant weakness is that such physiological measures are gathered in a sleep laboratory, where the artificial conditions and the fact that research participants are wired up to machines may affect sleep patterns.
Ψ Weaknesses of the self-report method. The traditionally used self-report method yields subjective data compared to the objective measurements of the EEG, EOG, and EMG.
Ψ Individual differences. Most people have five sleep cycles, which last approximately 90 minutes each. However, there is great variation in sleep patterns, as evidenced by individual differences in the total amount of sleep.
Ψ Universality. There are some universal characteristics of sleep.
CONCLUSIONS—SO WHAT DOES THIS MEAN?

Write the numbers of the following elaborations next to the correct evaluative points on the previous page.

1. For example, some people have a 9-hour sleep pattern, 7–8 hours is the average, yet many sleep for considerably less than this (4 hours or less). Longer sleepers spend more time in REM than shorter sleepers. There is also diversity in the pattern of NREM to REM sleep between people, and within the individual, as the pattern may vary in the same person over time.

2. Self-report is vulnerable to bias and distortion as a consequence of researcher effects and participant reactivity and so may lack validity. Furthermore, it offers no insight into the physiology of sleep.

3. Stages 3 and 4 occur only in the first two cycles and REM sleep always increases in duration with each successive cycle.

4. The sleep laboratory is reductionist (oversimplified) as it does not reflect the range of factors that can influence sleep in real life. The research lacks mundane realism and as a consequence the findings may lack generalisability to real-life sleep patterns and so ecological validity may be lacking. Consequently, the meaningfulness of the findings may be limited.

5. They are objective because they are less vulnerable to subjectivity and researcher bias.

How would you ensure your evaluation was fully explained and elaborated upon?

Note down some ideas:
Disruption of Biological Rhythms

Fill in the blanks.

Disrupting biological rhythms has negative consequences for the individual because this goes against a mainly end__________s, built-in pattern, and so there are physiological and psychological costs of disr__________n as the body attempts to readjust.

Seasonal affective disorder (SAD)

One significant disruption is the seasonal change of decreased light during the winter months because this can lead to serious depression in some cases. This condition begins in the autumn as the days shorten and so exposure to light decreases, and only tends to lift in the spring as the days lengthen and exposure to light increases.

RESEARCH EVIDENCE

Summarise the research evidence below.

Ψ The case of Pat Moore. How does this support the use of light therapy?

Ψ Booker and Hellekson’s (1992) research into incidence rate in Alaska. What does this research suggest may be the cause of SAD?

Ψ Lam et al.’s (2006) research. How does this further support light therapy?

Ψ Light therapy involving dawn simulation. How is dawn simulated and what effect does this have?
Shiftwork causes major disruption to the biological rhythms because the individual is working when the body wants to be asleep and trying to sleep when the body wants to be awake. The consequences of this are the same as the symptoms described for jet lag. If given enough time to adjust our bodies can reprogram our biological rhythms and thus cope with the shiftwork by reducing disturbance. Industrial accidents at Chernobyl, Bhopal, and Three-Mile Island all occurred between 1am and 4am, and most lorry accidents occur between 4am and 7am. This shows the dangers of shiftwork.

EVALUATION

Summarise the evaluation points below.

Ψ **Applications.** How can the research findings into SAD be usefully applied?

Ψ **Generalisability.** Why do case studies lack generalisability?

Ψ **Experimenter expectations/placebo effect.** What is the placebo effect and how may this explain the findings about the effectiveness of light therapy?

Ψ **SAD occurs in sunny countries.** How does this challenge our understanding of the causes of SAD?
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Summarise the research evidence below.</strong></td>
</tr>
<tr>
<td><strong>Ψ Akerstedt’s (1985) study of sleep deficit.</strong> Which deficits were found in this study?</td>
</tr>
<tr>
<td><strong>Ψ Burch et al.’s (2005) study on melatonin production.</strong> What were the effects of this disruption?</td>
</tr>
<tr>
<td><strong>Ψ Czeisler et al.’s (1982) “shift rotation” study.</strong> Which direction is best: forwards (clockwise) or backwards? How many days per shift rotation did Czeisler et al. conclude was optimal?</td>
</tr>
<tr>
<td><strong>Ψ Monk and Folkard’s (1983) “types of shiftwork” study.</strong> Which types of shiftwork patterns did they identify?</td>
</tr>
<tr>
<td><strong>Ψ Research application (Dawson &amp; Campbell, 1991).</strong> How have research findings on light been applied? How can the research into biorhythms be applied to the time when medication is taken?</td>
</tr>
</tbody>
</table>
EVALUATION

Summarise the evaluation points below.
Ψ Negative effects are well-supported. Give examples of research evidence.

Ψ Face validity. Why do the findings make sense?

Ψ Slow or fast rotation? Is either preferable? If so, which and why?

Ψ Novak et al.'s (1990) research into accident rates. What do these rates suggest about performance deficits?

Ψ Motor accident data. How does Horne (1992) account for the accidents?
Jet lag

Fill in the blanks.
Jet lag occurs when the individual crosses time zones because this disrupts the natural rhythm of the biological clock. Thus, jet lag is not caused by the rigours of travelling as is often misperceived. Instead, it only occurs when there is sufficient discrepancy between internal time (your biological clock, which is set to British time) and external time (local time of destination), which only occurs when travelling east to west or west to east, not north to south. The consequences of such disruption are a wide range of symptoms including fatigue, headache, sleep disturbances, irritability, and gastrointestinal disturbances.

Applications of the research. How have Czeisler’s et al.’s findings been applied to shiftwork patterns?

Self-report criticisms. What are the biases of self-report?

Individual differences. Why are some people “happy shift workers”?

Correlational criticisms. What are the weaknesses of correlational data?
## RESEARCH EVIDENCE

*Summarise the research evidence below.*

Ψ **Klein, Wegman, and Hunt’s (1977) “westbound flights” study.** Why are westbound flights easier to adjust to?

Ψ **Schwartz, Recht, and Lew’s (1995) “baseball” study (1995).** When did teams win more games?

Ψ **Research application.** Are melatonin tablets effective?

Ψ **Cho’s (2001) temporal lobe size study.** How does flying affect brain size and what cognitive effects are linked to this?

Ψ **Stewart and Amir’s (1998) research into emotional distress in rats.** What could emotionally stressed rats do less well than the unstressed rats?
EVALUATION

Summarise the evaluation points below.

Ψ Phase advance vs. phase delay. How does this explain jet lag?

Ψ Face validity. Which aspects of the research have intuitive appeal, i.e. they sound right?

Ψ Applications. How has an understanding of melatonin been usefully applied?

CONCLUSIONS—SO WHAT DOES THIS MEAN?

Answer the following questions in your conclusions.

• How do endogenous factors play a crucial part in regulating biological rhythms?

• To what extent do jet lag and shiftwork disrupt biological rhythms?

• What are the key weaknesses of research into biological rhythms?
Using this in the exam

Describe and assess the role of endogenous and exogenous factors in circadian biological rhythms. (25 marks)

Critically consider the consequences of disrupting biological rhythms. (25 marks)
Sleep States

For details, see Eysenck’s A2 Level Psychology (pages 43–61).

The Nature of Sleep

Fill in the blanks.

The sleep–wake cycle, as covered in the previous section, offers important insights into the nature of sleep. These include the role of biological clocks, the S_____ and the p_______ gland, and the role ofbiochemicals such as the m____________n released by the pineal gland when it receives electrical messages from the SCN that the light level is low. Melatonin influences the production of serotonin and this accumulated in the raphe nuclei in the hindbrain, near the pons, and stimulates the shutting down of the RAS (re_______ a_______ system) which is closely linked with brain activity. So serotonin could be the switch to start sleep.

Jouvet (1967) has also identified n__________ as a biochemical affecting sleep. Noradrenaline accumulates in the locus coeruleus in the pons and if this area was damaged, noradrenaline levels fell and REM sleep was impaired. This led him to conclude that different areas of the brain and the corresponding neurotransmitters controlled the two types of sleep, N____ and REM—the r______ n_______ and its serotonin pathway control NREM sleep; the locus coeruleus and noradrenaline pathway control REM sleep.

However, the circuitry involved is more complex than Jouvet suggests, as the pons, raphe nuclei, and locus coeruleus (among others) and a number of different n__________rs, especially serotonin, noradrenaline, and acetylcholine, are involved in sleep. Supporting evidence comes from links to other brain areas, and also shows that the relationships between brain areas and sleep may not be clear-cut as damage to the locus coeruleus or its pathways does not affect REM sleep.

A further factor is a biochemical, adenosine. This builds up during wakefulness and is then broken down during sleep. It has been suggested (NINDS, 2007) that the build-up causes dr__________s and could switch the brain into preparing for s_____ mode.

Refer back to the stages and cycles of sleep as an ultradian rhythm, as covered in the previous section, as these are also important to our understanding of the nature of sleep.

Sleep Deprivation

Fill in the blanks.

Sleep deprivation research has been carried out to try to clarify the functions of s_____. The reasoning being that the ill effects of not sleeping will reveal the f_________s of sleep.

Total sleep deprivation

Fill in the blanks.

Total sleep deprivation is when the individual experiences constant wa________ess, usually over a temporary period of time. This tends to occur very rarely in real life, as people are unlikely to subject themselves to the discomfort of total sleep de________ion. It has been
investigated for research purposes but it is difficult to organise large-scale studies of total sleep deprivation due to a lack of volunteers—unsurprisingly! Consequently, the case study is the most common research method.

### RESEARCH EVIDENCE

*Summarise the research evidence below.*

Ψ **Case studies: Peter Tripp and Randy Gardner.** For how long did they experience total sleep deprivation and what were the effects?

Ψ **Hüber-Wiedman’s (1976) meta-analysis.** What effects were identified over 6 nights?

Ψ **The “rotating rats” study (Rechtschaffen et al., 1983).** What were the findings of this study?

Ψ **The brain-damaged patient (Lugaressi et al., 1986).** Why was this condition fatal?

Ψ **Fatal familial insomnia.** When does the individual stop sleeping normally?
Partial sleep deprivation

Fill in the blanks.

Partial sleep deprivation is when the individual experiences a reduction in the amount of sleep compared to n________l. Partial sleep deprivation also occurs when participants are deprived of one particular st______e of sleep.

RESEARCH EVIDENCE

Summarise the research evidence below.

Ψ The “flowerpot” technique (Jouvet, 1967). How were the cats deprived of REM sleep only?

Ψ NREM and REM deprivation (Dement, 1960). What are the differences between NREM and REM deprivation?

Ψ Reducing the total night’s sleep (Webb & Bonnet, 1978). What was the reported minimum sleep per night with no ill-effects?

FIND OUT FOR YOURSELF: Research the consequences to health of sleep deprivation using the internet. Note it has been linked to obesity, diabetes, coronary heart disease, and many more illnesses. Then decide which poses a more serious problem for today’s society, total or partial sleep deprivation?
**EVALUATION**

*Match the terms below to the correct criticism.*

<table>
<thead>
<tr>
<th>Self-reports</th>
<th>Correlational</th>
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<tbody>
<tr>
<td>Validity of sleep laboratory research</td>
<td>Extrapolation</td>
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<tr>
<td>Cause and effect</td>
<td>Case studies</td>
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<td></td>
<td>Ecological validity</td>
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ψ ___________________________

The studies of sleep deprivation in humans mainly use case studies or small samples and so lack generalisability, as the effects may be due to characteristics that are unique to the individual participant. Thus, the effects experienced by Tripp and Gardner may not be representative of others, which is the key weakness of this method.

ψ ___________________________

Extrapolation from animals to humans in Rechtschaffen et al.'s and Jouvet's studies is an issue as generalisability may be limited given that humans and animals differ qualitatively not just quantitatively. This is due to the greater influence of psychological factors, such as cognition, on human behaviour.

ψ ___________________________

The participants who reported feeling fine on only 4 hours' sleep contradict how the majority of us feel when we get this little sleep, which raises the issues of participant reactivity and researcher expectancy. Participant cooperation may have occurred, with the participants answering as they thought the experimenter expected. Or social desirability bias may have occurred, with the participants reporting feeling fine in order to appear physically and mentally tough. Participant and researcher bias reduces the internal validity of the findings as the reported effects may be due to this rather than the sleep deprivation. The truth and value of Webb and Bonnett's (1978) research is questionable and so it may not be representative of real-life partial sleep deprivation.

ψ ___________________________

The case studies involving Randy Gardner, Peter Tripp, and the man with brain damage provide correlational evidence—sleep deprivation has not been manipulated as an IV because ethically and practically this is much more difficult to do with humans. Consequently, the research evidence lacks conclusiveness, as cause and effect cannot be inferred.

ψ ___________________________

Dement's research was an apparently well-controlled and systematic laboratory experiment that increases confidence in the internal validity. However, we cannot be certain of this, as the sleep laboratory may well have disturbed the participants’ sleep patterns. Thus, the effects may be due to the artificiality and reductionism of the sleep laboratory, rather than just the sleep deprivation. If this is the case, internal validity will be low.
Total sleep deprivation is very rare in real-life sleep patterns. It is worth noting that even insomniacs sleep for about 6 hours per night even though they may feel that they sleep much less. Consequently, research on total sleep deprivation lacks mundane realism and ecological validity. Research on partial sleep deprivation is more relevant to real-life sleep deprivation. However, given that much of this research is conducted in the artificial conditions of the sleep laboratory, then mundane realism and ecological validity are still a weakness.

We can’t infer cause and effect in the correlational evidence and we cannot be sure of this in the experimental evidence as extraneous variables may be involved. For example, the sleeplessness will cause stress, and in real life when sleep deprivation occurs there are likely to be reasons behind it, all of which may influence the effects. These confounding factors are a further threat to the internal validity of the research and so constrain conclusions on causation. However, given the amount of evidence and the medical condition fatal familial insomnia then we can be reasonably certain that sleep deprivation can be life-threatening, but that it is one of multiple causes in this fatal effect.
FIND OUT FOR YOURSELF: Research has found that more men (55%) report a better night’s sleep than women (37%) even when stressed (Kryger, 1994). Conduct a survey to test this finding and do an internet search on sleep deprivation: it has been suggested that you lose one IQ point the next day for every hour of lost sleep the night before. Not only that, lack of sleep is linked to increased risk of heart disease and cancer, so the search should be productive.


Theories of the Functions of Sleep

All animals sleep—this suggests that sleep serves some vital and universal function.

### Ecological/evolutionary theories

*Fill in the blanks.*

The many variations in animals’ sleep patterns suggest that sleep may serve an adaptive rather than a restorative function. This means sleep has been naturally selected because it promotes su________al. This is a gradual process where species that sleep have survived to rep________ce and so carry forth sleep into the next generation as an ad________ve behaviour. If it was non-adaptive, i.e. does not have an evolutionary purpose, then it should have disappeared. Thus, sleep is likely to be adaptive in some way as this is surely the reason why all animals sleep. Meddis (1975) suggested that sleep is adaptive because the immobility of sleep keeps animals safe from pre________rs and that it occurs when normal activities (e.g. feeding) are impossible. Thus, Meddis suggests that to be more or less still when it is too dark to see either f_______ or threats could be an advantage for some animals. Siegal (2005) proposed the hibernation theory, which suggested that the adaptive function of sleep is energy c________. This is particularly true of small animals with high m________c rates, such as squirrels and shrews, as the heat from the high metabolic rate is a significant energy loss and so they need to sleep to recoup this.

### RESEARCH EVIDENCE FOR ECOLOGICAL/EVOLUTIONARY THEORIES

*Summarise the research evidence below.*

Ψ Fatal effects. What evidence is there of these?

Ψ Variations in sleep patterns across species. What is a diurnal sleep pattern?
**Predator/prey sleep patterns.** Who sleeps longer?

**Metabolic rate and energy conservation.** How are these linked?

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**RESEARCH EVIDENCE AGAINST ECOLOGICAL/EVOLUTIONARY THEORIES**

*Summarise the research evidence below.*

**Ratio of predator/prey sleep duration (Allison & Cicchetti, 1976).** How does this conflict with Webb’s hibernation theory?

**Lack of energy conservation.** How is this comparable to a slice of bread?

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**EVALUATION**

*Summarise the evaluation points below.*

**Vulnerability.** How does this contradict sleep as a survival mechanism?

**Low adaptive value.** Which species may well be better off without sleep?
Lacks scientific validity. Why is there a lack of scientific support?

Deterministic and reductionist. Explain fully how evolutionary explanations ignore free will and are oversimplified.

Does not account for the effects of sleep deprivation. Why are evolutionary theories challenged by the negative effects of sleep deprivation?

Does not account for the different types of sleep. What are the different types of sleep and why is it a weakness that evolution does not consider these?

Nomothetic (universal) explanation is too reductionist. Why is a universal explanation too simplistic?

Restoration theories

Fill in the blanks.

According to restoration theories the purpose of sleep is to re________r and rec________e the brain and body, through restoring e______gy resources, repair and growth of tissue cells and muscles, and replenishing neurochemicals. Oswald (1980) claimed that NREM sleep restored the b______y and REM sleep restored the br______n, through protein synthesis. Horne (1988) expanded on this as he distinguished between c_______e (stage _____ and REM) and op________al sleep (stages ___to___) and claimed that only core sleep is critical for restoration of the brain as restoration of the body can occur during resting wakefulness. Restoration theories are supported by the fact that we often sleep more during times of stress and illness.
### RESEARCH EVIDENCE FOR RESTORATION THEORIES

*Summarise the research evidence below.*

Ψ **Growth hormone.** Which stage is this released in?

Ψ **High brain activity of REM sleep.** What evidence is there of this brain activity?

Ψ **Babies’ sleep patterns.** How long do babies sleep per day and how long in REM?

Ψ **Total sleep deprivation studies.** What is the REM rebound effect and how does this support restoration?

Ψ **The effect of physiological assaults on the brain.** What are the effects of such assaults?

Ψ **Neurogenesis does occur during sleep.** What is neurogenesis and how does this support restoration?
The effect of extra activity (Shapiro et al., 1981). How long was the ultra marathon?

Neurochemical restoration (Stern & Morgane, 1974). How does the effect of antidepressants support this?

RESEARCH EVIDENCE AGAINST RESTORATION THEORIES

Summarise the research evidence below.

REM sleep is more necessary than Horne suggests. Why is Horne’s suggestion that we only need about 50% of REM sleep not supported by research?

Duration of protein synthesis. Why is this limited?

Not all lost sleep is recovered. What percentage of lost sleep is recovered?

Increased activity (Horne & Minard, 1985). Whose study does this contradict?
The neurochemicals rise and fall during sleep and so are not solely being replenished during REM sleep. How does this illustrate the reductionism of restoration theory?

The high activity of REM increases energy expenditure. How does this contradict the energy restoration aspect of the theory?

EVALUATION

*Summarise the evaluation points below.*

Ψ Researcher effects and participant reactivity. How do these affect validity?

Ψ Reliability and validity. Where is there a lack of consistency in the research evidence?

Ψ Variations in sleep patterns. Why are the great variations in sleep patterns across species not accounted for by restoration?

Ψ Face validity. Why does restoration have face validity?
Objective measurement. What is measured objectively?

Multi-perspective. Explain the restoration of physiological and psychological function.

Further research. Which aspect of the restoration evidence could be improved with further research into the brain?

Lifespan Changes in Sleep

<table>
<thead>
<tr>
<th>Early sleep patterns in human babies and children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill in the blanks.</td>
</tr>
<tr>
<td>Human infants vary in their sleep patterns and do not have a set pattern at birth. Circadian rhythms are controlled by the brain and this is immature at birth, so the development of the rhythm could well be in line with early brain development and growth, especially synaptic growth. Frequent night awakenings is most common in babies from 4 to 12 months and can be attributed to a range of causes, e.g. their increasing knowledge that being awake is more interesting than being asleep and perhaps they have an increasing need for reassurance as they become more aware of their caregivers and the separation from them that sleep brings. Whatever the variations in baby and child sleep patterns, it is generally true that younger people sleep more than older ones. Babies spend far more time than adults in REM sleep—up to 50% of their sleep is in REM. Young adults spend about 20% of sleep in REM and elderly adults only about 15% in REM.</td>
</tr>
</tbody>
</table>

RESEARCH EVIDENCE INTO EARLY SLEEP PATTERNS

Summarise the research evidence below.

Scher’s (1991) study of night waking. What happens to night waking after 9 months?
EVALUATION

Summarise the evaluation point below.
Ψ Ethnocentrism. Why might these patterns of sleep be only true of Western babies?

Adult sleep patterns including changes with age

Fill in the blanks.
One key change in sleep with age is the decrease in slow-wave sleep. This deterioration takes place twice, between 16 and 25 years, and 35 and 50 years. It is not just the decrease in sleep that is the issue but the decrease in growth hormone, and consequently growth and repair are also slowed.

RESEARCH EVIDENCE INTO ADULT SLEEP PATTERNS

Summarise the research evidence below.
Ψ Van Cauter, Leproult, and Plat’s (2000) study of growth hormone. What happens to growth hormone with age?

Ψ A meta-analysis of the percentage of total sleep, slow-wave sleep, and REM sleep. What types of sleep decrease with age and what types of sleep increase with age?

Ψ Foley et al.’s (2007) “2003 Sleep in America” telephone poll. What did this research find about day-time napping?

Ψ Ancoli-Israel’s (2008) research of sleep in older women. What problems were associated with poor quality sleep in older women?
EVALUATION

Summarise the evaluation points below.

Ψ Sample bias. Which age groups are under-represented in the research?

Ψ Cause and effect. Why is cause and effect an issue with Foley et al.’s research?

Ψ Self-report criticisms. What are the weaknesses of the telephone survey poll and questionnaires as forms of data collection?

Ψ Gender bias. Which research is gender biased?

Fill in the sleep behaviour comparison table.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Babies and children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of sleep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount of REM sleep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth hormone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slow-wave sleep</td>
<td></td>
<td></td>
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<tr>
<td>Sleep latency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CONCLUSIONS—SO WHAT DOES THIS MEAN?

*Answer the following questions in your conclusions.*

- Which theory suggests that sleep deprivation has no negative effects and which suggests that it does? And so which theory has stronger support from the sleep deprivation research?

- What functions of sleep are not accounted for by the theories?

- How can a multi-perspective best account for sleep?

- What two stable variations have been found in sleep patterns across the lifespan?

**Using this in the exam**

Describe the nature of sleep.  
(9 marks)

Outline and evaluate one or more theories relating to the functions of sleep.  
(25 marks)

Discuss lifespan changes in sleep.  
(25 marks)
Disorders of Sleep

For details, see Eysenck’s A2 Level Psychology (pages 61–70).

Explanations for Insomnia, Primary and Secondary

**Fill in the blanks.**

Insomnia is the condition where there are problems falling asleep and/or staying asleep, and the sleep that occurs tends not to be d____ and is easily d___________. Insomnia is also linked with fatigue, having poor at______, impaired j__________, decreased performance, being ir____________, and also with an increased risk of ac___________. Insomnia is not a single condition as there are different forms based on the degrees of severity (mild, moderate, severe, acute, chronic) and the causes of the insomnia.

Insomnia can be categorised as pr__________ or se____________ insomnia, depending on the cause. Primary insomnia is the most common form of insomnia and has no clear un____________ cause. There is a sleep problem, but there is no physiological or psychiatric cause, and it is likely that the sleep problem is the result of maladaptive behaviours or learning. The clinical characteristics are that for at least a m_______ the individual would have suffered insomnia but this would not be linked with any other sleep disorder, such as parasomnia or narcolepsy, nor with another psy____________ such as clinical depression, nor with medications or substance abuse. Worrying about the insomnia can lead to a cycle that is hard to break because the more a person focuses on their sleep problems, the less likely they are to get good qu__________ sleep.

Secondary insomnia is insomnia that has a sp__________ cause. Examples of such causes include sleep ap_________, restless l______ syndrome (RLS) (both of which will be explained later in this section), circadian rhythm disorders due to night shiftwork, and various medical, substance use, and emotional problems.

<table>
<thead>
<tr>
<th><strong>Primary and secondary insomnia</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>True or false?</strong></td>
</tr>
<tr>
<td><strong>Statement</strong></td>
</tr>
<tr>
<td>Primary insomnia has a specific cause</td>
</tr>
<tr>
<td>Primary insomnia involves significant stress and anxiety</td>
</tr>
<tr>
<td>Primary and secondary insomnia cause daytime drowsiness</td>
</tr>
<tr>
<td>Secondary insomnia has a specific cause</td>
</tr>
<tr>
<td>Medical conditions can lead to secondary insomnia</td>
</tr>
</tbody>
</table>

**Factors affecting insomnia**

**Fill in the blanks.**

These factors affect insomnia because they interfere with the natural progression of brain activity from d____________ functioning to slowing down to sl___________. This progression was described earlier as part of the sleep–wake cycle.
Environmental factors
Any stimuli such as bright lights, loud n_________, very hot or very cold rooms, an uncomfortable bed, or a snoring companion can all contribute to insomnia because they interfere with the brain's natural calming down of neural a_________. A change in the location where one sleeps can also boost brain a_________ and lead to insomnia, hence we often do not sleep well unless in our own bed!

Stress
Acute st_______, perhaps from a major life event such as an exam or a job change, can lead to insomnia, again because brain activity is heightened, the s_________ ANS (autonomic nervous system) is active and so the p_________________ ANS cannot switch. Acute stress is transitory and so when it is over normal sleep should resume. However, with chronic stress the stressor persists, and so sympathetic ANS activity remains high, which can lead to long-term disrupted sleep.

Sleep hygiene/Bedtime behaviour
Sleep h_________ refers to the habits and bedtime behaviour patterns that promote the c_________ and slowing down of the brain in preparation for sleep. Poor sleep hygiene refers to habits that do not promote this progression: consuming ca_________ or al_________ or taking in nicotine interfere with brain activity and the sleep process. Similarly, st______ activities, particularly if these take place in the b_________, such as watching TV, chatting on the phone, or doing homework, can also lead to insomnia. A delayed bed-time for whatever reason—more stories, more TV, a drink—can delay settling down ready for sleep. Night fears, e.g. of the dark, also prevent the calming down needed for sleep. Poor sleep hygiene means the brain is very a________, is still alert, and is in d______________ mode, and so the parasympathetic ANS, the rest-and-digest mechanism, will not switch on and calm the brain, and insomnia is the result. Taking naps during the day is another aspect of sleep hygiene that can perpetuate insomnia.

Sleep apnoea
There are two types of apnoea, obstructive and central. The main characteristic of obstructive sleep apnoea is fairly brief interruptions of br_________ when the individual is asleep, each interruption being followed by choking and g_________ as they struggle for air. The individual often snores loudly. This happens because the upper airways temporarily collapse during sleep so that air cannot get into or out of the l_________. Blood oxygen levels may drop, and each episode ends with the person awakening to some extent and then going back to sleep. Although children and normal-weight people can suffer from sleep apnoea, possibly because of a smaller than usual upper airway, it is more common in overweight, middle-aged people, more often in men than in women.

Obstructive sleep apnoea (OSA) is linked to impaired co__________. Macey et al.’s (2002) MRI scanning study showed small but significant reductions in brain neurons, presumably because of oxygen d_________. Kumar et al. (2008) also used MRI scans to show that there is measurable loss of nearly 20% of the brain tissue in the mammillary bodies, which are part of the memory circuits. Childhood OSA is also linked to poor b_________, growth, at_________, memory, and classroom performance and lower childhood IQ scores. The effects of OSA on cardiovascular health have been studied in children aged 12 to 26 months (Goldbart et al., 2007) and children with OSA, unlike matched controls, showed high levels of v_________ heart strain. Both the inflammation and signs of heart strain reduced to normal levels following surgery removing the adenoids.
Central sleep apnoea presents as periods of not breathing when asleep but the cause here is organic. The brain does not send the necessary normal signals to the b__________ muscles, the diaphragm and the intercostals, so they do not contract frequently enough and the individual does not take a breath often enough. It is the central control m__________ in the brainstem that is faulty, sometimes because of a stroke, but oxygen therapy can produce significant improvements in patients (White, 2005).

**Personality**

Stress is clearly linked to insomnia. Vgontzas et al. (2001) found high levels of stress h__________ in insomniacs and concluded that insomniacs suffer from hyperarousal in the central nervous system (CNS) caused by chronic ac__________ of the hypothalamic–pituitary–a__________ axis, leading to increased risk of chronic anxiety and d__________ and physiological damage. De Sainte Hilaire, Straub, and Pelissolo (2005) hypothesised that s__________ activity could relate to both temperament and insomnia. They found harm avoidance correlated positively with sleep latency, the time taken to go from waking into deep sleep. Research by Leblanc et al. (2007) found strong links between insomnia and high scores on depression, anxiety, n__________ arousal, extraversion, arousal predisposition, stress perception, and emotion-oriented c_________. Similar links were found by Soehner, Kennedy, and Monk (2007) using the Eysenck Personality Inventory for extraversion and neuroticism, the Pittsburg Sleep Quality Index for quality of sleep, and the Sleep Timing Questionnaire for the duration, timing, and latency of sleep. They found links between higher neuroticism as a personality trait and the timing and poorer quality of sleep but not with sleep duration.

**Deadly insomnia**

There are very rare cases where insomnia becomes not just p__________ but deadly. This has been identified as a genetic condition named as f__________ f__________ insomnia (FFI) and it seems to have started with a mutation that affects certain proteins in the brain, particularly in the thalamus, so that they mis-fold and form prions. These prions clump together, cause neuron deaths, and the area of the brain affected develops a sp________-like structure, full of holes. Death follows, usually within a year of the first signs of the disorder developing.

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**EVALUATION**

*Summarise the evaluation points below.*

Ψ **Sample bias.** Why is this an issue of research into obstructive sleep apnoea?

Ψ **Direction of effect.** Why is it difficult to establish the direction of effect in the research into the factors?
Cause and effect. Why is causation not established?

Reductionism of correlations. What is reductionism and why is this an issue with correlational research?

Using normal samples instead of insomniacs. Why is this a criticism of Soehner et al.’s (2007) research?

Self-report criticisms. What are the weaknesses of self-report research?

Explanations of Other Sleep Disorders

Sleepwalking

Fill in the blanks.

Somnambulism is a relatively common sleep disorder, with estimates that it affects about 1 in 10 of us at some point in our lives. Typically the eyes are _open_, although often described as glazed or staring in appearance. Somnambulism is most likely to occur during NREM stages 3 and 4, in _slow-wave_ sleep. It can occur in REM sleep but this is much less likely. NREM sleep is earlier in the sleep period and so episodes of somnambulism tend to be in the _early_ rather than later parts of the night. Somnambulism is most common in childhood, peaking just before or at the time of puberty, however it can continue into adulthood. An episode may last only a few seconds, or hours, and when awake the individual will have no _memory_ of what they have been doing. The causes of somnambulism include a genetic predisposition, fatigue, previous lack of sleep, stress, or anxiety. In adults, alcohol and other drugs seem to act as triggers.
The genetic element in somnambulism is supported by Hublin et al. (1997) who used the Finnish cohort and found that the genetic contribution to somnambulism in childhood was 66% in men and 57% in women, and for adult somnambulism, 80% in men and 36% in women. Szelenberger et al. (2005) offer an explanation of sleep walking as they found both low and declining levels of delta waves, which could be signs of a chronic inability to sustain slow-wave sleep. The main issue with somnambulism, apart from the anxieties it may cause, is the moderately high risk of somnambulists inflicting themselves during an episode, in some cases bones have been broken!

Narcolepsy

Fill in the blanks.

Narcolepsy is rare but is characterised by chronic sleepiness, and so the individual may fall asleep at any time. Short naps of 10 to 20 minutes are common after which the sleepy feeling is temporarily reduced, only to reappear with 2 to 3 hours. Cataplexy can also occur—this is when the muscles lose strength when strong emotions are experienced. The body may droop or sag or even collapse as if paralysed, but there is no loss of consciousness; the individual does not faint. The episodes may be over within seconds or last some minutes. Sleep paralysis can also occur either at the beginning of sleep or when first awakening and is a brief loss of the ability to move, apart from the breathing muscles and eye muscles. This usually lasts a few minutes and can be very distressing especially as it is sometimes accompanied by a sense of fear or dread, e.g. they are derealised, and even hallucinations. Sleep hallucinations also may occur when dropping off to sleep or when awakening.

Research has established that in non-human animals such as dogs and mice a genetic mutation can cause narcolepsy. Lin et al. (1999) discovered that in dogs this mutation also produced a deficiency in a receptor for the neurotransmitter hypocretin, which blocks communication between neurons, particularly messages relating to when the body should wake. Injections of hypocretin in dogs reversed their narcolepsy, but this could not be generalised to humans as the human disorder has environmental as well as genetic causes, it is a nature and nurture phenomenon. Evidence for a genetic basis is provided by Mignot’s (1998) twin study, which showed a MZ 25–31% concordance rate for human narcolepsy and 1–2% for first-degree relatives of narcoleptics. This compares to a very low rate in the general population. A hypocretin deficiency is definitely implicated in human narcolepsy as Thannickal et al. (2000) found that narcoleptics have a reduction of about 85–95% in hypocretin neurons, whilst melatonin neuron numbers are unaffected, with the hypocretin loss being degenerative and perhaps autoimmune. Research in South China showed that narcolepsy is more common in those born in winter. We cannot be sure what it is about winter but one possibility is that viruses are more common in winter, so there might be a viral interaction with genes. Kim et al.’s (2008) research showed an increase in GABA levels in the medial prefrontal cortex of narcoleptics, however this may be an effect rather than a cause, and cause and effect cannot be established from correlational data. Certainly it seems most likely that narcolepsy is multi-factorial and so can only be explained by an interaction of multiple factors, maladaptive HLA genes, environmental factors, degenerative neurological changes, and abnormal neurotransmitter levels.

FIND OUT FOR YOURSELF: Carry out research on the sleep disorders and compare the effects on health of the different disorders.
CONCLUSIONS—SO WHAT DOES THIS MEAN?

Answer the following questions in your conclusions.

• What is the difference between primary and secondary insomnia?

• What is a key limitation of research into the factors that explain insomnia?

• Explain how nature and nurture interact to explain disorders such as insomnia, narcolepsy, and sleep walking.

Using this in the exam

Outline explanations of primary and secondary insomnia. (9 marks)
Discuss the factors affecting insomnia. (25 marks)
Describe explanations of other sleep disorders. (9 marks)
Example Essay Plan

1. Outline and evaluate theories and research studies relating to the functions of sleep. (25 marks)

The marking is broken down into three sets of criteria, AO1, AO2, and AO3, but this is not how you should write your essay. The essay should include all these criteria in a holistic way, e.g. as you write about each theory you will then write about the research studies supporting and challenging the theory, and therefore be able to comment on the strengths and weaknesses of the theory from various points of view such as methodological (e.g. participant sample size), ethical, reductionist/biological approach, etc.

AO1 (9 marks)
A general but accurate description of evolutionary theory and restoration theory is needed, more than just an outline, including descriptions of relevant research studies for each theory. A range of studies should be used giving both breadth and depth.

AO2 (12 marks)
Commentary and evaluation of the theories and the research studies is needed, integrated into your essay as advised above. A good focus would be the relative strengths and weaknesses of the theories with psychological evidence for what you are saying; also the advantages of an integrated or eclectic explanation for sleep.

AO3 (4 marks)
Evaluation and/or interpretation of the research could include the use of non-human animals in the research (e.g. Jouvet’s cats), the ethics of sleep deprivation studies, and the biological nature of these theories as a single and deterministic approach.

So the essay could be structured in the following way:

Give a detailed overview of the theories and include some AO2 at the outset
Identify the functions: adaptive (evolutionary theory); or the function may be the restoration of physiological and psychological functions.

Explain fully what an eclectic approach means, i.e. an interaction of the theories needs to be considered as the restorative functions of sleep have survival value, and so an eclectic approach has greater potential than either theory on its own for explaining sleep function.

Outline evolutionary theory, e.g. Meddis’ theory that sleep is adaptive because it keeps animals safe from predators and enables energy conservation.

Use research evidence to support the theories and give specific examples to illustrate
For example, research on differences in sleep patterns and duration can be linked to Meddis’ theory.

Use examples to illustrate, such as the differences in predator/prey sleep patterns and the Indus dolphins’ sleep pattern; the fatal effects of not sleeping for support; and research on the size of animals and metabolic rate.

Consider the research evidence against
The ratio of predator/prey sleep duration and the amount of energy conserved during sleep, i.e. why is this an unlikely explanation of REM sleep?
Cross-examine the research evidence for evolutionary theories

Explain fully the contradiction between Meddis’ theory and the ratio of predator/prey sleep duration. Then cross-examine this contradiction as it may be that Meddis’ theory is reductionist (oversimplified) as number of hours’ sleep may not only depend on being predator or prey.

Such evidence is correlational, so cause and effect cannot be inferred and other factors will be involved, such as body size, metabolic rate, energy consumption, e.g. cows have to graze fairly constantly to gain nutrition and so this would explain why they, as prey, sleep less. Smaller prey such as squirrels and shrews do sleep for long periods of time, which is consistent with Meddis, but apparently with humans the total amount of energy conserved per night’s sleep is equivalent to a slice of bread! This can also be cross-examined as we do feel refreshed after a good night’s sleep.

Conclude that the total amount of sleep may depend on a complex interplay of whether the animal is predator or prey, its food source, etc.

The variations in sleep patterns suggest evolutionary forces are at work but that this is a more complex process than either hibernation of predator avoidance.

Use criticisms

Use the many generic criticisms of evolutionary theory to assess the explanations, e.g. lack scientific validity—unfalsifiable and unverifiable; deterministic. Then consider criticisms more specific to the explanations, e.g. sleep makes us more vulnerable and has low adaptive value for some species.

Explain/elaborate on all criticisms

Remember AO2 must not resemble a shopping list—explain the criticisms fully and contextualise, i.e. clearly link them to the explanations.

Outline restoration theory including Oswald, who identified NREM-body and REM-brain processes, and Horne, who distinguished between core and optional sleep.

Use research evidence to support the theories and give specific examples to illustrate

Discuss the release of growth hormone in stage 4 sleep, the high brain activity of REM sleep, and babies’ sleep patterns.

The total sleep deprivation studies, e.g. Randy Gardner, and Dement’s research, which show the negative effects of loss of sleep are mainly psychological, and the REM rebound effect, and so support the emphasis Horne placed on stage 4 and REM sleep as essential to brain restoration.

Consider the research evidence against

A criticism of restoration theory is that protein synthesis has a limited time frame. Explain that amino acids are only available for 4 hours after a meal, so protein synthesis can only happen for a limited time, but growth hormone is released in stage 4 sleep so restoration is not invalidated. Perhaps we just do not yet know enough about the physiological basis of restoration.

We do not need to recover all missed sleep; the effects of sleep deprivation are more psychological than physiological. The neurochemical levels rise and fall throughout sleep, so it is too reductionist simply to say they are restored.
Elaborate on the evidence against and cross-examine it

Sleep deprivation research shows that activity level and sleep are not greatly related. In fact REM sleep increases energy expenditure rather than restoring energy levels. The research on sleep and activity level is inconsistent and therefore unreliable, which means we cannot conclude they are related but nor can we conclude they are unrelated.

While we do not need to recover all lost sleep, sleep deprivation research shows that stage 4 and REM sleep are recovered to a greater extent than the other stages, which supports these having a restorative function. The fact that effects are more psychological does not negate physical restoration as the biochemistry of the brain is fundamental to the psychological state, and so brain and body restoration interact.

Neurochemical rebalance may well be the restorative function of sleep. The fact that we do not yet have sufficient insight into the neurochemical processes of the brain does not invalidate the explanation but clearly there is a need for further research.

Evaluate positively and negatively

Evaluate the restoration theory both positively and negatively: it has face validity; objective measurements provide scientifically valid data; but research may be biased by researcher effects and participant reactivity so reliability and validity can be questioned; data on neurochemical levels and sleep are correlational.

Explain/elaborate on all criticisms

Explain the criticisms fully and contextualise, i.e. clearly link them to the explanations. For example, researcher effects and participant reactivity may have biased the research on sleep and activity level. This research is based on self-report as the researcher relies on the participant to tell them accurately how long they slept after activity and how long they would normally sleep. Hence, the validity (truth) of the findings may be limited, which reduces the meaningfulness of the research both as evidence for or evidence against restoration theory.

To elaborate on the correlational criticism you need to explain that causation cannot be inferred, so we cannot conclude that sleep causes neurochemical rebalance, only that they are linked. Furthermore, the direction of effect can be questioned as the balance of the neurochemicals affects sleep rather than just sleep affecting the neurochemicals, and so a much more complicated and bidirectional relationship probably exists.

Use a multi-perspective

Do this to bring the evolutionary and restoration theories together, i.e. a multi-perspective is needed, as this best accounts for the variations within and between species and the fact that sleep has more than one function.

Justify the conclusion

The universality of sleep suggests an adaptive function, i.e. it must have evolved because it confers survival value. The perceived “need” for sleep suggests some restorative function.

Energy conservation and the “safety” of being asleep are highly dubious and so another evolutionary function needs to be considered. The survival value of sleep is likely to be its restorative function. The REM rebound effect after sleep deprivation implicated this as a key stage of sleep, but further research is needed to more fully understand the mechanisms and processes of restoration.