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1. A factory introduces a rotating shift schedule for its workers, where employees alternate weekly between day shifts (8am to 4pm), evening shifts (4pm to midnight), and night shifts (midnight to 8am). After six months, the management notices a rise in employee fatigue, errors in operating machinery, and increased health complaints.

Using your knowledge of circadian rhythms and shift work, explain:

a) Why workers are experiencing these issues (2 marks).

Ans. The workers are experiencing desynchronisation between their endogenous pacemakers such as the sleep-wake cycle and exogenous zeitgebers such as the day-night schedule. Since these workers are having to work on weekly rotating shifts, this desynchronisation is occurring resulting in productivity and health issues.

b) Suggest two ways the factory could minimize these problems (2 marks).

Ans. One way is to introduce a forward rotating shift in the factory whereby workers will first work on morning shift for a week, then evening and then night. Another way is to allow for a few naps during the shifts so that the workers can restore their bodies.

2. Priya recently traveled from Mumbai (India) to Paris (France). She landed in Paris at 6:00 PM local time, but her body clock indicated it was 10:30 PM (Mumbai time). Priya noticed she felt tired earlier than the locals because her body expected her to sleep soon.

A week later, Priya traveled from Paris to Bangkok (Thailand), arriving at 7:00 AM local time. This time, her body clock told her it was only 1:00 AM (Paris time), and she struggled to adjust to the new schedule.

Explain why Priya found it easier to adjust to the first trip than the second one. (4 marks)

Ans. When Priya travels from India to France, she is travelling Westward. This involves phase delay whereby she has to adjust to a later time than her body clock, which is easier for the body to adapt to. However, when she travels from France to Thailand, she is travelling Eastward. This involves phase advance whereby she has to adjust to an earlier time than her body clock which is more difficult for her body to adapt to.

3. Emily, a 40-year-old marketing executive, flew from London to Los Angeles, crossing 8 time zones. Upon arriving, she felt disoriented and had trouble sleeping at night. During her flight, Emily drank several glasses of wine and watched movies instead of trying to sleep. When she landed, she spent most of the day in her hotel room with the curtains drawn, trying to nap.

a) Explain why Emily experienced severe symptoms after the flight. (2 marks)

Ans. Emily must have experienced these symptoms because firstly, she remained active during the flight by watching movies instead of sleeping, which would have allowed her to compensate for later feelings of sleepiness. Also, drinking wine must have interfered with her circadian rhythms, making it difficult for her to relax during the flight.

b) Suggest ways she could have reduced them. (2 marks)

Ans. Emily could have reduced her symptoms by firstly, sleeping or at least being restfully awake rather than watching movies during the flight. Secondly, she could have avoided drinking during the flight.

4. Ella and Ravi are studying the stages of sleep for their psychology project. Ella mentions that during one stage of NREM sleep, the brain's activity is dominated by theta waves (4-7 Hz) and includes occasional bursts of sleep spindles. Ravi points out that in a later stage, delta waves (1-4 Hz) begin to appear, and the number of spindles decreases.

a) Identify the NREM stage Ella is describing. (1 mark)

Ans. Stage 1 NREM sleep

b) Identify the NREM stage Ravi is describing. (1 mark)

Ans. Stage 3 NREM sleep

c) Explain one characteristic of the stage Ravi mentioned that makes it different from the stage Ella described. (2 marks)

Ans. NREM stage 3 mentioned by Ravi plays a role in the physical restoration of the body; whereas NREM stage 1 mentioned by Ella is a light stage of sleep that helps transition from wakefulness towards the restfulness of deeper sleep stages.

5. Sarah and James are discussing the study of dreams in psychology. Sarah argues that dreams are subjective experiences and cannot be studied scientifically, while James believes that psychologists should focus on REM sleep instead, as it can be measured objectively.

a) Explain why REM sleep is considered more suitable for scientific study than dreams. (2 marks)

Ans. REM is more scientific, as specified by James it can be measured objectively by using technology like EEG (electroencephalogram) for error-free measurement of its occurrence and duration. Dreams are less scientific as argued by Sarah since they have to be measured using self-report like dream narratives which is prone to bias and distortion.

b) One challenge psychologists face when studying dreams. (2 marks)

Ans. One challenge is that dreams cannot be measured reliably because as specified by Sarah, they are subjective experiences - they are psychological and not amenable to physiological measurement. They have to be investigated using self-report of people experiencing dreams as they do not have biological measures that can be captured in physiological recording.

6. Lila and Dan are discussing the sleep patterns of different animals for their biology class project. Lila argues that predators, like lions, sleep more because they are less vulnerable in their environment. Dan disagrees and claims that the environment, such as being aquatic or terrestrial, is the most significant factor influencing sleep patterns.

Using the evolutionary approach to sleep, explain how both Lila and Dan could be correct.

(4 marks)

Ans. Lila is correct because in the predator-prey hierarchy in the animal kingdom, it is the predator who are not endangered and thereby, can afford to sleep more without any threat to life, as is the case with lions. However, preys are endangered by predators and can therefore sleep less as they might have to move from place to place to be inconspicuous to the predator if they are approaching, which requires being awake. Dan is also correct because in the aquatic-terrestrial environmental classification in the animal kingdom, aquatic animals have to work harder to get oxygen below the surface of water as compared to terrestrials who easily have oxygen supply available. Thus, for example, dolphins have adapted to hemispheric sleeping rather than complete sleep so that they can keep approaching the surface for oxygen.

7. Sophia is a 30-year-old woman who works long hours as a software engineer. She often experiences poor sleep quality, with difficulty falling asleep and frequent wake-ups during the night. Recently, she has become concerned about the impact of her sleep on both her brain and body function.

One evening, after a long day of work, Sophia manages to get about 7 hours of sleep. During this time, she experiences deep NREM sleep followed by REM sleep, but also spends some time in light NREM sleep. Sophia wonders about the role of different stages of sleep in her health, particularly in relation to brain restoration and tissue repair.

a) Based on Horne's theory, explain why REM and deep NREM sleep are essential for Sophia's brain function. (2 marks)

Ans. REM sleep is essential for Sophia because her brain will restore at this time which is necessary for her as she is having poor sleep quality. NREM sleep is essential because her body will restore at this time which is necessary for her as she is worried about her health and specially, tissue repair of the body.

b) Discuss the possible role of light NREM sleep in Sophia's overall health, according to Horne's views. (2 marks)

Ans. Light NREM sleep will not help Sophia restore her health directly. However, it will help her to smoothly transition towards deep NREM stages which help body restoration, so indirectly they will improve her health.

c) Why is growth hormone important during NREM sleep, and what issue might Sophia face regarding body restoration during the night? (1 mark)

Ans. Growth hormone is important for tissue repair but it requires the aid of amino acids and protein to function which Sophia might not have available at night, making repairing difficult.

d) What alternative time might Sophia's body use to restore itself during the day, as suggested by Horne? (1 mark)

Ans. As suggested by Horne, Sophia can take a few restorative naps during the morning to afternoon time to restore her body.

8. Tom, a 28-year-old man, has been struggling with sleep for the past few weeks. He finds it difficult to fall asleep, often taking more than 30 minutes to drift off. He frequently wakes up several times during the night and struggles to get back to sleep. As a result, he feels extremely tired and irritable during the day, impacting his work performance and social interactions. Tom has not been experiencing any obvious triggers such as stress, and he does not have a history of any medical conditions.

a) Based on Tom's symptoms, what type of insomnia might he be experiencing? (1 mark)

Ans. Primary insomnia.

b) What diagnostic criteria are most relevant to Tom's condition? (2 marks)

Ans. One criterion is taking 30 minutes or more to drift to sleep, which is the case with Tom. Another is repeated awakenings at night and as seen in the case of Tom, he frequently wakes up several times during the night.

c) If Tom's insomnia persists for more than a month, what could be the possible classification of his condition? (1 mark)

Ans. Chronic insomnia.