

PAPUR ARHOLIAD / EXAMINATION PAPER

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CYFNOD ARHOLIADAU / EXAMINATION PERIOD:	MAI 2026 / MAY 2026
LEFEL / LEVEL:	5

MODIWL / MODULE: ECPS5018 THE BRAIN, BIOLOGY AND COGNITION

AMSER / TIME:	2 HOURS
CYFARWYDDIADAU / INSTRUCTIONS:	ANSWER <u>FOUR</u> OUT OF FIVE IN SECTION A ANSWER <u>THREE</u> OUT OF FIVE IN SECTION B ANSWER <u>ONE</u> OUT OF FIVE IN SECTION C

Adnoddau neu ddefnyddiau sydd eu hangen / Equipment or materials required:
Dewiswch o'r canlynol os gwelwch yn dda / Please select from the following:

Dim / None

Office Use Only:			
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Internal Verifier:		R Y/N?	No
Contribution to Overall Module Assessment (%):	50%		

SECTION A: ANSWER FOUR QUESTIONS

1. List any five major external features of a neuron.

(5 Marks)

Any five of the following:

- o Cell membrane,
- o Dendrites,
- o Axon Hillock,
- o Myelin,
- o Nodes of Ranvier,
- o Cell body,
- o Buttons,
- o Synapse

2. List any five symptoms of schizophrenia.

(5 Marks)

Any of the following:

- o Positive symptoms: Delusions, Hallucinations, Inappropriate Affect, Incoherent speech or thought, Odd behaviour, catatonia, etc.
- o Negative symptoms: Affective flattening, Alogia (no speech), Avolition (no motivation), Apathy, Anhedonia (no experience of pleasure), etc.

3. List any five neurotransmitters.

(5 Marks)

Any five of the following: Glutamate, Aspartate, Glycine, Gamma-aminobutyric acid (GABA), Dopamine, Epinephrine Norepinephrine, Serotonin, Acetylcholine, Nitric oxide, Carbon monoxide, Anandamide, Pituitary peptides, Hypothalamic peptides, Brain-gut peptides, Opioid peptides, Miscellaneous peptides

4. List any five structures of the Limbic System.

(5 Marks)

Any five of the following: Amygdala, Hippocampus, Hypothalamus, Thalamus, Cingulate gyrus, Cingulate cortex, Fornix, Septum, Mamillary bodies, etc.

5. List any five forms of forgetting from Long-term memory (LTM).

(5 Marks)

Any of the following: Trace-dependent Forgetting, Interference, Repression, Motivated Forgetting, Directed Forgetting, Cue-dependent Forgetting, Encoding Specificity, State-dependent Forgetting, Context-dependent Forgetting, Memory biases, Misleading information

SECTION B: ANSWER THREE QUESTIONS

- 1. Describe the two visual problems created by the arrangement of the retina and explain how these are overcome.**

(10marks)

- A. Incoming light distorted by retinal tissue it must pass before reaching receptors - Dealt with by fovea: indentation ~0.33cm in diameter at centre of retina. Thinning of retinal ganglion cell layer at fovea reduces distortion of incoming light.
- B. For bundle of retinal ganglion cell axons to leave eye, there is a gap in receptor layer - blind spot. Section of no receptors: anything falling on area not picked up. To deal with this, system uses info by receptors around blind spot to fill in gaps in image. • Called completion • Suggests visual system does more than just create a copy of the external world.

- 2. Compare and contrast Functional Magnetic Resonance Imaging (fMRI) with Electroencephalography (EEG) as techniques for studying the brain.**

(10 Marks)

fMRI provides images of brain structure and activity, uses strong magnetic field, two properties of oxygenated blood allow it to work. 1. Active areas of the brain take up more oxygenated blood than actually needed. 2. Oxygenated blood has magnetic properties through the iron, Structure is imaged using waves emitted by hydrogen ions, Function is imaged using signal created from interaction between oxygen and iron in the blood: Blood Oxygenated Level Dependent (BOLD) signal, Good spatial and temporal resolution, Produces 3D images of activity over the whole brain, But only provides indirect measure of neural activity through BOLD, Also, the 2 to 3 seconds to create image is too slow to capture neural responses e.g., action potentials that happen in milliseconds.

Electroencephalography (EEG) as techniques for studying the brain. EEG measures gross electrical activity of brain with electrodes attached to scalp, including action potentials and postsynaptic potentials. Includes wave, ERP, & combined with MRI. Main difference = fMRI shows image (structure/activity), EEG informs of electrical activity. Differences in spatial vs. temporal resolution.

- 3. Describe what was involved in the seven tasks used to formally assess H.M. and explain what they tell us about memory.**

(10 Marks)

The formal methods of assessment should be explained in detail: Digit span + 1 Block-tapping memory-span task Mirror-drawing Rotary-Pursuit Incomplete picture Pavlovian condition. As well as the three major scientific contributions: 1. Medial temporal lobes are involved in memory 2. STM, remote memory, and LTM are distinctly separate – H.M. is unable to move memories from STM to LTM, a problem with memory consolidation 3. Memory may exist but not be

recalled – as when H.M. exhibits a skill he does not know he has learned •
Difference between explicit (conscious) vs. implicit (unconscious) memories.

4. Describe the five main classes of anxiety disorders.

(10 Marks)

Generalized anxiety disorders – stress and anxiety in the absence of a causal stimulus

Phobic anxiety disorders – similar to generalized, but triggered by a particular stimulus (e.g., birds)

Panic disorders – attacks of extreme fear and stress; may occur with other disorders or alone

Obsessive-compulsive disorders (OCDs) – obsessive, recurring, uncontrollable thoughts alleviated by compulsive actions

Posttraumatic stress disorder – pattern of psychological distress following extreme stress

5. Describe what is involved in the processes of Aspiration, Radiofrequency, Knife-cuts, and Cryogenic blockage as methods for lesioning the brain.

(10 Marks)

Aspiration lesions: lesion to an area accessible to the eyes and instruments of the surgeon, cortical tissue is drawn off by suction through a glass pipette.

Radio-frequency lesions: place radio-frequency current through tissue from an electrode. Heat from the current destroys tissue, with the size & shape of lesion determined by duration & intensity of current.

Knife cuts: involves cutting nerves or tracts. Blade enters & swivels out to make the cut.

Cryogenic blockade: involves implanting cryoprobe in brain then pumping coolant through the system. Neurons are cooled to such a degree that they stop firing, but temperature is maintained above freezing to avoid structural damage. When tissue is allowed to warm back up, normal neural activity resumes.

SECTION C: ANSWER ONE QUESTION

- 1. Critically discuss the cognitive and biological evidence for a distinction between episodic and semantic memories.**

(50 Marks)

Brief account needed to begin describing Tulving's work/ideas on the distinctions between different LTM systems. Then a definition of episodic and semantic memory with examples should have been included. Answers should then have provided a detailed account of the various empirical literature and studies from brain-damaged patients, including those with amnesia (Spiers et al., 2001; Vargha-Khadem et al., 1997) and the evaluation of the Vargha-Khadem et al. study by Gardiner et al. (2008) and an explanation for the discrepancy. The evidence that episodic memory depends on the hippocampus whereas semantic memory depends on the entorhinal, perirhinal, and parahippocampal cortices (Vargha-Khadem et al., 1997; Bindschaedler et al., 2011). Evidence from patients with retrograde amnesia in particular (Bayley et al., 2006; Manns et al., 2003), the theory of consolidation to explain the difference, the evidence from the alcohol (Moulton et al., 2005) and sleep (Jenkins & Dallenback, 1924) studies to support the consolidation theory, and the critique of the sleep study regarding time of day (Hockey et al., 1972), and the alternative theory of semantisation. Evidence from patients with semantic dementia (Adlam et al., 2009) and that these patients show a double-dissociation with amnesic patients. An evaluation of using patients with brain damage in general (i.e., loss of other cognitive abilities, or strategies may be used to overcome issues). The essay could have also focused on patients with Korsakoff syndrome and the issues associated with basing evidence from this sample. Discussions on the distinction could have also focused on how different types of information can be forgotten and the influence of interference. Furthermore, an acknowledgment that perhaps the systems are not so distinct and are instead interdependent was also required (e.g., Burianova et al., 2010 on similar brain regions of activation; Kan et al., 2009 on learning). Stronger answers would have included work from additional readings (Renoult et al., 2016; Kim, 2016; Takashima et al., 2017).

- 2. Critically discuss whether biopsychological paradigms of animal behaviour are useful for understanding human biology and cognition.**

(50 Marks)

Assessment of Species-common behaviours: those displayed by all members of the species: e.g., grooming, eating, building nests, etc.). • Main tests Open-field test: place animal in empty chamber & record activity (does it move around or stay close to wall, how much droppings it produces, etc.). Tests of Sexual Behaviour. Tests of Aggressive and Defensive Behaviour: Colony-intruder paradigm: examine no. of combat encounters between dominant alpha male of established colony & smaller male intruder. • Dominant alpha is aggressive: biting, putting hair upright. • Intruder is defensive: goes up on back legs to defend from biting & tries to push alpha away with its front paws. • Elevated plus maze: a maze mounted 50cm from the ground, two arms of maze have sides while other

two do not • Amount of time rat spends in closed arms rather the open edge arms is compared. • Giving rat anti-anxiety drugs increases amount of time spent in open arms of maze: used for understanding usefulness of anti-anxiety drugs in humans? Traditional Conditioning Paradigms: • We can infer about the sensory, motor, motivational, and cognitive state of an animal from its ability to learn and perform various responses. • Pavlovian conditioning (pairing an unconditioned stimulus with a conditioned stimulus) • Operant conditioning & reinforcement. Semi-natural Animal Learning Paradigms: Conditioned Taste Aversion: pairing something that makes an animal ill with food so they learn to avoid it. • This really challenged traditional learning paradigms because taste aversion can be established after a single trial. Conditioned Defensive Burying: give rat a single aversive stimulus (e.g., a shock/blast of air) delivered from an object. • They then spray their bedding/hay at the object to cover it. • Anti-anxiety drugs decrease amount of burying behaviour.

3. Critically discuss the characteristics and the methods used to diagnose and treat epilepsy.

(50 Marks)

Primary symptom is seizures, but not all who have seizures have epilepsy • Epileptics have seizures generated by brain dysfunction • Affects about 1% of the population • Difficult to diagnose due to the diversity and complexity of epileptic seizures. Types of seizures • Convulsions – motor seizures: involve tremors, rigidity, loss of balance and consciousness. • However, others involve merely subtle changes of thought, mood, or behaviour • Causes • Brain damage • Faulty Genes – over 70 have been linked so far • Faults at inhibitory synapses, particularly GABA where neurons end up just firing in synchronized bursts. • Diagnosis • EEG – electroencephalogram • Why?.....Seizures are associated with high amplitude EEG spikes during an attack. Some epileptics experience psychological changes before a convulsion – known as auras • Such as a smell, hallucination, or feeling • Aura's nature suggests the epileptic focus • Warns epileptic of an impending seizure • Once diagnosis is given, its usual to assign the epilepsy to one of 2 categories: • Partial epilepsy – does not involve whole brain • Generalized epilepsy – involves the entire brain. Simple • Symptoms are primarily sensory or motor or both • Known as Jacksonian seizures after neurologist Hughlings Jackson • Symptoms spread as epileptic discharge spreads. Complex • Often restricted to the temporal lobes (temporal lobe epilepsy) • Patient engages in compulsive and repetitive simple behaviours (automatisms) • More complex behaviours seem normal & although conscious they do not have recollection of seizure. Grand mal • Loss of consciousness • Loss of Equilibrium • Violent Tonic-clonic convulsions • Rigidity (tonus) • Tremors (clonus) • Petit mal • Not associated with convulsions • Instead there is a disruption of consciousness associated with cessation of ongoing behaviour • The EEG of a petit mal seizure is different from other types: it is a bilateral symmetrical 3 per second spike and wave discharge. No cure, but frequency and severity can be reduced by antiepileptic medication (Rogawski & Löscher, 2004). However, these types of medication have severe side effects (Toledano & Gil-Nagel, 2008). Brain surgery is performed in grave situations (Guerrini et al., 2008).

- 4. With reference to cognitive and biological literature, critically discuss how humans perceive, process, and comprehend colour information. (50 Marks)**

Component theory (trichromatic theory) Proposed by Young (1802), refined by Helmholtz (1852) • 3 types of colour cone receptor in eye, each with different spectral sensitivity. • Colour of stimulus encoded by ratio of activity in each. • Evidence: any colour in visible spectrum can be matched by mixing 3 different wavelengths of light in different proportions. Opponent-process theory Proposed by Hering (1878) • 2 classes of cells encoding colour and another encoding brightness. • Each encodes two complementary colour perceptions. –One for red and green–Another for blue and yellow • Accounts for colour afterimages and colours that cannot appear together (reddish green or bluish yellow). Both theories correct: coding of colour by cones operates on component basis, opponent processing of colour seen at all subsequent levels. 1960s: technique to measure absorption spectrum of photo pigment contained in single cone confirmed Young's findings. • 3 different types of cones in retina with different photo pigment & own characteristic absorption spectrum. • Diagram shows some cones more sensitive to short, medium & long wavelengths. • 3 cones are red, green, & blue. One aspect theory could not account was Colour constancy: colour perception not altered by varying reflected wavelengths. Retinex theory (Land): colour determined by proportion of light of different wavelengths that surface reflects. Although wavelengths of light reflected by surface change with changes in illumination, efficiency which a surface absorbs wavelength & reflects unabsorbed portion does not change. Relative wavelengths are constant, so perception is constant. Dual-opponent colour cells are sensitive to colour contrast. Found in cortical "blobs", peg-like dual-opponent colour columns in primary visual cortex. Method of Land's (1977) colour-vision experiments: • View Mondrians illuminated by various proportions of 3 wavelengths from projectors: • Short, middle, & long. • Adjusting amount of light emitted from each (i.e., adjusting amount of light of each wavelength) had no effect on perception of colours on display. V4: Cells respond to colour and some to line orientation. Essays could then bring in more contemporary work related to colour and cognition (comprehension) including "The Dress" (Witzel et al., 2017), and colour and language (Sinkeviciute et al., 2024).

- 5. Critically discuss the effectiveness of anti-depressants in treating affective disorders, such as depression. (50 Marks)**

Four major classes of drugs used in the treatment of affective disorders
1. Monoamine oxidase inhibitors (MAOIs): Iproniazid • Increases levels of monoamines by preventing their breakdown by oxidase enzymes in cytoplasm of neuron • Must avoid foods high in tyramine – "cheese effect" • Normally these foods have little effect on blood pressure because tyramine is metabolized in the liver by MAO, but people who take MAO inhibitors & eat food containing tyramine run risk of stroke caused by surges in blood pressure. Tricyclic antidepressants –

Imipramine • Chemical structure includes 3 rings of atoms • They block reuptake of serotonin and norepinephrine – Thus, increasing levels of these in the brain • They are thought to be safer than MAOIs 3. Selective serotonin reuptake inhibitors (SSRIs) • They are serotonin agonists that exert effects by blocking the reuptake of serotonin from synapses. • Include Prozac, Paxil, Zoloft, and others • No more effective than tricyclics, but side effects are few and they are effective at treating other disorders 4. Selective norepinephrine-reuptake inhibitors (SNRIs): effective & block reuptake of norepinephrine. Hollon et al. (2002) compared efficacy of various pharmacology treatments for depression and found they were about the same for MAOIs, tricyclics, & SNRIs: • ~50% of clinically depressed patients improved • But a control group showed a 25% improvement • So, really only 25% of the depressed group were helped. • Kirsch et al. (2008): meta-analysis indicated that placebo was about 82% as effective as anti-depressants in severely depressed individuals • Drugs even less effective for mild to moderately depressed individuals. MRI of bipolar patients shown reductions in overall brain size and particularly the amygdala, cingulate cortex, and prefrontal cortex. • But certain brain structures found to be of reduced size in one study is of normal size in other studies. • Not all patients with bipolar suffer from same disorder? • Two structures are found to be abnormal in many studies: amygdala and anterior cingulate cortex. • Connections between these also disrupted in patients with affective disorders. Monoamine theory of depression: Suggests depression is associated with underactivity at serotonergic and noradrenergic synapses. Support provided by autopsy: serotonin and norepinephrine receptors more numerous in brains of deceased clinically depressed individuals who had not had pharmacological treatment whilst alive, which implicates a deficit in monoamine release. • When not enough amount of a neurotransmitter is released at a synapse, there are usually compensatory increases in the number of receptors for that neurotransmitter – called Up-regulation. • However, overall support for the monoamine theory of depression is weak and not all patients respond to monoamine agonists.

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