Grey Matter -2

Name: _____

Class: _____

Date: _____

Time:

Total Marks Available:

Total Marks Archived:

Level: Edexcel A level Biology

Subject: Biology

Exam Board: Pearson Edexcel Level 3 GCE AS and A level Biology A (Salters-Nuffield) and also Pearsons Edexcel AS and A Level Biology B (9BI0) - Is however suitable for use by AS and A level Biology Students of other Boards

Topic: Grey Matter -2

Type: Mark Scheme

To be used by all students preparing for Edexcel AS and A level Biology A and Biology B - Students of other Boards may also find this useful

Mark Scheme

Q1.

Question Number	Answer	Mark
(i)	The only correct answer is **D** – all of his introns plus all of his exons ***A*** *is incorrect because it does not describe the genome of the adult male* ***B*** *is incorrect because it does not describe the genome of the adult male* ***C*** *is incorrect because it does not describe the genome of the adult male*	**(1)**

Question Number	Answer	Mark
(ii)	The only correct answer is **D** – yes for animal, bacterium and plant ***A*** *is incorrect because animals and bacteria can also be genetically modified and be a source of a gene* ***B*** *is incorrect because animals can be genetically modified and be a source of a gene* ***C*** *is incorrect because plants can be genetically modified and be a source of a gene*	**(1)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to four of the following: • (repeated stimulus) decreases {sensitivity / permeability} of pre-synaptic membrane / calcium channels not opening **(1)** • so {fewer / no} Ca^{2+} ions move into pre-synaptic neurone **(1)** • so {fewer / no} vesicles {move towards / fuse with} (pre-synaptic) membrane **(1)** • so {less / no} neurotransmitter {released / can diffuse across gap} **(1)** • {action potential / depolarisation} less likely to occur in post-synaptic neurone **(1)**	ALLOW calcium channels less or not responsive	**(4)**

Q3.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • allows an animal (to learn) to ignore (repetitive) non-threatening stimuli (1) • therefore allowing it to focus on (potentially) more relevant stimuli (1)	ALLOW therefore allowing it to conserve {energy / resources} ALLOW converse – such as if animals did not habituate they would waste energy on unimportant stimuli	Expert (2)

Q4.

Question Number	Answer	Additional guidance	Mark
(a)	1. reference to phytochrome ; 2. idea that day length is the environmental cue ; 3. reference to critical period / photoperiod ; 4. this is more than 12 hours light / less than 12 hours darkness / eq ; 5. idea that different wavelengths of light are involved OR reference to inter-conversion of phytochromes e.g. because light supplies red light which converts P_R converted to P_{FR} ; 6. reference to florigen ;		(3)

Question Number	Answer	Additional guidance	Mark
(b)(i)	Both 1. chemicals ; 2. produced in cells / eq ; 3. idea that they move away from site of production ; 4. effect may be distant from production site / eq ; 5. long-term / permanent effect / example quoted / eq ; 6. involved in gene activation /eq ;	5. ACCEPT both can control growth 6. ACCEPT: Both can have an effect on gene inhibition	(3)

Question Number	Answer	Additional guidance	Mark
(b)(ii)	1. idea that weeds affected because e.g. more sensitive, take up more ; 2. idea that (auxin / IAA) causes cell elongation ;		(2)

Q5.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • {IAA/auxin} is a (plant) hormone (1) • (investigation showed) cells grew longer with IAA / IAA stimulates cell elongation (1) • {light sensing / IAA producing} cells are in the tip (of the coleoptile) (1) • (results show) cell elongation happened in cells below the (shoot) tip (1) • the response to IAA is (relatively) {slow / prolonged} (1)	ALLOW IAA caused cell growth / increases cell length ALLOW cells that respond to IAA are in a different part of the coleoptile to the light sensing structures for MP 3 and 4	Expert (3)

Q6.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to four of the following: • cytokine can bind to receptor on synaptic membrane (1) • effect on an ion channel (1) • therefore affecting the movement of ions across the membrane (1) • affecting the depolarisation of the membrane (1) • therefore affecting action potentials (in the neural circuit) (1)	ALLOW inhibitory or stimulatory effects ALLOW binds to acetylcholinesterase e.g. opens chloride ion channel ALLOW other described effects on membrane e.g. chloride ions moving in or potassium ions moving out e.g. threshold potential is not reached	**(4)**

Q7.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to the following: • use of {MRI / CT / PET} scans (1) • before treatment and after treatment (1)	ALLOW ultrasound scans / clinical investigation ALLOW regular scans / scans at stated frequency / over course of treatment	Expert (2)

Q8.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: • IAA diffuses from the tip of the coleoptile (1) • (therefore) can be taken up by cells in zone of elongation (1) • which causes cells to elongate (1) • details of action in zone of elongation (1) • (therefore) causes the coleoptile to { grow towards the light / increase in height } (1)	e.g. leads to lowering of the pH in the cellulose cell wall ALLOW: positive phototropism IGNORE: bend for growth	(4)

Q9.

Question Number	Answer	Mark
(i)	**B** - X *The only correct answer is **B*** ***A** is incorrect because W is a relay neurone* ***C** is incorrect because Y is a motor neurone* ***D** is incorrect because Z is a multipolar neurone*	**(1)**

Question Number	Answer	Mark
(ii)	**D** - sugar molecules which are joined by glycosidic links *The only correct answer is **D*** ***A** is incorrect because glycolipids are not made of amino acids* ***B** is incorrect because glycolipids are not made of amino acids* ***C** is incorrect because sugar molecules are not joined by ester bonds*	**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to three of the following: • { form synapses / connections } with other neurones (1) • { integrate / receive } impulses from other neurones (1) • involved in summation • { propagate a signal / initiate an action potential } to the {cell body / axon}		**(3)**

Q10.

Question Number	Answer	Additional Guidance	Mark
(i)	1. fMRI ; and any two from: 2. (fMRI) operates in real time / eq ; 3. as experience will be short lived / eq ; 4. Active areas will {light up / be coloured / eq} (on the image) / eq ; 5. high resolution (as areas involved may be small) / eq ; 6. Safer / eq ;	**2 ACCEPT** live images, 4 images per second **4. ACCEPT** idea of active areas require more oxygen/ oxygenated blood 5 **ACCEPT** more pixels, image is more detailed **6. ACCEPT** ref. to not using X rays, etc	**(3)**

Question Number	Answer	Mark
(ii)	D ;	**(1)**

Q11.

Question Number	Answer	Additional Guidance	Mark
(i)	<table><tr><th>Type of scan</th><th>Can be used to identify the tumour</th></tr><tr><td>CT</td><td>✓</td></tr><tr><td>MRI</td><td>✓</td></tr></table>	DO NOT ACCEPT HYBRID tick/cross	(2)

Question Number	Answer	Mark
(ii)	**The only correct answer is A** - blood flow ***B*** *is incorrect because fMRI does not measure brain activity by detecting bone density* ***C*** *is incorrect because fMRI does not measure brain activity by detecting dopamine release* ***D*** *is incorrect because fMRI does not measure brain activity by detecting lactic acid production*	(1)

Question Number	Answer	Mark
(iii)	***The only correct answer is A*** - CT ***B*** *is incorrect because fMRI does not use X-rays* ***C*** *is incorrect because MRI does not use X-rays* ***D*** *is incorrect because PET does not use X-rays*	(1)

Q12.

Question number	Answer	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Reference to role of ions in • nerve conduction • release of neurotransmitters • muscle contraction Mention of • passive diffusion through ion channels • active transport against concentration gradients Examples of ion transport • active transport – sodium potassium pump • hydrogen ions in chemiosmosis • calcium channels in pre-synaptic knob • sodium and potassium channels in neurones Idea that ions moving down a concentration gradient can do work • ATP synthase in chemiosmosis • cotransporters Ion channels in disease • chloride channels in cystic fibrosis • credit any other sensible suggestions • Ideas around control • lots of different genes/proteins involved in transporting ions across membranes • specificity of channels for particular ions • control of opening and closing of different channels	**(9)**

Level	Marks		Additional Guidance
0	0	No awardable content	
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	simple description of data provided or discussion of one aspect from specification e.g. role of ions in action potentials / muscle contraction / mucus production
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	Level 1 criteria plus disscussion of another aspects from specification including consideration in {disease / ill-health} in at least one
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.	Level 2 criteria plus appropriate use of data from tables linked to health or disease or

		The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	attempt at higher level reasoning e.g explaining role of {ion gradients / active transport of ions} expanding on role of mutations in disease beyond cystic fibrosis / discussion of channel specificity or evolution of variety of channels with many functions

Q13.

Question number	Answer
* (i)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content from table: • stimulated at just one point (V or W) – response lost after repeated stimulation • if the repeated stimulation is alternated between two points (V and W) the worm still responds by contracting its muscles / no habituation when stimuli alternated between different locations • different nerves / neurones / stimulated (by V and W) from diagrams: • there is a response at X every time the neurone is stimulated • { repeated stimulation / after three stimuli } there is no longer an impulse recorded at Y • electrode X is close to where the stimulus is applied and it detects an impulse each time • electrode Y is further from where the stimulus is applied • there is a synapse between the stimulus and the neurone monitored at Y Knowledge and understanding of habituation: • after repeated stimulation the impulse cannot cross the synapse • lack of neurotransmitter / not enough time to produce more neurotransmitter • calcium ion channels not opening when impulse arrives at the synapse • threshold not reached on the post-synaptic neurone and no action potential produced

Level	Mark	Descriptor	Additional Guidance
0	0	No awardable content	
1	1-2	Limited scientific judgement made with a focus on mainly just **one** study. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	One study focused on – probably the table of data Idea of different nerves involved
2	3-4	A scientific judgement is made through the application of relevant evidence from **both** studies. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Analysis refers to the table of data – idea of difference when stimulus at one place or alternating **and** the diagrams showing effects of stimulating nerves X and Y. Links made to impulses not present post synapse and an explanation for that
3	5-6	A scientific judgement is made, which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Analysis of both studies **linked** to knowledge and understanding of habituation, **links** made to location of synapse and reasons why neurotransmitter not released.

Question number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following points: • description of suitable range of (at least five) frequencies (1)	ALLOW range of five different frequencies above and below 20 per minute	
	• a method for making application of stimuli consistent / control of recovery time between tests (1)	e.g. (touch with a cotton bud) to same place each time e.g. give 2 minutes between each test	
	• a method for checking for habituation in earthworms (1)	e.g. observing for no response to touch / finding no change in length of earthworm	
	• repeats with other earthworms of same { species / size } (1)	(Maximum of 2 marks if investigation described in context of snails)	(4)

Q14.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to two of the following: • {immunise / infect} animals at different times during early development (1)	ALLOW compare animals with intact and with deficient (innate) immune systems	
	• investigate animals later in life for { effects on learning / the development of neurological conditions } (1)	ALLOW test animals' senses at different stages in development	**(2)**

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to two of the following: • time is required for heat to warm the blood (1) • because of the layer of insulation in the skin (1) • because it takes time for the warm blood to circulate (1)	ALLOW it takes time for warm blood to reach the fingertip	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	• maximum difference in temperature divided by time (1) • correct answer with units (1)	Example of calculation (32.0 - 27.5) ÷ 3 1.5 °C min^{-1} OR 1.5 °C per minute OR 1.5 °C / minute ALLOW 32.0 – 27.4 to give 1.53 for 2 marks Correct answer no working with units gains full marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to five of the following: • thermoreceptors detect increase in temperature (1) • description of role of hypothalamus in heat loss mechanism (1) • (therefore more) impulses are sent along the sympathetic { nerves / nervous system } (1) • which leads to constriction of shunt vessels (1) • therefore causing vasodilation (of arterioles) (1) • so more warm blood flows near the skin surface (1)	e.g. thermoreceptors in the hypothalamus detect temperature increase OR reference to role of heat loss centre / thermoregulatory centre in co-ordinating mechanisms of heat loss ALLOW so more warm blood in capillaries ALLOW radiation of heat energy from the skin	**(5)**

Q16.

Question Number	Answer	Additional Guidance	Mark
(a)	C (phospholipid)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(i)	rhodopsin		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(ii)	(cis) retinal		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)	A description that makes reference to the following: • opsin released causing sodium ion channels to be blocked (1) • which causes hyperpolarisation in the rod cell (1) • causing action potential in bipolar cell (results in action potential in the optic nerve) (1)		**(3)**

Q17.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to two of the following points: • serotonin is a neurotransmitter / there will be less neurotransmitter (1) • (less serotonin) results in fewer depolarisations of post synaptic membranes (1) • threshold not achieved / less chance of action potential being produced (in post-synaptic neurone) (1)	ALLOW no serotonin or no neurotransmitter ALLOW no depolarisations ALLOW no action potential produced	(2)

Q18.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	B		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	An explanation that makes reference to three of the following: • MRI gives better resolution (1) • therefore more detail can be seen (1) • no use of X–rays (1) • therefore {safer / less risk of mutation / eq} (1) • therefore can be used more often (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)	An explanation that makes reference to the following: • increased neural activity of {cerebellum / cerebrum} (1) • more oxygen needed so increase in {blood flow / oxyhaemoglobin} (1) • less {radio wave / signal} absorbed (1)		**(3)**

Q19.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to four of the following: • extract mRNA for one form of the (tau protein) (1) • copy mRNA into DNA (1) • use restriction enzymes {to create sticky ends) / cut theDNA and a vector} (1) • {ligate / insert / integrate} the TAU DNA into the vector(DNA) (1) • introduce vector into {fertilised egg / embryonic stem /zygote / cells / neural cell stem cells} (1)	IGNORE cut / remove TAU gene from a humanALLOW synthesis DNA sequence for one form e.g. use code specific for one of the tau proteins ALLOW insert gene into fertilised egg cell /embryonic stem cell ALLOW egg cell fertilised after inserting gene	Choose an item. (4)

Q20.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	• Idea that {cell body / centron} in middle / dendrites at both ends (1)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	An explanation that makes reference to five of the following: • reference to Schwann cells covering the axon in myelinated neurone (1) • {myelin/Schwann cells} provide insulation (1) • {action potential/depolarision} at nodes of Ranvier (1) • local currents occur over a longer distance (1) • reference to saltatory conduction (1) • impulse jumps from node to node (1)		**(5)**

Q21.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. identical twins (agreement) is greater / eq ; 2. credit correct manipulation of the data e. g. {41% more / 2.4x as much / 141% higher / eq} agreement than non-identical twins ; 3. idea that alleles are involved ; 4. idea that non-identical have genetic differences ; 5. idea that because less than 100% then some other factor is involved ;	ACCEPT converse where appropriate 2. ACCEPT 41% difference 3. ACCEPT gene alternatives 4. ACCEPT identical twins are genetically the same	(4)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	idea that there is less of a gap between the results ;	ACCEPT expressed as numbers, results similar (to each other), identical twin result is lower, non-identical twin result is higher	(1)

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea that active areas have more {oxygen / oxygenated blood} ; 2. active areas involved in face recognition will be identified / eq ; 3. idea of level of brain activity between identical twins and non identical twins is compared ; 4. to offer supportive evidence / improve validity of study ; 5. idea that fMRI shows brain activity in real time ; 6. idea of high resolution ; 7. comment on safety / eq ;	3. ACCEPT idea of {areas more active / more oxygenated blood flowing to areas} in identical twins compared with non-identical twins 3. ACCEPT idea of {more / eq} areas showing activity in common in identical twins than non-identical 7. ACCEPT fMRI does not use X rays	(4)

Q22.

Question Number	Answer	Mark
(a)(i)	100 (mV) ;	**(1)**

Question Number	Answer	Mark
(a)(ii)	<table><tr><th>Description</th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th></tr><tr><td>Stage when the concentration of positive ions is greatest inside the axon</td><td></td><td></td><td>☒</td><td></td><td></td><td></td></tr><tr><td>Stage when hyperpolarisation first occurs</td><td></td><td></td><td></td><td></td><td>☒</td><td></td></tr><tr><td>Site showing the resting potential</td><td>☒</td><td></td><td></td><td></td><td></td><td></td></tr></table>	**(3)**

Question Number	Answer	Mark
***(b)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence 1. diffuses across {gap /eq} ; 2. binds to (receptors on) post-synaptic membrane / eq ; 3. idea of gated-channels opening or Na^+ travels through post-synaptic membrane ; 4. causing a depolarisation / eq ; 5. (if sufficient present) an action potential is set up in {post-synaptic membrane/adjacent cell / eq} ; 6. details such as temporal or spatial summation ; 7. idea that allows coordination / one way flow of information ; 8. idea that it allows integration in post-synaptic cell ; 9. neurotransmitter broken down (by enzyme) / eq ; 10. so that do not get {prolonged /eq} action potential in post-synaptic membrane / make receptors available again ; 11. credit reference to fate of products e.g. reabsorbed through pre-synaptic membrane OR to be re-synthesised into neurotransmitter substance ;	**(5)**

Q23.

Question number	Answer	Additional guidance	Mark
	An answer that makes reference to the following: • frequency is {the same / similar} for all flies at 10 days (1) • for older flies with {0N4R the error bars overlap with thecontrol (1) • therefore 0N4R has {no / little} effect on the frequency ofimpulses (1) • for older flies 0N3R the error bars do not overlap withthe control } (1) • therefore 0N3R decreases the frequency of impulses (1)	ALLOW length of time between impulses ALLOW frequency decreases from 220 to 190impulses per second ALLOW length of time between impulses IGNORE unqualified length of time / increase ALLOW frequency decreased from 227 to 137impulses per second ALLOW more significant / greatest effect ALLOW length of time between impulses IGNORE unqualified length of time / increase ALLOW effect was greater in older flies if MP2 to 5not awarded	Choose an item. (4)

Q24.

Question Number	Answer	Additional guidance	Mark
(a)	**A** cell body ; **B** - axon ;		**(2)**

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. increasing Eugenol concentration increases percentage inhibition / positive correlation ; 2. description of non linear correlation ; 3. credit correct manipulation of the data e.g. between 0.1 and 1.0 mmol dm^3 percentage inhibition to increase by 55% ;	ACCEPT 2 – e.g. greatest increase in inhibition is between eugenol concentration of 0.2 and 0.4 mmol dm^{-3}	**(2)**

Question Number	Answer	Additional guidance	Mark
* **(b)(ii)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence) 1. {reduced / eq} Ca^{2+} enters { *presynaptic membrane* / into *sensory neurone*} ; 2. due to Ca^{2+} channel not opening / decreased sensitivity of *membrane* to Ca^{2+} ; 3. fewer *vesicles* {move towards / fuse} with *presynaptic membrane* ; 4. less *neurotransmitter* {released into / less diffuses across} {*synaptic* gap / eq} ; 5. less *neurotransmitter* binds to receptors on {*post-synaptic membrane* / adjacent neurone} ; 6. idea of reduced depolarisation / less Na^+ or cation channels open ; 7. idea of { threshold intensity / *action potential* / *impulse*} less likely to occur ; 8. idea of pain not being sensed as impulse {stopped before entering CNS / leaving the *sensory neurone*} ;	ACCEPT 1 – into *synaptic* knob / pre-synaptic neurone ACCEPT 4 (& 5) - named neurotransmitter example ACCEPT 7 - not reached as alternative to less likely to be reached	**(6)**

Q25.

Question Number	Answer	Additional Comments	Mark
(a) (i)	(terminal) dendrite ;		(1)

Question Number	Answer	Additional Comments	Mark
(a) (ii)	B ;		(1)

Question Number	Answer	Additional Comments	Mark
(b) (i)	1. Increasing eugenol concentration increase percentage inhibition / positive correlation ; 2. Description of non linear correlation ; 3. Credit correct manipulation of the data e.g. 0.8 mmol dm^{-3} increase causes percentage inhibition to increase by {x2.7 / eq} ;	**2. Ignore** references to rate or speed **Accept** greatest increase is between 0.2 and 0.4	(2)

Question Number	Answer	Additional Comments	Mark
(b) (ii)	Correct answer gains 2 marks 72.5 / 73.0 / 75 (%) ; ;	**Accept** for 1 mark (65 + 80) ÷ 2 or 145 ÷ 2 if answer incorrect	(2)

Question Number	Answer	Additional Comments	Mark
* (c)	QWC – Spelling of technical terms (shown in italics) must be correct and the answer must be organised in a logical sequence 1. higher concentration of Na^+ outside of neurone / eq ; 2. sodium ions move in causing a depolarisation / eq ; 3. eugenol may affect { Na^+ / voltage-dependent} gates / eq ; 4. eugenol reduces influx of Na^+ / eq ; 5. (so) depolarisation less likely to occur / eq ; 6. no impulse transmitted along neurone / eq ; 7. idea of no transmission to next neurone ; 8. idea of pain not being sensed as impulse stopped before entering CNS ;	**QWC emphasis is logical sequencing in the context of how eugenol affects the movement** **6. Accept** no action potential **7. Accept** no release of neurotransmitter	(6)