Name_____ _____ _____
Last (as on TCard) First (as on TCard) Preferred First (optional)

Student #_____ Signature_____

UNIVERSITY OF TORONTO
Faculty of Arts and Science

APRIL 2013 EXAMINATIONS

HMB220H1S Introduction to Human Behavioural Biology

Duration – 3 hours

No Aids Permitted

This exam is out of 85 marks.

Instructions:

Write your full name and student number on every page of the exam.

Part 1- Multiple Choice (55 questions worth 1 mark each, total 55 marks)
1.1 Answer the multiple choice questions on the scantron.
1.2 Refer to the "MARKING INSTRUCTIONS" on the scantron for information on filling it out (*e.g.*, use HB pencil; no stray marks anywhere on the scantron).
1.3 In the "FORM" box on the scantron, indicate which "FORM" (A, B, C or D) is indicated on the top of your exam page.
1.4 Fill in SIGNATURE, SUBJECT and DATE on the scantron.
1.5 Correctly bubble in your STUDENT NUMBER, LAST NAME and INITIALS on the scantron.

Part 2- Short Answer (5 questions, total 30 marks)
Answer all questions using complete, concise sentences and writing legibly using ink only in the lined space provided in this paper.

Invigilators are not permitted to interpret questions to individual students. If you think that a question is ambiguous, answer it as you understand it, then make a note here not on your scantron. Please be specific.

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Part 1 Multiple Choice. Choose the best answer for each question. Worth 1 mark each.

1. Floriana's doctor taps her patellar tendon with a hammer, causing her to kick the doctor in the face. This knee jerk reflex is caused by sending stretch signals to:
   A) motor neurons in the spinal cord that cause muscles to contract.
   B) motor neurons in the cortex that cause muscles to contract.
   C) the thalamus, which sends signals to motor neurons to contract.
   D) the cerebellum, which sends signals to motor neurons to contract.

2. For a postsynaptic NMDA receptor to be activated:
   A) glutamate must bind to it.
   B) the postsynaptic membrane must be depolarized.
   C) glutamate must bind to it and the postsynaptic membrane must be depolarized.
   D) acetylcholine must bind to it and the postsynaptic membrane must be depolarized.

3. In *The* Brain *that Changes itself*, Walter Freeman proposes that oxytocin leads to massive reorganization in which two stages of life?
   A) Falling in love and parenting
   B) Learning to speak and learning to read
   C) Breastfeeding and addiction
   D) Critical period of visual and auditory plasticity

4. The hippocampus and the amygdala are part of:
   A) the basal ganglia.
   B) the limbic system.
   C) the olfactory system.
   D) the hindbrain.

5. Which of the following activating system–cell body location pairs is *not* correct?
   A) Acetylcholine, basal forebrain
   B) Norepinephrine, locus coeruleus
   C) Dopamine, substantia nigra
   D) Serotonin, ventral tegmentum

6. The effects that hormones have on the adult brain are referred to as:
   A) organizing effects.
   B) activating effects.
   C) endocrine effects.
   D) hormonal effects.

7. The rate by which dopamine, epinephrine, and norepinephrine can be synthesized is controlled by a rate-limiting factor that is linked to the availability of:
   A) tryptophan.
   B) ChAT.
   C) tyrosine hydroxylase.
   D) histamine.

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8. What is correct about the Vagus nerve?
   A) 10th cranial nerve projects to heart and larynx
   B) 5th cranial nerve, projects to the eye muscles
   C) 12th cranial nerve, sensory input from the face
   D) 4th cranial nerve, functions to help balance the body

9. Natalie has a limb amputated after a motorcycle accident. She experiences phantom limb pain. How can this most easily be explained?
   A) encroachment of the denervated cortex area by some other part of the body.
   B) stimulation of the nerve endings of the stump.
   C) collateral stimulation of the thalamus.
   D) degeneration of the cortical area representing the lost limb.

10. Neurons in the primary motor cortex:
   A) start to discharge just prior to a movement.
   B) discharge during a movement.
   C) increase their rate of firing if a weight is added to the movement apparatus.
   D) All of the answers are correct.

11. What does the neural circuitry for female specific reproductive behaviour include?
   A) ventromedial hypothalamus, periaqueductal gray and spinal cord reflexes
   B) bulbocavernosus spinal neurons and the medial amygdala
   C) ventral pallidum and vomeronasal organ
   D) hippocampus and lateral amygdala

12. Neuronal maturation involves _____ and _____.
   A) migration; specialization
   B) dendrite growth; synapse formation
   C) migration; synapse formation
   D) specialization; dendrite growth

13. Various forms of _____ have been used as study pills by students.
   A) barbiturates
   B) opioids
   C) amphetamines
   D) antipsychotics

14. Steven surfs the internet for porn for 4 hours every night. What is NOT true about the changes Steven may experience?
   A) Less appetitive stimuli will be required to reach orgasm
   B) Fewer dopamine receptors will be expressed in the nucleus accumbens
   C) Human sex partners will activate the reward pathway to a lesser degree
   D) Pair bonding will be more difficult

15. In androgen insensitivity syndrome:
   A) a genetic male develops a female phenotype.
   B) a genetic female develops a male phenotype.
   C) males fail to undergo puberty.
   D) females fail to undergo puberty.

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16. Jacky is a thrill seeker who's favourite hobby is skydiving and ingesting cocaine. What genetic polymorphism would explain this behaviour?
    A) dopamine receptor mutation that reduces the affinity for dopamine
    B) dopamine transporter mutation that reduces its ability to remove dopamine from the synapse
    C) MAOA enzyme mutation that reduces its ability to metabolize dopamine in the synapse
    D) GABA receptor mutation that increases GABA receptor function

17. Pooja wants to get married to Kelvin, but Kelvin wants an open relationship. How could Pooja get Kelvin to agree to marriage?
    A) overexpress arginine vasopressin receptors in his ventral pallidum
    B) slip an oxytocin receptor antagonist into his drink
    C) inject oxytocin directly into his caudate putamen
    D) block GABA receptors in his hippocampus

18. While clubbing one night, Youki takes a hit of MDMA ("ecstasy"). This can have toxic effects on:
    A) dopamine terminals.
    B) serotonin nerve fibers.
    C) norepinephrine synthesis.
    D) glutamate release.

19. What would NOT contribute to the enhanced plasticity properties of newly born neurons?
    A) fewer AMPA receptors
    B) reduced inhibition
    C) increased excitability
    D) increased associativity

20. Chloe always seems to look away when you look into her eyes. You suspect a bit of Asperger's. What differences in her brain might be observed?
    A) reduced activation of the fusiform gyrus
    B) reduced activation of the amygdala
    C) reduced activation of the orbiotfrontal cortex
    D) reduced activation of the visual cortex

21. The premotor cortex is responsible for:
    A) planning movements.
    B) producing specific movements.
    C) producing movement sequences.
    D) inhibiting spontaneous movements.

22. What is FALSE about drug targets?
    A) THC, the psychoactive ingredient in marijuana causes severe sensitization
    B) amphetamines cause rapid and profound tolerance
    C) alcohol is often used to self-medicate for stress because it inhibits the amygdala
    D) heroin and its metabolites bind to opioid receptors in the brain

23. In order keep her awake in HMB220 class, Abd tickles Alexa. What causes Alexa's tickle sensation?
    A) touch sensations.
    B) the predictability of the touch sensations.
    C) the unpredictability of the touch sensations.
    D) the laughter associated with tickling.

24. Which of the following is *not* true?
    A) The cell membrane is semipermeable, so it keeps in large negatively charged protein molecules.
    B) The membrane keeps out Na^+ and allows K^+ to pass more freely.
    C) The membrane has a sodium–potassium pump that removes potassium from inside the cell and replaces it with sodium.
    D) The summed charges of the unequally distributed ions leave the inside of the membrane at –70 mV relative to the outside. This is the cell's resting potential.

25. Efferent is to afferent as:
    A) brain is to spinal cord.
    B) sensory is to motor.
    C) motor is to sensory.
    D) incoming is to outgoing.

26. Regarding steps likely required for addiction, which one is INCORRECT?
    A) Associative learning pathway inhibition
    B) Reward pathway activation
    C) Negative affect pathway activation
    D) Approach/motivational pathway activation

27. Masculinization refers to the effects of:
    A) estradiol on brain cells.
    B) too little estrogen on female embryos.
    C) testosterone on DNA transcription.
    D) too little estrogen on brain cells.

28. A brief depolarization of the neuronal membrane that makes it more likely that the neuron will fire an action potential is called:
    A) saltatory conduction.
    B) an inhibitory postsynaptic potential (IPSP).
    C) an excitatory postsynaptic potential (EPSP).
    D) spatial summation.

29. Bingeing, tolerance and associative learning can lead to what kind of changes in the brain?
    A) decrease in basal and increase in cue stimulated dopamine release
    B) decrease in glutamate signaling in the amygdala
    C) increase in prefrontal cortex input into the nucleus accumbens
    D) increase in the basal dopamine release in the nucleus accumbens

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30. An action potential usually goes only in one direction in an axon because:
    A) the ions can flow only in one direction.
    B) the refractory periods force the impulse to go in one direction.
    C) the ion flow is attracted to chemicals in the synaptic knob.
    D) autoreceptors inhibit backward flow of ions.

31. Tarini and Brett are on their honeymoon in Japan and are eating at an authentic sushi restaurant. The sushi chef brings you some samples of puffer fish and within a few minutes both of you and your friend begin feeling extremely weak, to the point where your muscles will not contract and you are no longer able to think clearly. You ask the sushi chef to call an ambulance because:
    A) you have an acute case of food poisoning.
    B) you may have ingested tetrodotoxin, which is a sodium channel blocker.
    C) you may have ingested tetrodotoxin, which prevents potassium channels from closing.
    D) you may have ingested TEA, which blocks potassium channels and prevents hyperpolarization.

32. Kevin can drink a full case a beer in an evening. His liver now contains a greater concentration of enzymes that break down alcohol. What is this adaptation called?
    A) cellular tolerance.
    B) metabolic tolerance.
    C) sensitization.
    D) habituation.

33. What are examples of genetic programming and environmental cues (respectively) that influence migration of axons to targets?
    A) expression of appropriate receptors for cell adhesion molecules; secretion of trophic factors
    B) receptor mediated actin polymerization; cell adhesion molecule interaction
    C) secretion of trophic factors like nerve growth factor; filipod extension and retraction to advance the growth cone
    D) post-synaptic receptor activation when growth cone meets another neuron; basal signaling or neural "chatter".

34. The role of glial cells is primarily:
    A) to carry out information processing in the brain.
    B) to send signals from one brain region to another.
    C) to modulate the activity of neurons.
    D) to process sensory input.

35. The _____ hypothesis of schizophrenia suggests that patients have _____.
    A) norepinephrine; too much serotonin
    B) serotonin; not enough serotonin
    C) dopamine; not enough dopamine
    D) dopamine; too much dopamine

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36. Myelin around axons:
    A) speeds up transmission of information.
    B) slows down transmission as if by an insulator.
    C) has no effect on speed of transmission but acts as a protective coat on the fragile axon.
    D) has no effect on speed of transmission but allows the cell access to nutrition.

37. Dillon is measuring synaptic transmission in a slice of hippocampus. After treating the tissue with an experimental compound, he notices that it is easier to induce long-term potentiation. What is one potential action of the compound?
    A) antagonist for the glutamate reuptake transporter
    B) antagonist for the GABA reuptake transporter
    C) agonist for postsynaptic GABA receptors
    D) agonist for presynaptic potassium channels

38. Which adult rats would display male reproductive behaviour if stimulated appropriately?
    A) females with ovaries removed and treated with excess estrogen at birth
    B) males lacking the aromatase gene treated throughout life with testosterone
    C) males castrated at birth treated with excess testosterone in adulthood
    D) females treated with excess testosterone in adulthood

39. What is the best explanation for falling in love/pair bonding?
    A) an association between the social recognition and reward pathway
    B) an unusually strong activation of the reward pathway
    C) a reduction in the activation of the amydgala and pre-frontal cortex
    D) lowering the threshold for long-term potentiation in the hippocampus

40. Fear conditioning involves neural circuits in the:
    A) hypothalamus.
    B) amygdala.
    C) frontal lobe.
    D) cerebellum.

41. A cation is found at higher concentration outside of a neuron at rest. An ion channel opens specific for that ion. Which way will the net flow be?
    A) inward
    B) outward
    C) neither
    D) unknown

42. You are analyzing a mouse model of autism spectrum disorder that displays repetitive behaviours like excessive grooming. Analysis of synapses reveal a reduction of glutamate receptors. Which gene is likely mutated in this mouse?
    A) Shank3
    B) MECP2
    C) Neuroligin 3
    D) Neuroligin 2

43. SSRIs treat depression by:
    A) blocking the reuptake of serotonin.
    B) increasing the release of serotonin.
    C) stopping the breakdown of serotonin.
    D) increasing the synthesis of serotonin.

44. A study by Thaler *et al.* examined the brain regions involved in human echolocation in blind individuals. Their study found that echolocation in blind individuals seemed to rely on activation in:
    A) Broca's area.
    B) Wernicke's area.
    C) primary auditory cortex.
    D) visual cortex.

45. Annie secretly drinks some vodka every time she comes to her HMB220 class in WI1016 to the point of developing an alcohol addiction. After the course is over, she quits drinking. The following year, she enrolls in a course also held in WI1016. What can she take to reduce her chance of relapsing?
    A) Opioid receptor antagonist
    B) GABA receptor antagonist
    C) glutamate receptor antagonist
    D) two supersize orders of McDonald's french fries

46. It has been found that in well-trained and habituated *Aplysia*, the number of sensory synapses:
    A) decreases but the size stays constant.
    B) stays constant but the size decreases.
    C) decreases and the size increases.
    D) decreases and the size decreases.

47. When a neurotransmitter diffuses across the synaptic cleft and binds to a transmitter-activated receptor, which of the following may occur in the postsynaptic cell?
    A) membrane depolarization
    B) membrane hyperpolarization
    C) initiation of chemical reactions
    D) All of the answers are correct.

48. Which of the following is the correct sequence for drug addiction?
    A) incentive salience, pleasure, associative learning
    B) associative learning, pleasure, incentive salience
    C) pleasure, associative learning, incentive salience
    D) incentive salience, associative learning, pleasure

49. A common behavioural phenotype in autism spectrum disorder is enhanced fear conditioning. What changes in the brain would you expect to be associated with this?
    A) greater expression of NMDA receptors in the amygdala
    B) weaker connection between the amygdala and the hypothalamus
    C) enhanced GABA release in the amygdala
    D) reduced phosphorylation of AMPA receptors in the amygdala

50. Psychoactive drugs have most of their effects at the:
    A) cell body.
    B) axon.
    C) synapse.
    D) dendrites.

51. Victoria is overheard saying, "Dr. Taverna is so anti-social that I bet he has an Autism Spectrum Disorder." She decides to test his theory and secretly gets a DNA sample. A genetic test reveals a copy number variant in the locus that contains the gene for neuroligin 1. There are 6 copies of this region leading to overexpression of the protein. What effect would this have in his brain?
    A) overexpression of glutamate receptors and abnormal brain development
    B) reduced plasticity at excitatory synapses and reduced learning abilities
    C) weaker connection between the amygdala and the hypothalamus
    D) reduced expression of AMPA receptors in the amygdala

52. Maruta lived right next to a factory that emits a constant 15-20 kHz noise (the whirring of generators right outside) for the first 2 years of her life. What is most likely true about Maruta's hearing as an adult?
    A) Maruta would not be bothered by the noise of the generators as an adult.
    B) Maruta would be very sensitive to noise at those frequencies.
    C) Maruta would be able to distinguish very subtle differences in musical notes within that frequency range.
    D) Maruta would be able to learn any Chinese language very easily as an adult.

53. When cues that have previously been associated with drug taking are encountered, the _____ system becomes active, producing the subjective feeling of wanting.
    A) serotonin
    B) limbic
    C) dopamine
    D) endorphin

54. What is a likely explanation for the remarkable rehabilitation of Cheryl, the woman in Doidge's book who gained her balance back without further need for the electronic balance apparatus?
    A) plasticity in parallel systems to fine tune balance input to the vestibular nucleus
    B) the birth of new neurons in the cochlear nucleus
    C) Cheryl uses only her muscles and not her brain to balance
    D) Cheryl learned how to dance using only her cerebellum for balance

55. Nathan routinely uses study pills (i.e., Ritalin) to help him stay awake and pull all-nighters during exam time. Normally if he takes a small dose he is fine, but lately when he takes the same dose he gets extremely agitated and cannot sit still. The same dose is having a larger effect on him than it used to. This is an example of:
    A) drug addiction.
    B) tolerance.
    C) behavioral sensitization.
    D) withdrawal.

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Part 2. Short Answer Section (5 questions, 30 marks total). Answer only in the lined space.

Question 1 (6 marks) Based on what you have learned in the course, explain why a corticotrophin releasing factor (CRF) antagonist might be an effective treatment for relapsing alcoholism and for Autism Spectrum Disorder.

Question 2 (4 marks) Can thinking change your brain? Propose a NOVEL experiment to test the hypothesis that thinking can change your brain. Include appropriate controls.

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Question 3 (6 marks) Patricia is attracted to a German international student. She thinks that she will have a better chance to date him if she learns German. She asks her friend Harprit, who took HMB220, to advise her on the fastest way to learn a new language. Harprit tells her to take drugs that affect GABAergic signaling and the extracellular matrix and to only study a couple of hours a day but for several months. Explain how these strategies would help her learn a new language

Question 4 (4 marks) Propose an experiment (include controls) that would test the hypothesis that the occipital lobe is required for braille reading (and not just detection of braille spots) in the blind.

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Question 5a (6 marks) Describe the phases of the action potential, starting from depolarization at the axon hillock and ending with release of neurotransmitter at the synapse.

Question 5b (4 marks) What would happen if potassium channels were faster to open and close (in terms of action potential shape and frequency). Explain your answer clearly.

Total = 85 marks, 12 pages