UNIVERSITY OF TORONTO
ASTRONOMY 101H1F MIDTERM TEST

THURSDAY, NOVEMBER 10, 2011
DURATION: 45 MINUTES
NO AIDS ALLOWED

UTORID: _____

CIRCLE YOUR TUTORIAL SECTION BELOW:

	Monday		Tuesday		Wednesday	
10:00	0101 -- Yevgeni	0102 -- Stephen	0701 -- JD	0702 -- Eric	1201 -- Stephanie	1202 – Nick
11:00	0201 -- Yevgeni	0202 -- Stephen	0801 -- Nathan	0802 -- Eric	1301 -- Stephanie	1302 – Nick
12:00	0301 -- Charles	0302 -- Eve	0901 -- Nathan	0902 -- Eve	1401 – JD	1402 – Nick
13:00	0401 -- Charles	0402 -- Eve	1001 -- Adam	1002 -- Dan	1501 – Stephanie	1502 – Dan
14:00	0501 -- Yevgeni	0502 -- Stephen	-	-	1601 – JD	1602 – Dan
15:00	601 -- Charles	602 -- Eric	1101 -- Nathan	1102 -- Adam	-	-

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Instructions:

1. ON THIS PAGE: Fill in your UTorID (e.g. smithm1) and circle your tutorial section.
2. ON THE NEXT PAGE: Fill in your name (as it appears on ROSI), your student number, and your UTorID (e.g. smithm1).
3. ON THE SCANTRON CARD: Fill in your last name, first initial, and student number in the spaces given and, using pencil, darkly shade in the corresponding bubbles. Then sign the card.
4. For each multiple choice question, mark your answer *in pencil* on the Scantron card by darkly shading the appropriate bubble. All answers to multiple choice questions must be transferred to the Scantron card. Under no circumstances will answers to multiple choice questions written on this paper be accepted.
5. Answer short answer questions in the spaces provided. Answers written in pencil will not be re-marked.
6. Mark values are indicated with each question.
7. Make sure that your midterm has 9 pages.

NAME: _____

UTORID: _____

STUDENT NUMBER: _____

Question	Marks
A1-A21 (MC)	/21
B1	/4
B2	/6
B3	/4
Total	/35

PART A: Multiple choice questions. CIRCLE THE MOST CORRECT ANSWER (1 mark each)

1. Without telescopes or other aid, we can look up and see the Moon in the night sky because it:

   (a) emits thermal radiation.
   (b) emits visible light.
   (c) reflects visible light.
   (d) glows by radioactive decay.
   (e) reflects infrared light as visible light.

2. The sky is blue because:

   (a) the atmosphere transmits mostly blue light.
   (b) the atmosphere absorbs mostly blue light.
   (c) the atmosphere scatters blue light more effectively than red light.
   (d) the atmosphere scatters red light more effectively than blue light.
   (e) the Sun emits more blue light than all other colours combined.

3. On Mars, the daytime sky is reddish but it turns blue at sunset. What does this tell us about Mars' atmosphere?

   (a) It must be very similar to our own, which produces the same pattern of colours.
   (b) It must scatter red light more effectively than blue light.
   (c) It must scatter blue light more effectively than red light.
   (d) It must be very thin.
   (e) It must be made mainly of nitrogen.

4. Compared to X-rays, infrared light has:

   (a) lower energy and higher frequency
   (b) lower energy and shorter wavelength
   (c) higher energy and longer wavelength
   (d) higher velocity and lower frequency
   (e) lower energy and longer wavelength

5. How does the spectrum of a molecule differ from the spectrum of an atom?

   (a) A molecule has additional spectral lines due to changes in its rotational and vibrational energies.
   (b) An atom has a larger range of spectral lines because its electrons are freer to move around.
   (c) Molecules typically only have spectral lines at ultraviolet wavelengths.
   (d) Atoms typically only have spectral lines at infrared wavelengths.
   (e) Molecules do not have spectral lines that are caused by electrons changing energy levels.

6. In space, no one can:

   (a) see you.
   (b) feel your gravity.
   (c) hear you scream.
   (d) heat you up by conduction.
   (e) steal your cookies.

7. From laboratory measurements on Earth, we know that a particular spectral line formed by hydrogen appears at a wavelength of 121 nanometers (nm). The spectrum of a particular star shows the same hydrogen line appearing at a wavelength of 122 nm. What can we conclude?

   (a) The star is moving toward us.
   (b) The "star" actually is a planet.
   (c) The hydrogen in the star is hotter than the hydrogen in our lab.
   (d) The hydrogen in the star is colder than the hydrogen in our lab.
   (e) The star is moving away from us.

8. Betelgeuse is the bright red star representing the left shoulder of the constellation Orion. **All the following statements about Betelgeuse are true.** Which one can you infer from its red color?

   (a) It is much more massive than the Sun.
   (b) It is much brighter than the Sun.
   (c) Its surface is cooler than the surface of the Sun.
   (d) It is much younger in age than the Sun.
   (e) Its chemical composition is different from that of the Sun.

9. Mars and Venus both have rocky surfaces and atmospheres made mainly of CO_2 (carbon dioxide). The compositions of both planets are similar. Both of them have experienced periods of heavy bombardment. Why is Mars cold and Venus is hot?

   (a) Mars is too far from the Sun to receive any heat.
   (b) Mars' atmosphere is much thinner than Venus' atmosphere.
   (c) Mars has ice caps which cool it down, while Venus does not.
   (d) Mars has no active volcanoes, while Venus has many.
   (e) Mars has a smaller surface-area-to-volume ratio, so its atmosphere lost its heat to space more easily than Venus' atmosphere did.

10. Overall, the chemical composition of Jupiter is most like that of:

    (a) a comet.
    (b) the Sun.
    (c) the Earth.
    (d) an asteroid.
    (e) its own moons.

11. How does the nebular theory of planet formation account for the Kuiper Belt?

(a) It envisions the Kuiper Belt as leftover debris from the formation of the solar system.
(b) It envisions the Kuiper Belt as the debris from collisions among dwarf planets.
(c) It envisions the Kuiper Belt as liberated moons of the gas giant planets.
(d) It envisions the Kuiper Belt as material kicked out of the inner solar system after the formation of the terrestrial planets.
(e) It doesn't account for the Kuiper Belt.

12. Consider a planet half the **radius** of the Earth but with the same **mass** and composition. In which of the following ways would this planet have to be different from Earth?

(a) It would be unable to hold on to an atmosphere as thick as Earth's.
(b) It would have many more volcanoes than Earth does.
(c) Its orbit would be much smaller than that of the Earth.
(d) It would emit far more infrared radiation than Earth does.
(e) Its interior would cool more quickly than Earth's has.

13. If Earth's atmosphere were to warm slightly, what would happen?

(a) The atmosphere would just radiate the extra heat away into space and cool back down directly.
(b) More water would evaporate into the atmosphere, trapping more carbon dioxide, which would help cool the atmosphere back down.
(c) More carbon dioxide would be released by the oceans, making the greenhouse effect stronger and causing the warming to continue.
(d) The ice caps would begin to melt, reflecting less heat into space, and accelerating the warming indefinitely.
(e) Microorganisms in the ocean would grow faster, capture more carbon dioxide, and produce a rapid cooling trend ending in another 'snowball Earth' phase.

14. In what sense do astronomers believe Mars used to be more Earth-like?

(a) Mars used to have primitive forms of life.
(b) Mars used to be quite a bit larger and was pared down to its current size by collisions with planetessimals.
(c) Mars used to have liquid water flowing freely on its surface.
(d) Mars used to have a thick oxygen/nitrogen atmosphere.
(e) Mars used to be closer to the Sun, where it was warmer.

15. Which of Venus and the Moon has the older surface, **on average**, and how do we know?

(a) Venus, because we know the planets formed before the Moon did.
(b) the Moon, because it is heavily cratered.
(c) Venus, because radiocarbon dating tells us it is very old.
(d) the Moon, because it has clearly been well preserved by the vacuum of space.
(e) Venus, because it looks like it was resurfaced by volcanoes about 500 million years ago.

16. The **shapes** of impact craters on planetary surfaces are most strongly determined by:

    (a) The shape of the impactor--comets produce round craters and asteroids produce irregularly-shaped craters.
    (b) The explosive nature of the impact, which renders all impact craters nearly circular.
    (c) The composition of the rocks which are hit.
    (d) The angle at which the impactor hits--impacts from directly above produce round craters, while those at glancing angles produce elongated craters.
    (e) The size of the impactor, with larger impactors producing larger craters.

17. Earth has very active geology (volcanoes, plate motions, etc.) while Venus appears more geologically quiet. Given that Earth and Venus are essentially identical in **size** and **composition**, which of the following is the most likely explanation for this difference?

    (a) The interior of Venus is not being heated by radioactive decays.
    (b) Venus has a very thick atmosphere which is very effective at transferring heat away from the planet by convection.
    (c) Venus has already radiated away most of its internal heat to space.
    (d) Venus's thick atmosphere keeps the surface completely molten, so Venus doesn't have a proper crust.
    (e) Venus' mantle is the same temperature throughout, so it does not transfer heat effectively by convection.

18. Let's say astronomers discover a large body orbiting in the asteroid belt. It's about 800 km in diameter, nearly spherical, made of rock, and heavily cratered. What is the likely explanation for the origin of this object?

    (a) It's a planetessimal left over from the formation of the solar system.
    (b) It's an asteroid.
    (c) It's a Kuiper Belt object which has strayed into the inner solar system.
    (d) It's an escaped moon of Jupiter, freed by gravitational interactions with Mars.
    (e) It is the parched home planet of reptilian humanoids whose charismatic leader, Anna, is plotting to take over the Earth and steal our water. Join the resistance!

19. Why are Neptune and Uranus blue in colour?

    (a) Because they are very cold.
    (b) Because they have thick water layers which, like Earth's oceans, appear blue.
    (c) Because they are made of gases which mainly absorb red light.
    (d) Because they are warm enough to glow in blue light.
    (e) Because they are mainly made of hydrogen, which appears blue when it is cool.

20. Which of the following constitute(s) good evidence that the **very early** solar system must have been full of large rocks?

(a) The large number of very old, very large impact craters seen on planetary surfaces.
(b) The existence of the main asteroid belt.
(c) The extinction of the dinosaurs in an impact event 65 million years ago.
(d) Both (a) and (b).
(e) All of the above.

21. Why would astronomers be surprised that Mercury has a magnetic field?

(a) Because Mercury was not known to contain a lot of magnetic minerals.
(b) Because Mercury was thought to have solidified a long time ago.
(c) Because Mercury is known to be very hot, and heat destroys permanent magnets.
(d) Because none of the other terrestrial planets have strong magnetic fields.
(e) Because the Moon and Mercury are virtually identical and the Moon does not have a magnetic field.

BONUS QUESTIONS:

22. If you tried to land a spaceship on a gas giant, what would happen?

(a) You'd go right through it because it's made of gas.
(b) You'd descend through a thick layer of clouds and eventually reach a small solid core.
(c) You'd be repelled by the planet's immensely strong gravity.
(d) You'd be crushed by the pressure that keeps most of the planet's interior in liquid form.
(e) You'd encounter sentient monoliths made of an unidentifiable black substance which were mysteriously broadcasting the message “All these worlds are yours except Europa. Attempt no landing there.”

23. How many **stars** are there in the **solar system**?

(a) 1
(b) 8
(c) about a dozen
(d) about 400 billion
(e) uncountably many

REMEMBER TO TRANSFER YOUR ANSWERS TO THE SCANTRON CARD! YOU WON'T RECEIVE MARKS FOR ANSWERS RECORDED ON THIS PAPER.

PART B: Short answer questions. Answer ALL of the following questions in the spaces provided. Point form is acceptable where appropriate. Marks may be deducted for lack of clarity or concision.

1. The nebular theory of planet formation:
   (a) [1 mark] Imagine a solar system which contains a Sun-like star and five planets: two like Neptune orbiting at 0.3 and 0.5 AU from the star, one like Jupiter orbiting at 1.3 AU from the star, and two like Mars, orbiting at 2.0 and 4.0 AU from the star. Is this system consistent with the nebular theory of planet formation? Why or why not?

   (b) [2 marks] Most objects in the solar system move in ways which are directly accounted for by the nebular theory of planet formation. Briefly state two **significant** exceptions.

   i. _____

   ii. _____

   (c) [1 mark] Consider **ONE** of your answers from part (b). What modification or addition to the nebular hypothesis must be made to account for this observation?

2. [6 marks] Using the table below, list three properties of a star (or other celestical object) which can be determined from its **spectrum**. For each property, state which feature of the spectrum allows us to measure it.

Property of the Star	Spectral Feature Which Allows its Measurement

3. [4 marks] The diagram below shows a set of energy levels for an electron in an atom. **On the diagram** answer questions (a)-(d) below.

   (a) Use an **arrow** to indicate any transition between these energy levels which would **emit** some light. **CLEARLY LABEL** this transition.
   (b) Use an **arrow** to indicate any transition between these energy levels which would **absorb** some light. **CLEARLY LABEL** this transition.
   (c) Of the photons (particles of light) emitted or absorbed by the transitions you drew in parts (a) and (b), which one would have the **higher** energy? **CLEARLY LABEL** this transition.
   (d) In the box below, state the total number of **spectral absorption lines** which can be formed using only transitions between the energy levels shown.

highest energy

lowest energy

number of possible absorption transitions using these levels:

THE END